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A Review on Indias Urban Transportation

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Abstract: *Traffic congestion, pollution, and road accidents are all challenges that have arisen as a result of India's growing population and vehicle ownership. The transportation industry is an important part of the nation's economy, but also contributes significantly to climate change. Many transportation plans ultimately lead to fixing the climate change problem in order to attain sustainable mobility since climate change is a global hazard. India, like other nations across the world, is investing greater effort into sustainable mobility through different governmental measures. This article examines the major transportation issues that India faces, as well as how the Indian government's transport industry policy initiatives for cities have developed since independence. Motorisation is inextricably linked to urbanisation. Both motorisation and urbanisation complement each other. The influence of NMT on urban transportation is likewise directly related to its growing pace. The difficulties and inadequacies in existing policies are explored, as well as potential policy frameworks. According to this survey, most government policy efforts have yet to achieve the desired degree of success. The absence of monitoring, complicated institutional capacity and urban governance, uneven land allocation, and ineffective overall growth and movement plans are all contributing factors. Due to the continuing COVID-19 situation, the urban transportation scene is expected to shift dramatically. Travellers' mobility preferences are likely to be affected by increasing risks that come with congested settings paired with social distancing techniques in public and shared transportation. With the increased usage of e-services, urban freight demands may also shift.*

Keywords: *COVID-19, Non-Motorised, Traffic, Urban Transportation.*

I. INTRODUCTION

Transportation i.e., conveyance of passengers or goods from one place to another place. The act for transportation is a movement of a body having non-zero positive mass in between the places. The stage of transportation starts from the time when the mode of transportation was not known. Initially people used manpower like walking, running for transportation. On-going towards the progress in transportation in the place of manpower, animal powered and then machine powered comes into existence. In the mode of transportation, we have three modes i.e., land, water and air mode. The transport sector in India is very large and diverse. This sector has a very large impact over the GDP of the country. The growth in the Indian economy has witnessed inflation. In this paper, we are proceeding towards the discussion of urban mode of transportation. In India, the importance of urban transportation arises from its role in decreasing poverty, boosting access to labour supply, and thereby raising income in underprivileged neighbourhoods. In the active modernisation development of Indian towns, mobility movements have become a prominent factor. The increase of population in urban cities from rural areas causes a substantial increase in the demand for transport in most of the Indian cities. India's urban regions, which comprise a huge number of big cities, are not very well served in terms of inter-city transportation. Overcrowding and time-lag are a common occurrence in cities, showing the seriousness of transportation issues. Statistical data shows that pollution, traffic accidents are a serious problem because of transportation. The COVID-19 situation will provide this segment with several additional obstacles, particularly in metropolitan regions with strong travel demand. Several people's lives have been placed on pause as a result of the COVID-19 outbreak, prompting them to reconsider their preferences and lifestyle. There could also be a heightened feeling of environmentalism. Between all everyday routines and industries affected by the epidemic, the transportation sector in particular, including people's travel habits in particular, are expected to alter as the nation adjusts to a new reality. To adhere to social distance standards, public transportation systems will need to operate with restricted capacity if communities continue to relax lockout limits. Similarly, taxis and other shared services would be impacted by the laws.

II. METHODOLOGY AND SCOPE OF WORK

The information is gathered on the growth of urban transportation networks in India after financial liberalisation in the early 2000s through a thorough literature study. National and international research articles, journal articles, book reviews, planning. A vast spectrum of blog entries, journalistic and magazine websites, as well as local, national, and international media, were consulted throughout the literature review.

Based on the literature analysis, the results of the study on predicted patterns, difficulties, and impediments were unified. A vast spectrum of blog entries, journalistic and magazine websites, as well as local, national, and international media, were consulted throughout the literature review. Based on the literature analysis, the results of the study on predicted patterns, difficulties, and impediments were unified.

III. URBANIZATION AND MOTORIZATION IN INDIA

In India, around 377 million people reside in 8,000 cities and towns, accounting for nearly 38% of the population and contributing more than 50% of the country's GDP. As per the estimation, by 2031, this As a result of the rural-to-urban transition, an increase in urban population of roughly 600 million people, accounting for nearly 40% of the overall Indian population. Cities and towns are likely to become more urban in the future decades. The number of automobiles per 1,000 inhabitants in Indian urban centres has increased dramatically since 2001. Between 1991 and 2009, the total number of registered cars in the nation increased at a CAGR (Compounded Annual Growth Rate) of 9.8%. The rate of increase of registered automobiles in cities with populations greater than a million people is much higher than in the rest of India. Meanwhile, car registrations in metro areas climbed at nearly double the pace of those in cities with populations of more than a million people. In 2011, 22 cities had a CAGR of 8.7% in total car registrations, accounting for roughly 28% (39.7 million) of all vehicle registrations.[1]

Two-wheelers are risky, detrimental to the environment, and unsustainable since it is hard to provide appropriate infrastructure for the growing number of two-wheelers. Many analysts believe that current levels of motorisation are somewhat sustainable, but the current high motorisation trajectory is untenable, and hence the focus on properly balancing demand across multiple forms of transportation is crucial.[2] .

India has seen an expansion of the urban population from 286 million to 377 million between 2001 and 2011. Nearly half of them live in sparsely populated cities (with populations of less than 0.5 million). Cities with population of 0.1million to 1 million, such as Surat, Nashik, and Faridabad, experienced the fastest interannual growth, while metro cities like Mumbai, Delhi, Kolkata, Chennai, Hyderabad, and Bengaluru experienced slower peripheral growth, with villages enclosing the core city going to merge with the larger metropolitan area. According to the census statistics of 2011, there are three cities with populations over ten million people and another 53 cities with populations above one million people. The top ten Indian cities, which account for 8% of the total Indian population, are expected to provide 15% of the country's GDP, while the other 53 cities with populations of one million or more contribute 31%.[3]

Due to the sheer structural hurdles discussed, bicycle ownership is quite high in most metropolises, but riding is even less than 10%. The bicycle market grows at a 4% annual pace, with elevated bicycles and bicycles for children expanding at a substantially quicker rate (50 to 55%) than the basic, low-cost bicycle segment. Bicycle robbery, fear of insecurity, and a lack of infrastructure such as bicycle parking places and cycle paths in the city are all reasons that limit the use of bicycles in urban areas.[4]

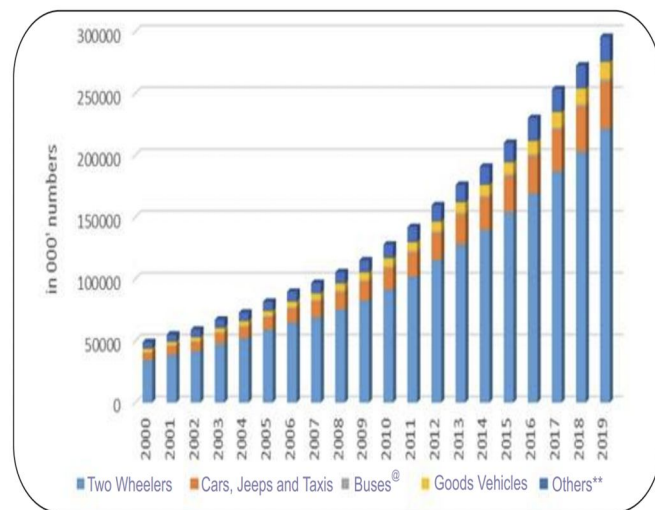
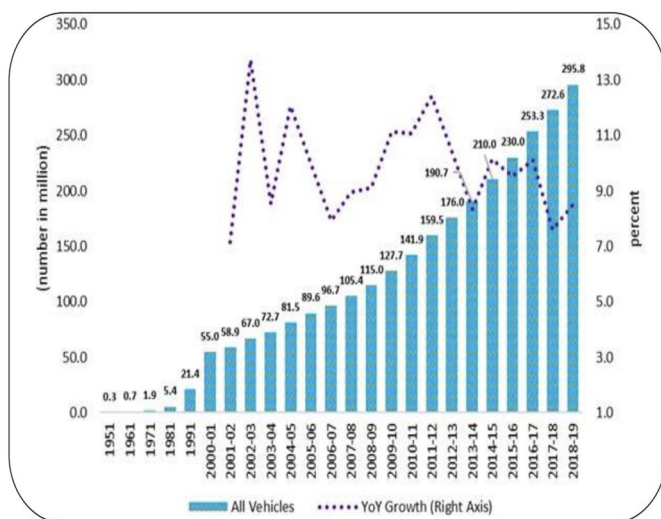


Fig. 1: Number of Registered Vehicles (in Million) in India

Fig. 2: Number of Registered Motor Vehicles (in 000') Category wise

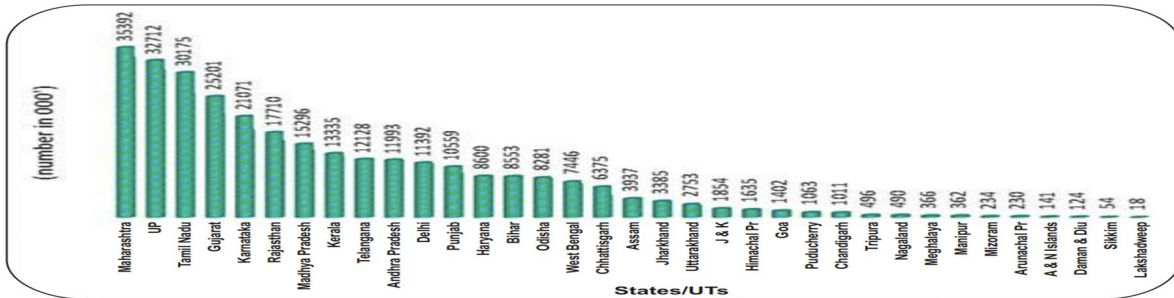


Fig.3: State/UT wise distribution of Registered Motor Vehicle (in 000) as on 31st March, 2019

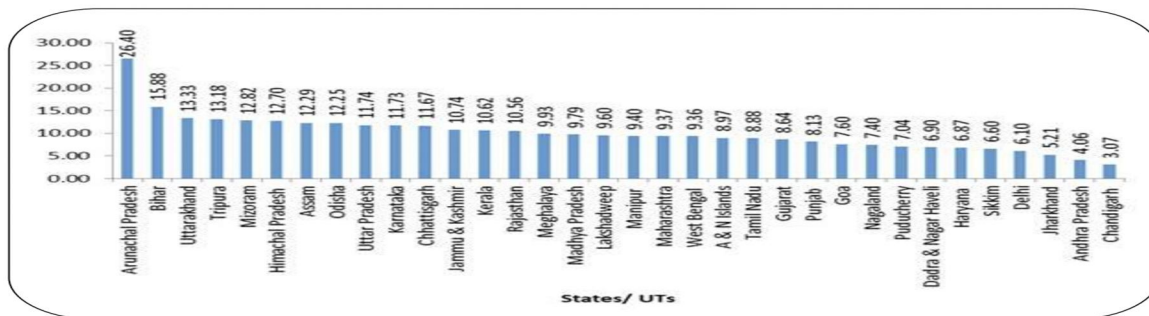


Fig.4: State/UT wise CAGR of Registered Motor Vehicles during 2009-19

IV. CAUSE OF URBANISATION

Trends and patterns in urbanisation provide significant difficulties to urban mobility systems. In 1951, there were just five Indian cities with populations of one million or more, and 42 cities with populations of less than 0.1 million, implying that much of India was basically a village. In 2011, there were 323 cities with a population of more than 0.1 million people and 53 cities with a population of more than 1 million people.

Cities as per population (in million)	No. of cities
>10	2
5-10	3
2-5	8
1-2	32
Total million-plus cities	46
0.5-1	48
0.1-0.5	184
Total number of cities	323

Table: No.of cities in India by population (in million)

The main consequences of rapid motorization, of massive urbanisation and dependency of private vehicles, are physical fragmentation, social inequalities, and environmental issues. Rapid urbanisation caused rapid motorisation, and a shrinking modal share of non-motorised transport are the main factors driving urban population mobility in Indian cities (NMT). As a result of these causes, travel demand has tremendously increased. Meanwhile, increased levels of motorised vehicle ownership and use have resulted in alarming increases in negative externalities such as traffic jams, air pollution, road mortality, as well as social equity and security problems. Higher CO₂ emissions are one consequence of motorization; others include constant congestion, time spent queuing in vehicles and an extremely high accident rate.

V. NON-MOTORISED TRANSPORTATION (NMT)

Walking, biking, and other small-wheeled transport (wheel scooters, skates, and hand carts) are examples of non-motorized transportation (NMT), often known as Active Transportation. People who walk to work in Indian cities outweigh those using private motorised transportation. The growth rate of cities is inversely proportional to the participation of NMT, resulting in greater access to private modes of transportation. As sprawl-based urban planning becomes the norm in major cities, urban design that encourages walking and cycling is under attack. New expansions and townships are still being planned on the basis of low-density, segregated land use with broad roadways. Average travel distances in megacities with populations of more than 10 million people have climbed to 9-12km. [5]. Cities with populations of 2-5 million people, such as Pune, Surat, Kanpur, and others, have an average journey distance of 6km and a high NMT share of 40-50%. In cities with populations of 1-2 million people, this percentage rises to 60-70%. In the future decades, smaller communities are more likely to lose their walking and cycling share to individual motorised transportation. These localities have not invested in NMT infrastructure or have a clear public transportation option to deter people from using personal transportation. In terms of infrastructure planning, sidewalks and cycling tracks are the most overlooked. For example, the Plan for Naya Raipur, the state capital of Chhattisgarh, calls for a 50% share of private automobiles by 2030 and calls for the construction of 60 to 100 meter wide highways. Because NMT modes are seen to be sluggish, they slow down city travel. Local rules limit their usage on major thoroughfares or confine it to residential streets. Cycle rickshaws have been limited in numerous cities to specific locations inside the metropolis. In Kolkata, cycle rickshaws were first disallowed on 38 roads before being expanded to 174 important roads in 2012 to boost traffic speeds. Despite the fact that bike traffic is permitted on select streets after office hours, the restriction has had a negative economic impact.

VI. IMPACT OF AN URBAN TRANSPORTATION

- 1) *Congestion on Roads:* When urban transportation networks can no longer handle the number of movements which use them, traffic congestion arises. The structural transportation infrastructure, as well as patterns of urban land use as well as their accompanying trip-generating activities, dictate the location of congested regions. Traffic congestion levels vary throughout time, with a clear peak during the daily commute-to-work times. Although overloading is at fault for the majority of traffic congestion, there are other facets of this fundamental problem that demand attention. Increasing amounts of private automobile, public transportation, and commercial vehicle traffic have revealed the shortcomings of urban roadways in developed nations, particularly in older city centres where street designs have mostly remained unchanged since a very long time. Developing countries are facing large numbers of traffic accidents and fatalities because of high traffic and congestion.
- 2) *Crowding in Public Transport:* At such busy periods, the 'human congestion' that occurs within public transportation vehicles adds salt to injury, literally. Long lines at stations, crowding at terminals, stairways, and ticket offices, and excessively prolonged bouts of hot and oppressive transit in overloaded carriages characterise a large amount of the day's trips.
- 3) *Off-Peak Deficiency of Public Transport:* When public transportation providers supply enough cars to fulfil peak-hour demand, off-peak usage will be inadequate to keep them financially engaged. If, on the other hand, fleet size is tailored to off-peak demand, the cars would be so overburdened during peak hours that the service will most certainly fail. For public transportation providers, this inequality in car usage is at the heart of the urban transportation challenge. Many companies now have to have enough cars, equipment, and people on hand just to offer peak-hour service, which would be a grossly inefficient use of assets. Off-peak service reductions are sometimes the only option to save money, yet this drives away existing customers and encourages more automobile usage. Carriers in developing nations, on the other hand, are not affected by the "off-peak dilemma."
- 4) *Parking Problems:* The number of automobiles now outnumber the total number of family members. It is clear that India's parking system is insufficient in comparison to present requirements. The problem has grown to the point where about 40% of the roadways are occupied for parking on regular business days. Most vehicles delayed in city traffic aren't attempting to get somewhere; they're simply looking for a parking spot. For many, the parking problem is an urban transportation issue: having enough money to buy a car is one thing, but knowing where to park it is another. But the driver is not the only one who suffers. Cities are blighted by unsightly multi-story parking garages, and cityscapes are transformed into metal seas as automobiles jam into every square meter of available space. Congested streets hinder public transportation, and walking in anything resembling a straight path becomes difficult. The supply of enough automobile parking space for city employees and consumers within or on the periphery of central business districts (CBDs) is a challenge with severe consequences for land use planning. The expansion of pedestrian zones and shopping malls in city centres aims to provide more pleasant surroundings for shoppers and other visitors. Such traffic-free zones, on the other hand, cause issues because they generate new pathways of accessibility to business

districts for vehicle travellers and public-transport users, with the latter losing their earlier advantage of being transported straight to the major retail area.

5) *Impact on Environment & Energy Consumption*

- a) *Atmospheric Pollution:* Motor vehicle operation is a polluting practice. Traffic emissions, particularly from badly maintained diesel engines, may be exceedingly noxious, and when combined with noise, make walking in metropolitan areas quite uncomfortable. Engine emissions are present on every metropolitan street, and they almost likely contribute to the production of smog. According to environmentalists, the rapid growth in the number of automobiles on our roads, which has occurred without (as of yet) any serious restrictions, is rapidly escalating into an environmental disaster. According to the Centre for Science and Environment (CSE), when motor vehicle speeds are reduced, the amount of the three primary air pollutants (CO, hydrocarbons, and nitrogen oxides) increases dramatically. For example, at 75 kmph, CO emissions are 6.4 gm/veh.km, while at 10 kmph, they are five times higher at 33.0 gm/veh.km. Similarly, at the same speeds, hydrocarbon emissions rise by 4.8 times, from 0.93 to 4.47 gm/veh.km. As a result, traffic jams in Indian towns, mainly during peak hours, not only causes delays but also aids to pollution.
- b) *Noise Problem:* The problem of pollution is not the only one. In the core areas of our urban centres, traffic noise is a big issue, and there are additional environmental consequences of attempting to manage rising traffic levels. It is widely recognised that traffic noise is the most significant environmental issue created by driving in metropolitan settings. Noise from traffic is both bothersome and distressing. Walking and other activity in urban settings may be annoying, and road noise, probably more importantly, can be heard inside buildings. As a result, working becomes more difficult since noise disrupts attention and discussion. Noise levels can also disrupt home life by interfering with sleep and relaxation. Traffic noise is typically a constant sound that the listener dislikes. It occurs as a result of air pressure variations that are picked up by the human ear. Noise is often measured on a decibel scale, with a 10 dB increase corresponding to a double of loudness. Automobile noise emanates from a variety of places. The engine, exhaust, and tyres are the most important, however extra noise can be produced by the body, brakes, loose fittings, and aerodynamic noise in freight trucks. The speed of the vehicle, the density of the traffic flow, and the condition of the road surface on which the vehicle is driving all impact the amount of noise. Vehicles that accelerate or drive on an inclined slope make more noise than those driving in a steady stream on a level route. Buses, motorcycles and sports cars, as well as cargo trucks, create more noise than the ordinary private automobile, especially while stopping and starting. The Wilson Committee produced data showing that a decibel noise level of 84 dB was about as loud as humans could tolerate, and they advocated legislation making any engine noise over 85 dB unlawful. They suggested that allowable levels be gradually reduced, but this has not happened.

VII. POLICY MEASURES TO IMPROVE URBAN TRANSPORTATION IN INDIA

- 1) *Efficient and effective use of Bus Services:* People's transit in urban India is primarily reliant on the country's highways. It is self-evident that, of all the modes of road-based passenger transportation, the bus takes up less road space and emits less pollution per passenger-kilometre than customised vehicles. As a result, bus transportation should be prioritised in urban transportation planning. Within Indian towns, a vast range of bus transportation services is required. When given the chance, citizens exhibit a wide range of transportation choices, yet municipal governments in many regions prefer a baseline level of bus service. Providing additional services, such as guaranteed seats or rapid buses, in exchange for increased tickets is frequently seen to be inequitable. To put it another way, diversity is frequently limited. The poor financial and operational efficiency of publicly owned urban transport companies, which are the principal suppliers of bus transportation services in Indian towns, has been compounded by government control and regulation. Transit systems are under economic pressure to increase fees as operating costs grow. If the system is funded, some of its less profitable or deficit services will be eliminated. They also have to give discounted travel to other organisations, such as freedom fighters, journalists, and students, in addition to paying a high amount of various taxes.
- 2) *Parking Problem Minimization:* In today's world, India has the most serious challenges in terms of automobile parking space, particularly in metropolitan regions. The problem is expected to deteriorate now that there are much more automobiles on the road than there is adequate space. Cities are teeming with individuals who park their automobiles wherever they can, wasting space that could have been better utilised. People believe Indian cities to be some of the living alternatives due to the absence of a transportable area. Except for Chandigarh, no other Indian city was designed to accommodate the massive number of automobiles that the country today faces. The minimal priority given to parking by city planners has further exacerbated the

problem. It is believed that those in charge of city planning should seek out advantageous conditions. It is absolutely critical to address the concerns through altered public policy. One of the most effective methods is to eliminate the parking subsidy programme. Furthermore, the parking fee should be determined by the area's land value. Furthermore, in certain of the busiest places, such as important tourist attractions, commercial districts, heritage zones, and so on, roaming and entry of automobiles and large trucks may be tightly forbidden. Indians are more focused on receiving services for free, which creates a lot of confusion when it comes to establishing such regulations and standards. In any case, the policies must be applied in order to resolve the issues. There are a variety of alternative things that might assist you in resolving this issue, such as multilevel auto parking.

- 3) *Encouraging Sustainable Transportation:* It is not an alternative to develop a green and sustainable transportation system to handle and fulfil the transport demand of an ever urban population and freight confronting megacities, a transport system is needed. There are numerous definitions for sustainable and green transportation as a consequence of the efforts of many organisations and professionals. This paper gives an idea of sustainable and green transportation as any method of individual transit that really is cost-effective, secure, and provides a choice of forms of transport. It also has a low impact on the environment because it employs sustainable or recycled energy rather than fossil fuels.
- 4) *Promoting use of Bicycles:* To meet the demands of urban people to access public services and opportunities is a critical part of managing rapid urbanisation, decreasing poverty, and resolving equitable and environmental challenges. Walking and cycling are more than just low-carbon forms of transportation; they also help to improve urban quality and social cohesion. These are low-cost, adaptable, and accessible forms of transportation that allow most people in low- and middle-income nations to participate in the business and community, as well as access education, healthcare, and other urban services.
- 5) *Co-ordination Between Transport Facilities:* The goal of transportation synchronisation is to make the best use of a country's transportation resources and potential in order to get the most out of each mode of transportation, related to specific benefits of each as shown in operation efficiency and cost standards. The following should be the guiding principles in designing a transport coordination policy: There should be coordination in improving the facilities for simple transit points of passengers and cargo between regions serviced by various modes of transportation. Each mode of transportation should be employed in its most appropriate domains, where it can operate efficiently and cost-effectively. It is essential to maintain a certain level of balance in the supply of transportation services. To put it another way, there should not be an excess of transportation infrastructure in certain places and an insufficient quantity in others. Where there are several modes of transportation, there should be managed cohabitation to minimise mutually unproductive rivalry. Multimodal road rail, rail river, and road river services have potential in emerging nations, with features such as comprehensive booking procedures and combined management arrangements. In a few nations, transportation coordination is problematic, limiting economic progress. Proper planning will aid in the development of a new transportation system while also combining with the existing system.
- 6) *Traffic Calming Measures:* Pedestrians and motor vehicles may interact in relative safety at speeds below 30 km/h. Dissuading traffic from entering specific areas and building physical speed lowering measures such as road construction, roundabouts, and road berms are examples of speed control and traffic calming tactics. These precautions are always accompanied with 30 km/h speed limitations; however, they can be constructed to reach a variety of speeds. Speed management by design, often known as traffic calming, is the process of controlling speed by designing the road with the goal of aligning the road's layout with the intended speed.
- 7) Concrete efforts will be needed to make sure that the COVID-19 issue does not aggravate unfavourable effects linked well with the mobility sector, given the projected behavioural shifts. The overarching main goal is to make public transportation safe and accessible while avoiding a significant rise in the number of private automobiles on the road. Public transportation is also critical for promoting economic activity by providing worker mobility, particularly for people not having access to alternative forms of transportation. Non-motorized transportation will provide an alternative mode of transportation for many travellers. According to studies, India's average distance covered for business trips is perfect for cycling and walking. If there is a market for urban freight, the negative externalities of more automobiles on the road might be mitigated to some levels such as
 - a) Providing safety measures on public transport
 - b) By Reducing travel demand and encouraging corporates to promote sustainable travel modes
 - c) By Increasing the capacity of public transport services
 - d) By Providing flexibility in public transport systems
 - e) By Promoting non-motorized transport(NMT)

VIII. CONCLUSION

In order to maintain effective urban economic growth in Indian cities, mobility and urban accessibility are essential. In terms of temporal growth and stabilisation of the built form, they are likewise inextricably linked to urban resources and flows. Although many countries' promises, carbon emissions must be reduced, necessitating the execution of aggressive programmes. Given the increasing inefficiencies associated with transportation, India's policy position on urban transportation is steadily transitioning from supply-oriented to demand-oriented measures.

A systematic strategy for addressing complicated urban mobility difficulties appears to be well adapted for a complete grasp of the topic and their interrelations. Meaningful policy measures to address it can only be created after comprehending the interdependencies between the components of the system that function behind the symptoms. Undervaluation, for example, causes overuse of highways during peak hours; expanding development patterns makes mass transit ineffective; and urban planning for machinery instead of people, cities are built for automobiles rather than persons. It's vital to understand that mobility is a result of something else. Need resulting from people's need to engage in required economic or social services NMT, public transit, and private autos are all just means to a goal.

The modal share of NMT, mainly cycling, is also increasing. People of all ages and economic levels expressed an interest in switching to NMT. This means that NMT has a good chance to become the preferred short-distance mode of transportation for people rather than the more polluting ones. The overall impact on shared mobility is unknown, since the percentage of commercial shared taxis has decreased, although carpooling has increased in several places following COVID-19. The urban transportation environment is going to alter dramatically in the coming years, but there is room for policy action to reduce the negative consequences that these changes will bring.

This vision sees towns and transportation networks as instruments for achieving desirable societal results, with transportation serving as a facilitator. Sustainable urban forms and combined settlements can help achieve this by drastically reducing travel distances and, in certain cases, travel demands. Compressed towns not only bring activities and tasks closer, but they also make cycling and walking more safe and efficient lanes, as well as low-cost, elevated public transportation alternatives. Ultimately, in Indian cities, The transportation infrastructure is a major enabler of economic growth, poverty alleviation, and wealth distribution. Multimodal mobility in Indian cities necessitates the integration of urban transport and land use planning systems in order to increase synergies, encourage linkages, and enhance functioning. Jam, traffic fatalities, emissions, conventional means that prioritise public funds and expenses in private transportation over public modes of transportation cannot handle these and other current urban transportation challenges. Additional public funds should be invested in the development of NMT and relatively high transportation infrastructure. It's also necessary to consider the urban transportation industry in many ways of network financing and costing. Urban transportation networks influence the spatial design and layout of types of building in cities. The study recommends that in order to be successfully derived by adding in Indian cities, robust, connected, clear responsibilities, constitutional authority, economic freedom, and improving the reliability are required to develop and allow participatory institutions.

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