HOW ACCESSIBLE ARE LOW-INCOME SETTLEMENTS?

The Case of Delhi

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Abbreviations

CPWD	Central Public Works Department
DDA	Delhi Development Authority
DIMTS	Delhi Integrated Multimodal Transit System
DJB	Delhi Jal Board
DMRC	Delhi Metro Rail Corporation
DRSDO	Delhi Rural & Slum Development Organization
DSIIDC	Delhi State Industrial and Infrastructure Development Corporation Ltd
DTC	Delhi Transport Corporation
DUSIB	Delhi Urban Shelter Improvement Board
EWS	Economically weaker section
GNCTD	Government of National Capital Territory of Delhi
HIG	High-income group
IPT	Intermediate public transport
LIG	Low-income group
MCD	Municipal Corporations of Delhi
MIG	Mid-income group
NHAI	National Highway Authority of India
NMT	Non-motorized transport
RTO	Road Transport Office

Why this study?

Widely dissimilar concerns have converged around vehicles and mobility in our cities—public health, fuel splurge and climate impacts. Curbing local air pollution saves lives, especially those of the poor. At the same time, reducing carbon and energy imprints of transportation save fuels and helps minimize climate change. Even before Indian cities could deal with deaths and illnesses from toxic air, energy security and the global warming potential of the transport sector had tiptoed into their agendas. Studies show that Indian cities with high life-threatening per capita particulate emissions also have high heat-trapping per capita carbon dioxide emissions.

This multiple burden of risks demands an active and aggressive policy response. Under the National Clean Air Programme (NCAP), as many as 122 cities are committed to reducing particulate pollution by as much as 20–30 per cent by 2024. At the same time, India's Intended Nationally Determined Contributions (INDC) is to reduce energy intensity of growth by 33–35 per cent by 2030. To achieve these targets cities will require transformative changes in technology road maps across all sectors, urban planning, and design and governance systems.

But this change will not be possible without addressing inequity in the provisioning of urban services. Vulnerable communities in our cities must be taken into account, particularly low-income groups who are also the bigger victims of environmental degradation of urban areas. They inhabit the margins of cities, literally and metaphorically. Such underdeveloped and degraded areas are mostly outside the pale of planning and raise a serious environmental justice question. Can solutions to bigger city-wide problems—pollution, climate impacts and livability—exclude these communities who form an integral part of the warp and weft on Indian cities? COVID-19 has shown us that the answer to this question is in the negative.

Even though the concern around livability and accessibility of poor people's settlements is not new, the extent of this problem was not as evident to planners of cities before. The pandemic has made these invisible masses visible. The hard economic lockdown enforced during the early stages of the pandemic in India has exposed the bad living conditions of the urban masses who have migrated to cities for jobs and earnings. The migrant crisis exposed the crowded, uninhabitable and inaccessible neighbourhoods inside the cities as well as in the peripheries. This has also drawn focus to the extreme peripheralization that is currently underway and

is pushing low-income groups to far off and unconnected places, adding to the hardships they face by increasing distances from job centres, education and other essential services. How can urban policies respond to this crisis?

Nor is this a problem of the poor alone. It is encouraging a trend towards car-centric development in cities that is worsening pollution and climate change problems for all. It is clear that the mobility solutions that work for the poor also help to mainstream solutions needed for pollution and climate change mitigation. This is a crucial stage in India's urban transition when closely built dense and compact cities are beginning to sprawl, making a rapid transition from walking and cycling cities to automobile cities. If the needs of low-income groups become the defining parameter for mobility and urban spatial planning, Indian cities can be less auto-centric and more equitable. Success in scaling up transportation alternatives for the urban majority will make mobility less energy-intensive and polluting. Exclusion of the poor from urban and transportation planning can further enhance social and economic impacts of pollution and climate change on them. Such exclusion will also distance cities from sustainable mobility solutions that emerge from the travel patterns of the poor.

From this standpoint, Centre for Science and Environment (CSE) has carried out an investigation to understand various aspects of this exclusion.

Over the last decade, investment in urban renewal has increased substantially in India. Several policies have been crafted for urban renewal, redevelopment and urban mobility and transportation systems. Cities are either preparing new master plans or revising old plans. A plethora of urban planning guidelines have been framed to guide infrastructure planning. In fact, the policy framework for both transport and housing has begun to incorporate the criteria of inclusion and pro-poor planning and principles. But there is a big gap between polices and what is happening on the ground.

This report outlines the imperatives of pro-poor accessibility and urban planning for long-term sustainability of cities. While principally a lot of these issues are known, understanding this from a grassroots perspective in diverse neighbourhoods has become necessary to provide clear policy insights. Therefore, a deep dive effort has been made to evaluate diverse neighbourhoods representing both planned and unplanned settlements in Delhi of varying economic status to determine equity of accessibility in urban India, its shortcomings and measures that can help rectify the situation.

This is a specific investigation into accessibility—how, why and where people move,

and ease and affordability of movement; and what determines access in different settlements. If these issues are not addressed adequately across settlements and neighbourhoods in cities, sustainable transport—walking, cycling and public transport—that is needed to cut emissions from explosive motorization driven by personal vehicle usage, is in danger of serious erosion.

Deep dive

A rapid survey has been carried out in 16 settlements of Delhi, concentrated in the southern parts of the city. The settlements have been selected based on the Master Plan of Delhi 2021 (MPD21) classification of settlements that are technically "planned" and "unplanned" (with sub-standard MPD norms). While the legality of planned standard settlements is fully established, settlements falling under the unplanned category can either have a legal or a semi-legal status. On several occasions in the past, such settlements have been notified and given legal status through notifications retrospectively, after they had grown autonomously and organically over decades through gradual immigration. Moreover, the Recognition of Property Rights of Residents in Unauthorized Colonies Act was passed in 2019 to ensure tenureship in unauthorized colonies (which constitute the largest chunk of unplanned substandard settlements). Encroachment (colonies) with no legal recognition have not been included in this study.

In addition to this technical classification of MPD21, the *Economic Survey*, published by the Government of National Capital Territory Delhi (GNCTD), brings out a descriptive classification of settlements that includes categories like unauthorized colonies, urban villages and *jhuggi-jhompris*. Circle rates or legal land values prevailing in the settlements available from records of the revenue department of GNCTD have been used as a proxy for understanding the economic status of these settlements.

This analysis has generated evidence from ground, based on a rapid survey of the settlements. A set of indicators has been selected based on the review of national policies, guidelines, Service-level Benchmark, Ease of Living Index of the Ministry of Housing and Urban Affairs (MoHUA) and a few global indexes related to liveability and accessibility. These indicators have been used to assess local conditions related to transport, mobility patterns, provision of infrastructure and services, and accessibility to quantify the disparity between settlements. Indicators and sub-indicators have been grouped into five thematic areas. These are area-level equity in terms of locational advantages and disadvantages of settlements; interface of settlements with services and facilities available in the city; access of

settlements to public transport; equity in intra-neighbourhood accessibility; and quality of accessibility infrastructure, including street design and facilities within the settlements. Based on these, the settlements have been benchmarked.

The selected group of settlements is diverse in nature. There are unauthorized colonies that have been subsequently regularized. These include Tughlakabad Extension, Tigri Extension, Govindpuri, Kalkaji, Khanpur, Pooth Kalan and Khirki Extension. Then there are resettlement colonies like Garhi and Zamrudpur in East of Kailash. There are slum clusters like Jawaharlal Nehru Camp in Kalkaji. There are also villages that have become part of the urban system like Shahpur Jat and Tughlakabad village. In addition, the study also includes planned and higher income settlements including East of Kailash, Kailash Colony, Greater Kailash and Chittaranjan Park. These are all located in South Delhi.

This ground-level analysis is a reality check for the next move. Unplanned colonies, understandably, are hugely burdened with legacy problems as they have grown incrementally and without planning support. They are fully and very densely built areas with hugely constrained infrastructure. There is barely any space left to manoeuvre as all vacant and open spaces have ceased to exist. This contributes to the hardships and higher cost of mobility in these settlements. A different policy approach for retrofitting change in terms of improving access and services will be needed in these settlements.

Planned and higher income settlements predictably perform better on most criteria compared to the unplanned settlements but still fall short of the benchmark for accessibility- and public transport-oriented design. This is inciting dependence on personal vehicles in these neighbourhoods. Even this spectrum of colonies require intervention to improve connectivity and accessibility to promote walking, cycling and public transport.

This investigation into the diverse group of existing settlements has provided a deep insight into the framing of guidelines needed for new development, in-situ development of slums and resettlement of low-income communities that have the scope of planning.

In fact, Delhi mirrors the national challenge in terms of what is going wrong with local area plans at the settlement-scale in our cities. Even though city-wide mobility patterns and connectivity have started to draw some attention in terms of investments in big transit systems, there is a huge disconnect between this investment and local area mobility planning to optimize these interventions to

find a full range of solutions. Qualitative solutions can be achieved only if there is seamless connectivity and accessibility from each doorstep in all neighbourhoods across the city.

Such a system design can deliver only if connectivity, local accessibility and affordable access of low-income neighbourhoods and poor communities are taken into account. This framework can then roll for all neighbourhoods irrespective of social structure. The system has to ensure that buses and Metro services through feeders penetrate deep inside neighbourhoods through well-connected and networked systems, the intermediate public transport (IPT) system is well-organized and integrated with the city-based system, all settlements are well-served by a highly walkable network of streets and cycling facilities, and there is ample provision of basic amenities within settlements. This integrated system also has to aim to minimize modal interchanges in public transport to enhance overall access to city-wide systems.

Insights

This case study has brought out an enormous disparity in equity in access. A simple scoring method has been adopted to benchmark the settlements based on indicators assigned to the thematic areas that include both binary and graded scoring methods to understand relative positioning of the settlements.

This scoring and comparison of unplanned settlements with planned settlements on the yardstick of 'area-level equity' in terms of locational advantages and disadvantages of settlements shows that planned settlements are 2.8 times better placed than unplanned settlements. In turn, other planned areas have, on an average, 1.6 times more road space and 1.4 times more open qualitative space.

With regard to the criterion of 'interface between settlement and the city', planned settlements are about 1.3 times better connected than low-income unplanned settlements. Again, within the low-income settlements, planned low-income settlements have relatively better chances of being located strategically in relation to a major economic hub and important locations within a city. But in the organically grown unplanned low-income settlements, inter-modal transfer requirement increases the waiting time for a mode by 1.1–1.6 times. Most importantly, this increases the cost of the journey. In fact, the monthly cost of transport increases by 1.5–3.5 times.

With regard to the criterion 'quality and affordability of access to public transport services', planned areas have 1.5 times better access to the connecting and boarding points of public transport systems like Metro stations and pick-up and drop-off

stops of buses, than unplanned areas. Planned formal public transport network is more accessible in planned settlements. Low-income unplanned colonies depend on informal and shared IPT like *Grameen Sewa* to access other systems and services. This adds to the cost as well as the hardships faced by these settlements as these systems do not necessarily penetrate deep due to infrastructure limitations. These modes also have huge route restrictions.

With regard to the criterion of 'equity in intra-neighbourhood accessibility', or how people move and access services and amenities inside settlement clusters, most of the assessment settlements do not have adequate amenities and services like schools, markets, ATMs, convenience stores, pharmacies, etc. within the neighbourhood. As densely built unplanned settlements are stressed in terms of availability of land, and the quality of infrastructure does not comply with applicable design standards, people are forced to depend on mobility services to access the services beyond the neighbourhood. This increases (motorized) transportation requirements as the services are not within walkable distances. In fact, planned areas have 1.3 times better intra-neighbourhood accessibility than unplanned areas.

With regard to the criterion of 'status of accessibility infrastructure within neighbourhoods', all areas fall short of meeting the requirements of infrastructure for all street activities for safe access and connectivity. Unplanned areas are impacted more. Higher-income planned settlements have about 1.8 time more infrastructure than unplanned settlements. Streets of high-income areas are 1.7 times more walkable, IPT penetration in these areas is 1.9 times higher, and the sense of safety is 1.7 times higher.

This comparative analysis shows that, predictably, both unplanned and planned low-income settlements fall woefully short of accessibility requirements. This is logical given the fact that these settlements have originated through unplanned occupation of land as migrants into the city built them with no support from planning bodies. Also, several villages have also been integrated within the urban landscape and have a legacy of their inherent spatial design that now has been built over. Over time, a number of slums have been regularized as "designated slum areas" or some of them have been resettled without paying much attention to their connectivity and accessibility aspects.

Planned higher-income settlements have problems too: Overall, standard planned settlements have scored better. These settlements perform well in a local and neighbourhood context as they are more in compliance with development control norms. Despite that, they underperform on the quality of the local streets,

walkability, safe cycling and quality of access roads. At times, these colonies fall short of benchmarks on planning of right-of-way, availability of clear width, absence of encroachment, consistency of width, shading etc. In fact, despite availability of consistent right-of-way in most of their streets, not all local streets have clear width for walking and cycling due to encroachment. Street management is weak and in most parts streets are encroached with parked vehicles. However, these areas are safer as they have comparatively better illumination, openness, presence of security personnel and proximity to police booths.

Access to major roads, the public transport network and last-mile connectivity is better in these settlement compared to unplanned colonies. But they still fall short of the benchmark. Even high-income planned settlements can be disadvantaged from the perspective of access to public transport. For example, East of Kailash and Kailash colony have better connectivity and access overall. But Greater Kailash and Chittaranjan Park, also high-income planned settlements, have inadequate access in terms of distance and availability of options to connect with public transport systems. An earlier assessment by CSE (*Gridlocked Neighbourhoods*) had shown how nearly seven bus routes were withdrawn from this area over time. This has increased dependence on personal vehicles.

The way forward

This ground-level review of settlements has generated indicative evidence that reaffirms the fact that barely any effort has been made to integrate unplanned settlements into the planning process to improve livability and accessibility in them. This has reconfirmed inequity in access and vulnerability of low-income settlements and the inherent challenges these settlements face. In fact, locational disadvantages continue to plague most settlements. Even planned and high-income settlements that are comparatively better experience infrastructure deficit.

Urban renewal process in cities cannot ignore inclusive strategies for equitable access to sustainable transport and access infrastructure in all neighbourhoods. Equity is needed not only for local area improvements but also city-wide mainstreaming of walking, cycling and public transport strategies that can benefit all neighbourhoods. Currently, all state governments are in the process of implementing policies and plans related to clean air, climate mitigation and environment management. All of them have provided for sustainable mobility to reduce emissions, cut exposure and decarbonize transport. But these policies and plans will have to address equity and environmental justice issues.

Policies are firming up on new development and redevelopment in cities—National Habitat Standards, Transit-Oriented Development (TOD) Policy, Service-level Benchmark at the Central level and master planning and local area development plans at the state level. These define parameters related to urban design and planning for accessibility. But there is no clarity or policy focus on local improvement and retrofitting of changes even in densely populated unplanned settlements to improve connectivity and accessibility for the masses.

What is possible? These settlements are fully built with very high density. Solutions will have to be worked out differently for different settlements groups.

Frame guidelines for improving street and access infrastructure in planned and unplanned low-income settlements: Densely built settlements with very limited to no open spaces have very little scope of substantial redevelopment. Their street network is inherently very limited and does not have proper width. The largest streets would be 9 m or 12 m in width while the rest can be less than 6 m wide. A substantial part of the network is unpaved, or full of potholes and uneven surfaces.

Guidelines are needed for local network improvements by concretizing road surfaces and coupling them with underground stormwater systems and utility ducts. Concretized streets with separate utility ducts and channels as well as space for movement of emergency vehicles are needed. Such streets are low maintenance and can take heavy wear and tear. They are intensely used and mixed-use roads that limit the possibility of too much designing according to road users. They will have to be designed as "shared streets" as that is the way they function in any case.

A standard set of specifications can be developed regarding them. These specifications and guidelines can be part of the Request for Proposal (RFP) documents for any local redevelopment programme and project, especially if government incentives are available. Incentives and subsidy should be linked with those specifications.

Developing such guidelines and specifications is also important for housing schemes under the Pradhan Mantri Awas Yojana (PMAY) for the economically weaker section (EWS) and rental housing. Financing of these projects is the only handle available to get quality work delivered through construction agencies and planning bodies, and to ensure provision of improved streets and services. The RFPs of these projects need to include specifications for an internal direction process. A deterrence mechanism for non-compliance with specifications is needed as well.

Settlement-wise plans for improvement in accessibility and connectivity: Several cities in India are preparing or amending their respective master plans or developing zonal plans. Delhi is preparing its MPD 2041. This is an opportunity to assess area-level infrastructure deficit by settlement type and suggest remedial measures in terms of minimum distance required to access services, etc. Assessment of all settlement types based on these criteria needs to be carried out and retrospective planning provided.

For new development, resettlement, in-situ development and urban renewal, it is recommended that the principles of an urban form-based code for compact mixed-use and mixed-income development with accessible streets, and the provision of TOD policy are implemented. Compact high-density, mixed land-use and mixed-income development within 400–500 m radius from transit nodes like a metro stations are needed. This can bring many more people close to transit lines to be able to access public transport easily and reduce dependence on personal vehicles.

Data-driven action for targeted improvement in all settlements: This ground-level evaluation has underscored the importance of generating and tracking data on geo-spatial attributes of settlements and from surveys on layouts, built-up areas, availability of open spaces, street and circulation networks, encroachments, mobility patterns, and level of public transport services. The data can open up opportunities for local area improvement plans. All new generation local area-level action including parking area management, connectivity and accessibility plans will need new capacities in urban local bodies to generate such inventories to prepare better for their implementation.

Need a city-wide plan for deployment of integrated and affordable public transport services to all settlements: This is needed to ensure equal opportunities in all settlements from the access perspective. While improving the local physical infrastructure for access, it is also important to develop zonal plans to improve public transport services, connectivity and access. Doing so requires system designs that will enable easy transfers from the vulnerable settlements, minimize interchange, and also reduce the cost of the journey. It will also require seamless integration of IPT with buses and the Metro service and also more direct routes—as far as possible—for IPT. This will have to be supported by walkable streets. It will require settlement-wise mapping and inventory of local streets, their condition, access and interchange points to identify local solutions.

MoHUA may adopt policy guidelines in this regard. Additionally, a policy on fare integration is needed to keep integrated public transport services affordable for all. Such a policy requires financial, social, benefit and care packages. As seen globally, for example in Curitiba, Brazil, a successful Bus Rapid Transit System (BRTS) runs a flat fare for marginally weaker sections irrespective of trip length and multiple transfers during the trip (see *Box: Global examples of inclusive planning and equity, on pp. 34–35*). The fare is also reviewed annually so that workers do not have to spend more than 10 per cent of their income on transport. Integrated ticketing or a one-card system can eliminate transfer changes. Integrating such systems with IPT, which is the prime mover of poorer sections, can work wonders. Most IPT and shared IPT services operate on distance-based fixed fares. Chip-based tickets can be introduced for low-income groups instead. At the end of a trip, the operator can encash chips at the terminating point. The same method can be used for bus transport, thus eliminating the need for a second ticket.

State governments need to adopt policies on route planning of all services for reliable and affordable connectivity, and deeper penetration of services in low-income settlements.

Integrate housing programmes with transport connectivity and accessibility requirements: Under PMAY, there will be a massive expansion of the housing stock. The key verticals of this programme include beneficiary-led individual house constructions that largely target low-income households. This vertical has garnered the maximum incentive, as much as 63 per cent. The beneficiaries largely live in unplanned colonies. With *pattas* and security of tenure, beneficiaries can be motivated to improve their houses. But the overall welfare gains in these settlements need to be optimized. Buildings and the larger settlement cannot be seen in isolation from each other.

Similarly, the other vertical of 'Affordable Housing in Partnership', which is provided by the private sector, has got about 32 per cent of the total incentives under the PMAY. But a lot of attention will have to be paid to the locational attributes and connectivity of these housing provisions. Even though PMAY has asked for integration of such housing stock in the master plans of cities, the integration has not happened at a desirable scale. Most of the housing stock is coming up at the edge of cities without reliable and affordable connectivity. This often leads to under-utilization and the problem of vacant housing as beneficiaries abandon these houses for practical reasons. Poor area-level services and transportation costs increase the overall cost of living in these settlements.

Also, the other verticals including in-situ slum redevelopment, credit-linked subsidy scheme and rental housing for the poor and migrants will require detailed guidelines for accessibility, connectivity and public transport provisioning. Such requirements are not part of the housing provisions. This disconnect needs to be addressed.

Need a funding strategy at the city level: State governments and urban local bodies (ULBs) or municipal corporations need to frame investment plans and also create dedicated funds for local area improvements and infrastructure augmentation in the settlements. A portion of the revenue from commercial and residential areas, and parking revenue from parking area management plans can be earmarked for local area improvements.

Need an institutional framework: The challenge of fixing these problems gets even more complicated due to the fractured responsibility of different agencies in different land-use and settlement classes. This is a phenomenon in all cities of India. For instance, in Delhi, overall land development is a subject under the Delhi Development Authority (DDA), but provision of infrastructure and maintenance is complicated. DDA is responsible for complete land development (housing, social and physical) in planned standard areas. In low-income settlements, it is responsible for DDA scheme-housing for low-income group (LIG) and EWS, but for unplanned sub-standard areas it remains only a land-allotting agency and development can further be carried out by concerned agencies like Delhi Urban Shelter Improvement Board (DSUIB), Delhi State Industrial and Infrastructure Development Corporation Ltd (DSIIDC), Delhi Rural and Slum Development Organization (DRSDO), etc. Similarly, for street infrastructure, while the major responsibility lies with the municipal corporation, at times other agencies take some of the responsibility in unplanned areas. But again, water and electricity is commonly provided in all areas by Delhi Jal Board and BSES.

Similarly, arterial roads that cut across all settlement types are managed by National Highway Authority of India (NHAI), Central Public Works Department (CPWD), DDA and the transport department. But local roads, streets and pedestrian facilities are the responsibility of Municipal Corporation of Delhi (MCD) and DDA. Moreover, MCD, DSIIDC and Public Works Department (PWD) also take care of street furniture in some areas. Coordination is needed with providers of bus services, Metro and IPT. Bus services across Delhi are operated and maintained by Delhi Transport Corporation(DTC) and Delhi Integrated Multimodal Transit system (DIMTS); Metro services by Delhi Metro Rail Corporation (DMRC); and auxiliary services

like autorickshaws, shared IPT, *Grameen Sewa*, e-rickshaw, e-autorickshaw, cycle-rickshaw by Road Transport Office (RTO). While planned areas have a network of all services except *Grameen Sewa*, unplanned areas have access to only a few, including limited access to Metro and bus networks. Thus, it is a complicated institutional framework.

To untangle this complex web requires zonal plans with aligned responsibilities for coordinated action and a task force to oversee and monitor implementation. At the local level, a bulk of the street infrastructure and access design is the responsibility of the municipal corporations to improve walkability, safety and deeper penetration of rickshaw or IPT modes in these areas. These neighbourhoods need to plan differently the design integration, street alignment correction, adequate street infrastructure and paving, among other things.

This study builds a case for the need of a strong policy and coordination framework with a funding strategy for implementation. This effort will have to be conjoined with the environmental justice approach to ensure that solutions work for everyone and all vulnerable communities equitably.

This report also captures the imperatives of pro-poor planning and accessibility in urban India and presents the evidence of inequity in access across neighbourhoods of Delhi. It will hopefully help to build insight into equity-based planning as a way forward.

1. Imperatives of pro-poor urban planning and accessibility

Poor are part of the urban majority: Poverty statistics in India give out a clear message that the poor are a significant part of the urban majority and need to be the defining parameter of urban planning. As per the Ministry of Statistics and Planning (MoSPI) data of 2019, 21.92 per cent people live below the poverty line. The poorest are not benefitting from growth as they work in the unorganized sector. According to the *Periodic Labour Force Survey* 2017–18, only 9.8 per cent employment is in the organized sector, whereas 82.6 per cent is in the unorganized sector, which is largely unaccounted for in the economy.[1]

Any kind of exclusion worsens chronic urban poverty. This has serious implications when India is rapidly urbanizing. As per UN estimates of 2018,[2] 34 per cent of India's population lives in urban areas. This is expected to be 55 per cent by 2050. India is projected to add 416 million urban dwellers by 2050, which is almost equal to the projected addition by the next two biggest contributors, i.e., China and Nigeria, put together.

COVID-19 pandemic has put a spotlight on overcrowding and lack of basic services: It has taken a pandemic and a humanitarian crisis to expose overcrowded and unhygienic spaces in low-income neighbourhoods that worsen the risk of contagion. It is as if COVID-19 has drawn a black line under the importance of addressing livability and accessibility issues in all neighbourhoods inclusively to make cities safe for all.

Delhi was ranked as a top immigration city globally by the World Economic Forum in 2017.[3] Rural–urban interstate migration in Indian cities has doubled and increased to 4.5 per cent annually to be 4–5 million a year.[4] One in every six urban dwellers in India lives in slums. According to the 2015 *Slums Compendium of India*, slum population is as high as 45 per cent in certain cities. Any kind of exclusion, therefore, not only exacerbates urban poverty, but also undermines informal services that support a city's economy. Overall, the informal sector contributes substantially to the GDP of India.[5] Equity will have to be the defining parameter of urban and transport planning and growth.

The ongoing COVID-19 pandemic has further aggravated the crisis of exclusion, pushing a larger population into chronic poverty. According to the World Bank, nearly 40 million migrant workers (inter- and intra-state) were affected by the hard lockdown in India.[6] Rough estimates take this number up to 120–140 million.[7] A massive population has lost jobs. According to the Centre for Monitoring Indian Economy, the unemployment rate has shot up to 23.52 per cent from 8.75 per cent in March 2020.[8] A big decrease in buying power has serious implications for accessing quality and reliable services, and affordable and livable habitat. These issue cannot be resolved through market mechanisms alone. Urban planning policies will have to respond to this crisis. Equitable public planning and service accessibility has become more important than ever before.

The poor are more vulnerable to public health and climate impacts: While the zero carbon modes of walking and cycling of the urban poor have created the ecological space to avert the tipping point of climate change and air pollution, they themselves are falling victim to life-threatening local air pollution. Toxic vehicular fumes are taking a heavy toll in Indian cities. Malnutrition and poor access to health services increases the health risks. Exposure to toxic vehicular fumes is highest among the poor, who have to work and live in the most disadvantaged locations. Unfortunately, health costs for the poor often remain underestimated due to policy oversight and their inability to enter official healthcare databases because they cannot pay for most health services. Interlinking of goals of public health and climate mitigation and the co-benefit framework for mitigation can ensure reduction in the concentration of both heat-trapping gases as well as life-threatening fumes. This requires proper articulation in urban planning and design.

Transportation modes of the urban poor are part of the solution: By 2030–31, on an average, Indians will travel thrice as many miles as they travelled during 2000–01. A study carried out by the Indian Institute of Technology, Kanpur shows that without interventions, increase in passenger mobility will change the modal split in favour of personal vehicles. The share of public transport may drop from 75.7 per cent in 2001–02 to 44.7 per cent by 2030–31. On a per passenger basis, a car uses six times more energy than a bus.

The environmental impact of this change can be minimized only if people use public transport, and walk and cycle more. While the poor are captive users of cycling and walking modes, middle-income groups are shifting to more energy-intensive automobiles. Even today, the baseline data in our cities reflects substantial use of public transport, non-motorized transport (NMT), para-transit and walking.

According to the 2011 Census, about 60 per cent of the urban population travels within 5 km daily and about 40 per cent of trips are on foot and bicycles. The share of walking and cycling is dominant in cities, which reflects low vehicle ownership as well as low affordability. Census 2011 put the share of people using personal modes to travel to work at less than 14 per cent.

In fact, shares of walking and cycling trips are higher in smaller cities. The NMT share is about 30 per cent in cities with more than a million population, which increases to nearly 60 per cent in smaller cities. The share of public transport is more than 40 per cent in cities with more than five million population as they have organized bus and Metro systems, and about 10–20 per cent in cities with one to two million population that are primarily served by informal route taxis and autorickshaws. NMT has a larger share of trips in smaller cities. The diversity of public and para-transit modes and high share of walking and cycling represent the key strength in Indian cities. The challenge is to protect and improve upon this baseline in an inclusive manner.

City mobility plans for sourcing of Central government funds as well as city master plans have begun to set targets for achieving higher modal share for public transport. If meeting such targets can be enabled, growing automobile dependency can be prevented. In this context, equity-based inclusive mobility planning assumes even greater significance.

Need compact cities: This agenda is not only about investing in public transport but also about adopting an urban planning approach that will prevent sprawling and gated development to reduce distances. Public policy needs to promote dense, mixed land-use and mixed-income development in a compact urban form to bring jobs, homes and recreation closer to cut travel and emissions. Such an effort has to align with the transit and transport systems in the city. The unique travel pattern of the poor is intrinsically linked with the close urban form and is built around short trip distances that are walkable. If this is disturbed with urban sprawl, then the transportation regime for the poor can become increasingly difficult and unaffordable, with the risk of limiting their livelihood options.

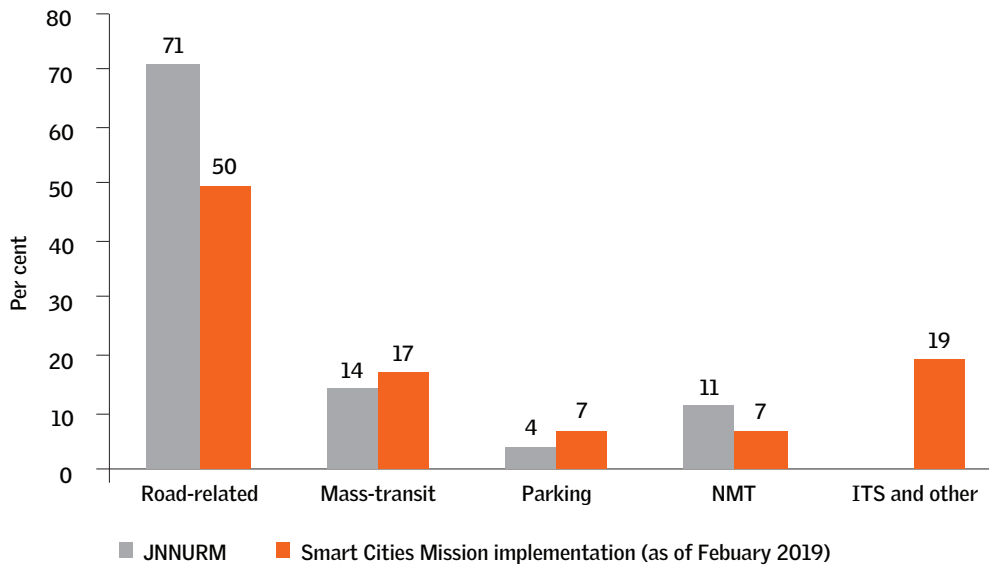
Public policy and funding of transportation need to ensure equity: National policies including National Urban Transport Policy, Smart Cities Mission, National Habitat Standard and Transit-Oriented Development Policy have begun to acknowledge the needs of the poor and concerns around poverty. But the policies have so far not been able to change practices. More often than not, city development plans and city mobility plans that were initially prepared for sourcing of Central

government funds for transportation do not even address the travel needs of low-income classes, especially those living in the peripheries of cities.

Also, an analysis of the funding pattern under different programmes and schemes shows that public funding is still biased towards car-centric road building despite very low car ownership in Indian cities. The recent investments in urban transport projects reflects this inequity in distribution of urban funds disproportionately towards roads and highways. Data accessed in February 2019 from MoHUA on implementation of the Smart Cities Mission shows that more than 50 per cent of the funds were invested in road-building, including on expansion of roadways, improving their aesthetics, etc. This is in contrast to the barely 7 per cent funds spent on footpaths and NMT and the mere 17 per cent spent on public transport. This means that about 50 per cent investment is made for 15 per cent of the users and only 24 per cent for 85 per cent of affordable transport users, clearly demonstrating that inequity and imbalance persist (see *Graph 1: Comparison of investment of funds on urban transport components*). Resources are not equitably allocated for the infrastructure for NMT (the dominant mode of transport in general and the predominant mode for the poor). However, the projected funding strategy of the Delhi Decongestion Plan that has been framed by MoHUA shows a departure from this trend and is focused on a more equitably distributed approach to implementing sustainable modes, including public transport, walking and cycling infrastructure. But parallel forces are making noises to push for elevated and tunnel roads.

Graph 1: Comparison of investment of funds on urban transport components

Only 24 per cent of the funds are spent on 85 per cent of the people (using affordable transport)



Source: MoHUA

Conventional financial policies do not adequately promote public transport and NMT. ULBs impose higher taxes on buses than they do on cars. A trip is often cheaper on a two-wheeler than by public transport. Car parking competes for public space. It is ironic that in Delhi a car is allotted 23 sq m of land in structured parking, but a poor family gets only 18 sq m under the low-cost housing scheme. The car-owning minority uses up more public space without paying its full cost.

Transportation reforms may become anti-poor if not planned well: As cities begin to opt for more transportation reforms and capital-intensive formal transportation systems to scale up public transport, it creates pressure on resources at the cost of infrastructure for access, walking, cycling, and affordable public transport systems. As part of fiscal reforms, cities are increasingly aiming to capitalize on land value gains along the transit lines to fund Metro systems, and relaxing building norms to allow more built-up areas for densification.

The Urban Renewal Mission has prescribed ways of mobilizing resources through taxes on property development across transit routes, land value capture and leveraging of the land banks available through liberal property development. But most cities have begun to initiate these measures without creating regulatory safeguards to ensure that such measures do not out-price the poor and low-income groups from such development.

Higher land and housing values are limiting affordable housing units for low-income and chronically poor groups near transit routes and points; and potentially stifling development of affordable and mixed-income housing projects. This runs the risk of making urban transportation projects heavily dependent on real estate development at the cost of the poor and may shift focus away from the objective of social equity. Therefore, regulations and safeguards must attach primacy to inclusionary zoning regulations, mandatory affordable and low-income housing and in-situ development of slums. Otherwise, captive users of public transport may be pushed out of the zone of influence, which will defeat the purpose of increasing public transport ridership.

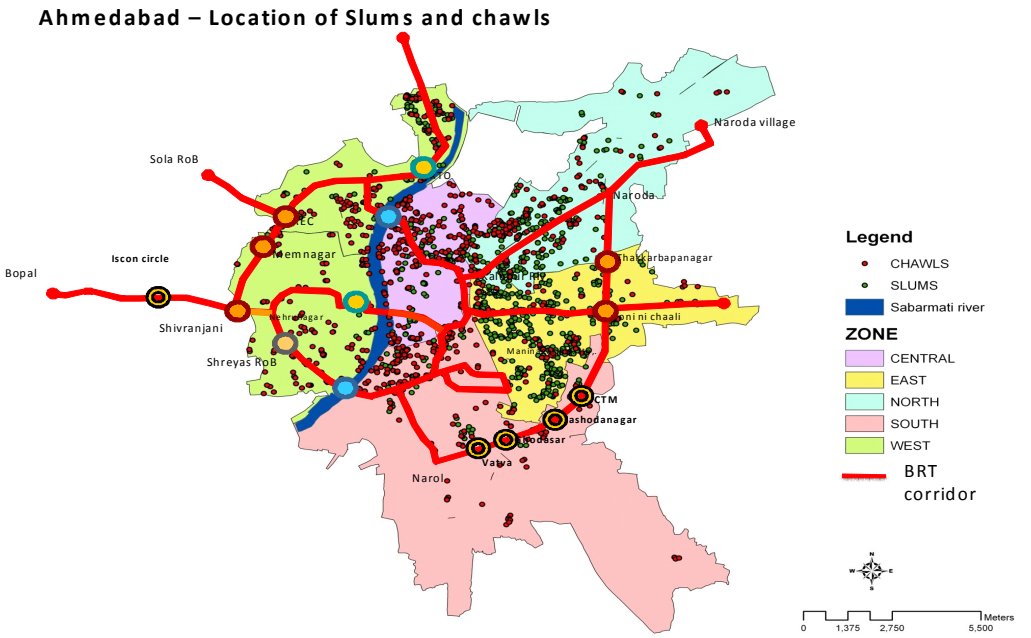
Moreover, if the market out-prices the poor and pushes them to the peripheries, even that will require planning interventions to ensure affordable and reliable access and transportation. To some extent, that may even be unavoidable given the current urban landscape. But it will require even more attention to mitigate the negative fallouts for the people. Regulatory conditions of affordable housing for the low-income groups as well as the chronically poor must be laid down in new development in advance.

Urban planning pushing the poor to the peripheries, disrupting livelihoods and increasing travel distances and costs: Transport planners are pointing towards the increased conflict between the interests of the poor, the outlook towards transport, and habitat planning. Middle-class environmentalism is pushing for high-end mass transport systems that are often exclusive in nature and push out the poor from the planning process. A study carried out by D. Mahadevia of Centre for Urban Equity of the CEPT University shows that the Ahmedabad BRT has displaced slum residents and nearly 2,000 vendors, endangering their livelihoods. This has serious implications, given the fact that a large number of urban workers work on the streets.

Public policy will have to integrate land-use and shelter policies in cities with public transport projects. These projects must not exclude and relocate the poor in cities. The CEPT study has found that there are many slum clusters along the proposed BRT lines in Ahmedabad. But their assessment has also shown that enough public land is available along the network that can be used for an inclusive land-based policy (see *Map 1: Slums along the BRT corridor in Ahmedabad*).

Map 1: Slums along the BRT corridor in Ahmedabad

These slums must be included in any and every urban planning policy

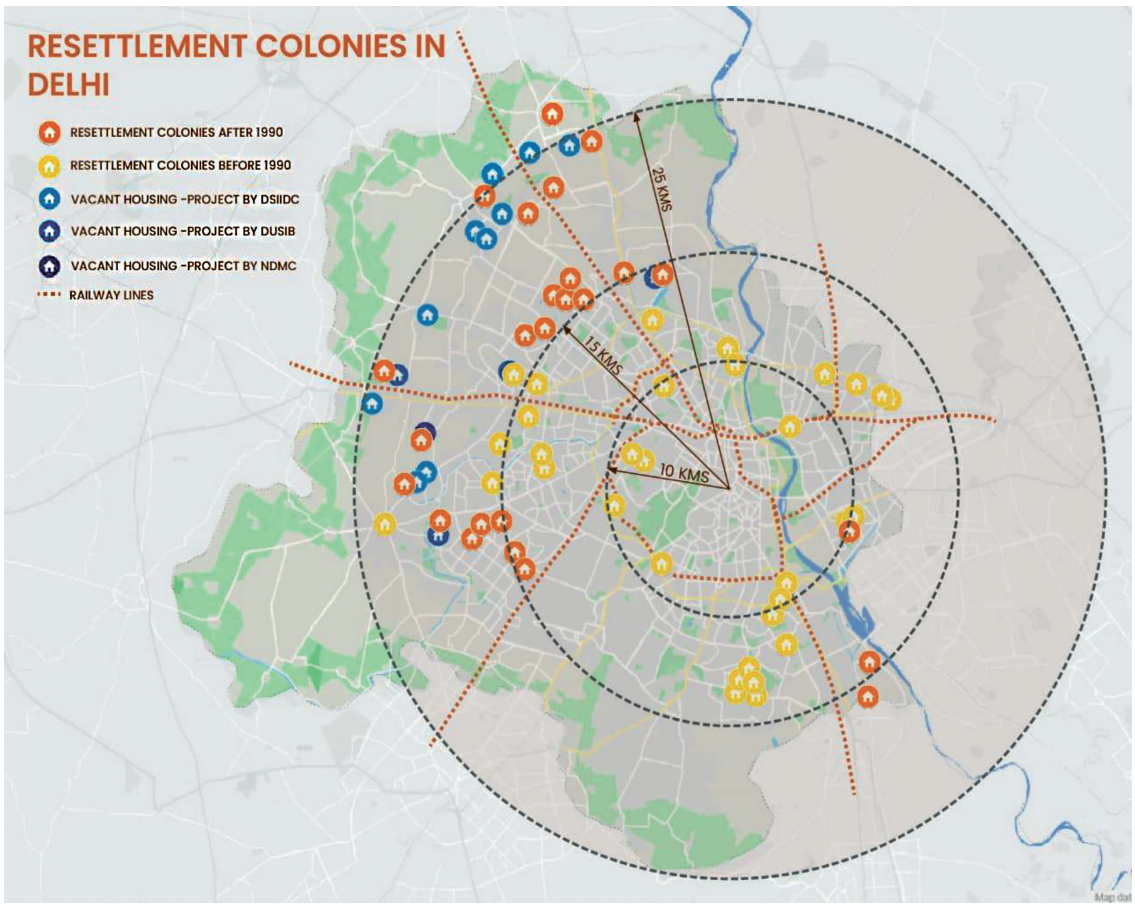


Source: Darshini Mahadevia, *Inclusive transport, paper presented at the workshop on promoting low-carbon transport in India*, CEPT University, New Delhi, 12 November 2010

Like in many other cities, planned low-income settlements in Delhi, whether in the form of resettlement colonies or affordable housing built under government schemes, are invariably located at a considerably long distance from access to livelihood and services. Affordable homes are not closer to affordable transport. For example, some of the older resettlement areas such as Savda Ghevra, Baprola, Bawana, Holambi Kalan, Papan Kalan, Rohini and Narela are relocated in the peripheries of Delhi. In fact, a recent study on resettlement of informal or slum settlements by Social Design Collaborative shows that planned resettlement areas are always located outside the city core (see *Map 2: Spatial distribution of planned resettlement areas*). It has also been observed that many of these allotted areas have vacant houses despite their being a huge shortage of affordable housing. This is indicative of a wasteful mismatch between supply and demand.

Map 2: Spatial distribution of planned resettlement areas

Planned low-income areas are almost always located away from the city core, defeating their very purpose



Source: Social Design Collaborative

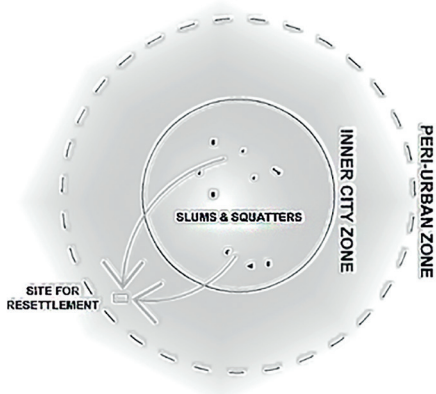
A report by CURE India shows that in 2002, communities from Yamuna Pusta, Nagla Machi, Khan Market and Airport areas were resettled 30 km west to Savda Ghevra, a peri-urban area just short of Rohtak in Haryana.[9] By 2010, Savda Ghevra had about 8,000 families but people found it difficult to commute and access opportunities as there was no bus connectivity, no water supply, nor a sewerage network or other physical infrastructure provisions. The report by CURE also states that resettlement to peripheries is not just a costly investment for the city in terms of delivering infrastructure and services, but is also devastating for the families, as social ties break, and access to livelihood, education and health services becomes more difficult. Often, the "affordable" housing becomes so expensive that families cannot meet their daily needs, leading to deterioration in the quality of life (see *Map 3: Relocation of multiple slum communities to Savda Ghevra*).

Even though this experience is common in such settlements across the country, documentation of ground-level experiences with regard to connectivity and accessibility still remains extremely inadequate.

Marginalized within the city: It is also important to note that this narrative is not only about settlements banished to the peripheries of the city. Many settlements have cropped up and grown organically around the city. They have grown incrementally over decades through immigration and have varying legal status. Many villages within Delhi have also now been integrated with the urban

Map 3: Relocation of multiple slum communities to Savda Ghevra

Relocation has moved people away from services and livelihood opportunities, and increased mobility woes, lowering their standard of life



Source: CURE India, 2014

landscape. Delhi Master Plan 2021 classifies such settlements in Delhi as unplanned settlements. Delhi's Economic Survey report further classifies unplanned settlements into six categories: unauthorized colonies, regularized unauthorized colonies, slums designated areas, *jhuggi-jhompris*, resettlement colonies and urban villages. The seventh type is planned colonies.

Several of these settlements have been notified and regularized retrospectively to provide them legal status. But even within the city, these settlements are not well served by public transport services and lack local connectivity. They are hugely deficient in local infrastructure, amenities and essential services. The challenge is worsened because they are already fully built spaces with very little scope of renewal and retrofitting. However, there is scope for making qualitative improvements, but that is yet to find adequate policy focus. The development in the rest of the city is continuously marginalizing and disenfranchising them harming not only them but everyone else. Rapidly expanding car-centric infrastructure is making it difficult for everyone to use sustainable modes.

Transportation costs are higher for relocated urban poor

Transportation costs for relocated urban poor are increasing significantly due to increase in daily trip distances and dependence on more than one mode as well as long-distance motorized travel. More motorized travel also adversely affects the modal share within the city. Often, households try moving back to central locations within cities as squatters.[10]

A 2007 study carried out by the Transportation Research and Injury Prevention Programme (TRIPP) in slums of Delhi that were relocated because of the Delhi Metro project found that shares of walking and cycling trips declines in relocated slums and use of buses increases. The Metro does not benefit the slums, even those that are located just next to it, as it is unaffordable for the city's poor (see *Table 1: Impact of the Metro project on modal share in relocated slums*). Such is the social exclusion of the weaker socio-economic section.

The study also found that relocation has increased the cycling distance from 3 km to 7.29 km on an average; and for relocated areas, even commuting distances by buses has increased from 4.7 km to 14.68 km and journey time from 5 minutes to 63 minutes, on an average. Accessibility has deteriorated significantly as distance of education, health and other urban services has increased for about 52–63 per cent of the households.

Table 1: Impact of the Metro project on modal share in relocated slums

Metro does not benefit slums, and relocation due to the Metro declines zero emissions trips and increases shift to buses in slums

Location		Slum near the Metro		Slum relocated due to the Metro	
Modal share		Before	After	Before	After
Walking	Per cent	77.99	77.96	79.94	74.86
Cycling		3.95	4.00	5.66	3.29
Rickshaw and others		8.57	8.71	4.17	1.23
Bus		8.16	7.21	9.79	19.51
Three-wheeler		0.88	0.75	0.26	0.48
Metro		0.00	0.41	0	0
Car		0.34	0.34	0.15	0.03
RTV		0.14	0.62	0	0.21
Train		0	0	0	0.34

Source: Geetam Tiwari 2007, Urban Transport Planning, Symposium on the problem of urban transport, Seminar November 2007

As a result of the relocations, usage of NMT (zero emission transportation) is under threat. In fact, non-motorized vehicle use has declined for as much as 59 per cent of the households in the relocated slums. This clearly brings out that even the urban mass transport projects that are otherwise promoted for sustainability fail to be inclusive and affordable. Ironically, they may affect the poor adversely. These studies bring out quite clearly that the poor are not the expected beneficiaries of high-end transportation projects like the Metro, but they face enormous disadvantages due to such projects. Many a time, relocation to city peripheries devoid of basic transportation facilities instigates a demand for informal modes of transport like para-transit and shared para-transit.

Cost of the urban commute for the poor: For EWS, higher spending on transport leads to lower spending on housing, health and education, letting them spiral into greater poverty. As per CSE's calculations, unskilled daily wage labourers in Delhi spend, on an average, around 8 per cent of their income on travel by a non-AC bus, 14 per cent by an AC bus and 22 per cent by the Delhi Metro. Comparative figures are even higher for Ahmedabad and Bengaluru. If one counts the cost of making interchanges (at the 25 per cent rate derived previously in the study),[11] the total journey cost becomes even more unaffordable. And if the criteria of 15 per cent of income spent on transport is considered as the upper cap of affordability, then almost one-third or 34 per cent of Delhi's population stands excluded from basic non-AC bus services.

A study on displaced settlements in Ahmedabad carried out by D. Mahadevia of Centre for Urban Equity of CEPT University, shows that increased dislocation and relocation of urban poor because of urban projects is increasing their economic stress. A review of consumption expenditure shows that the share of transport cost in household budgets has increased significantly for the bottom 50 per cent of the population. The expenditure share in education and health has stagnated.

Most affordable housing has not been planned with a view to reduce the distance and cost of commute for the lower-income population.[12] This trend not only decreases their access to public transport in order to access economic opportunities but increases the cost of access significantly. There is a direct correlation between increased distance and cost of transport infrastructure which indirectly burdens the commuting cost, impacts the environment, depletes resources, and damages the socio-economic weave of a city. In urban areas, there is a positive correlation between accessibility and income security.[13]

Integrating transport of the poor (para-transit): Most unplanned neighbourhoods depend on informally organized small para-transit systems—shared autorickshaws, *Grameen Sewa*, e-rickshaws and cycle rickshaws. Most of these modes are also victim of middle class disdain. In most cities, public policies do not allow these vehicles to operate in the heart of the city and confine them to the peripheries. In Delhi, shared IPT operate on a route permit-basis only, and *Grameen Sewa* operations are restricted to only peripheral areas. Both these modes are partially allowed to access some Metro stations.

These low-capacity, high-occupancy modes are cheap and provide flexibility based on passenger capacity, operation (fixed route permit or area permit), and service distance (cycle rickshaw up to 3 km and shared vehicles for 4–7 km). But this deployment needs to be augmented and organized better according to the service range and integrated with the larger public transport network in the city to ensure seamless connectivity for all. These systems can even work for the urban majority with better planning and deployed according to service gaps in the city.

Moreover, zero emission cycle rickshaws face the brunt of huge restrictions or bans. In Delhi, there was a move to remove all of them. The High Court had to intervene to prevent that and ask for a cycle rickshaw policy. Kolkata has enforced a ban on cycle rickshaws. There is a policy disconnect on integrating zero emitters like bicycles and cycle rickshaws with the mainstream transportation regime of urban centres.

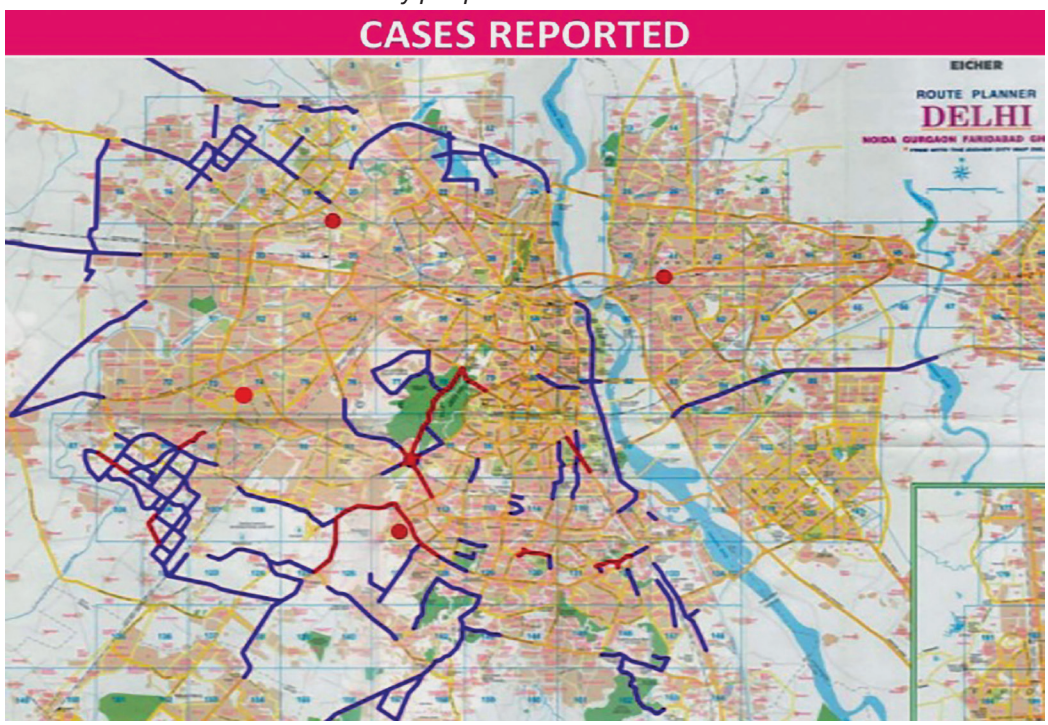
Gender unfriendly and unsafe peripheries

Increased peripheralization of low-income neighbourhoods is also making them more vulnerable to crime against women, which further compromises their socio-economic prospects. A study on women safety on roads of Delhi conducted by UTTIPEC found that most unsafe areas are located in the peripheries of the city (see *Map 4: Gender-based crime on roads*). These are the areas where the city's urban poor reside. Most access roads in these areas are dark, deserted and dangerous, with bare minimum infrastructure.

There are also major problems of access to basic facilities and utilities within resettlement colonies and neighbourhoods. Most of these unplanned settlements, resettlement areas and *jhuggi-jhompris* do not have access to proper sanitation and community-based sanitation is available for limited hours daily. This causes major inconvenience for women. At night, at several places, women cannot access public facilities. Additionally, most harassment takes places after 8 p.m. when access on dark roads and lanes becomes difficult for women. Dearth of sanitation facilities also increases the expenditure of low-income households, as they have to pay to use common facilities which ought to be free.

Map 4: Gender-based crime on roads

Most unsafe areas are located in city peripheries



Source: UTTIPEC, 2012

Policies on inclusivity a non-starter

Several policies have taken shape over the last decade that have taken on board the principles of equity and inclusivity. National Urban Transport Policy, National Clean Air Action Plan and Habitat Standards, Smart Cities Mission and Transit-Oriented Development Policy are a few of these policies recognizing the need for equitable and affordable transport and NMT infrastructure. But there is a gap between policy and implementation. Even the plethora of City Development Plans and Comprehensive Mobility Plans that were framed to access Central government funding under the Urban Renewal Mission have failed to address the needs of transport and mobility beyond roads, highways and demand assessment for public transport; and ended up focusing on diverting more funds towards road building while under-funding sustainable and affordable public transport.

In the meantime, the trend towards sub-urbanization and sprawled gated and segregated development has continued, undermining the advantages of the compact mixed-use urban form. More low-income settlements have been pushed to the peripheries. These settlements as well as those that have cropped up organically within cities have grown in size and density without much support from public policy and planning to create accessible and well-served livable places.

From an accessibility perspective, in most cases, street networks, footpaths and NMT infrastructure are wanting, and the need for auxiliary transport modes has been ignored. Hence, travel needs of informal settlements, slums and low-income groups living in unplanned areas have not been integrated properly with city-wide systems.

Lessons from Delhi

To understand this challenge and the potential for change, a deep-dive assessment of select planned and unplanned settlements with different economic profiles has been carried out in Delhi. This assessment can hopefully inform emerging policies and implementation strategies, and also the master planning process in Delhi and other cities. Delhi is in the process of preparing its 2041 Master Plan. In fact, MPD 2021 was originally focused quite overwhelmingly on vehicles, highway network expansion and parking infrastructure, and ignored the needs of sustainable urban transport. But it was subsequently amended to include a full-fledged Chapter 12 on sustainable transport that prioritizes people over vehicles. The chapter addresses all segments of transport and provides targets to improve qualitative aspects of public transport by improving ridership, accessibility and street networks;

increasing provision of NMT, IPT and other shared modes; and ensuring equitable distribution of road space, standards for neighbourhood access to public transport, neighbourhood street safety, road safety, universal accessibility, parking provision as a vehicle restraint measure, etc.

These provisions now require a template for implementation.

What ails Delhi's mobility framework?

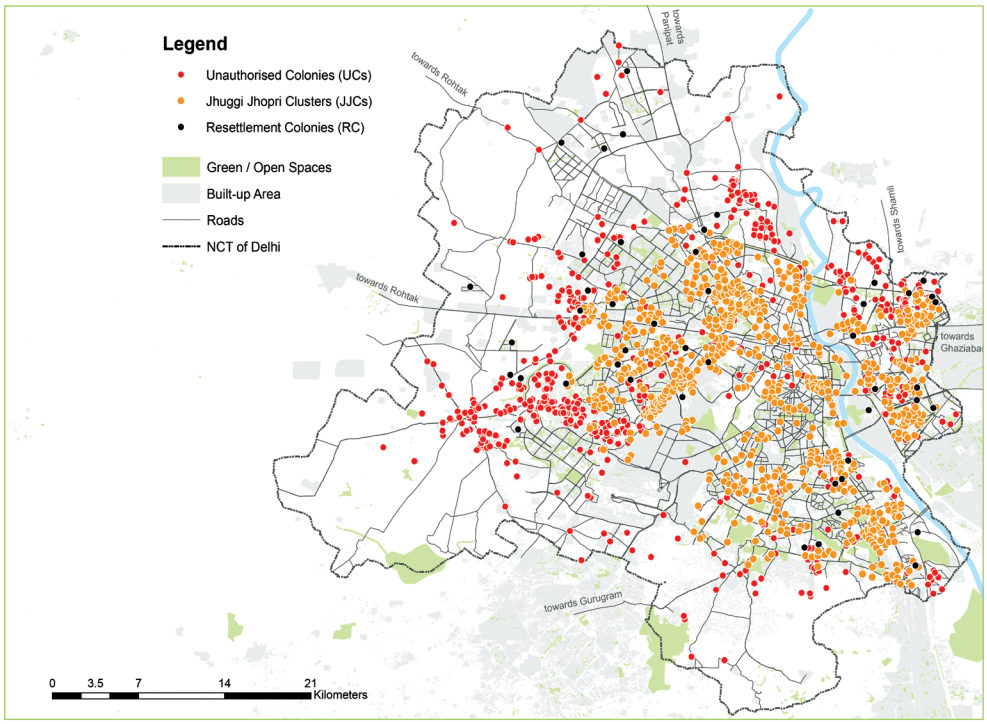
Delhi, the capital city of India, is not only one of the biggest urban agglomeration but also the world's second most populous city. It was estimated to have 23 million people in 2020 and is projected to be the world's most populated city by 2050. According to the *Economic Survey of Delhi* 2019–20, about 7.7 million people, i.e., one-third of Delhi's population, lives in informal settlements (this is over and above those living in urban villages and resettlement colonies). Other estimates, like the ones provided by a 2001 study by the Delhi Urban Environment and Infrastructure Improvement Project (DUEIIP),[14] a 2008 Delhi Jal Board report, and a 2015 paper of Centre for Policy Research, put the number of Delhi's population living in unplanned settlements at about 80 per cent.[15]

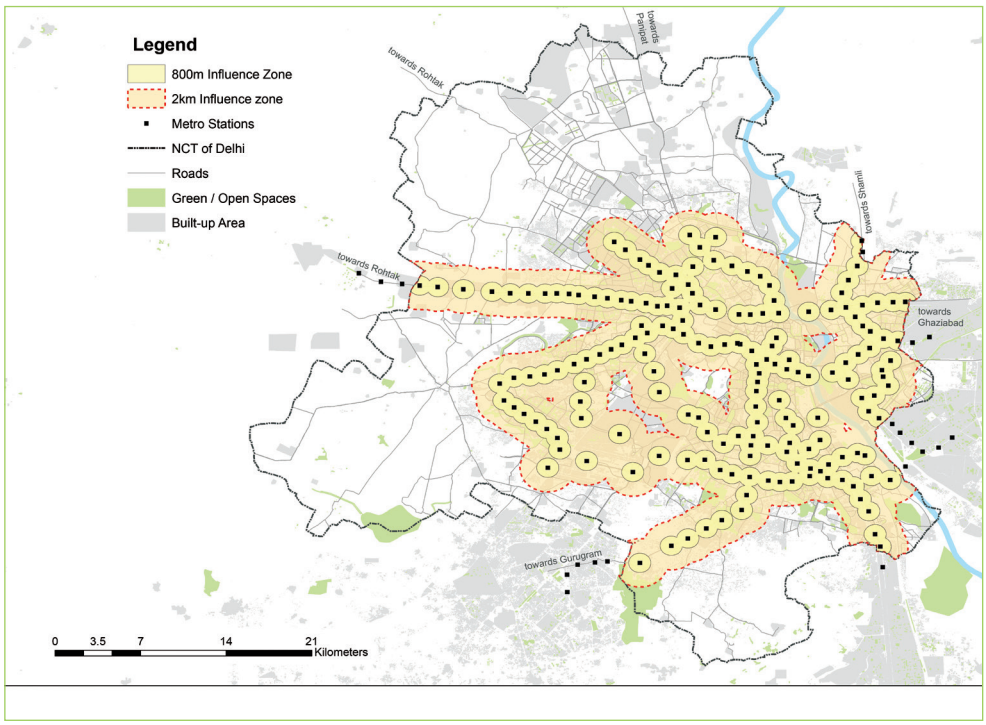
Constant immigration is increasing the number of people living in informal settlements. It has been reported that more than 6.3 million people living in Delhi (nearly 40 per cent of the city's population) are migrants from other states.[16] As per Census 2011, in Delhi (which is 97.5 per cent urban), about 40 per cent of the people are inter-state migrants,[17] and 1.78 million people live in slums that are scattered across the city.[18]

A comparison based on Census 2011 data on quality of housing and access to basic infrastructure in slums and other settlements in Delhi provides some interesting insights (see *Table 2: Quality of living and access infrastructure in Delhi*). Only 51 per cent of household in slums have access to drinking water. The Delhi average is 80 per cent. Access to electricity is, however, good across slums. But only 49 per cent of households in slums have closed drainage. With regard to other essential services, only 55 per cent of households in slums have access to banking services. The average figure for Delhi is 79 per cent. Proximity to essential services has a bearing on the need to travel. Most informal settlements in Delhi are also outside the pale of the Metro system (see *Map 6: Spatial distribution of unplanned settlements and the Metro network in Delhi*).

Map 5: Spatial distribution of unplanned settlements and the Metro network in Delhi

Unplanned settlements have poor access to the Metro network





Source: DDA

GLOBAL EXAMPLES OF INCLUSIVE PLANNING AND EQUITY

Globally, several initiatives have made efforts to integrate parameters based on equity and inclusivity to address the mobility needs of the marginalized. Some examples are:

Restructuring bus routes to connect low-income neighbourhood in Lima: In Lima, 60 per cent of the low-income population is spatially segregated along the north and south periphery, away from access to public transport. The only form of transport that was available to these areas was in the form of shared IPT vehicles called Combi. These vehicles had long halts and longer travel times. Lima's BRT was conceptualized to address these issues. Existing major routes were reconfigured in the form of a 'trunk and feeder' model of connectivity to these areas.[19] The feeder routes include a comprehensive mix of modes like older buses and existing IPT, and constructing of walkways and staircases to connect uphill areas. The BRT system, with last-mile connectivity, was a comprehensive approach to not only connect areas, but decrease congestion, and reduce air pollution and emissions from vehicles. The public transport reformative approach reduced the average travel time from 38 to 50 minutes for these communities, which helped them to have some extra time for work or family, and improved their living conditions.[20]

Social fare for low-income residents: Social fare by Curitiba BRTS is a great step to bridge the affordability gap among various social strata. Riders pay one uniform fare, regardless of the distance being travelled or the number of transfers. This is called the "social fare", alluding to the fact that shorter journeys subsidize the cost of longer journeys disproportionately taken by low-income residents. Also, fares are regularly reviewed to ensure that the "average worker" spends no more than 10 per cent of their income on transportation.[21]

Indirect social benefit programmes by Curitiba city BRTS: Eco-citizen's programme is another scheme that encourages homeless and low-income households to collect and separate recycling materials from inaccessible neighbourhoods. In exchange for bringing recycling materials to one of the 92 sites, "eco-citizens" receive bus tokens, fresh fruits and vegetables, and children's school supplies. The programme has benefited sixty impoverished neighbourhoods with 31,000 families and nearly a million bus tokens have been given to them.

PROPAV,[22] an accessibility improvement programme: One of the earliest known solutions to improve accessibility was a low-cost programme developed in Brazil during the 1970s. The programme aimed to improve accessibility to transport and livelihood by upgrading infrastructure. Programme provisions included creating a paved road network throughout neighbourhoods to improve overall walkability and connecting it to sheltered bus stops. For safety, improvements were carried out in the form of illumination and improved connectivity through mini-buses that reduced waiting time. This was a simple, innovative low-cost solution that improved equity in accessing transport and door-to-door connectivity.

Metro Joint Development Policy in Los Angeles reserves 35 per cent of housing near transit points for affordable housing: Due to increasing property values, housing near transit points does not remain affordable for low-income households to buy or rent. This pushes these households away from the transit points which, in return, affects transit ridership. The Metro Joint Development Policy developed by the Los Angeles County Metropolitan Transportation Authority (Metro) is an inclusive real estate development programme to guide and allow the Metro to own and develop properties closer to transit.[23] This policy provides for the Metro authority to be able to work with affordable housing developers to create transit-oriented affordable housing near metro stations and transit networks. Its objective is to make at least 35 per cent of the housing the Metro develops affordable. Additionally, the policy allows affordable housing developers to avail a discount on land price of up to 30 per cent fair market value, proportional to the number of affordable units to be created. As of July 2019, the initiative has created over 2,000 housing units, of which 31 per cent are affordable.

Two loan programmes, the Metro Affordable Transit Connected Housing (Metro-MATCH) and the Transit-Oriented Communities Small Business, have been formulated to achieve the policy's goals. Metro-MATCH provides loans to developers for acquisition and pre-development and financing of rental housing in the half-mile radius around high-frequency transit nodes to preserve affordable housing and boost ridership. TOC-SB provides loans to owners of vacant ground-floor retail properties adjacent to transit points to create new tenant spaces and below-market rentals.[24]

Accessory Dwelling Unit to meet rental housing shortages within the city: Minneapolis Accessory Dwelling Unit Ordinance (ADU), introduced in 2014, is a neighbourhood preservation strategy with increased density near transit-adjacent neighbourhoods that permits building smaller additional housing units near and within existing buildings. Permissions under the ADU are given in single- and two-family lots in all neighbourhoods within half a mile of the Green Line LRT along a mile-long corridor on St Paul's western end. ADU has helped in accommodating more people within the same plot. In the four years since its passage, 92 permits have been issued by the city.[25]

Borrowing the concept of housing during World War II which allowed small additional housing units in incidental spaces, garages, basement etc., to accommodate sudden surges in population, this concept allows sprawling for small affordable housing units within the existing housing neighbourhood with access to transport and facilities in the neighbourhood. There are three primary ADU types: internal, attached and detached. An internal ADU is located within the walls of an existing or newly constructed home, while an attached ADU would be located in a separate addition to an existing home. An ADU can also take the form of a "detached", free-standing structure on the same lot as a principal dwelling unit. Legal provisioning of such housing could immensely help meeting affordable housing demand within cities.

Choosing affordable housing over parking requirement to rationalize urban space utilization: In mid-2015, the city of Minneapolis made a progressive amendment to zoning regulations related to parking for residential properties located near high-frequency transit areas. It is an attempt to bring drastic cost reduction in real estate values as building a parking place in a multi-storey apartment is quite expensive as it requires deep excavation and materials to strengthen the foundation.

Earlier, the law allowed one parking space per unit. According to the new provisions,[26] properties with 50 units need not construct off-street parking facilities, whereas properties with 50 or more units are required to provide one parking space per two dwelling units. It decreases the cost to developers and increases opportunities for low-income groups to purchase or rent a dwelling unit near transit areas. Since the changes made to reduce parking requirement and promote affordable housing units to meet market demand there has been an increase in apartment building near transit zones beyond the downtown area.

Denver Regional Transit-Oriented Development Fund:[27] Launched in 2010, this is the first of its kind fund aimed to create and preserve areas along current and future transit-oriented corridors for affordable housing. The idea behind this is that low-income families need affordable housing closer to affordable transit. To meet this requirement, a low-cost property acquisition fund was launched by Enterprise and Denver-Area Partners. Today, a fund of US $24 million is available for qualified borrowers. In the past 10 years, 1,354 affordable homes along with 0.1 million sq ft area of commercial and non-profit space have been built through 16 loans amounting to a total of US $32.8 million. The success of this model can be gauged from the fact that 68 per cent of the processed loans have already been repaid.

Bonus density provision in exchange for floor-area-ratio (FAR) to encourage affordable housing units near transit points:[28] This is a strategy to meet affordable housing targets as per the "Affordable Housing Master Plan" in locations closer to transit stations in Arlington County, Commonwealth of Virginia. It is a land-use tool to allow for additional density and height along the transit network without relying on county funding. The county board has amended the zoning ordinance to remove the provision limiting bonus FAR to 0.25 for offices. In return, development has to provide affordable housing and community facilities.

Prescribe-a-Bike by Hubway bike share programme, Boston city: It is a subsidized membership programme targeting low-income communities in Boston. The Prescribe-a-Bike programme allows doctors at Boston Medical Centre to write low-income patients prescriptions for yearly membership to the city's bike-sharing system for just US $5. It is US $80 less than the standard fees for membership of bike share. This low-income resident usage rate is a considerable accomplishment compared to most other American bike-share systems. Boston Bikes representatives reach out to social service agencies in low-income neighbourhoods to raise awareness around the subsidized memberships.[29]

Table 2: Quality of living and access to infrastructure in Delhi

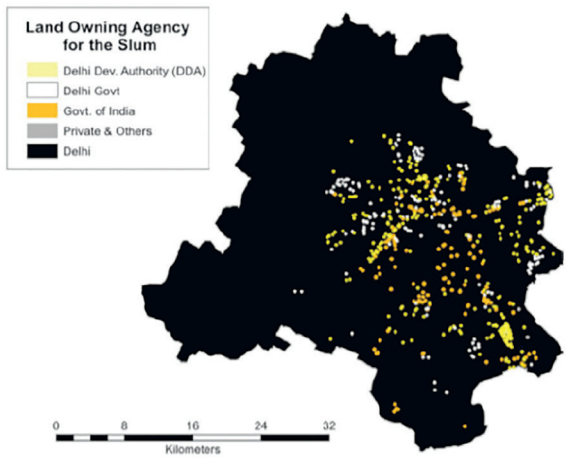
Access to basic utilities is poor in slums in comparison to the Delhi average

	Quality of housing			Access to services and utilities within premises				
	Percentage of households							
	Good	Livable	Dilapidated	Drinking water	Electricity connectivity	Household toilet	Closed drainage	Banking services
Slums	32	59	10	51	97	50	49	55
Delhi average	65	32	3	80	99	89	65	79

Source: Census 2011

Map 6: Spatial distribution of slums in Delhi

Estimates say 1.78 million people live in the slums of Delhi



Source: http://wws.princeton.edu/sites/default/files/content/India_Policy_Workshop_Report-Final.pdf

Transport network connectivity

Adequacy of transport connectivity and accessibility within settlements is linked to the adequacy of city-wide public transport services, their connectivity and integration with overall travelling patterns.

The share of different modes used to meet daily travel requirements was last estimated by Census 2011. The combined modal share of personal vehicles (two-wheelers and cars) was 40 per cent. Buses, Metro, taxi, chartered buses, and autorickshaws make up another 45 per cent and the rest are school buses and trains. Thus, personal vehicles and public transport already have nearly an equal share. If this is not addressed, the balance will tip even more towards personal vehicles (see *Graph 2: Comparison of modal share to share of registered vehicles in Delhi*).

Delhi has invested significantly in scaling up public transit systems, especially the Metro system. Currently, Delhi has the world's sixth largest metro network with

389 km route length and 253 stations. Its public bus system has 5,500 buses (DTC and Cluster) and about 2,000 bus stops for loading and off-loading passengers. However, over the last decade, the ridership of buses has declined consistently. Ridership of the Delhi Transport Corporation (DTC) has declined from 46.7 lakh in 2012–13 to 29.9 lakh in 2017–18, a decline of 36 per cent over five years at an annual decline rate of 7 per cent.[30] The Delhi Metro ferried 27 lakh passengers daily in 2019, losing around 4 lakh passengers post the two fare hikes in 2017. There may have been some gains thereafter.

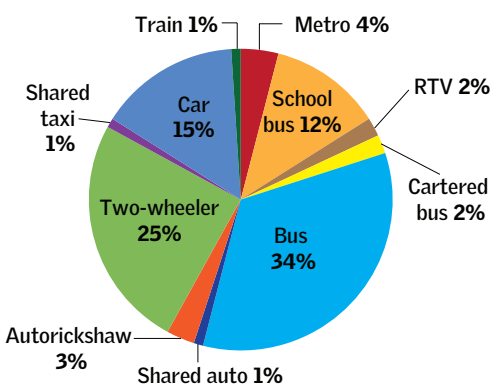
New modal share estimates have not been carried out since Census 2011. But vehicle registration data for the year 2018–19 shows that two-wheelers (68 per cent) and cars (29 per cent) together constitute 97 per cent of the total new registrations in the city. This must have had a profound impact on modal share in recent times. COVID-19 has caused a near-total collapse of the public transport system with massive loss of ridership and revenues. Buses have suffered the most, increasing the requirement of viability gap funding by nearly 70 per cent. This has stymied efforts to improve augmentation and deployment of public transport services.

For a city like Delhi, already facing enormous public transport infrastructure deficit, the burden of making services more inclusive has been increased. If this is not addressed quickly as part of the green recovery process, the poor will be hurt more. Delhi is nowhere near achieving the MPD21 target of 80 per cent modal share of

Graph 2: Comparison of modal share to share of registered vehicles in Delhi

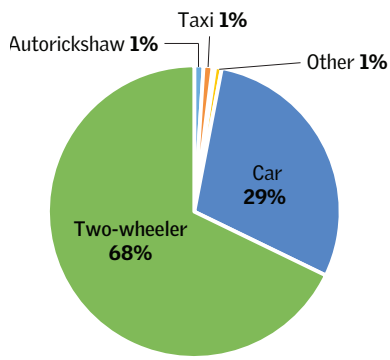
The number of private vehicles has been creeping up. If not addressed now, the balance will be tipped even more in their favour

Mode share of trips in Delhi



Source: *Rationalization of Bus Routes in Delhi, Department of Transport, GNCTD, 2011*

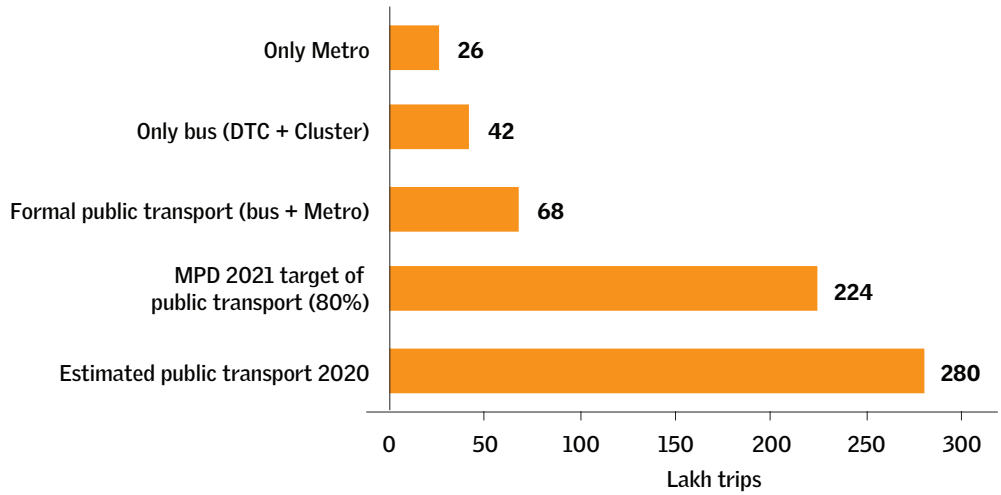
Passenger vehicle registration in Delhi



Source: Economic Survey of Delhi 2018-19

Graph 3: Deficit in trips to be carried out by public transport

MPD 2021 set a target of 80 per cent daily trips to be by public transport. Only about one-fourth of it has been met



Sources: Master Plan for Delhi 2021; Economic Survey of Delhi 2019–20; DTC, 2019; DMRC, 2019; and Committee on Delhi Traffic Decongestion, 2017

public transport by 2020. How difficult is that to achieve? Based on the estimate of per capita trip rate in Delhi in MPD 2021, 280 lakh trips were generated in 2020.

According to the *Economic Survey of Delhi* 2019-20, Delhi Metro catered to almost 27 lakh daily trips, DTC catered to around 30 lakh daily trips and Cluster Scheme (a public–private partnership model) buses catered to 12 lakh daily trips. This adds upto 68 lakh daily trips, i.e., only 24 per cent of all daily trips. Even if the 4 per cent three-wheeler autorickshaw trips are added to it, the percentage of total public transport trips rises only up to 28.This is nowhere near the 80 per cent target of MPD 2021 (see *Graph 3: Deficit in trips to be carried out by public transport*).

The shortfall is being met by walking, cycling, personal vehicles (cars and two-wheelers), suburban rail and informal public transport (taxis, autorickshaws, *Grameen Sewa*, private buses and so on). Even if Delhi Metro attains its target of almost 48 lakh daily trips by 2021, which is unlikely given the pandemic, there is still a large deficit to be filled by the city bus system and Metro together. This gap will increase dependence on personal vehicles and poorer people will be more distressed users of already stressed IPT and bus systems and will become forced captive users of long-distance walking and cycling in hostile traffic conditions.

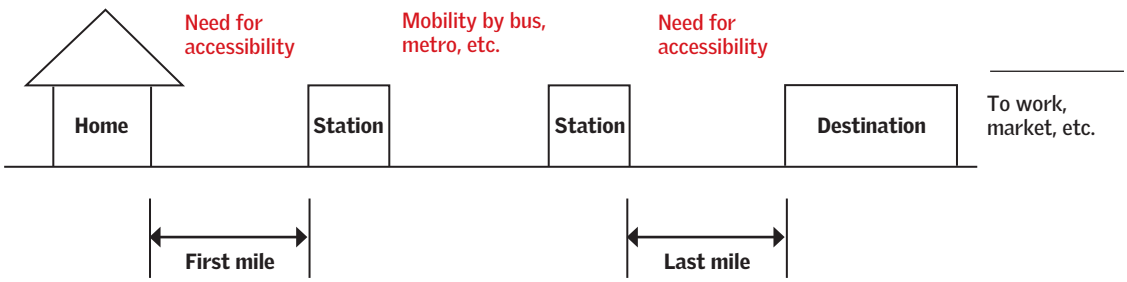
2. What ails accessibility in Delhi's neighbourhoods?

While there are serious concerns around the huge deficit in public transport services at the city level, there is very little understanding of how this deficit plays out at the neighbourhood-scale (that determines the choices people make regarding transportation modes). In high-income neighbourhoods, this deficit leads to more motorization and dependence on personal vehicles. In low-income neighbourhoods, it causes more economic and social hardship while making the people living in these areas disenfranchised captive users of stressed public transport, walking and cycling in extremely hostile conditions.

To investigate this deeper and to understand the legacy challenges in select areas and the gaps in current planning approaches that lead to disparity among settlements, a case study of Delhi's neighbourhoods has been carried out. Neighbourhood-scale movement and its integration of local infrastructure with larger city-wide public transport networks is the most neglected aspect of the planning.

For the purpose of the study, a diverse set of settlements has been selected for deeper analysis. To select the neighbourhoods, the residential settlement classification of the Delhi Master Plan 2021 has been considered. In addition, settlement classification on the *Economic Survey of Delhi* 2019–20 as well as land categorization of Department of Revenue, and GNCTD's circle rates have been consulted to assess the economic status of these settlements. However, while selecting different settlement typologies, informal encroachments and illegal slums have not been considered as these settlements do not have the legal status that can

Figure 1: First- and last-mile connectivity is needed to make the public transport network work for all



Source: CSE

allow planning interventions. According to all these criteria, three distinct types of settlements can be identified:

- **Unplanned Type A** (**semi-legal**): These are organic settlements that had originally sprawled as a result of urbanization and were later recognized under the Master Plan Delhi through notifications. This category includes a few developed unauthorized colonies, urban villages and designated slum areas. These areas have bare minimum infrastructure provisions. This category is of low-income unplanned settlements that are formal and semi-legal in nature.

- **Unplanned Type B** (**legal and semi-legal**): These are EWS and LIG colonies planned, allotted (with or without schemes) or resettled, and later notified as urban residential colonies. These colonies exist with relatively better infrastructure provisions, and a few were planned with MPD norms as low-income group areas. On an average, these settlements are inhabited by relatively higher income groups than Type A settlements, but lower income groups than a standard neighbourhood. This category of settlements includes relatively planned areas, is formal, and can be either legal or semi-legal in nature.

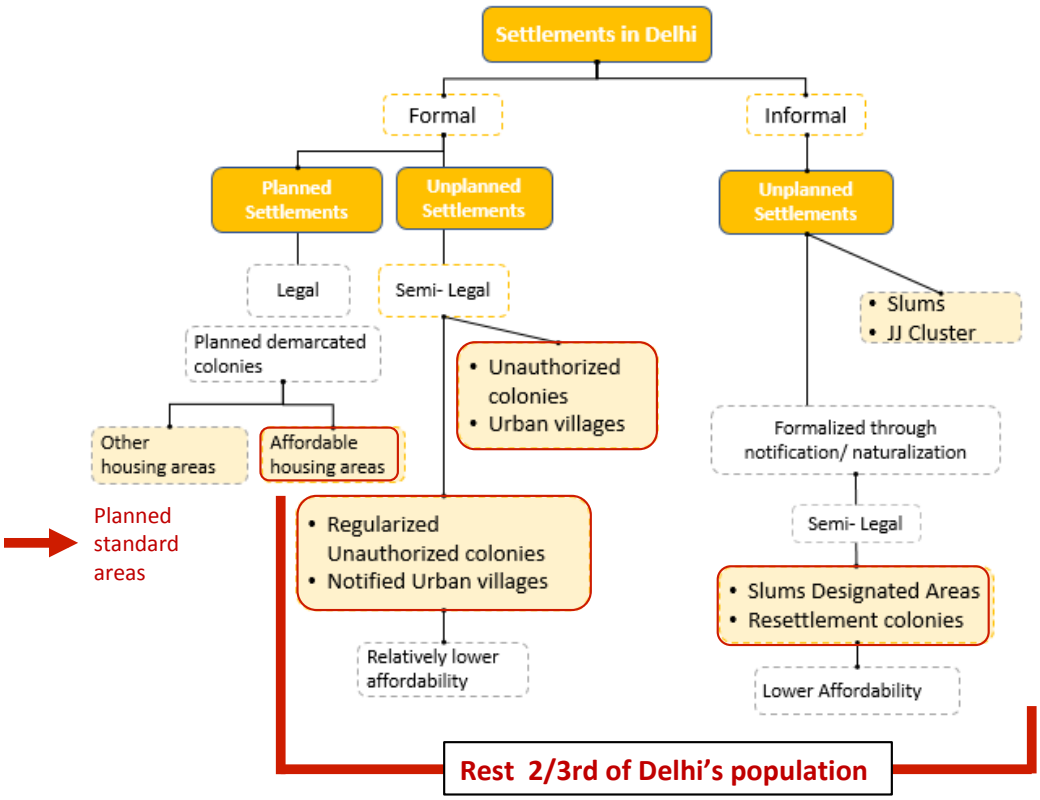
- **Planned or standard or other settlements** (**legal**)**:** These are the only settlements planned as residential areas within designated residential land-use and are built in conformity to the provisions of MPD 2021. They are formally planned and developed by DDA. This category of settlements are typically high-income planned colonies and are formal and legal in nature.

MPD 2021 defines settlements into planned and unplanned settlements where planned settlements are the ones complying with MPD norms, and unplanned settlements include unauthorized colonies, resettlement colonies, slums, etc. A more detailed categorization of unplanned settlements has been done in the *Economic Survey of Delhi*, based on housing quality, ownership status, etc. The Survey identifies six categories of unplanned settlements: unauthorized colonies, regularized unauthorized colonies, designated slum areas, *jhuggi-jhompris*, resettlement colonies and urban villages (the seventh type is planned settlements). Among these, unauthorized colonies (both regularized and non-regularized) form the major clusters (see *Figure 2: Classification of settlements in Delhi*).

In absence of detailed primary surveys of income profiles of the settlements, circle rates of the property are a useful proxy to determine the overall economic status indicatively. The terms of low-income and higher income settlements have been derived accordingly.

Figure 2: Classification of settlements in Delhi

Unauthorized colonies (both regularized as well as non-regularized) form the largest cluster



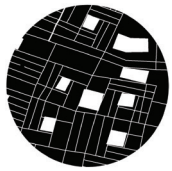
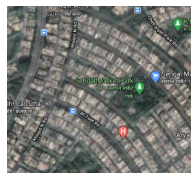
Note: According to revenue land categorization, only one-third of Delhi's population lives in 29 per cent planned standard settlements
Source: Based on the Economic Survey of Delhi 2019–20, MPD 2021, Revenue Department of GNCTD

Study settlements

A total of 16 areas have been selected for the rapid assessment to represent different categories. For technical reasons, the nomenclature of classification of settlements as per MPD 2021—planned and unplanned has been retained. Most of these settlements are from two districts of South Delhi and include planned affordable housing areas, unauthorized colonies, urban villages, resettlement colonies, designated slum areas and planned residential areas that have existed for decades. About 75 per cent of the selected neighbourhoods fall in the unplanned category, while 25 per cent fall in the planned category. The selected areas represent different built forms, varying degree of compliance with standards and provisions of the Master Plan of Delhi. Their legality, land ownership patterns, land prices and population densities vary significantly (see *Table 3: Distribution of study settlements*).

Table 3: Distribution of study settlements

Three-fourths of them fall in the unplanned category

	Unplanned		Planned	Source
	Type A	Type B	Settlements	
Income group	Low-income areas	Low-income areas	Mid-to-high income areas	Circle rates as per Revenue Department of GNCTD
Settlement structure	Unplanned settlements 	Relatively planned settlements 	Planned 	GIS and MPD gazette notifications
Built form				Google Maps
Compliance with standards	-	As per MPD norms for substandard areas and LIG and EWS areas	As per MPD norms	Economic Survey of Delhi 2019–20 and MPD 2021
Recognition under the ambit of MPD	Formal	Formal	Formal	MPD 2021 and MPD gazette notifications of DDA
Legality	Semi-legal	Semi-legal	Legal	MPD 2021 and MPD gazette notifications of DDA
Land ownership	Yes	Yes	Yes	Economic Survey of Delhi 2019-20
Land value	Circle rate of the selected settlements—Rs 46,000 to Rs 60,000 per sqm	Circle rate: Rs 46,000 to Rs 60,000 per sq m	Circle rate: Rs1.6 lakh to Rs2.5 lakh per sqm	Circle rates as per Revenue Department of GNCTD
Selected settlements	Garhi, East of Kailash (resettlement colony) Zamrudpur, East of Kailash Jawaharlal Nehru Camp, Kalkaji (slum cluster) Govindpuri, Kalkaji (regularized unauthorized colony) Khirki Extension (unauthorized colony) Shahpur Jat (urban village) Tughlakabad Village (urban village) Khanpur (unauthorized colony) Pooth Kalan (regularized unauthorized colony)	Madangir (planned low-income colony) Tughlakabad Extension (unauthorized colony) Tigri Extension (regularized unauthorized colony)	East of Kailash Kailash Colony Greater Kailash Chittaranjan Park	Reconnaissance survey

Source: CSE compilation

In addition, the sample also includes planned higher-income neighbourhoods that serve as benchmark for comparison. It may be noted that in relation to the principles laid down in URDPFI guidelines, it can be assumed that planned settlements have better accessibility and connectivity due to adequate planning. They also provide more economic opportunities compared to unplanned settlements. However, even though these settlements have been used for comparison they also have limitations and fall sort of several standards and design guidelines for connectivity and accessibility. Therefore, the comparison is indicative and not absolute.

These settlements have been in existence for decades. Most of the low income settlements have grown more organically and without planning. They are constrained by legacy problems associated with location, land-value, informal structures, unplanned infrastructure and very high density development.

Accessibility assessment

For the rapid assessment of these areas, this study has adopted a set of indicators to measure the level and quality of the accessibility infrastructure. These indicators are based on the guiding principle that people are the centre of development. Their mobility and accessibility concerns should be given primacy. Accessibility planning has to focus on the where, why and how of people's movement to ensure sustainability of mobility. It also needs to go into the economics of mobility.

The indicators have considered city-scale provision of transport services and the interface of settlements with them to access the main economic hubs and other services across the city as well as settlement-scale accessibility.

The indicators have examined five major themes related to accessibility. They are:

i) Area profile: area-level equity
ii) Interface between the settlement and the city
iii) Quality and affordability of access to public transport services
iv) Equity in intra-neighbourhood accessibility
v) Status of accessibility infrastructure within neighbourhoods

While the first two themes concern pan-city accessibility, the remaining three concern neighbourhood-scale accessibility.

While developing these indicators, some of the well accepted global national metric and benchmarking systems related to accessibility and livability were reviewed.

Some of these include, 'The Global Livability Index (GLI)', that considers the quality of road network and public transport availability; 'Mercer's 21st annual Quality of Living survey (MQL)', that considers transport expenses as the only indicator; and 'the Better Life Index (BLI)', that considers safety while walking at night as the only indicator of mobility and transport. But these indexes are very limited in scope with regard to transport and mobility. Also, the Human Development Index developed of United Nations development Programme does not consider indicators related to infrastructure and living provisions and services.

There are also a couple of public transport-related global accessibility indexes. Public Transport Accessibility Index used by Transport for London and also accepted for application in global research, assesses demand on a public transport network and is used in route rationalization and route augmentation processes.[31] It consists of statistical method-based calculations and parameters that require mapping of the network, including points of interest, access times, waiting times, route options, etc.

Then there is the Ease of Moving Index developed by Ola mobility institute to understand the evolving mobility sector in Indian cities and changing perception towards and demand of ride-hailing services. It ranks cities to identify rapidly evolving mobility needs.[32] It is a primary survey extensive index with more than 50 parameters targeting public transport users, intermediate public transport users and private vehicle users.

More relevant to the current exercise of understanding the neighbourhood-level accessibility is the 'Ease of Living Index' developed by MoHUA. It focuses on quality of life in cities across 15 categories using 78 indicators. The sub-index category 'Transport and Accessibility' includes indicators on use of public transport and non-motorized transport, and existing infrastructure based on availability and safety. The indicators concern geographical coverage, availability and mode share of public transport; percentage of road network with dedicated bicycle tracks; percentage of interchanges with bicycle parking facilities; mode share of non-motorized transport; availability of Passenger Information System (PIS); the extent of signal synchronization, availability of paid parking spaces; percentage coverage of footpaths—wider than 1.2 m; percentage of traffic intersections with pedestrian crossing facilities; and the extent to which universal accessibility is incorporated in public rights-of-way.

Even though this index is meant for city-level assessments, there are several indicators that can be adapted and applied to the neighbourhood scale. As many

Table 4: Indicators defining transport and road safety in Ease of Living Index of MoHUA
Some of these indicators have been modified suitably for the neighbourhood-scale by the CSE study

Parameter	Indicators	Applicability at the local level (Yes or no)	Derived indicator for local level
Transportation and mobility	Core		-
	Geographical coverage of public transport	y	Availability of public transport network
	Mode share of public transport	y	No. of bus stops within 500 m
	Percentage of road network with dedicated bicycle tracks	y	Frequency of buses
	Mode share of non-motorized transport	y	Presence of NMT
	Availability of paid parking spaces	y	Existence of parking
	Percentage coverage of footpaths (wider than 1.2 m)	y	Accessibility infrastructure
	Support		-
	Availability of public transport = No. of vehicles per day per 1,000 persons	n	-
	Percentage of interchanges with bicycle parking facilities	n	-
	Availability of Passenger Information System	n	-
	Extent of signal synchronization	n	-
	Percentage of traffic intersections with pedestrian crossing facilities	n	-
	Extent to which universal accessibility is incorporated in public rights-of-way	y	-
Safety and security	Core		-
	Number of streets, public places and junctions covered by surveillance systems	y	Street safety and illumination on streets
	Number of recorded crimes per lakh population	n	-
	Extent of crimes recorded against women, children and elderly per year	y	Gender safety in public places
	Support		-
	Transport-related fatalities per lakh population	y	Road safety

Source: Ease of Living Index, MOHUA

as 29 of the 78 indicators can be iterated to be used at a local area-level. Among transport infrastructure, 50 per cent indicators can be iterated to be applied at the local area-level (see *Table 4: Indicators defining transport and road safety in Ease of Living Index of MoHUA*).

Based on the review of these metrics, CSE has framed a set of criteria and indicators for assessment of the selected settlements in Delhi.

Accessibility benchmarks for Delhi's settlements

To carry out the assessment of the state and status of accessibility and related infrastructure across different settlements, a mix of qualitative and quantitative indicators has been adopted that can be grouped into five major thematic aspects:

- **Area profile—area-level equity**: This gives a general idea about the settlements in terms of number of households, populations, access to open spaces and the road networks, availability of area-level infrastructure, land distribution, etc.

- **Interface between the settlement and the city—spatial coverage of the public transport network**: This is to understand the coverage by the city's public transport network and its closeness to the settlements.

- **Quality and affordability of access of settlements to public transport**: Access to good quality or affordable mobility and transportation systems results in better economic options. This can be measured with three major indicators: distance to access, time taken and cost incurred.

- **Equity in intra-neighbourhood accessibility:** This is to assess inclusiveness within localities in terms of distribution of services and utilities like schools, healthcare facilities and markets.

- **Status of accessibility infrastructure within the settlements:** This helps to measure last-mile connectivity, which is a whole range of available options that connect one's origin or destination to public transport besides facilitating movement of people to access local services. This includes availability of footpaths, network of streets, non-motorized transport options, cycleable streets and penetration of intermediate transport. Often, mere presence of a footpath doesn't determine walkability. There are qualitative aspect like presence of adequate footpath space, safety, signage, lack of encroachment like electric poles or parked cars, etc.

Within these broad indicators several sub-indicators have been developed for more detailed analysis of the neighbourhoods.

Area profiles: A set of standards and norms prescribed by the statutory document (MPD 2021) govern development and planning of settlements in Delhi. Accordingly, the local government is responsible for developing and providing services, utility, etc. Some of the important criteria that impact the quality of access in settlements

Table 5: Area profile

Size and location of a settlement are important factors

Indicator	Sub-indicator
Area profile	Population (MCD election 2017)
	Ward no.
	Type of settlement
	Land value (average)
	Area (sq m)
	Area under roads
	Area under open spaces
Quality of settlement	Average household size
	Population density
	Road density within the settlement: (a) > 15 per cent (b) 12–15 per cent (c) 10–12 per cent (d) < 10 per cent
	Open space density within the settlement: (a) > 15 per cent (b) 10–15 per cent (c) 4–9 per cent (d) 3 per cent or less
	Is the area governed by a municipality? (Yes or no)

Source: CSE

are size and location of the settlement, and road and open space density. It is important to quantify availability of area-level infrastructure, land distribution, etc.

Interface between settlement and the city: Residential neighbourhoods need to be integrated with the cityscape, in a way that captures locational advantages, connectivity to the city core, proximity of major roads and public transport, etc. If these indicators are addressed adequately during the planning stage, people can enjoy equitable access to the city's mobility networks. The aim is to measure the coverage of the city's public transport network and its closeness to settlements (see *Table 6: Interface between settlements and the city*).

Quality and affordability of access to public transport services: While the first two thematic areas address city-wide parameters, this attempts to examine accessibility within the local area. It is not just about the mere existence of public transport and mobility options, but how people can access the system in the local setting. This matters more in deciding mobility choices. Here, along with physical proximity, access includes ability to afford, availability of modal options and presence of connectivity in the local area. This segment aims to bridge the gap for settlements and enhance equity in accessibility (see *Table 7: Quality and affordability of access to public transport services*).

Table 6: Interface between settlements and the city

Access to transport networks and major roads is obviously a big plus

Indicator	Sub-indicator
Connectivity (arterial, sub-arterial, or collector)	No. of major roads connecting the area: (a) Multiple (b) Two (c) One (d) No direct connectivity to major roads
	Distance to main road: (a) Within 500 m (b) 500 m–1 km (c) 1–2 km (d) More than 2 km
Availability and serviceability of public transport options	Bus
	Metro
	Autorickshaws
	Grameen Sewa
	E-rickshaw
	Cycle rickshaw
	Footpath
	NMT lane
	No. of metro stations within 800 m
	No. of bus stops within 800 m
	Distance between two bus stops: (a) 400 m or less (b) >400 m
Pan-city connectivity	
City centre (Connaught Place or India Gate)	Distance (km)
	Interchange (no. of public transport modes)
	Time (PT) min
	Waiting time (PT) (minutes)
	Walk time (minutes) to access
	Cost (Rs)
City-level economic centres: N—Karol Bagh and Chandni Chowk S—Lajpat Nagar, Nehru Place and Okhla	Distance (km)
	Interchange (no. of PT)
	Time (PT) min
	Waiting time (PT) (minutes)
	Walk time (minutes) to access
	Cost (Rs)

Major hospitals (AIIMS and Safdarjung)	Distance (km)
	Interchange (no. of PT)
	Time (PT) min
	Waiting time (PT) min
	Walk time (minutes) to access
	Cost (Rs)
Distance (weighted average)	
Interchange (PT) (weighted average)	
Waiting time (PT) (minutes) (weighted average)	

Source: CSE

Table 7: Quality and affordability of access to public transport services

Access to affordable and decent mobility options is also essential for access from neighbourhoods to larger city-based systems

Indicator	Sub-indicator
Accessibility to public transport	
Nearest Metro station	(a) Within 250 m (b) Within 800 m (c) Within 1 km (d) Within 2 km (e) More than 2 km
	Access time by walking (PT) (a) 5 minutes (b) 10 minutes (c) 15 minutes (d) 20 minutes (e) Cannot walk to the Metro
Nearest bus stop	(a) Within 250 m (b) Within 400 m (c) Within 1 km (d) More than 1 km
	Access time by walking (PT) (a) 5 minutes (b) 10 minutes (c) 15 minutes (d) 20 minutes or more
Nearest IPT stop (autorickshaw or e-rickshaw)	(a) Within 250 m (b) Within 400 m (c) Within 1 km (d) More than 1 km
Nearest rickshaw stop	(a) Within 250 m (b) Within 400 m (c) Within 1 km (d) More than 1 km, or doesn't exist

Source: CSE

Equity in intra-neighbourhood accessibility: Residential neighbourhoods are governed by prescribed standards to ensure equity and self-reliance in access to basic intra-neighbourhood amenities. However, not all neighbourhoods enjoy equal benefits. This segment aims to identify settlements and their inclusiveness in comparison to existing standards and highlight disparity between low-income and other settlements. It also aims to quantify the socio-economic disparity in the quality of access to neighbourhood facilities and amenities like schools and markets. This can inform strategic planning to improve equity in access.

Table 8: Equity in intra-neighbourhood accessibility

Neighbourhoods that provide basic services like health and education to their residents decrease the need to travel out of them to access these services

Indicator	Sub-indicator
Primary education	(a) Within 500 m (b) Within 1 km (c) Within 2 km (d) Not available in the neighbourhood
Secondary education	(a) Within 500 m (b) Within 1 km (c) Within 3 km (d) More than 3 km
Primary healthcare	(a) Within 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off
Secondary healthcare	(a) Within 500 m (b) Within 1 km (c) Within 3 km (d) More than 3 km
Neighbourhood playground or park	(a) Within 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off
Community market, DDA convenience store, etc.	(a) Within 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off
Local area market	(a) Within 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off
Police station or chowki	(a) Within 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off

Source: CSE

Status of accessibility infrastructure within the settlements: This segment addresses the micro-area-level infrastructure that facilitates safer street networks or walkable neighbourhood or last-mile connectivity. Such infrastructure consists of a whole range of available options that connect one's origin with destination with the help of public transport and access infrastructure. This includes availability of footpaths and network of streets, NMT options, cycleable streets, and IPT penetration to enable door-to-door mobility. At times, only the presence of a footpath does not determine walkability. It is more about the quality of the network—clear continuous width free of obstruction, and safety of access. The same holds true for adequate conditions for cycling and NMT movement.

Additionally, the role of intermediate public transport needs to be understood as it acts both as a direct mobility provider and also as a means to access other transport systems. These systems are crucial for functioning of most of these residential areas. This segment also tries to identify and measure permeability of IPT within these settlements.

Table 9: Status of accessibility infrastructure within the settlements

Accessibility infrastructure act as capillaries to the veins and arteries of formal public transport systems

Indicator	Sub-indicator
Equitable distribution of road infrastructure	
Major roads (arterial, sub-arterial and collector)	Average width of major roads in the area: (a)15 m (b) 10–12 m (c) 6–9 m (d) Less than 6 m
Universal accessibility of major roads	Sidewalks on connecting major roads: (a) Road with well-defined footpath width of 1.5–2 m (b) Adequate width but encroached upon or inadequate footpath (c) Exist throughout, but with inconsistent width (d) No sidewalks
	Continuity of sidewalks
	Tabletop crossings for universal accessibility
	Kerb ramps
	Pedestrian or non-motorized kerb ramps at T-crossing signals
	Auditory signals
	Graphic signage

Access road to the settlement connected to any major road in the area	Number of access roads: (a) Multiple (b) Two roads (c) One (d) No main access roads in the settlement
	Consistent or inconsistent right-of-way (ROW)
	Adequate ROW (6 m or more) / Inadequate ROW (less than 6 m)
	Paved or unpaved or irregular access roads
	Whether encroachment-free, or only partially encroached upon, or encroached upon throughout
Quality of local streets	Consistent or inconsistent ROW
	Adequate ROW (6 m or more) / Inadequate ROW (less than 6 m)
	Paved or unpaved
	Not encroached upon, or only partially encroached upon, or encroached upon throughout
Walkability of local roads	Walkability (clear walking space of 2 m) (a) Consistent clear walking space on all local roads along with other activities (b) Inconsistent width but manageable along with other activities (c) Inconsistent and difficult with other activities (d) Very narrow and irregular
Cycleability of local roads	Cycleability (extent of consistent clear width of at least 2 m throughout) (a) Consistent space on all local roads along with other activities (b) Inconsistent but manageable on all local roads with other activities (c) Manageable only on a few local roads (d) Very narrow streets, uncomfortable cycling or walking with cycle
Extent of IPT penetration	Extent of IPT penetration in the area (width 6 m or more) (a) On all local roads (b) On a few roads (c) IPT can barely enter (d) Cannot enter the area
Sense of safety within the neighbourhood (walkability and street design elements)	Illumination in the area: (a) Good (b) Okay (c) Bad (d) Barely illuminated
	Illumination at junctions
	Illumination in public places
	Illumination at public transport stops
	Signage within the area: (a) Clearly visible (b) Minimal (c) Only at entry points (d) No signage
	Activity on road (presence of hawker or vending space)
	Pedestrian crossings

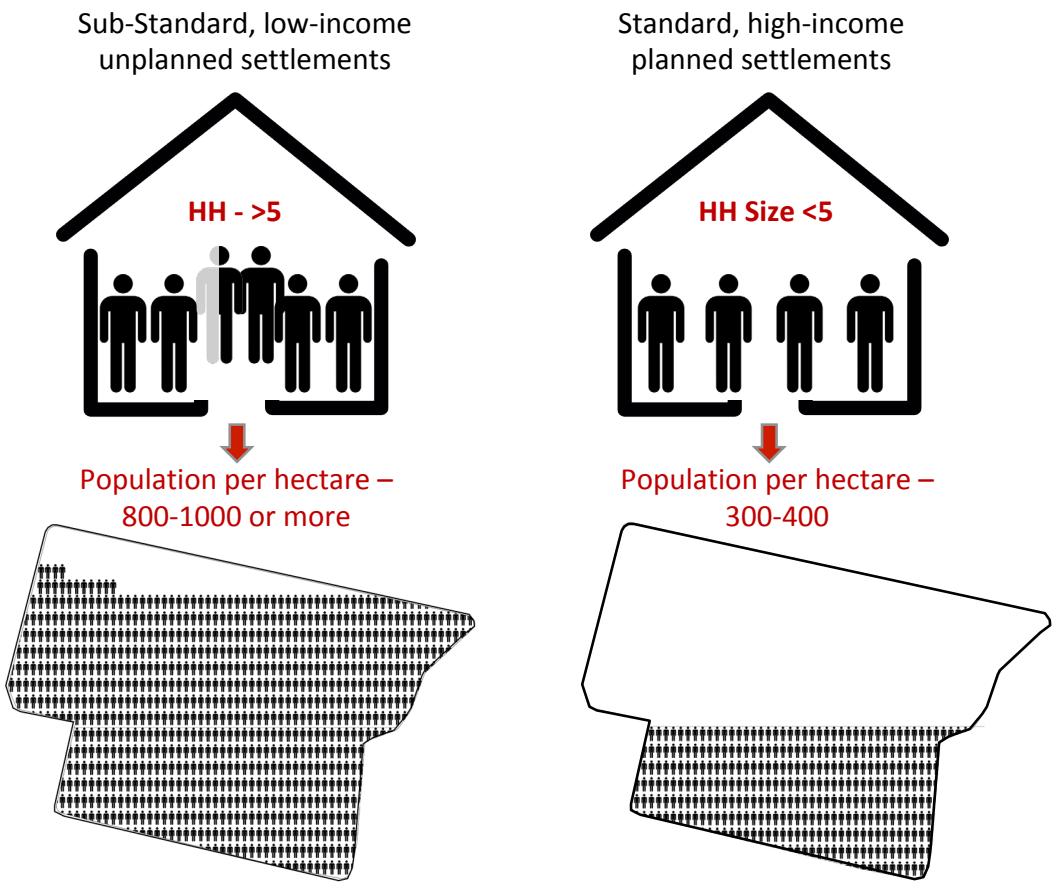
Source: CSE

3. Findings

The ground-level survey in 16 settlements in the South Delhi district based on these indicators has provided penetrating insights into the way mobility is organized and accessed in urban India. Secondary studies have been used to support the findings, wherever appropriate.

Figure 3: Disparity in distribution of space between unplanned and planned settlements

Unplanned settlements are more densely built, leaving less open spaces for other uses



Source: Compiled on the basis of data from Census 2011 and DUAC reports for wards of Delhi

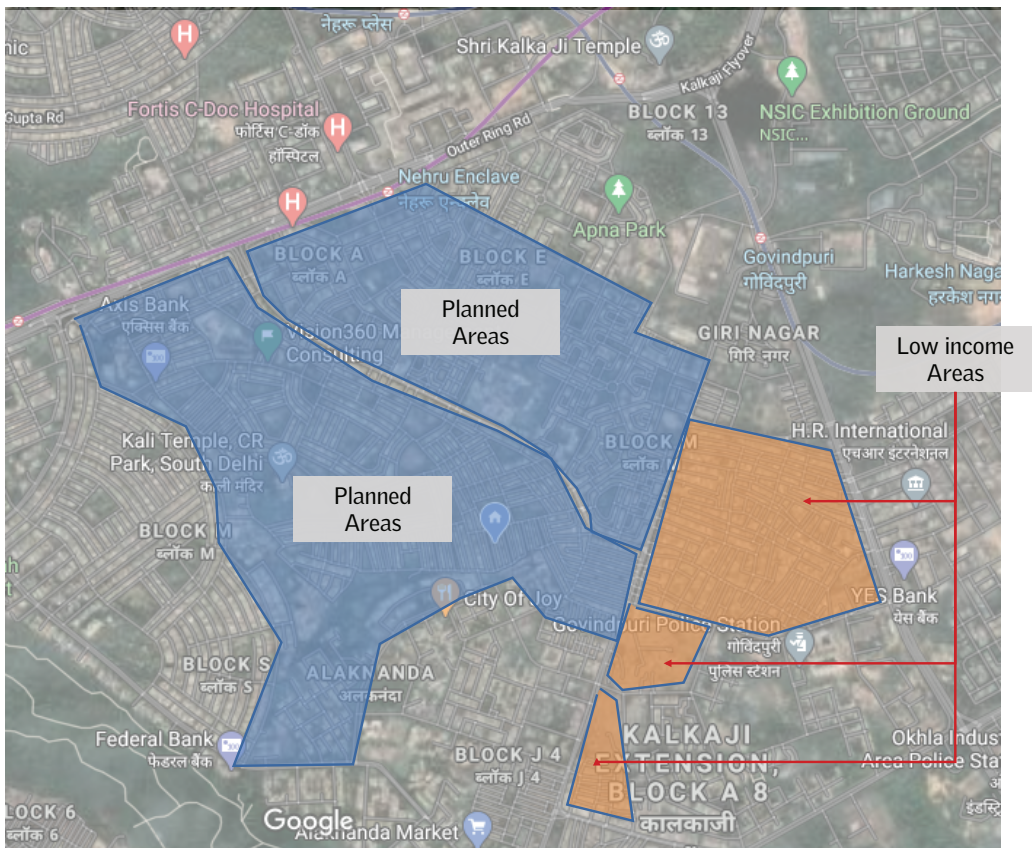
Area profile

There is much lesser provision of infrastructure in unplanned areas than in planned areas. Lower-income settlements are more densely populated and are densely built to accommodate larger populations. As per Census 2011, the low-income unplanned settlements of Govindpuri, Jawaharlal Nehru Camp and Tughlakabad Extension have an average household size of 5.6, 5 and 5.03 respectively. In comparison, the planned areas of C.R. Park and Greater Kailash have a household size of only 3.9.

Further, ward-level reports by Delhi Urban Arts Commission (DUAC) highlight that within the Kalkaji district low-income unplanned areas have a higher population density of up to 1,000 people per hectare (pph) whereas planned areas have a much lower population density of 200–400 pph.[33] Other unplanned areas like Pooth Kalan and Khanpur have even higher household sizes and population densities.

Map 7: Spread of planned and unplanned low-income areas within the Kalkaji district

Population densities in unplanned areas are typically much higher than in planned areas



Source: CSE

Unplanned areas are already fully and very densely built and have a legacy challenge. Barely any open space is left in these areas. This is evident from the geo-spatial assessment of mass and void (that is, built-up and un-built spaces) and how their ratio varies across settlements. The scope of interventions in unplanned areas, in the form of creating open spaces to improve circulation, is minimal.

To understand the built-up ratio, this study has examined an area of 70,650 sq m (with a radius of 150 m) in each of the selected settlements. For example, in Kalkaji, 61 per cent of the land area has been built up in a planned manner. But in unplanned settlements like Govindpuri, Jawaharlal Nehru Camp and Tughlakabad Extension (all part of the Kalkaji district), 89 per cent of the land area has been built up, which is 1.4 times higher concretization. When all 17 areas are considered, the unplanned settlements (Garhi, Tughlakabad Extension, Khanpur, Tughlakabad Village, Khirki Extension, Pooth Kalan, Jawaharlal Nehru Camp, Tigri Colony, Madangir, Zamrudpur and Govindpuri) have built up, on an average, about 87 per cent of their areas. This implies that in general unplanned settlements have about 1.2–1.4 times higher built-up areas than other settlements (see *Figure 4: Mass and void ratio in settlements*).

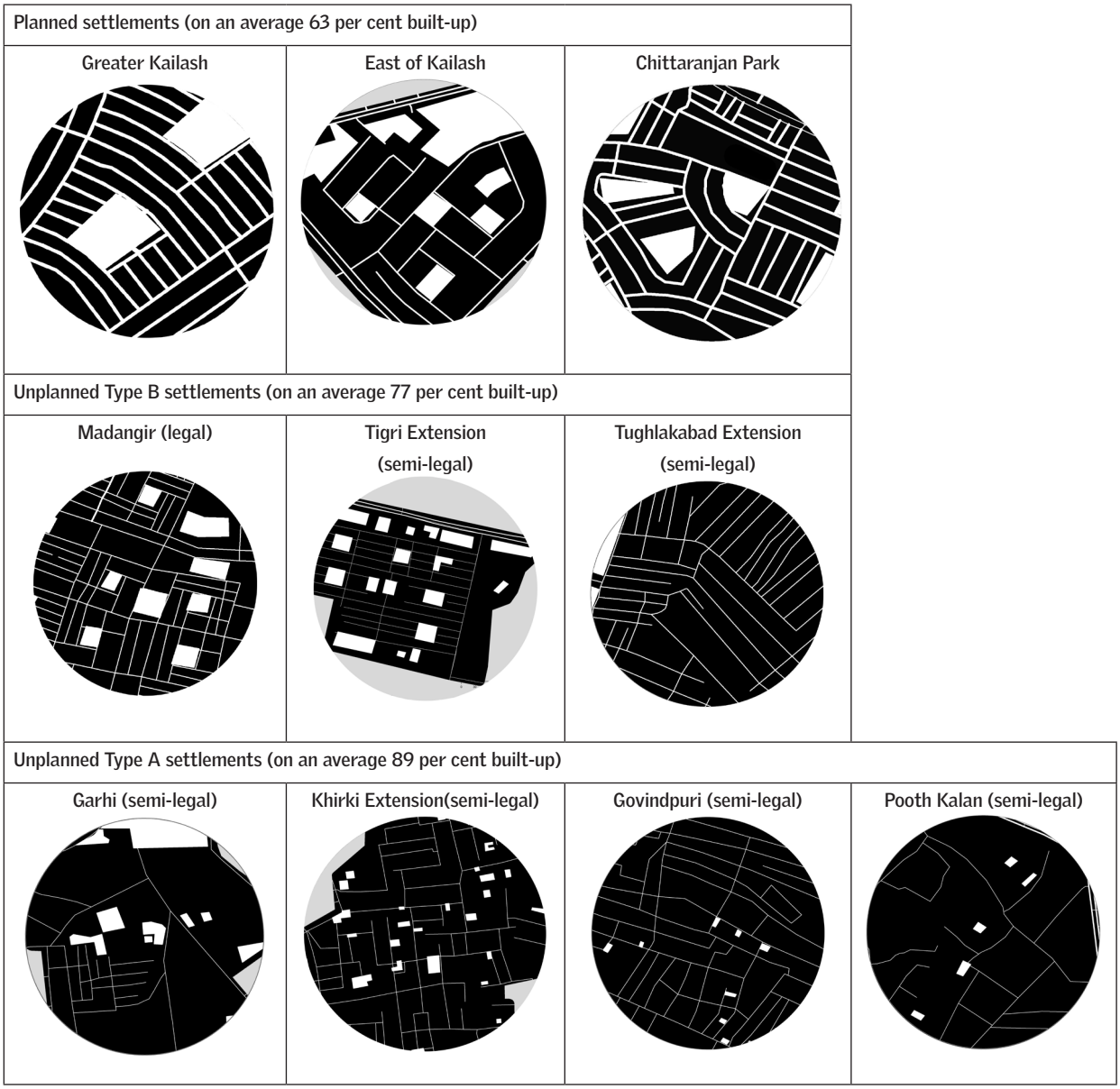
URDPFI guidelines also recommend that 25–35 per cent of the area in settlements should be earmarked as open and recreational space. As per the prescribed standards of MPD 2021, a neighbourhood should have at least 20–30 per cent space as open green and circulation area. However, on-ground investigation reveals that due to higher built-up area, Govindpuri and Jawaharlal Nehru Camp barely have 6 per cent area as road and 1 per cent as open area; while Chittaranjan Park and Greater Kailash have 22 per cent area under roads and 17 per cent under open greens.

A geo-spatial view of the typical layout in these areas shows the stark difference between unplanned areas and planned areas (see *Figure 5: Built density in residential settlements*). Madangir, Tughlakabad Extension and Tigri are comparatively better planned and have 11 per cent more area under roads and open areas than Garhi, Khanpur, Tughlakabad Village, Khirki Extension, Pooth Kalan, Jawaharlal Nehru Camp, Zamrudpur and Govindpuri.

Understandably, unplanned areas built up to maximum capacity, compromising provision of qualitative spaces. Unplanned low-income areas do not have any kind of green areas like dedicated parks, playgrounds or open spaces essential for improving the quality of living for all age groups. Moreover, due to limited road space, intra-neighbourhood circulation obstructs walking and the movement of intermediate public transport.

Figure 4: Mass and void ratio in settlements

Unplanned settlements have 1.2–1.4 times built-up area compared to planned settlements



Notes:

1. Mass refers to any built-up permanent structure. Voids are non-built-up spaces such as roads, parks or any kind of open or incidental spaces.

2. Radius taken 150 m (area 70,650 sq m)

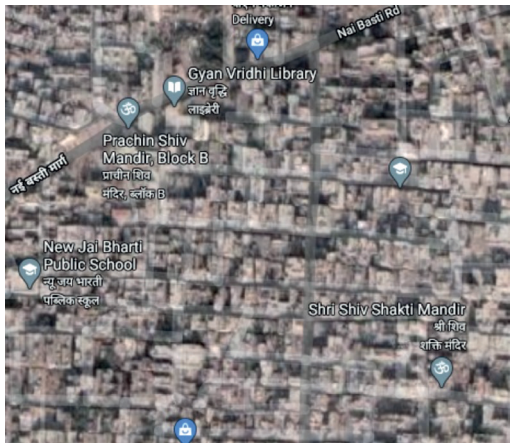
3. High-income sub-standard areas that qualify under 'Low Density Residential Area' exist in Delhi as well. They have sparse population and built density, and as high as 90 per cent open green areas but barely any adequate accessible roads. These areas do not conform to adopted planning standards in urban areas and have been excluded from this study.

Source: Geospatial analysis, CSE

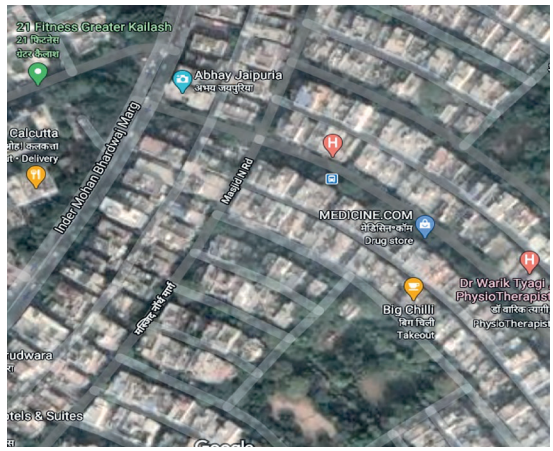
Figure 5: Built density in residential settlements

Low-income unplanned settlements hardly have any qualitative open spaces

A low-income area with dense built structure



A different area with built density as per MPD standards



A typical lane in a high-density neighbourhood

A typical lane in a planned low-density neighbourhood

Source: CSE

Interface between the settlement and the city

Ideally, access to public transport should be assessed based on how many people can access a Metro station within 400–800 m of their home and have a bus stop within 250–400 m of their residence. It has been projected that 80 per cent of Delhi's households will be within a radius of 400 m of a Metro station one the Metro network is complete. Ostensibly, this will be a big advantage, but to leverage it the Metro needs to be more accessible and affordable for the urban majority.

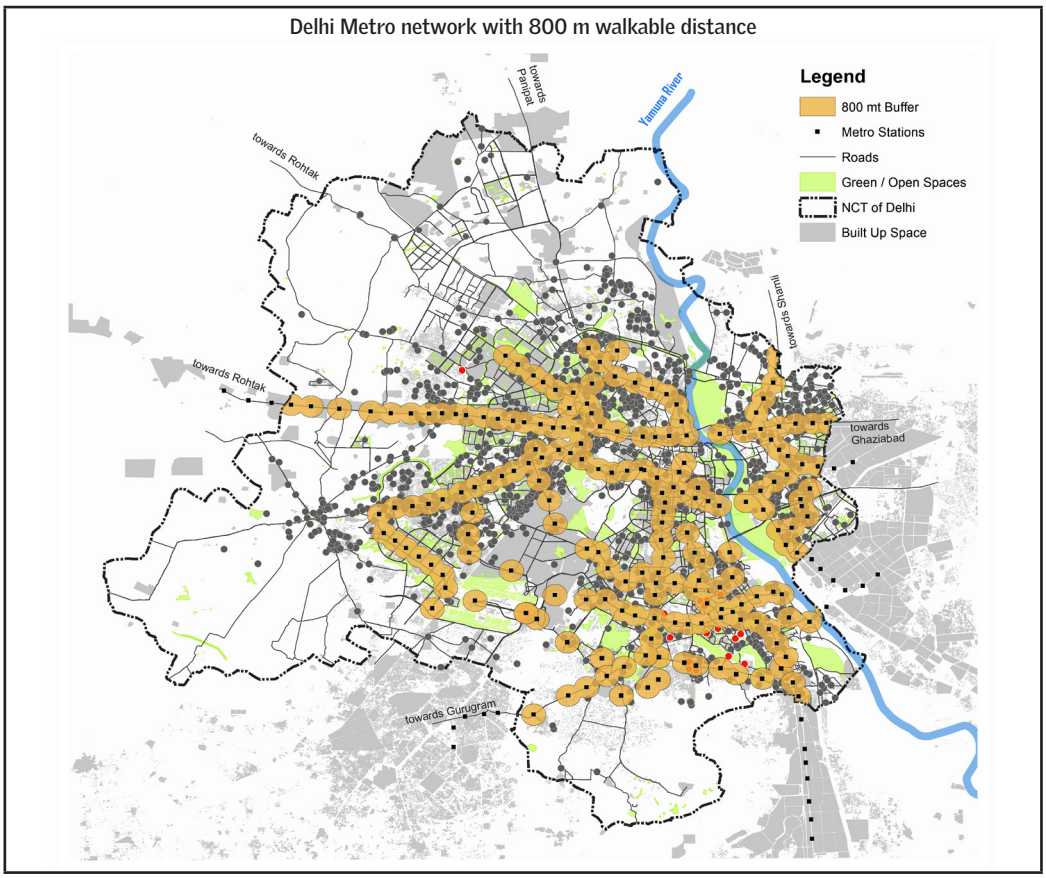
However, at this stage, due to limited data availability, it has not been possible to estimate the percentage of the population that lives within the access zone of

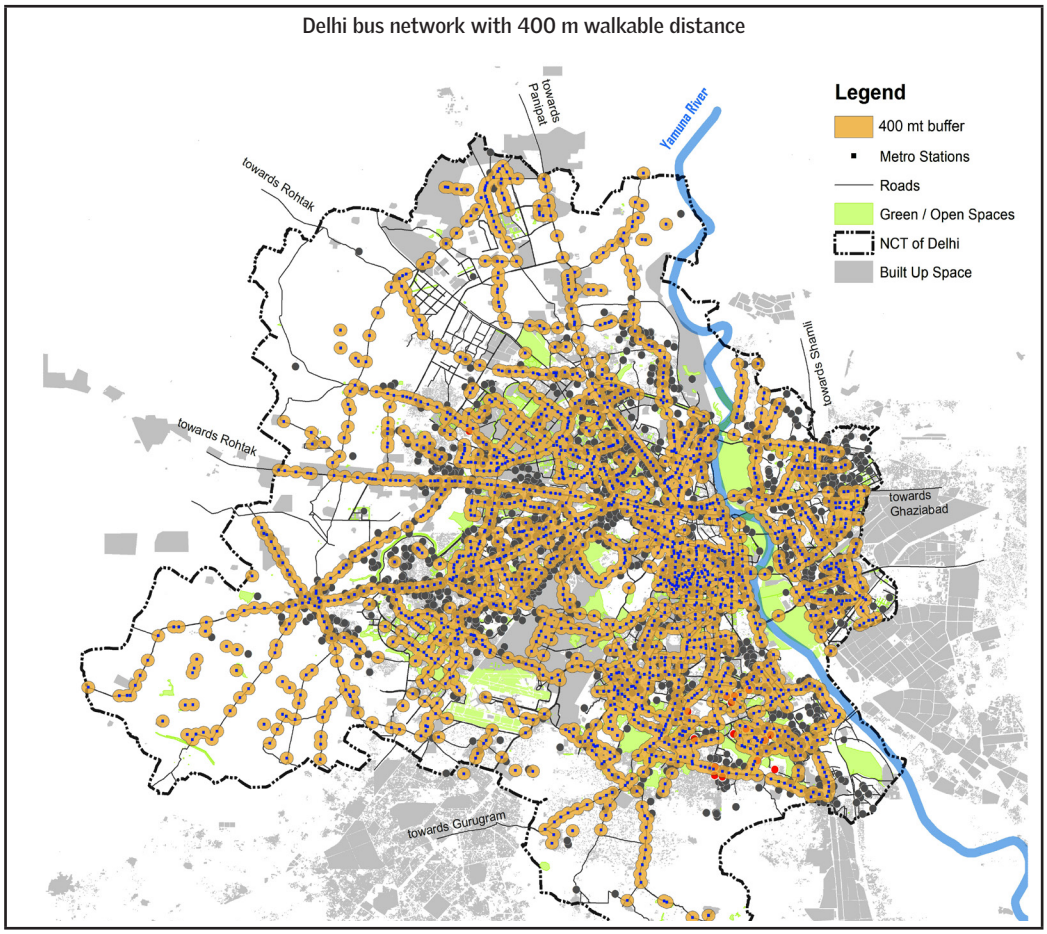
Metro and bus stations. But it is possible to assess the extent of Delhi's geographical area that lies within walkable distance from a Metro station. If the criterion of walkable distance of 800 m (about a 10-minute walk), as prescribed under the TOD document, is considered, about 20 per cent of Delhi's geographical area has access to the Metro (see *Map 8: Spatial distribution of public transport network in Delhi*). If a 2 km distance range from the Metro network is considered, 43 per cent of Delhi's area lies in the Metro-accessible zone.

If walkable access distance to existing bus stops is considered, then approximately 64 per cent of Delhi's area is covered. Thus, 64 per cent of Delhi's area has access to at least one public transport stop within recommended standards, even though it doesn't necessarily indicate adequacy of the bus service in terms of frequency and reliability or ease of access to Metro stations, especially from areas that have locational disadvantages. This also does not indicate the proportion of population living within this distance range.

Map 8: Spatial distribution of public transport network in Delhi

About 64 per cent of Delhi's developed land areas fall within the combined access zone of bus and Metro network





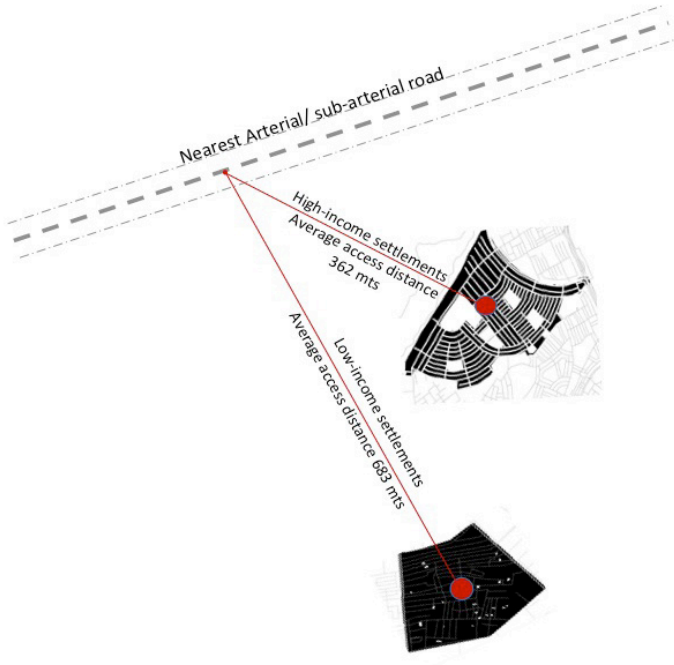
Source: CSE, based on data from DDA and DTC

Many of these settlements are located at some distance from even major roads, compared to other settlements within the same area. While planned settlements have a connecting arterial road within 250-400 m, low-income unplanned settlements can be comparatively more disadvantaged (see *Figure 6: Average access distance to settlements*).

Even if unplanned settlements are located along busy functional roads, direct entry points from those roads to the colonies are restricted by design. At most times, traffic to and from these settlements is diverted or blocked to ensure free flow of vehicular traffic on main roads. For example, Sangam Vihar, housing more than 1.5 million people, generating an estimated 2 million or more trips daily, is located on the busy Mehrauli–Badarpur road. But the main access road to Sangam Vihar is blocked and the traffic to and from is diverted. In this case, one is forced to take a U-turn 1 km ahead for entry into the colony. This not only increases the distance of commuting, but also induces more physical effort to make a trip. It renders access

Figure 6: Average access distance to settlements

Many unplanned settlements are located away from major arterial roads

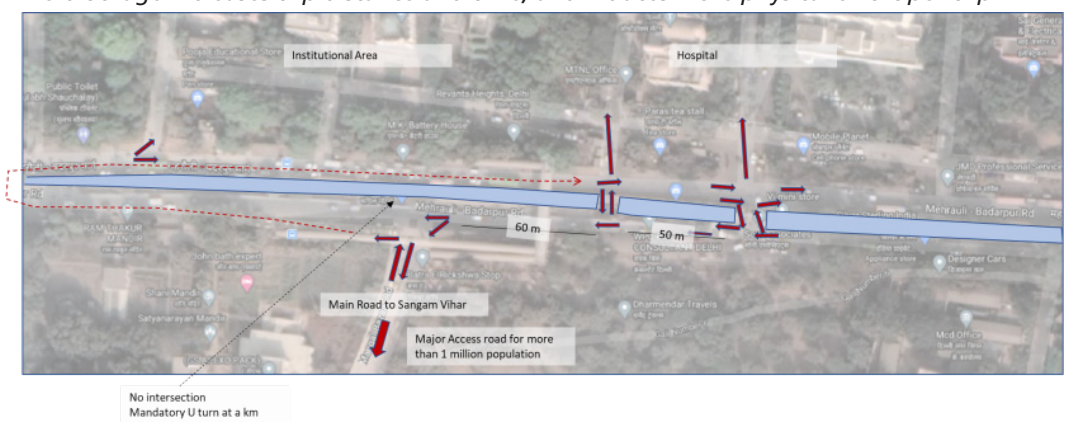


Source: CSE

to public transport modes on the main arterial road difficult (see *Map 9: Blocked intersection on the major access road to Sangam Vihar, one of the largest unplanned neighbourhoods in Delhi*). This story is repeated in other areas like Madangir, Khanpur and Zamrudpur. At times, the shortest way to access these areas is to cut across roadside parks or *nallahs*, etc.

Map 9: Blocked intersection on the major access road to Sangam Vihar, one of the largest unplanned neighbourhoods in Delhi

The blockage increases trip distance and time, and induces more physical effort per trip



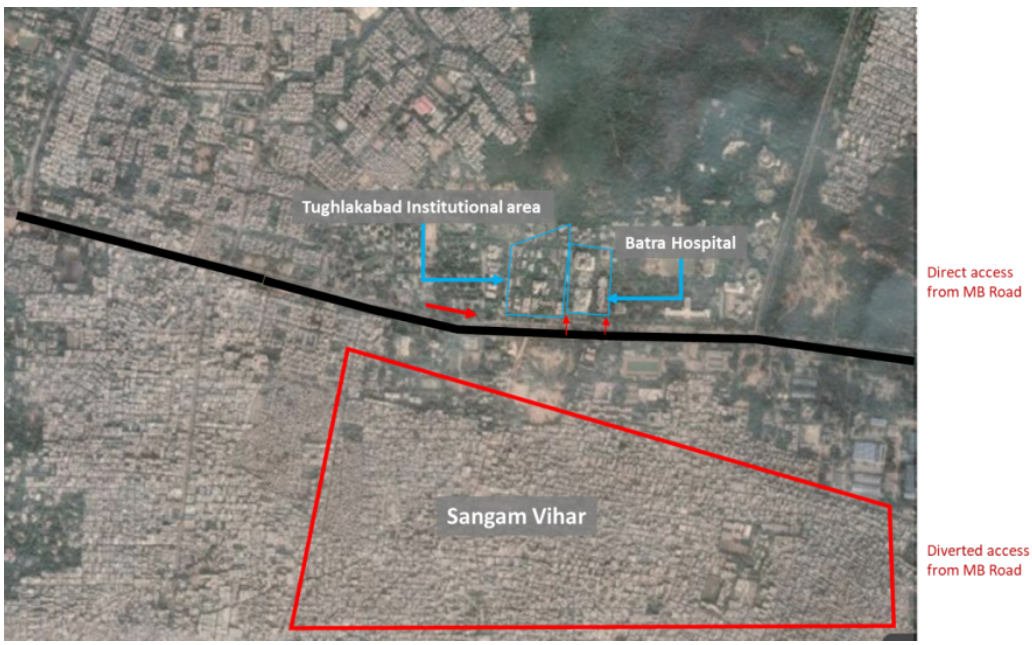
Source: CSE

However, just before entry to Sangam Vihar there are two direct accesses, one at 50 m and another at 60 m, to enable direct entry to Batra hospital and Tughlakabad Institutional Area on the opposite side. While it cannot be denied that a secondary health service should be provided direct access, but at the same time a settlement generating close to 2 million estimated trips should be provided direct access too. The increase in distance makes overall mobility in this area more challenging. Regulation of the only entry and exit to the colony to ensure proper traffic flow on a major road of the city at large, without addressing the more substantial issues related to ease of access of this large population to public transport, para-transit penetration, cycling facilities, and walking infrastructure creates more dysfunction and forces even this community to motorize or shift to two-wheeler trips, wherever possible (see *Map 10: Access points to Sangam Vihar*).

The URDPFI guidelines state that adequate planning of public transport networks and connectivity should enable people to access city-level facilities and amenities. This is the principle of 'centrality of settlements' that a city needs to connect residential settlements with commercial areas and other facilities with seamless connectivity to enhance accessibility to all areas of importance.

Map 10: Access points to Sangam Vihar

Access points to Sangam Vihar, which has a huge residential population, have been blocked for ease of traffic on the main road, but Tughlakabad Institutional Area and Batra hospital, which do not generate comparable daily trips by a large margin, have been provided easy access



Source: CSE

If trips to the city centre, commercial centres and healthcare facilities are considered for measuring adherence to the principle of 'centrality of settlements', it is found that even though all settlements surveyed were in closer proximity to each other and are often located at similar distances from major centres in the city, it is only planned settlements that have relatively better connectivity. Commuting from unplanned settlements requires longer walks, and more connecting modes to reach public transport nodes. This involves more interchanges.

For examples, though Garhi (low-income unplanned settlement) is located close to the planned residential area of East of Kailash, commuting from Garhi involves a longer walk to the Metro station. If a bus trip is considered, then travelling from Garhi to Connaught Place involves 16 minutes of walk and interchange of two buses. But travelling from a residential block of East of Kailash includes nine minutes of walk and no mode transfers (see *Map 11: Commuting to the city centre in Metro and bus from Garhi and East of Kailash*). Other areas mirror these patterns.

Results were similar when other unplanned and planned neighbourhood that are adjacent to each other were examined on their commuting characteristics.

Most of the unplanned settlement areas studied are at a considerable distance from the Metro transit network. At the same time, only about 40 per cent of these settlements have adequate direct bus routes. The dependency on multiple public transport modes to commute to the nearest city-level economic centres makes access more complicated. A typical commute from a low-income settlement to the city centre, that involves walk–bus–walk–metro–walk or long walk–IPT–bus–walk or walk–bus–walk, is long and cumbersome. The absence of seamless connectivity is physically uncomfortable. This not only increases the time and cost of the trip, but makes it an unpleasant experience as well.

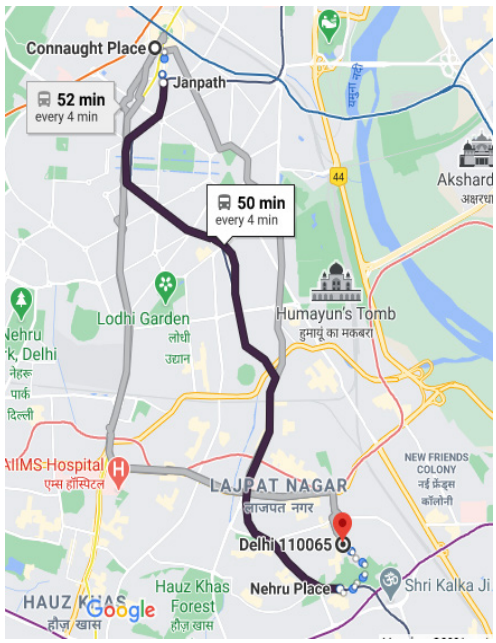
The poor spend more on commuting by public transport: The patchy links in connectivity not only increase inter-modal transfers and walk time but also raise the cost of commuting. However, some areas (like Govindpuri and Tughlakabad Extension) are better served by buses. The frequency of buses varies broadly between 10–15 minutes on one route. On other routes the headway between buses is more than 40 minutes. But access from the low-income colonies to the bus routes on the arterial or sub-arterial routes have other challenges that will be discussed later.

Map 11: Commuting to the city centre by Metro and bus from Garhi and East of Kailash

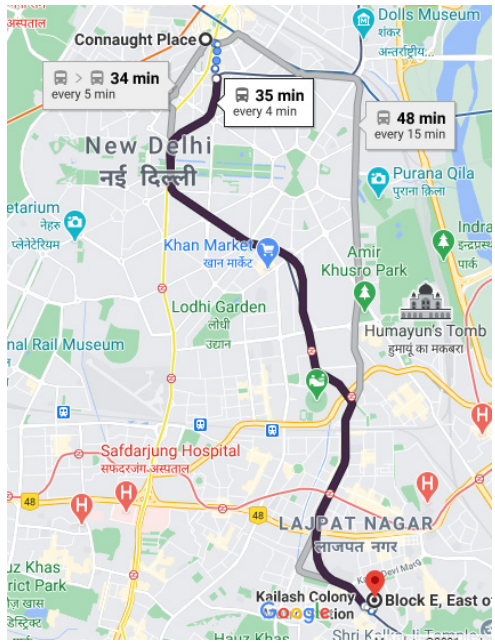
Although the two settlements are located next to each other, their public transport experiences differ vastly

Difference in commuting by Metro to Connaught Place

From Garhi (includes 27 minutes of walk)

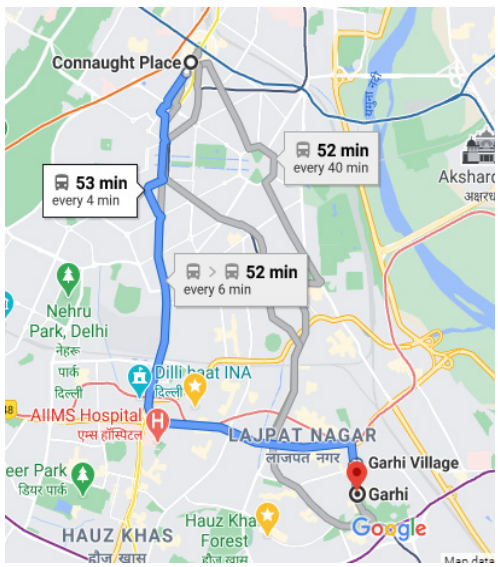


From East of Kailash (includes 13 minutes of walk)

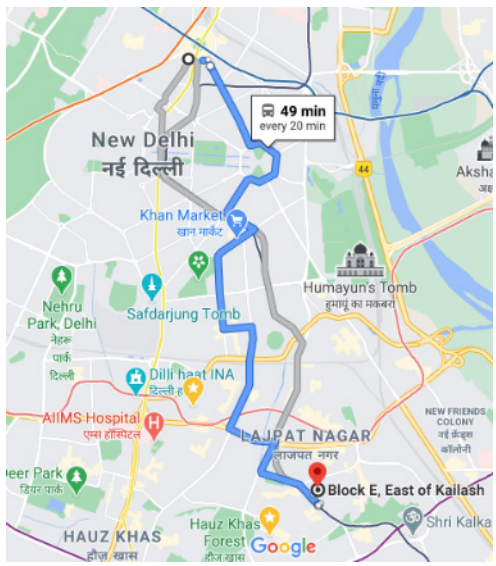


Difference in commuting experience by bus to Connaught Place

From Garhi (includes 17 minutes of walk)



From East of Kailash (includes 12 minutes of walk)



Source: CSE

It was found that on an average walk time of a trip is 1.2–1.8 times in unplanned areas compared to planned standard areas. While one can choose to consider an IPT for one leg of the journey, it adds to the cost and if one chooses to eliminate the cost of the IPT, the physical effort of walking long distances to the transit nodes is necessitated. To travel almost the same length but with more interchange of modes, a trip from an unplanned area can cost 1.5–3.5 times that of a trip from a higher-income area.

An earlier CSE study, *The Urban Commute*, had stated that on an average an unskilled worker in Delhi has to spend around 8–14 per cent income on transportation if they travel by a bus and about 22 per cent if they travel by the Delhi Metro, which is much higher than the national average of 15 per cent income spent on transport expenditure. Also, 34 per cent of Delhiites cannot afford the minimum bus fare of non-AC buses in Delhi.

Further, on-ground investigation has highlighted that, typically, a person living in an unplanned area spends about Rs 800–1,000 per month on commuting by buses, and if they consider the IPT option as a connecting mode, an additional expenditure of Rs 1,000 is accrued per month. To avoid this, people tend to walk 1.5 km or more to reach transit stations. The time wasted on walking could otherwise be spent on education, family, recreation or extra productivity at work.

Quality and affordability of access to public transport services

Ease of mobility is influenced by location, physical infrastructure, built form and availability of (mobility) options in an area. Currently, Delhi's overall urban mobility provisions include Metro rail; bus; autorickshaw, or cycle- and e-rickshaws; *Grameen Sewa*; and walking infrastructure like footpaths, street network, etc. But not all areas get served by all modes. There is wide variation across neighbourhoods which requires more granular understanding.

On-ground assessment of the settlements has highlighted that some unplanned areas like Shahpur Jat, Khirki and Madangir can barely be accessed by three modes. But another set of unplanned areas such as Govindpuri, Tughlakabad Extension and Zamrudpur can be accessed by four–five modes (see *Table 10: Availability of mobility provisions in settlements*). These settlements are approachable by more than one access road too. An average unplanned settlement has access to only 50 per cent of mobility provisions compared to what other settlements can access.

Table 10: Availability of mobility provisions in settlements

On an average, an unplanned settlement has access to only 50 per cent of the mobility options to which a planned settlement has access

Access to mobility provision	Low-income settlements												Other settlements			
	Garhi	JLN camp	Pooth Kalan	Khan-pur	Govind-puri	Zamrud-pur	Khirki Ext.	Shahpur Jat	Tughlaka-bad Village	Madangir Camp	Tughlaka-bad Ext.	Tigri Colony	CR Park	GK II	East of Kailash	Kailash Colony
Bus	●	●	●	●	●	●	●		●	●	●	●	●		●	●
Metro	●				●	●							●	●	●	●
Auto	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Grameen Sewa		●	●	●	●				●	●	●	●				
E-rickshaw					●	●					●		●	●	●	●
Cycle rickshaw	●					●									●	●
Footpath					●								●	●	●	●

Source: CSE survey

Quality of access to the network matters too. Notified design standards for Delhi govern the 'need to' and 'need for' access in residential areas of all sizes. As per the accessibility standards prescribed by Transit-Oriented Development Policy 2019, a bus stop should be located within 400 m and a Metro station within 800 m of a settlement; and other auxiliary modes should be available within the immediate surroundings (see *Table 11: Access to public transport points from residences)*. In addition, Service-level Benchmarks, 2015 of MoHUA prescribe a waiting time of less than 4 minutes as ideal and of more than 10 minutes as least efficient. These should be considered acceptable for public transport services.

Table 11: Access to public transport points from residences

Public transport should be within walking distance from residences as per guidelines

Hierarchy of facilities	Desired frequency and availability at peak hours (non-peak hours can change as per requirement)	Accessibility standards from home or work
MRTS station	2 minutes	Approximately 800 m or 10 minute walk
Metro feeder	1 minute or less	Approximately 400 m or 5 minute walk
Bus stop	1–5 minutes	Approximately 400 m or 5 minute walk
IPT and autorickshaw stand	24 hour availability	Approximately 250 m or 3 minute walk
Cyclerickshaw stand	Flexible	Approximately 250 m or 3 minute walk
Cycle rental stand	24 hour availability	Approximately 250 m or 3 minute walk

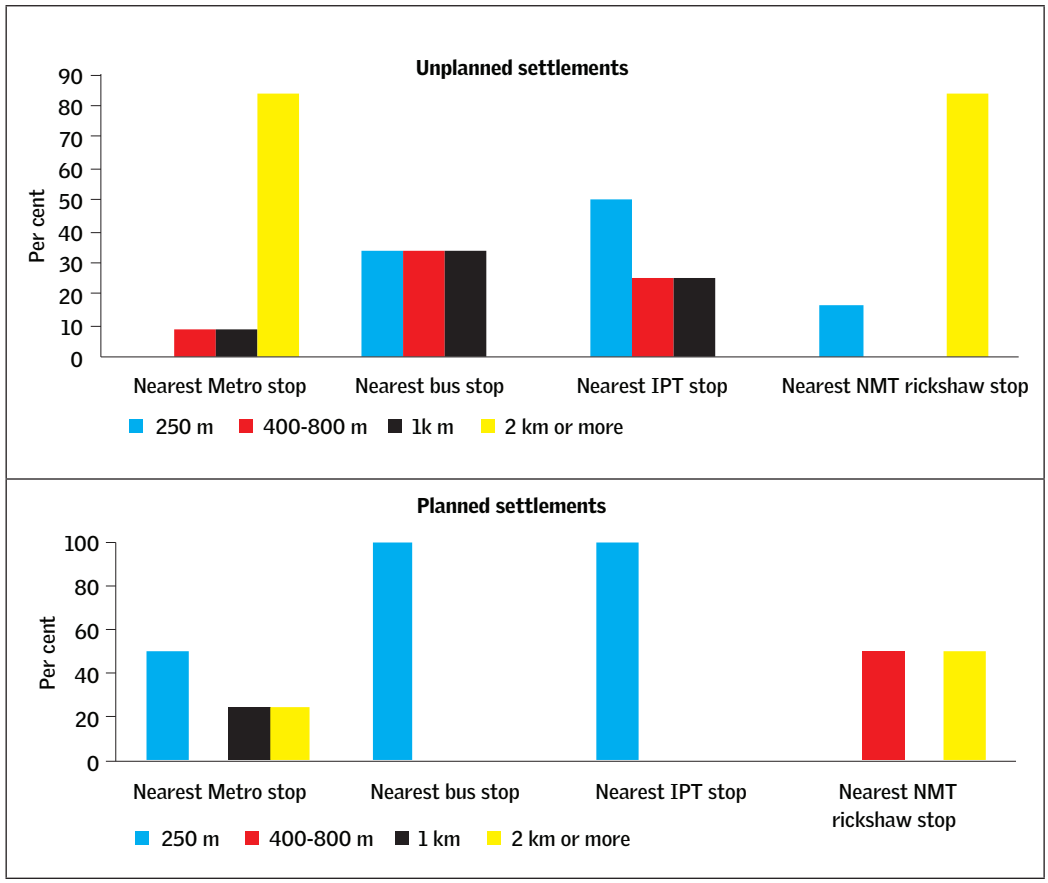
Source: MPD, Chapter 12, Clause 19.6.3 C, Table 19.5

But on ground, only one-third of unplanned settlements have access to a bus stop within the prescribed standard. In contrast, most planned settlements surveyed have access to bus stops within a 250 m radius.

There is barely any unplanned settlement within 800 m access distance from a Metro. It is hoped that for in-situ development of slums and upcoming affordable housing colonies, the principles of TOD Policy that advocate high density affordable housing to be located closer to Metro stations are followed. Redevelopment should ensure improved access. Several existing unplanned colonies have legacy issues as these have grown autonomously. But it is possible to develop guidelines for their renewal as well (see *Graph 4: Access distance to public transport points from unplanned and planned settlements*).

Graph 4: Access distance to public transport points from unplanned and planned settlements

Only one-third of unplanned settlements have a bus stop within prescribed standards



Source: CSE

In fact, both unplanned and planned low-income areas depend on informal services like IPT. In addition, low-income settlements in peripheral areas are mostly served by the *Grameen Sewa*. But *Grameen Sewa* has its own limitations in terms of operational areas, route permits, fleet size, quality of vehicles, etc. Only three-wheeler autorickshaws that operate without restriction have high penetrability and provide relatively better access.

Even planned higher income neighbourhoods can be disadvantaged in terms of more direct and shorter access to Metro stations or bus routes. An earlier CSE assessment has shown how Chittaranjan Park (also within the Kalkaji district)—a planned and higher-income settlement and also part of this study—remains disadvantaged from the perspective of public transport connectivity. Over the years, nearly seven bus routes have been withdrawn from the area, and despite having two metro stations in the vicinity, last-mile connectivity was poor. However, since the time of that CSE assessment, e-rickshaw connectivity to the Greater Kailash Metro station has improved. But these colonies have also become increasingly car-dependent.

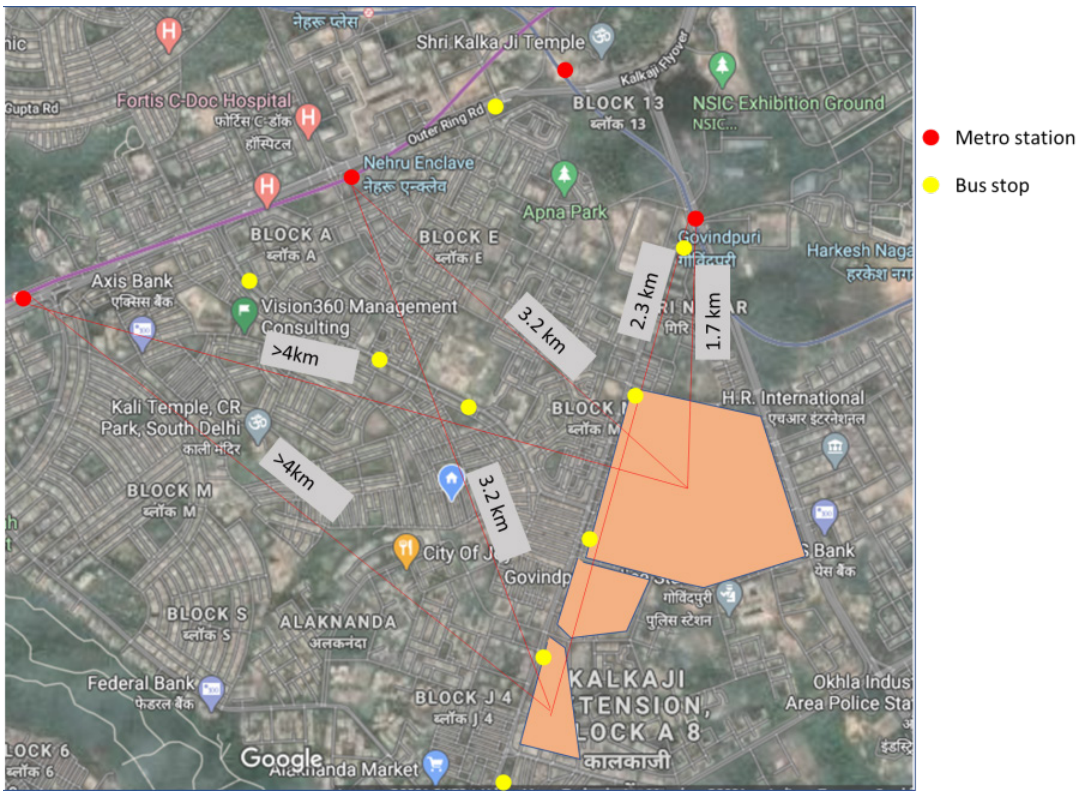
On the other hand, within the Kalkaji district, unplanned low-income areas like Jawaharlal Nehru Camp, Govindpuri, and Tughlakabad Extension are dependent, on an average, on three modes and two transfers to reach the Metro station. In this case, Metro stations are beyond the local mobility network of the IPT (*Grameen Sewa* and e-rickshaws) that connects these areas (see *Map 12: Access distance to Metro stations and bus stops from unplanned settlements*). Bus service remains insufficient and at times involves intra-mode transfers. The frequency of buses on the one route passing through these areas can vary from 10–40 minutes. Very poor walking and cycling infrastructure makes the situation worse.

Equity in intra-neighbourhood accessibility

A lot of the problems stem from the way the settlements themselves are organized internally. As they have largely grown in an unplanned manner (with only a few being planned), the benchmark for accessibility to basic services and amenities and transport are not in compliance with standard guidelines. It is important to connect the intra-settlement movement with availability of basic amenities and essential services within the local areas because a significant proportion of mobility needs is generated in order to access these services and amenities. If most of the basic services and amenities are not available within the settlement, residents have to spend more time and money to access them. This cost accrued by sub-optimal availability of basic services largely remains hidden.

Map 12: Access distance to Metro stations and bus stops from unplanned settlements

On an average, residents of Jawaharlal Nehru Camp, Govindpuri, and Tughlakabad Extension have to make two inter-modal transfers to reach the Metro station. Bus services remain insufficient as well



Source: CSE

Understandably, unplanned areas are hugely land-constrained. These areas have been over-built leaving very little space for other services. These have grown mostly in an unplanned and ad hoc manner or have been planned without much regard for the basic requirements of MPD 2021 and URDPFI guidelines with regard to fundamental services and amenities.

Nonetheless, a comparison with MPD 2021 and URDPFI guidelines can be indicative of the huge deficit in services that adds to the degree of difficulty in navigating through these settlements. MPD 2021 and URDPFI guidelines together prescribe 11 intra-neighbourhood amenities that are essential for a neighbourhood with a population size of above 5,000.[34] These amenities are primary and secondary education, primary and secondary healthcare, parks and playgrounds, convenience and local shopping, service markets, ATMs, community halls and religious facilities. MPD 2021 also recommends that these amenities should be within 1–10 minutes

walking distance of a household.[35] Additionally, URDPFI recommends that ATMs and community facility establishments should be within a 1 km range, and secondary education and healthcare should be located within a 3 km range. Unplanned neighbourhoods are clearly not compliant with these guidelines. A huge disparity is manifest between the amenities available in low-income neighbourhoods like Garhi, Jawaharlal Nehru camp and Shahpur Jat (typically four–five) and the amenities available in higher-income neighbourhoods like CR Park, Greater Kailash, East of Kailash and Kailash Colony (eight–nine amenities).

Most unplanned areas like Tughlakabad Extension, Pooth Kalan, Zamrudpur, JLN Camp and Govindpuri lack parks, playgrounds and open spaces. People living in Tughlakabad Extension have access to primary healthcare and local market areas in Govindpuri. Other areas like Tughlakabad Village do not have access to formal security or local police booths (see *Table 12: Access to intra-neighbourhood amenities*).

Table 12: Access to intra-neighbourhood amenities

Typically, unplanned settlements have access to four–five amenities, while planned settlements have access to eight–nine amenities

	Low-income settlements												Other settlements			
Access to intra-neighbourhood amenities	Garhi	JLN camp	Pooth Kalan	Khan-pur	Govind-puri	Zamrud-pur	Khirki Ext.	Shah-purjat	Tughlaka-bad Village	Madangir	Tughlaka-bad Ext.	Tigri Colony	CR Park	GK II	East of Kailash	Kailash Colony
Primary education	●		●	●	●	●	●		●	●	●	●	●	●	●	●
Secondary education	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
Primary heathcare				●		●			●	●		●	●			
Secondary healthcare			●				●	●		●	●	●				
Neighbourhood playground or park						●		●		●	●	●	●	●	●	●
Community market or DDA convenience store, etc.	●		●	●	●		●			●			●	●	●	●
Local area market	●	●			●	●			●	●			●	●	●	●
Police station or chowki		●			●	●	●	●		●			●		●	●
ATM	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Community hall or recreational facilities						●				●		●	●	●	●	●
Religious places	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

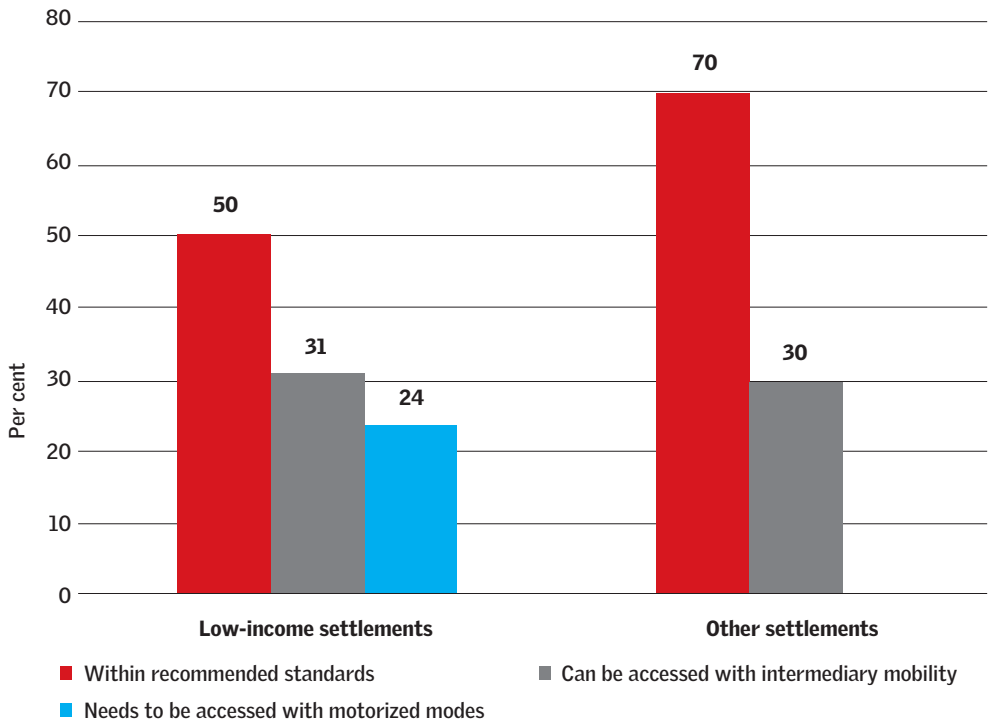
Source: CSE

Overall, it can be said that planned settlements have access to about 70 per cent provision of amenities. But unplanned settlements have access to only 50 per cent intra-neighbourhood amenities within the recommended standards of access distance. Moreover, it has also been observed that this gap compels a person living in a low-income settlement to be dependent on motorized modes like IPT to access the necessary amenities located at a distance (see *Graph 5: Disparity in access to intra-neighbourhood amenities*).

However, settlements located closer to major roads and with mixed land-use development have better access to amenities. This implies that the settlement structure in itself forces the poor to be relatively more dependent on the city's mobility services to access basic amenities. These things amplify the disparity in 'opportunity to access', 'cost of access' and 'time to access'.

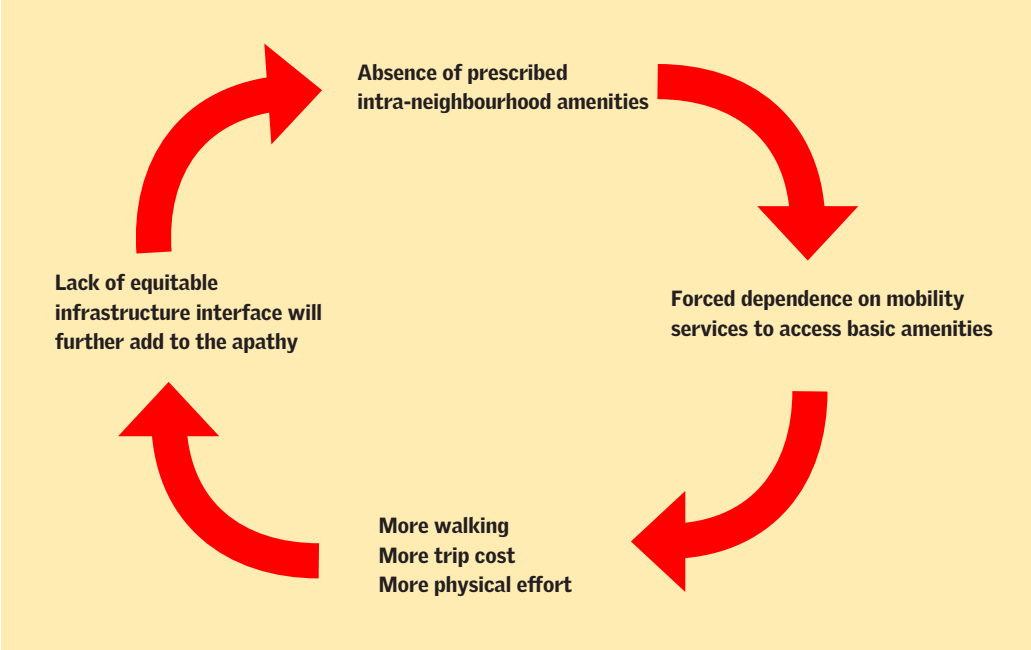
Graph 5: Disparity in access to intra-neighbourhood amenities

24 per cent of residents of low-income settlements are dependent on motorized modes to access basic amenities



Source: CSE

Figure 7: Settlement structure amplifies disparity in access too



Source: CSE

Status of accessibility infrastructure within the neighbourhoods

Though all study areas fall short of meeting the requirement of adequate street infrastructure, it is the low-income areas that are impacted more. For areas that have been notified under the MPD 2021, provision of infrastructure irrespective of land-use is the responsibility of the local urban government. Essentially, every other residential category except slums and a few rural villages legally qualify to have more or less similar infrastructure and services as prescribed under MPD 2021 norms. These infrastructure provisions include major roads and road elements, access roads and their attributes, principles of complete road design, universal accessibility, walkability, penetration of IPT, local streets and their characteristics, a sense of neighbourhood safety, etc.

MPD 2021 norms also recommend that at least 10–12 per cent of the space in residential neighbourhood should be under roads, and the width of local streets should not be less than 6 m. However, densely built low-income areas do not have the free space to provide street infrastructure and other utilities. These areas have bare minimum circulation space and haphazard local street networks. Low-income

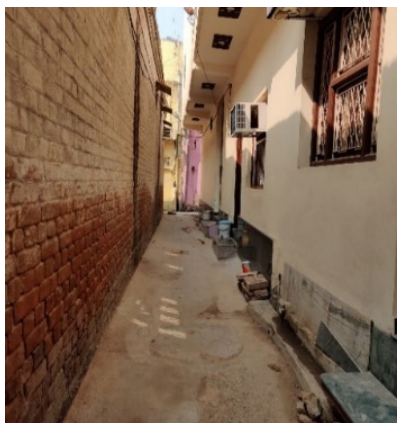
settlements like Govindpuri and Jawaharlal Nehru Camp barely have 6 per cent of their space under roads. Ground assessment of 14 low-income settlements shows that they do not have an average road width of more than 3–4 m (except for a small number of roads in Garhi and Madangir that are 6 m wide). Streets in Tughlakabad Extension and Pooth Kalan are not more than 1.5 m wide on an average (see *Figure 8: Road width in low-income areas compared with other areas*).

Figure 8: Road width in low-income areas compared with other areas

Internal streets in Tughlakabad Extension and Pooth Kalan are not more than 1.5 m wide and are unsafe for mobility

Low-income settlements have narrow local streets

1.5 m-wide road in Pooth Kalan



1.5 m-wide road in Tughlakabad Extension

2 m-wide road in Tigri Colony

Other residential settlements in Delhi have local streets 6 m or more in width

8 m-wide local road in East of Kailash

About 12 m-wide local road in Vasant Kunj

Source: CSE

Settlements are generally connected to major roads via a connector road. The connector road is responsible for catering to all categories of inner and thorough traffic (personal, commercial and freight) as well as walking and cycling. As per prescribed standards, a connector road should be constructed and operated on the principle of 'complete street' in terms of universal accessibility, well-defined and adequate ROW that is consistent in width, separate footpaths, freedom from permanent encroachments, etc.

Naturally, the reality is very different due to the way these settlements have come up. Access roads to unplanned settlements are dilapidated. They lack proper geometry, leveling and clear width, are encroached upon, and have irregularly placed electricity poles that obstruct the ROW. Long stretches of the access road to Sangam Vihar, Tughlakabad Village and Garhi are unpaved, broken and dusty, and vulnerable to water-logging. These issues have not only increased the inconvenience of commuting on foot but also in vehicles.

Figure 9: Access roads of settlements

Entry roads are in a bad shape, making commuting a Herculean task

Source: CSE

Unsafe cycling and poor walkability within the inner local street network: Most of these settlements are high footfall areas. Most people walk to access amenities and services within a reasonable distance. However, local street networks in unplanned settlements are not only narrow but also have irregular width, potholes, manholes, water logging, and obstruction due to electric poles, encroachment, parked vehicles, construction debris, electrical wires and more. It is a fight for space. Moreover, these streets are so narrow that walking itself is unsafe and inconvenient. Cycling remains challenging. This highlights not only deficit in street infrastructure but also poor serviceability of streets.

Too often, the quality of local streets in planned settlements of Delhi is not up to the mark as per standards prescribed under MPD 2021. Even where adequate road width is available, local street network in most colonies of Delhi are found choked with parked vehicles, there is lack of clear walking and circulation space and inadequate lighting. If all parameters are taken together, the quality of streets in CR Park and Greater Kailash is about 1.8 times better than the quality of streets in Govindpuri, Tughlakabad Extension and Jawaharlal Nehru Camp.

These factors not only create inconvenience but also hamper walkability and cycling (on which 77 per cent of the urban poor depend). Moreover, the structure of roads in itself eliminates penetration by rickshaws or IPT modes, making commuting difficult in low-income areas. It was also observed that due to lack of local markets within these areas, absence of open areas and lack of access to other open areas, weekly markets were set up along the major access road to the settlements. This, in turn, not only attracted higher footfall on certain days but also led to obstruction of the roads by irregular encroachers.

Figure 10: Quality of the local street network in unplanned settlements
Safe and unhindered walking and cycling is difficult in these congested lanes

Source: CSE

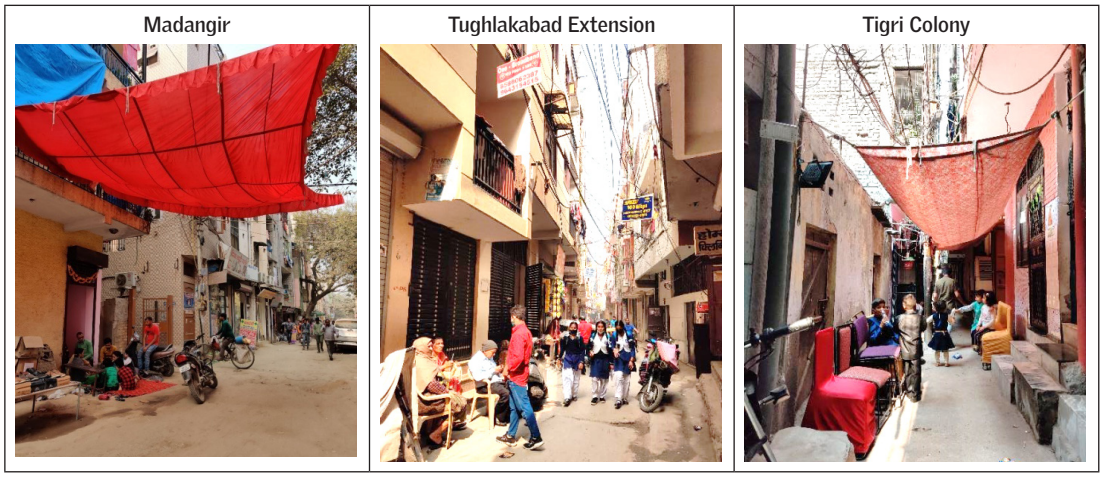
Figure 11: Quality of the local street network in planned settlements

Planned settlements have wider local streets for unhindered movement

Source: CSE

Figure 12: On-street social activities in unplanned settlements

Since there is paucity of open spaces in these settlements, streets are used for all manner of activities, resulting in temporary hindrances time and time again



Source: CSE

Figure 13: Weekly markets on the road

Lack of a formal market space means roads double up as occasional market places to meet demand

Source: CSE

Key cumulative takeaways

When all selected settlements are benchmarked as per key indicators for quality of access under all thematic areas, low-income unplanned settlements predictably rank lower.

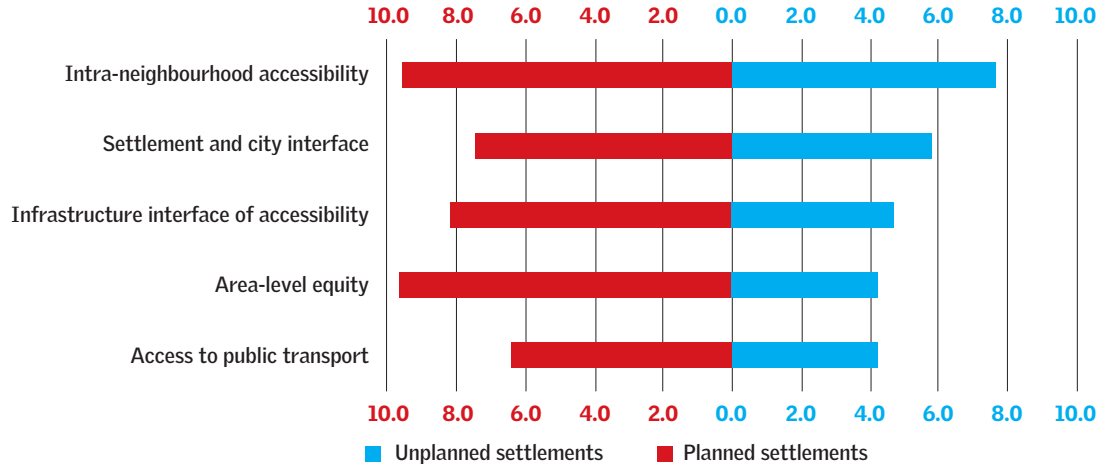
A simple scoring method has been adopted to benchmark the settlements based on the indicators and sub-indicators for all thematic areas related to equity in access. The method has followed binary scoring for indicators based on existence or non-existence of a parameter's requirements. The method has also followed graded scoring of indicators with variables that capture both qualitative and quantitative differences. The scoring takes into account compliance with the requirements of regulations, planning standards and Service-level Benchmarks (as applicable and as far as possible).

The objective of the scoring is to first assess if the requirements of the regulations and standards have been met across all neighbourhoods which is the common minimum requirement (see *Annexure: Theme-wise indicators and sub-indicators applied to track variability across settlements*). The score has been applied on a scale of 1–10. Predictably, low-income neighbourhoods have performed poorly (see *Graph 6: Thematic scores of unplanned and planned settlements*).

This scoring and comparison of unplanned and planned settlements on the yardstick of **'area-level equity'** in terms of locational advantages and disadvantages of settlements shows that planned settlements are 2.8 times better placed than

Graph 6: Thematic scores of unplanned and planned settlements

Although planned settlements have performed better on all themes, they are way ahead of unplanned settlements on some themes, while on others, the difference is less stark



Source: CSE

unplanned settlements. On an average, planned areas have 1.6 times more road space and 1.4 times more open qualitative spaces.

With regard to the criterion of **'interface between settlement and the city'**, planned settlements are about 1.3-times better connected than unplanned settlements. But planned low-income settlements have relatively better chances of being located strategically in relation to major economic hubs and important locations within the city. However, in the organically grown unplanned settlements, intermodal transfer requirement increases as does the waiting time per mode by 1.1–1.6 times. Most importantly, this increases the cost of the journey. In fact, the monthly cost for transport increases by 1.5–3.5 times.

With regard to the criterion of '**quality and affordability of access to public transport services'**, planned areas have 1.5 times better access to the connecting and boarding points of public transport systems like the Metro and buses than unplanned areas. Planned formal public transport networks are more accessible in planned settlements. Low-income unplanned colonies depend on informal and shared IPT like *Grameen Sewa* to access other systems and services. This adds to the cost as well as the hardship faced by commuters as these systems do not always penetrate deep due to infrastructure limitations. These modes have huge route restrictions in the city as well.

With regard to the criterion of '**equity in intra-neighbourhood accessibility**', i.e., how people move and access services and amenities inside the settlement clusters, most settlements do not have adequate access to schools, markets, ATMs, convenience stores, pharmacies, etc. As densely built unplanned settlements are stressed in terms of availability of land, and the quality of infrastructure does not meet applicable design standards, people are forced to depend on mobility services—largely motorized—to access basic amenities outside the settlement. This increases transportation requirements. In fact, planned areas have 1.3 times better intra-neighbourhood accessibility of services than unplanned areas.

With regard to the criterion of **'status of accessibility infrastructure within neighbourhoods'**, all areas fall short of meeting the requirements of street infrastructure for all street activities for safe access and connectivity. Unplanned areas are impacted more. Planned settlements have about 1.8 time more infrastructure provisions than unplanned settlements. Streets in high-income areas are 1.7 times more walkable, IPT penetration is 1.9 times higher in them, and the sense of safety is 1.7 times higher.

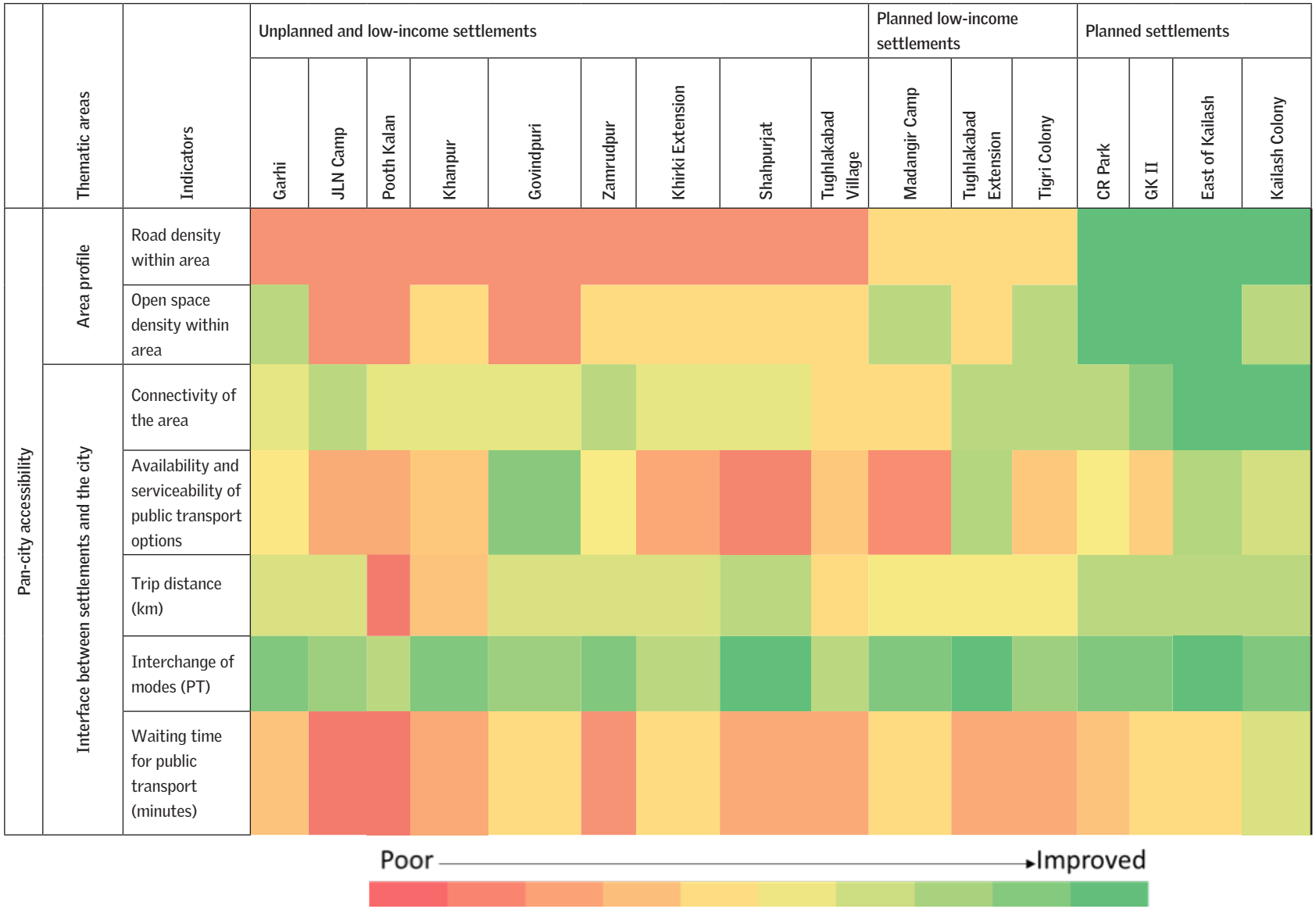
State of planned and standard settlements

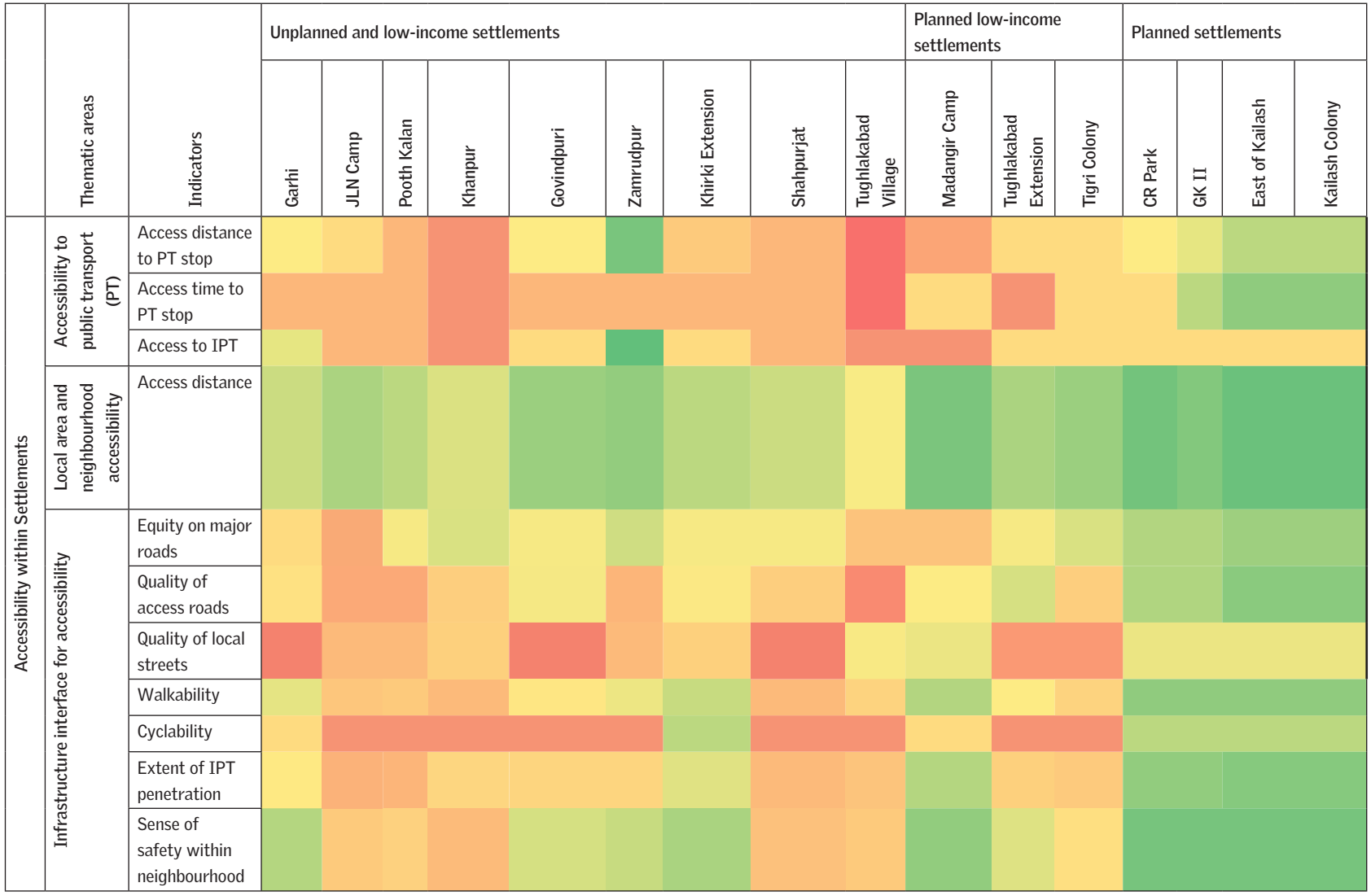
It is important to emphasize that even though planned settlements have scored comparatively better than unplanned settlements, they also have limitations and disadvantages.

This assessment shows that these settlements fair better in the local and neighbourhood context as they follow development control norms. But they score low on quality of local streets, walkability, safe cycling and quality of access to the roads. This scoring is influenced by ROW, availability of clear width, encroachment, consistency of width, shading, etc. Not all local streets within planned residential colonies have clear and consistent width and are encroached upon by parked vehicles. However, these areas were safer than sub-standard local streets due to better illumination, openness of streets, presence of security guards, proximity to police booths, and better gender distribution on roads.

Moreover, not all areas have equal pan-city connectivity and access to last-mile modes. While East of Kailash and Kailash Colony have adequate connectivity and access, Greater Kailash and Chittaranjan Park have poorer access to pan-city and last-mile modes (see *Table 12: Heat map of settlement scores*).

Table 13: Heat map of settlement scores




Accessibility within Settlements
Thematic areas
Indicators
Unplanned and low-income settlements
Planned low-income settlements
Planned settlements
Garhi
JLN Camp
Pooth Kalan
Khanpur
Govindpuri
Zamrudpur
Khirki Extension
Shahpurjat
Tughlakabad Village
Madangir Camp
Tughlakabad Extension
Tigri Colony
CR Park
GK II
East of Kailash
Kailash Colony
Accessibility to public transport (PT)
Access distance to PT stop
Access time to PT stop
Access to IPT
Local area and neighbourhood accessibility
Access distance
Infrastructure interface for accessibility
Equity on major roads
Quality of access roads
Quality of local streets
Walkability
Cyclability
Extent of IPT penetration
Sense of safety within neighbourhood
Poor
Improved

Source: CSE

The way forward

This ground-level review of settlements has generated indicative evidence that reaffirms the fact that barely any effort has been made to integrate unplanned settlements in the city-wide planning process to improve livability and accessibility. This has reconfirmed inequity in access and vulnerability of low-income settlements and the inherent challenges that exist in these settlements. In fact, locational disadvantages continue to plague most settlements. Even planned settlements that are comparatively better off experience deficit in infrastructure.

Urban renewal process in cities cannot ignore inclusive strategies for equitable access to sustainable transport and access infrastructure in all neighbourhoods. Equity is needed not only for local area improvements but also for city-wide mainstreaming of walking, cycling and public transport strategies that can benefit all neighbourhoods. Currently, state governments are in the process of implementing policies and plans related to clean air, climate mitigation and environment management. All of them have provided for sustainable mobility to reduce emissions, cut exposure and decarbonize transport. These policies and plans will have to address the issues of equity and environmental justice as well.

Policies are firming up on new development and redevelopment in cities. National Habitat Standards, TOD Policy and Service-level Benchmarks, etc., at the Central level and master planning and local area development plans at the state-level are defining parameters related to urban design and planning for accessibility. But there is no clarity or policy focus on local improvement and retrofitting in densely populated unplanned settlements to improve connectivity and accessibility for the masses.

What is possible? These settlements are completely built with a dense typology, leaving little space to maneuver change. Solutions will have to be worked out differently for different settlements groups.

Frame guidelines for improving street and access infrastructure in planned and unplanned low income settlements: Densely built settlements with very limited to no open spaces have very little scope of substantial redevelopment. Street networks are already very limited. The streets themselves are narrow—the largest ones would be 9–12 m wide, while the rest can be as narrow as 6 m. A

substantial portion of the networks is unpaved. The streets are full of potholes and have uneven surfaces.

Guidelines are needed for local network improvement by concretizing road surfaces and building underground stormwater and utility duct systems. Concretized streets with separate utility ducts and channels as well as space for movement of emergency vehicles are needed. Such streets are low-maintenance and can take heavy wear and tear. Since the streets in low-income neighbourhoods are intensely used and mixed-use, their design must be nimble and eclectic. They will have to be designed as "shared streets" as that is the way they function.

A standard set of specifications can be developed. These specifications and guidelines can be part of the Request for Proposal (RFP) documents for any local redevelopment programme or project, especially if government incentives are available. Incentives and subsidy should be linked with those specifications.

Developing such guidelines and specifications is also important for the housing schemes under the Pradhan Mantri Awas Yojana (PMAY) for EWS and rental housing. Financing of these projects is the only handle available to get quality work delivered through construction agencies and planning bodies and to get good streets and services. RFPs of these projects need to include specifications for an internal direction process. This needs a deterrence mechanism for non-compliance with the specifications as well.

Settlement-wise plans for improvement in accessibility and connectivity: Several cities in India are preparing or amending their respective master plans or developing zonal plans. Delhi is preparing its MPD 2041. This is an opportunity to assess area-level infrastructure deficit by settlement type and suggest remedial measures in terms of minimum accessible distance to access services, etc. An assessment of all settlement types based on these criteria should be carried out and retrospective planning provided for.

For new development, resettlement, in-situ development and urban renewal, it is recommended that the principles of urban form-based code for compact mixed-use and mixed-income development with accessible streets and provisions of TOD policy should be implemented. Compact high density, mixed land-use and mixed-income development within 400–500 m radius of transit nodes like a Metro stations is needed. This can bring a higher number of people close to the transit lines to be able to access public transport easily and reduce dependence on personal vehicles. Such a

policy must provide design specifications for accessible street density, walkable and cyclable neighbourhoods, and smaller block sizes. This can ensure safe, walkable and well-designed neighbourhood street networks with desired clear width based on street design guidelines.

Data-driven action for targeted improvement in all settlements: This ground-level evaluation has underscored the importance of generating and tracking data on geo-spatial attributes of settlements and from surveys on layout, built-up area, availability of open spaces, street and circulation networks, encroachment, mobility patterns and level of public transport services in each settlement. This can open up opportunities for local area improvement plans. All new generation local area-level action including parking management area plans, and connectivity and accessibility plans, will need new capacities in urban local bodies to generate such inventories to prepare plans for implementation.

Need a city-wide plan for deployment of integrated and affordable public transport services to all settlements: This is needed to ensure equal opportunities in all settlements from the access perspective. While improving the local physical infrastructure for access, it is also important to develop zonal plans to improve public transport services and connectivity. This requires a system design that will enable easy transfers from vulnerable settlements, minimize interchange, and reduce the cost of the journey. It will also require seamless integration of IPT with bus and Metro services and also more direct routes—as far as possible—for IPT. It will have to be supported by walkable streets. It will require settlement-wise mapping and inventory of local streets, their condition, and access and interchange points to identify local solutions.

MoHUA may adopt policy guidelines in this regard. Additionally, a policy on fare integration is needed to keep integrated public transport services affordable for all. It will require financial and benefit packages, a well-designed subsidy policy, and social fare and care packages. As seen in Curitiba, when BRTS runs a flat fare for marginally weaker sections irrespective of trip length and multiple transfers in trip and the fare is also reviewed annually so that workers do not have to pay more than 10 per cent of their income on transport, the system is a success. Integrated ticketing or one card system can eliminate transfer changes. Integrating such systems with IPT as well, which is a prime mover of poorer sections, is very helpful. Most IPT and shared-IPT services operate on distance-based fixed fares.Chip-based tickets can be introduced for low-income groups. At the end of a trip, the operator can encash chips at the terminating point. The same can be used for bus transport, thus eliminating the need for a second ticket.

State governments need to adopt policies on route planning of all services for reliable and affordable connectivity, and deeper penetration of services in low-income settlements.

Integrate housing programmes with transport connectivity and accessibility requirements: Under the housing programme of PMAY, there will be a massive expansion of housing stock. Key verticals of this programme include beneficiary-led individual house construction that largely targets low-income households. This vertical has garnered the maximum incentive, as much as63 per cent, under the PMAY. The beneficiaries largely live in unplanned colonies. With *pattas* and security of tenure, the beneficiaries can be motivated to improve their houses. But the overall welfare gains in these settlements need to be optimized. Buildings and the larger settlement cannot be seen isolated from each other.

Similarly, the other vertical of 'affordable housing in partnership', which is provided by the private sector,has got about 32 per cent of the total incentives under PMAY. But a lot of attention will have to be paid to the locational attributes and connectivity of this housing provision. Even though PMAY has asked for integration of such housing stock in the master plans of cities, it has not been integrated at a scale that is needed. Most of this housing stock is coming up on the edges of cities, without reliable and affordable connectivity. This often leads to under-utilization and the problem of vacant housing as the beneficiaries abandon these houses for practical reasons. Poor area-level services and transportation costs increase the overall cost living in these settlements.

The other verticals, including in-situ slum redevelopment, credit-linked subsidy scheme and rental housing for the poor and migrant population, will require detailed guidelines for accessibility, connectivity and public transport provisioning. Such requirements are not already part of the housing provisions. This disconnect needs to be addressed.

Need a funding strategy at the city level: State governments and urban local bodies or municipal corporations need to frame investment plans and create dedicated funds for local area improvements and infrastructure augmentation in settlements. A portion of the revenue from commercial and residential areas, and parking revenue from parking management area plans can be earmarked for local area improvements.

Need an institutional framework: The challenge in fixing these problems gets further complicated due to the fractured responsibility of different agencies in

different land-use and settlement classes. This is a pan-India phenomenon. For instance, in Delhi, for street infrastructure in unplanned and planned sub-standard areas including slums and resettlement colonies, municipal corporations are responsible. Delhi Development Authority is responsible for land development. In planned standard settlements, DDA is in charge of land development and MCD for street infrastructure and stormwater drainage. Delhi Jal Board provides water in all settlements. But MCD and GNTCD are in charge of sanitation. Housing in sub-standard areas is managed by DUSIB.

Similarly, arterial roads that cut across all settlement types are managed by NHAI, CPWD, DDA and the Transport Department. But local roads, streets and pedestrian facilities are the responsibility of MCD and DDA. Moreover, MCD, DSIIDC and PWD also take care of street furniture in some areas. Coordination is needed with providers of bus services, Metro and IPTs. Management of their services in standard and planned areas is organized by DTC (Delhi Transport Corporation), DIMTS (Delhi Integrated Multimodal Transit system), transport department's Road Transport Offices (RTOs), and DMRC. In unplanned substandard areas, only bus and Metro provide minimal service. Thus, it is a complicated institutional framework.

This requires zonal plans with aligned responsibilities for coordinated action and a task force to oversee and monitor implementation. Bulk of the street infrastructure and access design is the responsibility of the municipal corporations to improve walkability, safety and deeper penetration of rickshaw and IPT modes in these areas. These neighbourhoods need to plan differently the design integration, street alignment and infrastructure, including paving.

This study is a timely reminder, if ever one was needed, for a robust policy framework with a coordination framework and a funding strategy for implementation. This effort will have to be conjoined with the environmental justice approach to ensure that solutions work for everyone equitably, especially for the vulnerable communities.

Annexure

Theme-wise indicators and sub-indicators applied to track variability across settlements

A total of 18 indicators and 60 sub-indicators have been applied to measure the status of five thematic areas that define and determine accessibility of settlements.

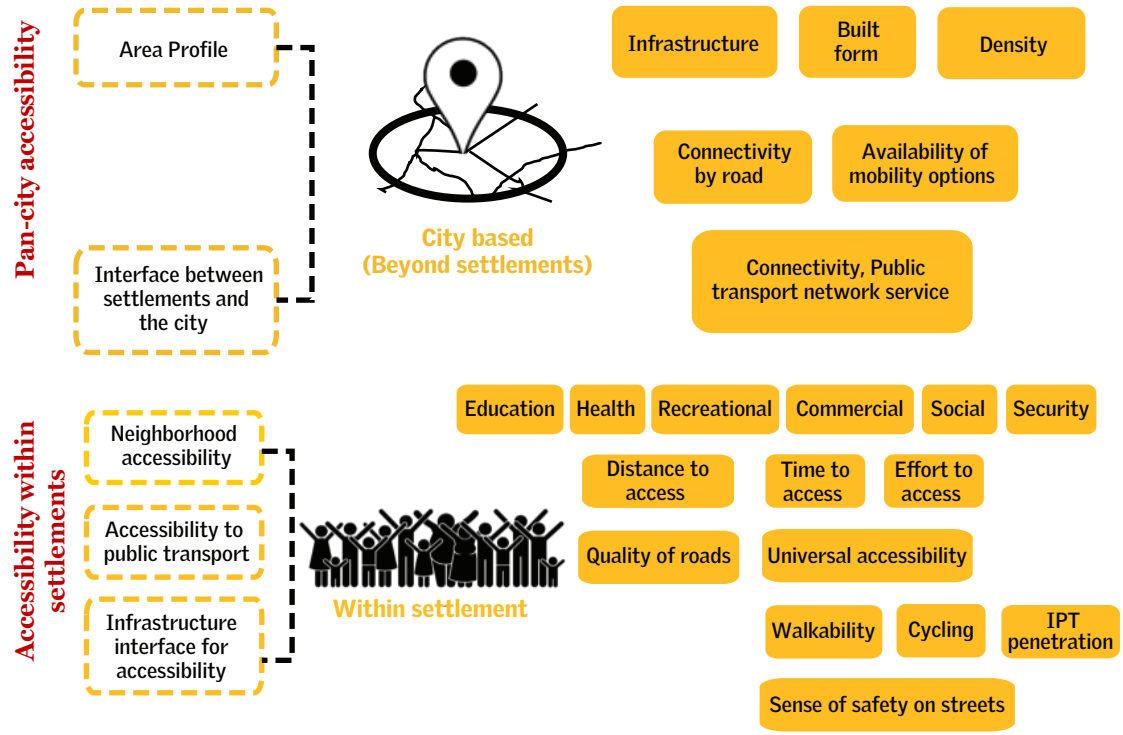
The first two themes are concerned with pan-city accessibility and include indicators that reflect area-level infrastructure, built form, density, connectivity by road, availability of mobility options, and connectivity by public transport network.

The second set of three themes are concerned with accessibility within the settlements and include indicators related to access to health, education, shopping, recreation; and factors like access distance, time taken to access, effort made to access, quality of the streets, universal accessibility, walkability, ability for IPT penetration and promoting sense of safety.

The indicators and sub-indicators have a mix of both qualitative information and quantitative data. The data has been sourced from published information and rapid local survey. Published information include Census 2011 and data from Delhi Electoral Zones, Municipal Corporation of Delhi and Delhi Development Authority, among others. Published reports also include the ones on urban districts of Delhi by DUAC and documentation by grassroot organizations such as CURE India.

Additionally, significant data has been retrieved through geo-spatial analysis of settlements through GIS data mapping and on-ground reconnaissance surveys. Information has also been accessed through GIS and real-time Google data. It was originally planned that an extensive primary user survey to build on the public transport characteristics will be carried out, but the plan had to be curtailed due to the norms of social distancing enforced during the pandemic lockdown.

Figure: Schematic map of themes and indicators of accessibility



Source: CSE

Table: Detailed indicators considered for settlement-based analysis
i) Area profile

Indicator	Sub-indicators	Description of indicators	Data sources and remarks
Area profile	Population (MCD Election, 2017)	Information	Census or MCD electoral data, 2017
	Ward number	Information	MCD electoral map, Census and DUAC report
	Type of settlement	Information	Economic Survey of Delhi 2019–20; DDA; and revenue department, GNCTD
	Land value	Information	List of colonies by DDA; and revenue department, GNCTD
	Area under roads	Information	GIS
	Area under open space	Information	GIS
Quality of settlement	Household size	Equity in per unit space	Because there is no official benchmark, done as per current practices
	Population density	Equity in land distribution = population per hectare or per unit space	DUAC, CURE and Census
	Road density within settlement (a) > 15%, (b) 12–15% (c) 10–12% (d) less than 10%	Equity in circulation space = local road network per area	GIS
	Open space density (a) > 15%, (b) 10–15% (c) 4–9% (d) 3% or less	Proportion of quality open space to building blocks = sq m open area to sq m built-up area	GIS
	Is the area governed by a municipality? (Y/n)	Equity in public services = Right to access civic public facilities and services	Municipality ward list

ii) Settlement and city interface

Indicator	Sub-indicator	Description of indicators	Data sources
Connectivity (arterial, sub-arterial and collector)	No. of major roads connecting the area: (a) Multiple (b) Two roads (c) One (d) No direct connectivity to major roads	Connectivity of the area to high order roads	Google Maps and GIS
	Distance to main road: (a) Within 500 m (b) Between 500 m to 1 km (c) Between 1 km and 2 km (d) 2 km and above	Nearness to high order roads	Google Map and GIS
Availability and serviceability of public transport options	Bus	Availability of mobility options compared to the rest of the city	Primary
	Metro		Primary
	Auto		Primary
	Grameen Sewa		Primary
	E-rickshaw		Primary
	Cycle rickshaw		Primary
	Footpath		Primary
	NMT lane		Primary
	No. of metro stations within 800 m	Geographical coverage of the Metro network	Google Maps and GIS
	No. of bus stops within 800 m	Geographical coverage of bus network	Google Maps and GIS
	Distance between two bus stops is: (a) 400 m (b) > 400 m	Geographical coverage of bus network	Google Maps and GIS
Pan-city connectivity			
City centre (Connaught Place or India Gate)	Distance (km)	Equity in connectivity to the city centre	Google Maps, GIS and fare chart of public transport (bus, Metro, autorickshaw and IPT as per availability in that order) (Private vehicles have not been considered for this study)
	Interchange (no. of PT modes)		
	Time (PT) (in minutes)		
	Waiting time (PT) (in minutes)		
	Walk time (in minutes) to access		
	Cost (Rs)		

City-level economic centres N-Karol Bagh and Chandni Chowk S-Lajpat Nagar, Nehru Place and Okhla	Distance (km)	Equity in connectivity to city-level economic centres	
	Interchange (no. of PT modes)		
	Time (PT) (in minutes)		
	Waiting time (PT) (in minutes)		
	Walk time (in minutes) to access		
	Cost (Rs)		
Major hospitals like AIIMS and Safdarjung	Distance (km)	Equity in connectivity to city level heath facilities	
	Interchange (no. of PT modes)		
	Time (PT)) (in minutes)		
	Waiting time (PT) (in minutes)		
	Walk time (in minutes) to access		
	Cost (Rs)		
Distance		Distance to access	Aggregate of sub-indicators
Interchange (PT)		Physical effort to access	Aggregate of sub-indicators
Waiting time (PT) (in minutes)		Time as a cost to access	Aggregate of sub-indicators

iii) Accessibility to public transport

Indicator	Sub-indicator	Description of indicators	Data sources and remarks
Accessibility to public transport			
Nearest Metro station	(a) Within 250 m (b) Within 800 m (c) Within 1 km (d) Within 2 km (e) 3 km or beyond	Quality of access to transport facilities, w.r.t. accessibility standards	Google Maps, GIS and reconnaissance
	Access time by walk (PT) (in minutes) (a) 5 (b) 10 (c) 15 (d) 20 (e) Cannot walk to Metro		Google Maps, GIS and reconnaissance

Nearest bus stop	(a) Within 250 m (b) Within 400 m (c) Within 1 km (d) 2 km or beyond	Quality of access to bus transport facilities w.r.t. accessibility standards	Google Maps, GIS and reconnaissance
	Access time by walk (PT) (in minutes) (a) 5 (b) 10 (c) 15 (d) 20 or more		Google Maps, GIS and reconnaissance
Nearest IPT stop (autorickshaw or e-rickshaw)	(a) Within 250 m (b) Within 500 m (c) Within 1 km (d) 2 km or beyond	Equity in access to IPT facilities w.r.t. accessibility standards	Google Maps, GIS and reconnaissance
Nearest rickshaw stop	(a) Within 250 m (b) Within 500 m (c) Within 1 km (d) Doesn't exist or 2 km or beyond	Equity in access to NMT	Google Map, GIS and reconnaissance
Access distance (PT)		Distance to access	Aggregate of sub-indicators
Access time (PT)		Time to access	Aggregate of sub-indicators
Access to IPT		Equity in access to IPT	Aggregate of sub-indicators

iv. Intra-neighbourhood accessibility

Indicator	Sub-indicator	Description of indicators	Data sources and remarks
Local area or neighbourhood accessibility			
Primary education	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2 km (d) Doesn't exist or is far off	Equity in access to education	Google Maps and GIS
Secondary education	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2–3 km (d) Within 5 km or beyond		Google Maps and GIS

Primary healthcare	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off	Equity in access to healthcare	Google Maps and GIS
Secondary healthcare	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2–3 km (d) Within 5 km or beyond		Google Maps and GIS
Neighbourhood playground or park	(a) Within area or up to 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist	Equity in access to recreational facilities	Google Maps and GIS
Community market or DDA convenience store, etc.	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off	Equity in access to neighbourhood commercial centres	Google Maps and GIS
Local area market	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2 km (e) Doesn't exist or is far off	Equity in access to local commercial centres	Google Maps and GIS
Police station or chowki	(a) Within the area or up to 500 m (b) Within 1 km (c) Within 2–3 km (d) Within 5 km or beyond	Indicates extent of access to provision of safety and security in the city	Google Maps and GIS

v. Infrastructure interface of accessibility

Indicator	Sub-indicator	Description of indicators	Data sources and remarks
Major roads (arterial, sub-arterial and collector)	Average width of major roads in the area: (a)15 m (b) 10–12 m (c) 6–9 m (d) Less than 6 m	Quantifying availability of major roads leading to the area	Google Maps and GIS
	Sidewalks on connecting major roads: (a) Road with well-defined footpath width 1.5–2 m (b) Adequate width but encroached upon or inadequate footpaths (c) Exists throughout with inconsistent width (d) Doesn't have a sidewalk	Provision for right to pedestrian movement on major roads	Reconnaissance

Universal accessibility on major roads	Continuity of sidewalks	Provision for universal access on major roads	Reconnaissance
	Tabletop crossings for universal accessibility		Reconnaissance
	Kerb ramps		Reconnaissance
	Pedestrian or NMT crossings signals		Reconnaissance
	Auditory signals		Reconnaissance
	Graphic signage		Reconnaissance
Access road to the settlement connected to any major road in the area	Number of access roads: (a) Multiple (b) Two roads (c) One (d) No main access road to settlement	Quantifying access to settlement	Google Maps and GIS
	Consistent or inconsistent ROW	Quality of access to settlement	Google Maps and GIS
	Adequate ROW 6 m or more or inadequate ROW of less than 6 m		Google Maps and GIS
	Paved or unpaved or irregular		Reconnaissance
	Encroached 'less or partially' or throughout		Reconnaissance
Quality of local streets	Consistent and inconsistent ROW	Quality of local roads	Google Maps and GIS
	Adequate ROW 6 m or more or inadequate ROW less than 6 m		Google Maps and GIS
	Paved or unpaved		Reconnaissance
	Encroached 'less or partially' or throughout		Reconnaissance
Walkability on local roads	Walkability (clear walking space of 2 m) (a) Consistent clear walking space on all local roads along with other activities (b) Inconsistent width but manageable along with other activities (c) Inconsistent and difficult with other activities (d) Very narrow and irregular	Quality of movement of pedestrian	Reconnaissance

Cycleability of local roads	Cyclability (extent of consistent clear width of at least 2 m throughout) (a) Consistent space on all local roads along with other activities (b) Inconsistent but manageable on all local roads with other activities (c) Manageable only on a few local roads (d) Very narrow streets, uncomfortable cycling and walking with cycling	Quality of cycling	Reconnaissance
Extent of PT penetration	Extent of IPT penetration in the area (width 6 m or more) (a) On all local roads (b) On a few roads (c) IPT can barely enter (d) Cannot enter the area	Quality of IPT penetration within the neighbourhood	Google Maps, GIS and reconnaissance
Sense of safety within the neighbourhood (walkability and street design elements)	Illumination in the area (a) Good (b) Okay (c) Bad (d) Barely illuminated	Quality and sense of safety within the neighbourhood	Reconnaissance
	Illumination of junctions		
	Illumination of public places		
	Illumination of PT stops		
	Signage within area: (a) Clearly visible (b) Minimal (c) Only at entry points (d) No signage		
	Activity on road, presence of hawkers and vending space		
	Pedestrian crossings		

Some regulatory standards considered for identifying indicators

As of 2021, there are multiple laws and policies that govern urban areas as detailed in previous sections of the report. Of these, Masterplan Delhi 2021 norms and guidelines direct development within various land uses in Delhi. MPD2021 prescribes a set of development control norms to identify and define residential development and neighbourhoods, and basic accessibility standards for intra-neighbourhood amenities. TOD Policy prescribes general accessibility standards to access public transport modes from one's place of origin; then there are service-level benchmarks for urban transport that determine the extent of adequate transport services within cities. These standards form the base of extracting information on ground and measuring the extent of availability.

Table: MPD 2021 guidelines for a neighbourhood

	Facilities and utilities within a neighbourhood
Area with population of up to 5,000	Convenience shopping, totlot, park, playground, primary education and milk booth
Area with population of up to 10,000	Primary school, secondary school, primary healthcare centre, local shopping, service market, informal market, auto-stand, park, playground, etc.

Source: MPD 2021, Table 3.3

Table: Accessibility criteria of social infrastructure and amenities within a neighbourhood

Hierarchy of facilities	Population per unit (Ref: Masterplan Chapter 9)	Accessibility standards from place of residence
Cluster housing	250	Approximately 100 m or 1 minute walk
Housing area	5,000	Approximately 250 m or 3 minute walk
Neighbourhood	10,000	Approximately 400 m or 5 minute walk
Community	1 lakh	Approximately 800 m or 10 minute walk
District	5 lakh	Approximately 2,000 m or 10 minute cycling

Source: TOD Policy 2016; MPD TOD Chapter 12, 3C table 19.6

Table: Accessibility guidelines for other amenities

Facilities and amenities for a neighbourhood	Accessible distance
Primary school	1.6 km
Secondary school	Within 2 km
ATM, convenience shopping, childcare and religious place	800 m
Community hall, medical clinic, etc.	1.6 to 2 km

Source: URDPFI Guidelines 2014, Green city planning point 5.4.1.2- pg. 144; Right to Education Rules 2009 point 4.1.b – pg. 2

Table: Accessibility to public transport stops from one's residence

Hierarchy of facilities	Desired frequency or availability at peak hour (non-peak hour can be based on requirement)	Accessibility Standards from home/work
MRTS station	2 min	Approximately 800 m or 10 minute walk
Metro Feeder	1 min or less	Approximately 400 m or 5 minute walk
Bus stop	1 to 5 min	Approximately 400 m or 5 minute walk
IPT/ Auto stand	24 hr availability	Approximately 250 m or 3 minute walk
Cycle rickshaw stand	Flexible	Approximately 250 m or 3 minute walk
Cycle rental stand	24 hr availability	Approximately 250 m or 3 minute walk

Source: TOD Policy, 3C table 19.5

Table: Service-level benchmark for urban transport that can be applicable to neighbourhood areas in a city

Level of service	1	2	3	4
Percentage area under roads	> 15	12–15	10–12	< 10
Average waiting time for public transport	< 4 minutes	4–6 minutes	6–10 minutes	>10 minutes
Waiting at signal (for pedestrian crossing)	< 25 minutes	25–50 minutes	50–75 minutes	> 75 minutes
Percentage of road or street network where NMT can access	> 50	25–50	15–25	< 15
Encroachment on NMT Roads or streets by parking (per cent)	< 10	10–20	20–30	> 30
Availability of traffic surveillance	> 75%	50–75%	25–50 %	< 25 %
Paid parking availability (per cent)	> 75%	50–75%	25–50 %	< 25 %

Source: SLB Standards, 2015

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The enduring image of a city is a busy population always on the move. Yet, as this assessment by the Centre for Science and Environment shows, mobility in Indian cities is severely hampered by a wide range of constraints: inadequate public transport and lack of access to it, less-than-ideal last-mile connectivity and non-motorized transport facilities, and lack of adequate streets—the spine of settlement structure.

These problems are compounded by urban designs and planning that do not pay enough attention to the needs of low-income settlements, resulting in densely packed neighbourhoods that are a nightmare to navigate; built farther and farther away from centres of economic opportunity and services within the city. We must realize that this is not a problem of the poor alone. Such exclusion will also distance cities from sustainable mobility solutions that emerge from the travel patterns of the poor.

This report traverses through the multiple issues ailing mobility in Delhi (as a case study) in search of a way out.

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