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Exploring the Effective Modes of Sustainable Urban Mobility for Tier-2 Cities

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Abstract

Infrastructures, particularly transportation infrastructures, play a pivotal role in the economic and social development of nations. Among all the infrastructures, transportation and urban mobility infrastructure stands out as a critical component for fostering inclusive growth and mitigating environmental impacts. Sustainable urban mobility has emerged as a critical focus area for policymakers, urban planners, and transportation experts worldwide. Rapid urbanization, coupled with increasing environmental concerns and congestion, necessitates a paradigm shift towards sustainable transportation systems. This paper presents a comprehensive analysis of sustainable modes of transportation related to urban mobility and exploring the effective Modes of Sustainable Urban Mobility for Tier-2 Cities.

Keywords: - Urban Mobility, Infrastructure, Sustainability, Urbanisation, Transportation

Background

Infrastructures, particularly transportation systems and urban mobility, are fundamental pillars for the socio-economic development of any nation. In rapidly urbanizing countries like India, urban mobility infrastructure plays a pivotal role in facilitating economic growth, enhancing social connectivity, and improving quality of life for urban area residents. However, the conventional approach to urban mobility, characterized by heavy reliance on personal motor vehicles and inadequate public transportation, has led to a myriad of challenges, including traffic congestion, air pollution, road safety concerns, and social inequities in access to mobility services.

In the Indian context, rapid urbanization, population growth, and economic development have placed immense pressure on existing urban mobility infrastructure, exacerbating urban mobility challenges. Indian cities are grappling with issues such as traffic congestion, air pollution, inadequate public transportation networks, and lack of pedestrian and cycling infrastructure. Moreover, socio-economic disparities in access to transportation services further exacerbate mobility challenges, particularly for marginalized communities.

Due to industrialization and economic expansion, Indian cities are becoming more and more urbanized. The process of urbanization has an effect on the way land uses are distributed spatially and how activity dispersion creates transport demand. Thus, it becomes essential to arrange people's and commodities' movement in a way that minimizes traffic and other negative effects on the environment in urban areas.

Moreover, the transport system, usually a multi-modal public transport network, interconnects these spatially scattered activity locations. This network is often planned by the government on a long-term basis, typically spanning decades, to cater to the evolving needs of the population and changing patterns of land use and development.

The land use system, integral to these decisions, dictates the spatial arrangement of opportunities such as job centres, commercial areas, healthcare facilities, residences, and recreational spaces. Transport infrastructure serves as the link between these dispersed destinations, facilitating the movement of people and goods to meet the demand created by these displacements.

Introduction

Sustainable Mobility refers to the movement of people from one place to another in a sustainable manner with minimal societal, economic, environmental and climate impacts. (WWF-India, 2018)

Sustainable mobility is not only about reducing one's own travel footprint but also to reduce the same of the society, therefore, a sustainable transport system should not only look into individual's mobility need but also the mobility need of the society at large. (TERI, 2014)

Definition of sustainable urban mobility by TERI

"Sustainable Urban Mobility is a system that incorporates economic viability, environment stability and social equity by meeting the needs of transport and land use of both current and future generations in an efficient manner".

Sustainable transport system goes beyond the concept of consuming lesser amounts of fossil fuels to improve energy security and proactively work towards lowering carbon emissions. It is about taking holistic approach by considering economy, society and environment along with the mobility and accessibility requirement of the people. For instance, a narrow approach towards sustainable transport would be implementation of alternative fuel vehicles like biofuel, hydrogen, electricity etc. without addressing the problem of acquisition, maintenance, operation and parking cost of the vehicle. This kind of technological advancement should not be restricted to automobile modifications but should also be involved in traffic management systems and in dissemination of traffic information. Furthermore, this approach does not include the indirect cost like that of accidents, sprawl, poor health and more (Ms. Priyamvada Kayal, 2014)

Aim

The aim of the study is to exploring effective modes of sustainable urban mobility applicable for tier-2 cities

Objectives

1. To study the various mode of sustainable urban mobility and issues related to urban mobility
2. To study the effective approach and strategies for the sustainable urban mobility
3. To identify the effective modes of sustainable urban mobility applicable for tier-2 cities

Modes of Sustainable Urban Mobility

a) Public Transport

Public Transport consists of Mass Rapid Transport system (MRTS), Bus Rapid Transport system (BRTS), Light Rail Transport system (LRT), Para-transit, and personalized transport. MRTS, BRTS, LRT can carry large number of people in one go. In some cities water transport modes like ferries are also used as means of public transport. Para-transit modes include tempos and mini-buses, and personalized transport modes include autos and taxis.

b) Non-Motorized Transport (NMT)

NMT consists of walking and cycling. These modes of transport are usually taken up for shorter distances and are slower in speed than the other public transport modes.

c) Intermediate Paratransit Transport (IPT)

Intermediate Paratransit Transport (IPT) includes Cycle rickshaws and E-

rickshaws. Cycle rickshaws and E-rickshaws can be clubbed with non-motorized transport fleet owing to their character of slow speed and their utility for shorter distance and last mile connectivity.

d) Private Vehicles (Clean Fuel Technology)

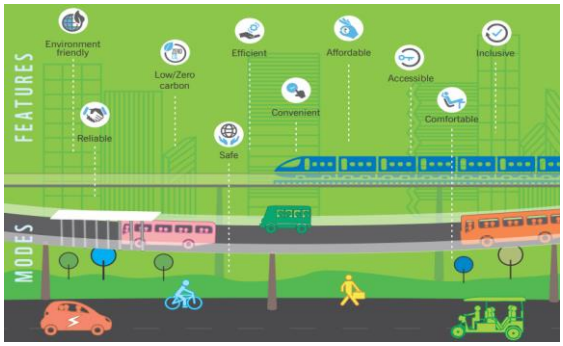
Electric Vehicles, though in early stage of development, are being seen as a sustainable mobility solution. (WWF-India, 2018)

Hydrogen based, Petrol or Diesel hybrid vehicle and biofuel vehicle are also sustainable mobility solution.

Feature of Sustainable Urban Mobility

Sustainable urban mobility has numerous feature based on the type of mode and vehicle used. But Sustainable urban mobility has major feature like environmental friendly, low or zero carbon footprint, inclusive, affordable, efficient, accessible, convenient, reliable and safe. (WWF-India, 2018)

Figure 1-Sustainable Modes of Urban Mobility and their Feature



Source: - Demystifying the Future of Mobility, 2018

Issues of Urban Mobility

There are lots of issues related to urban mobility. Several authors have mentioned various issues from economic, social and environment perspective that are generated by the movement of goods and people. Most of these issues arise due to excessive use of personalized vehicles. The issues are compiled in the table-1

Table 1– Issues Related to urban mobility

Economics	Social	Environmental
Traffic congestion	Mobility for vulnerable groups	Air pollution
Infrastructure costs	Human health impacts	Habitat loss
Consumer costs (fares, automobiles, etc.)	Community cohesion and street life loss	Hydrologic impacts
Mobility barriers	Community livability	Depletion of non-renewable resources
Accident damages	Aesthetics	Noise
Productive rural land loss	Isolation in suburbs	Urban sprawl
Urban land loss to bitumen surface	Public safety	Storm water run-off problem
Time loss due to sprawl		Photo chemical smog, lead and benzene

Source: (Litman & Burwell, 2006); (Newman & Kenworthy, 1996)

Approach and Strategies to achieve the sustainable urban mobility

Avoid-Shift/Retain-Improve (ASRI) approach, emphasizing the importance of reducing travel, shifting toward more sustainable modes (such as public transport and non-motorised transport), and improving existing transportation methods. This approach involves interventions related to clean fuels, advancements in vehicle technologies, and the utilization of information and communication technologies. (Singh, 2014)

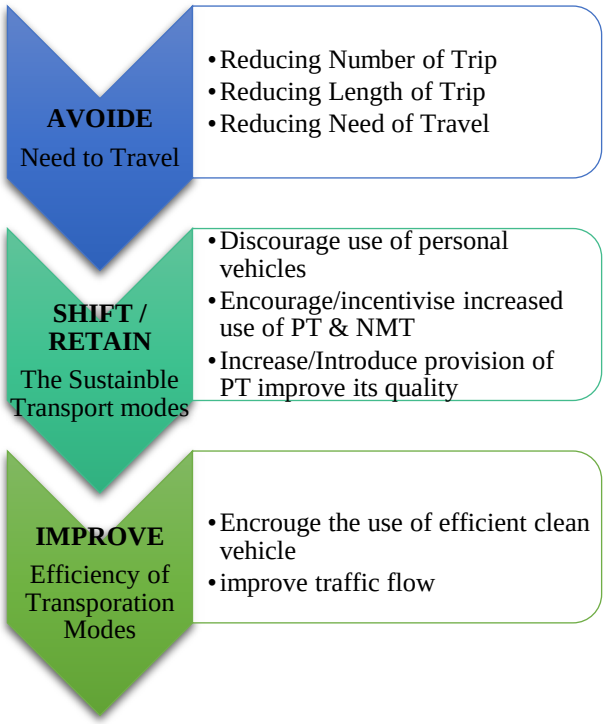
It's essential to acknowledge that not all measures will be universally applicable or suitable for every city. Instead, each city should consider a tailored combination of these measures based on its unique context, requirements, and the feasibility of implementation. This tailored approach allows cities to optimize their strategies for sustainable urban transport based on their specific needs and circumstances.

The ASRI approach outlined to reduce travel needs, decrease the number of vehicles on the road, increase the shares of public transport (PT) and non-motorised transport (NMT), and enhance the quality of the vehicle fleet in cities. It recognizes that the effectiveness of these measures varies, and not all of them will be universally applicable to all cities. Therefore, the recommendation is for each city to adopt a customized combination of these measures based on its specific context, requirements, and feasibility.

The success of these measures is contingent on ongoing support through frequent monitoring, awareness generation, and capacity building at the city level. Regular assessment and awareness initiatives can help cities gauge the effectiveness of implemented measures and make necessary adjustments to align with their sustainability goals and urban transport needs. (Singh, 2014)

The A-S/R-I Approach

Figure 2 – ASRI Approach



Source: - Policies for Sustainable Mobility (TERI)

Effectiveness of Urban mobility Modes

The efficiency of urban transport in cities, considering factors such as capacity, energy use, CO_2 emissions, and costs. The evaluation takes into account different traffic conditions, including peak (congestion) and off-peak traffic (no congestion). Various road and rail vehicles are compared, including cars, buses, motorcycles, metro, tram/light rail, and trains/heavy rail.

Efficiency in transportation refers to how resource consumption, expenses, and benefits from their use are related. Traditionally, consumers' and carriers' expenses have been the main focus of transportation costs. Nevertheless, evaluations sometimes disregarded external costs that have an influence on the public, such as accident-related costs or environmental effects. The idea of sustainable transportation places a strong emphasis on include external expenses in cost-benefit calculations.

During peak periods, public transport generally exhibits better capacity, lower costs, and improved environmental performance per passenger compared to individual transport. However, during off-peak hours, the effectiveness of transport modes becomes more complex, leading to potential differences in results compared to peak periods.

Across all conditions, public transport tends to have lower costs compared to individual transport modes.

Rail transport systems generally demonstrate the highest infrastructure and vehicle capacity. Comparatively, in off-peak periods, the capacity of individual and public road transport (buses) becomes comparable, and due to lower occupancy rates in public transport, sometimes even higher for cars.

Public transport typically shows lower energy consumption and CO2 emissions per passenger during peak hours. However, systems like metro and light rail can be relatively energy-intensive.

Conversely, individual transport tends to have lower energy consumption and emissions per passenger during off-peak periods.

A well-designed urban transport system involves a role for each transport mode. During peak hours, public transport—especially rail systems—should form the backbone. To enhance the environmental performance of public transport, prioritizing electric and hybrid systems is recommended. Individual transport modes are crucial during off-peak periods when passenger numbers might not suffice for high public transport occupancy rates. (Pomykala, 2018)

Sustainable Urban Mobility Challenges

Efficient city function relies on accessibility for both goods and services. However, the push for accessible cities necessitates a shift towards sustainable transportation modes, encouraging diverse modes of transport, including pedestrian pathways. Mobility, in this context, extends beyond transportation modes to encompass how people and places are interconnected. Urban planning and design should prioritize bringing together individuals and locations by creating cities focused on accessibility and optimal urban densities, rather than merely expanding transport infrastructure.

The emphasis on sustainable urban mobility plans underscores the need for concerted efforts to create cities that prioritize accessibility and efficient use of space. The challenges faced by stakeholders in urban planning highlight the complexities of integrating sustainable mobility into the urban landscape. By addressing these challenges and focusing on accessible urban design, policymakers and urban planners can work towards creating more sustainable, integrated, and inclusive cities.

Creating consciously planned cities is crucial to effectively address sustainable urban transport. This involves developing a strategic plan for urban mobility that improves overall quality of life while aligning with existing planning practices. The responsibilities for preparing and executing sustainable mobility plans span various planning professionals. Local urban planning authorities play a key role in implementing auto-free zones and integrated planning, while urban designers focus on designing bikeways, cycle tracks, public transport systems like bus rapid transit and light rail, pedestrian pathways, and infrastructure like flyovers. Policymakers are responsible for decisions regarding bike-sharing, carpooling, car-sharing, and congestion charges. Public dissemination of these initiatives is vital for their successful implementation and public acceptance. (Giduthuri, 2015)

Conclusion

Urban transportation modes are determined by technological and economic factors. The following criteria were taken into consideration while analysing the characteristics that impact the development of a city transport mode: space accessibility, travel time in different directions inside the city, the mode of transportation's environmental performance and the total system cost of transportation.

When weighing sustainability objectives like reducing carbon emissions, promoting public health, and improving urban liveability, it is preferable to give public transit systems like BRT and LRT precedence over the usage of private vehicles. Rail networks, even with their highest capacity and efficiency, would not always be affordable or viable for medium-sized growing cities. Consequently, expanding and enhancing BRT systems could be the most practical and long-term answer in these cases. But the ultimate choice should be made in light of each community's unique needs and characteristics, accounting for factors including population density, infrastructure condition, and financial resources. One of the main goals of public transportation in medium-sized, expanding communities is to improve their current bus networks. When it comes to public transportation, bus rapid transit (BRT) and city bus service are

considered more economical and effective than many other options, such as light rail transit (LRT). Cities with low population densities and dispersed areas can employ NMT and pedestrian modes of urban transportation. The most ecologically beneficial modes of urban transportation include walking and biking, particularly in smaller towns with larger student populations.

Recommendation

The suggested modes of urban mobility for tier-2 cities are walking and NMT, in order of preference. Tier-2 cities have lower population densities and lower geographical spreads, making pedestrian and NMT modes of mobility the most practical for short-distance significant journeys. The most cost-effective, environmentally responsible, and sustainable forms of urban mobility are NMT and walking.

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