INCLUSIVITY OF PUBLIC TRANSIT FOR SLUMS IN BHOPAL

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Abstract

The inclusion of all communities originating from different backgrounds within society is often referred to as social inclusion. The concept of social inclusion lies in providing equal opportunity to every individual for taking part in political, cultural, economic activities, irrespective of their caste, race, sex. It refers to an urban space where all are treated equally, given equal opportunities and access to all public facilities and services. In the so-called third world, welfare services such as healthcare, education, and other determinants of physical quality of life are considered as paramount. The public mobility services for the general public acts as a major facilitator in order to provide benefit from welfare services. The ease of reaching from a specific origin to a specific destination taking account of the delays due to spatial hindrances is referred to as accessibility (Adhvaryu,B 2019, 19-35). If due to economic or physical challenges, the citizens are unable to access the public transport facilities then they are indirectly omitted from taking part in various social and economic activities taking place in society. Good connectivity and accessibility ensure the inclusivity of the public transport system which is an indicator of a fair society. The modal shift of commuters towards public transit services highly depends on its accessibility levels. To ensure that commuters have equal opportunities to access jobs, education, and other services, PTAL (public transit accessibility level) is often evaluated. The accessibility to public transport can be evaluated using different methods like LUPTAI (Land use public transport accessibility index), PTAL (public transport accessibility level), and TTSAT (Time based transit service area tool). Public transport accessibility levels are a detailed and accurate measure of the accessibility of a point to the public transport network which considers walk access time and service availability. Public transportation is often referred to as an affordable model for every section of society due to its cheap fare price. The major question lies in the inclusivity of public transit services for the economically weaker section of society. Does public transportation available and accessible for those who need this or who cannot afford other mobility services? The present study intends to focus on affordable and inclusive transportation for economically weaker sections of society. The present study is an attempt to assess the issues with public transport services in Bhopal for economically backward areas (slums). The present study shall help in understanding the accessibility level of currently provided public transit services by evaluating the PTAL (public transit accessibility level) for socially backward areas.

Keywords- **Affordable transportation, Social equity, Inclusive transport, Public transit accessibility level, Slums**

Background

An area with substandard housing and lack of basic amenities like poor sanitation, low Water supply, improper transit services, and high population density is often termed as slums. As estimated by UNDP, about one-sixth of the world's population lives in slums. The increase in income disparity, high land value, and increasing poverty rate along with increased population and demographic change are considered to be one of the major factors behind the formation of slums. The typologies of slums can be classified based on their location within a city e.g. Inner-city slums, slums in scattered pockets, and slums in peri-urban areas. Slums in these locations have formed as a consequence of one of the three processes: deterioration of existing neighborhoods, such as inner cities and public/ industrial housing, strategic squatting, or illegal subdivision of vacant sites.

The location of a slum governs various aspects such as access to public transit services, types of livelihood, land values, housing conditions, and access towards other basic amenities to fulfill day to day livelihood needs. The scattered slum pockets are those settlements which are accommodated mostly by urban poor's in developing cities. Most low-income households illegally occupy vacant land close to their workplace without the consent of the owner or the local authorities. In the case of fast urbanizing cities, most of the informal settlement takes place in peri-urban areas due to the low availability of land and lack of affordable housings. Mostly, the peri-urban slums are not regulated by government authorities as they lie outside their jurisdiction which makes it even more difficult to plan for their inclusivity. This leads to their high cost of commuting for jobs which disturbs their cost of living. In the Indian context, the larger is the city size, the higher is the percentage of urban trips served by public transport. Thus according to this, 30 percent of urban trips are served by the public transport in cities with a population between 1 and 2 million, whereas it's 42 percent for cities with populations between 2 and 5 million, and 63 percent for cities with populations over 5 million as per Census 2011. The process of urbanization is taking place rapidly in India. This induces a direct demand for the high quality of public transit services. With the drastic increase in population and demand for mobility, issues related to the current public transit system needs to be upgraded in most of the million-plus cities in India. One of the ultimate goals of any transport policy is to ensure accessibility. Ensuring adequate facilities and infrastructure is also one of the major topics of discussion for transportation geography studies. According to the primary census, the abstract total population of Bhopal Municipal Corporation residing in the slum was 4, 79,699 in 2011 which is about 26% of the total population.

Transportation can play a vital role in promoting the economic development of urban poor. Good accessibility towards public transport services helps in providing easy reach towards the job, education, health, and other leisure facilities. Due to the lack of mobility options, urban poor are forced to restrict their travel to essential trips. In recent studies, it has been proven that ability to move to reduce the feeling of depression and also affect the mental wellbeing of an individual. The effect of transport-related social exclusion on health is seldom studied. Why upgrade slums? Targeting poverty, social exclusion, and environmental vulnerability is a primary development objective, not only of national policies but also of urban and local development interventions including climate and natural disaster resilience action plans. Countries and cities which have been successful in drastically reducing poverty, social exclusion, and environmental vulnerability saw an equal reduction of poverty. They combined pro-poor economic growth, redistributive measures, and inclusive sectoral policies in order to tackle the multi-dimensional aspects of poverty, tackling not only economic aspects, but also those that are people-based (such as social exclusion), place-based (such upgrading and tenure regularization), and issue-based (such as education, health, etc.). The informal economy, where many of the urban poor work, produces a significant portion of the city's economic growth and generates a large share of the Gross Domestic Product (GDP), even if it is typically officially not recorded. In India, the contribution of

the urban poor to the GDP is about 25%, but resources allocated to them are not even 2%. Unhealthy living conditions in slums compromise not only livelihoods but economic sustenance of the city.

Introduction to Bhopal and its Public Transit Services

Bhopal is the capital of Madhya Pradesh, 16th largest city in India, and is also recognized as 'city of lakes' for its various natural and artificial lakes. The city is located on the malwa plateau. According to the 2011 census of India, the population of Bhopal is around 23, 68,145 on a total area of 2,772 sq.km which constitutes to the population density of 854 persons per sq.km. Bhopal is well connected with national and state highways, NH-12, SH-18, and SH-23 pass through the district during the 2000s the emergence of the Kolar municipality area in the southern part of the city along with other residential regions such as near Shahpura, Piplani, barkhera patani, and lalghati also started to develop of public transport services which lead to increase in demand for public transport services. Transport demand in Bhopal also grew rapidly due to the emergence of commercial and industrial activities. The rapid increase in motorization. During this period only various educational institutes also started to develop at the peripheral part of the city which resulted in the need for good road network connectivity of public transport services to provide accessibility towards these institutes.

The public transit system of Bhopal consists of intercity buses for intercity travel and BRTS and Mini bus (in some parts) which carries passengers for intracity services. The bus system in Bhopal runs on the PPP model (Public-Private Partnership). BCLL (Bhopal City Link Limited) manages the BRTS (Bus rapid transit system) in Bhopal. BRTS Bhopal has 225 buses with a total route length of 186 km. According to table 1, 3 truck routes cater to 131 bus stops and 8 standard routes which cater 432 bus stops. SR 3 caters the most number of bus routes with 58 of them out of total 516 bus stops which is about 11.2% of total bus stops and it runs from Gandhi Nagar to Aakriti eco-city, Whereas TR 2 has least number of bus stops with 34 of them in total which originates from Old bus stand to HEG Mandideep. The highest route length is for SR 8 which is about 27 km. SR 8 runs from coach factory to Bairagarh Chichli, whereas SR 2 runs for only 15 km and it comprises 45 stops.

Table 1 Detail of bus numbers and bus route in Bhopal

S.no.	Route	Type (No.)	Bus Stops	Route length	The average distance between stops
1	Chirayu Hospital/ Bairagarh to Aakriti Eco City	Trunk route 1	50	24 km	480 m
2	Old Bus Stand to HEG Mandideep	Trunk route 2	34	23 km	676 m
4	Bairagarh/ Sehore Naka to HEG Mandideep or Bangrasiya	Trunk route 4	47	23 km	490 m

5	Bairagarh/ Sehore Naka to Bairagarh Chichi	Standard route 1	35	19 km	542 m
6	Nehru Nagar to Katara Hills	Standard route 2	45	15 km	333 m
7	Gandhi Nagar to Salaiyya/ Aakriti Eco City	Standard route 3	58	24 km	413 m
8	Karound Chauraha to Bairagarh Chichli	Standard route 4	50	25 km	500 m
9	Chirayu Hospital/ Bairagarh to Awadhpuri Khajuri Kalan	Standard route 5	50	25 km	500 m
10	City Depot Square to Ayodhya Nagar	Standard route 6	48	23 km	479 m
11	Gandhi Nagar to Patel Nagar Bypass	Standard route 7	46	20 km	434 m
12	Coach Factory to Bairagarh Chichi	Standard route 8	53	27 km	509 m

Source- BCLL (Bhopal City Link Limited)

Introduction to Slums in Bhopal

Bhopal Municipal Corporation is divided into 69 wards and 209 locations as notify slums and 171 unmodified slums which together amount to a total of 380 Poverty pockets with a total of 128170 households. Out of the total number of 1, 28,170 households 49.8%are under BPL (Below Poverty Line) category (Municipal Corporation, 2006).

Status of Roads and Street Lights

Roads

Roads act as a direct link to access public transport and infrastructure in the urban scenario. According to BMC (Bhopal Municipal Corporation) report, 73% of the total road length is metaled, but not in good condition as these are not properly maintained. Out of the total 430 km stretch of road only 27% were completely covered lined roads

Table 2- the condition of roads

Total number of Poverty Pocket	Total Length of Road in KM	Length of Pucca Road in km
380	430	315

Source- Bhopal Municipal Corporation

Table 3- Percentage deficiency of Pucca Roads

Percentage of Pucca Road	0	0<25%	25<50%	50<75%	>75% but < 100%	100%	Total
Number of Poverty Pockets	101	122	80	37	21	19	380
Percentage	27	32	21	10	5	5	100

Source- Bhopal Municipal Corporation

Streetlights

Out of the total 380 poverty pockets, there are only 6367 street light poles. Over 24% of the poverty pockets had five of less functional street light poles indicative of the extreme lack of infrastructure in this area. Only 50% (approximately) of the total road length is covered through street light poles.

Literature Review

Accessibility in many kinds of literature has been mentioned as the ease of travelers to reach any activity places using a particular transportation system (Tahmasbia, Behnam 2019, 163-177). Good connectivity and accessibility of public transit services for basic amenities as well as leisure, not only promotes sustainability but also promotes a better quality of life which is considered to be paramount (Saif, Atiullah 2018, 1-9). Access to public transportation is important from the spatial equity perspective (Singha, A.P 2012, 163-167). The promotion of accessibility for any transportation policy is paramount, however, if the public transit services are not optimally available, it may create social exclusion. Public transport accessibility areas translate to higher accessibility to desired work destinations of the urban poor (Adhvaryu, B. 2019, 19-35). Public transport is not only about accessibility towards services but it also provides a platform for social interaction and establishes social connections.

The methods to quantitatively measure the accessibility level involves counting opportunities such as jobs and shopping destinations within reach and assessing the degree of travel impedance. The performance of a city in terms of its economic and environmental aspects can be enhanced by providing a better and more efficient public transit system. Internationally, over the last decade and a half or so, there has been interesting in the unequal distribution of transport mobility benefits between different social groups and/or different areas, particularly as this relates to people without private car access in communities that have become increasingly car-dependent. The Social Exclusion Unit (SEU) popularized this recent awareness of the social value of transport, exploring accessibility barriers that make it difficult or impossible for people to participate fully in society. Using the accessibility planning approaches, the mobility services available to society have always played a crucial role in facilitating urban development employing promoting social capital and community strengthening (Stanley, Janet 2017, 108-115). The diversity of public transit services makes mode choice flexible varying with travel purpose, distance, and time. The improvement in urban public transport services for urban poor's residing majorly in informal settlements enhances their access, not only towards basic amenities but also for better educational facilities and job opportunities (Onyango, G.M 2018, 145-156).

The lack of availability and affordability towards healthcare and educational services negatively impact the quality of life as they are identified as its major determinants. Unlike wealthy countries, this is observation is more relevant in low-income developing countries as the services are located at a greater distance which impedances its availability. On the other hand, investing time and

money for constructing flyovers and better quality of the road is not going to solve this issue, eventually makes it futile and worse as this directly encourages the use of private mode to travel and discourages the use public transport because anyways the urban poor's can seldom afford private mode for commuting (D.Harshanee. Jyasekhra 2015, 738-751). Travel time impedance is the most common way of estimating the accessibility by considering access, egress, and the transfer time from origin to destination (Tahmasbia, Behnam 2019, 163-177). Accessibility is not only referred to as physical access to opportunities and services, but also considers affordability, reality, and safety. A good network does not necessarily imply good public transport networks because the frequently provided public transport services in India are bus-based, especially for intra-city traveling, therefore they occupy the same roads as available for private vehicles.

The improved motor friendly infrastructure services not only encourages the use of private mode but also act inverse to the mohring effect which is an observation that 'as the demand for public transit increases, the frequency of services will also increase, resulting in reduced travel time.' Accessibility can also be defined as "the potential of opportunities for interaction. The necessity to conduct a baseline study followed by its detailed assessment becomes paramount for authorities and policymakers to make better decisions about investments in public transit system (Kim, Junghwan 2019, 8-18). The evaluation of PTAL (Public transport accessibility level) becomes important for improving the process of urban planning through using approaches such as integrated land use planning, more effective parking policies, locations for affordable housings, etc. The sustainability of the urban setting is governed by the quality of public transit services. An inclusivity study conducted in Ahmedabad depicts that living in high PTAL areas may not result in a high accessibility level for urban poor residing in the same zone. It, therefore, follows that planners can superimpose housing locations of the urban poor on a PTAL map to identify specific areas to enhance their mobility needs (Chopde, Abhay 2016, 293-300).

Methodology

The present study intends to assess the availability and accessibility of public transport services in Bhopal. PTAL (Public transport accessibility level) is evaluated for slums as well as for posh neighborhood areas to assess whether the public transit services are equally accessible or not. A primary survey was conducted to collect the data required for the estimation of PTAL.

Finally, for understanding the perception of slum dwellers about public transit services in Bhopal, a qualitative study was conducted alongside the primary survey.

Steps to Calculate PTAL

Identify the Point of Interest (POI) and Service Access Points (SAP): Point of interest is defined as a point for which the accessibility level is to be measured concerning a public transport stop.

Calculation of Access Walk Time from POI to SAP: The actual road network distance from POI to SAP is measured via a primary survey. The average walking speed is considered as 3.2 km/hr.

Determine routes at each SAP and calculate the Average Waiting Time (AWT): AWT is defined as the period when a passenger arrives at an SAP until the arrival of the desired service. All services on all routes are taken into consideration during peak hours.

$$AWT=0.5*(60/f) +K$$

f=hourly frequency

K=reliability factor

Calculate Total Access Time (TAT) for each valid route at each SAP:

TAT=WT+AWT

WT=waiting time

AWT= average waiting time

Convert TAT into Equivalent Doorstep Frequency (EDF):

EDF=0.5*(60/TAT) OR 30/TAT

The reason for dividing 30 by TAT is to re-apply half the headway rule because the values have a different meaning. In the third step, frequency is converted in AWT, and in step 5, TAT is converted back into a frequency (EDF).

The above calculation includes three elements: walk time+ average waiting time (assumed to be half the headway) + reliability factor. TAT is now converted into a number that is comparable to service frequency that considers the additional walk time taken to reach the stop along with the reliability of the service (Abhay Chopde, 2016).

Calculate accessibility index (AI) for each POI: route with the highest frequency is assigned a weighting factor of 1 and for all the other routes, a weighting factor of 0.5 is assigned.

Table 4 PTAL grading standards

PTAL	Range of Index	Description
1a	0.01-2.50	Very poor
1b	2.51-5.0	Very poor
2	5.1-10.0	poor
3	10.01-15.0	moderate
4	15.01-20.0	Good
5	20.01-25.0	Very good
6a	25.01-40.0	Excellent
6b	40.01+	Excellent

Source- Transport for London

Sample calculation and similarly, PTAL was calculated for all the selected points.

Typical accessibility index calculation sample #1

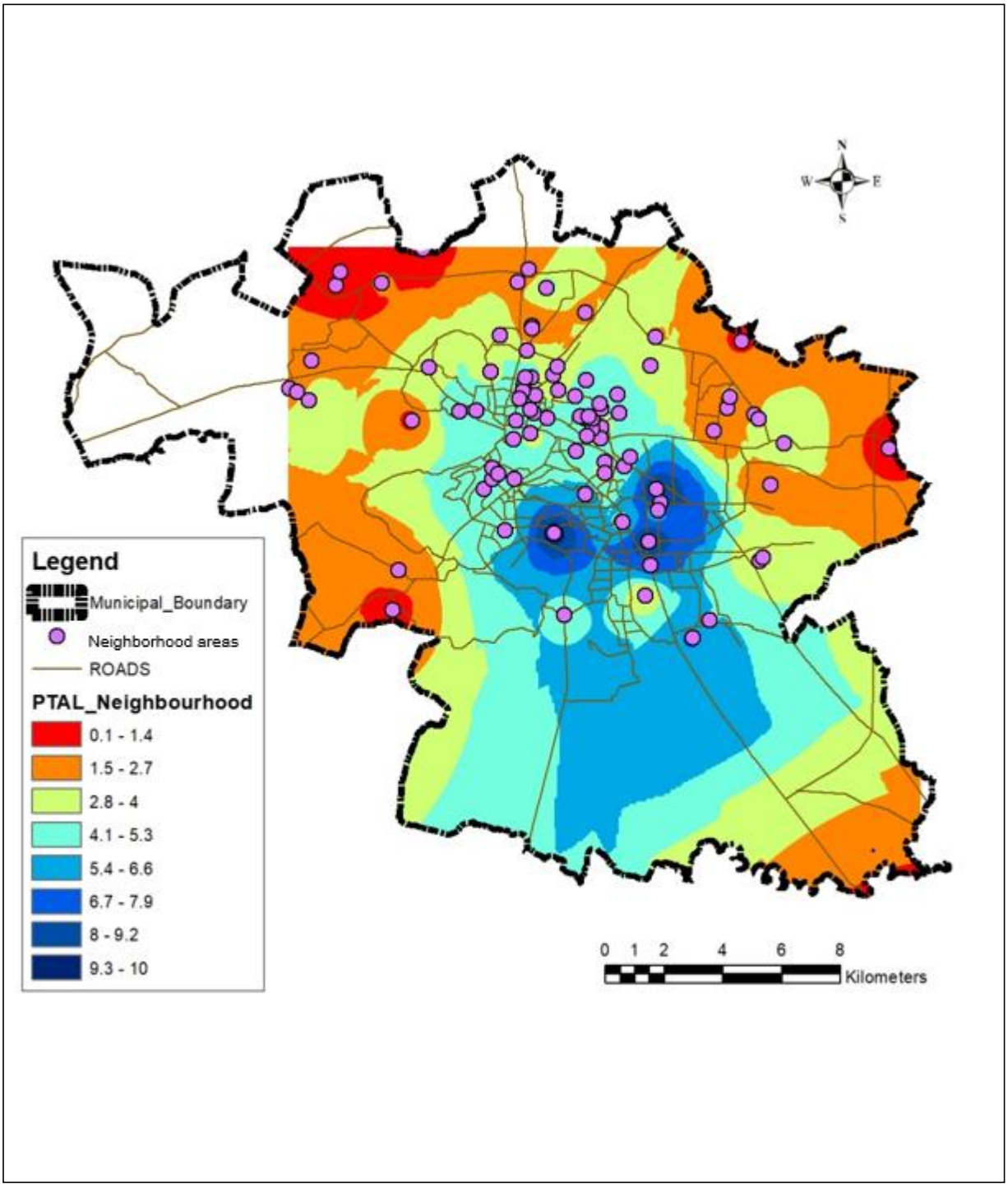
Mode	SAP name	Distance (m) of SAP from POI	Frequency (per hour)	Reliablity factor (k)	AWT (km/hr)	WT (min)	AWT (min)	TAT (min)	weight	EDF (per hour)	AI
BRTS	A	700	10	3	4.8	8.8	6.00	14.8	1	2.0	2.0
	B	900	10	3	4.8	11.3	6.00	17.3	0.5	1.7	0.9
											2.9

Key:
POI – point of interest;
SAP – service access point;
WT – walk time; AWT – average waiting time;
TAT – total access time;
EDF – equivalent doorstep frequency;
AI – accessibility index

Result &Conclusion

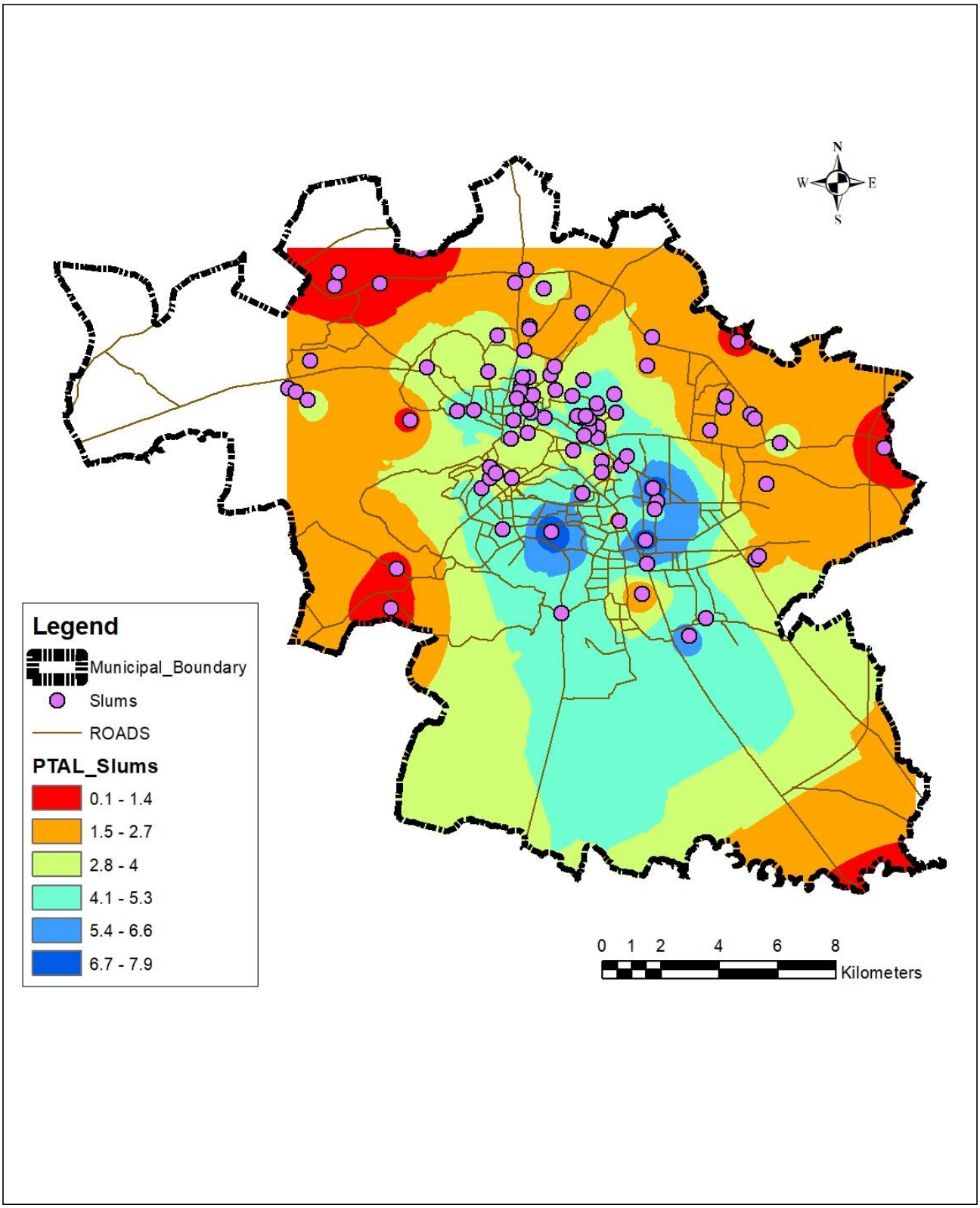
Mapping PTAL for Slums and Posh Neighborhood areas

The PTAL for posh neighborhood and slums in Bhopal is as follows



Map 1 PTAL For posh neighborhood areas in Bhopal

Source- Primary survey



Map 2 PTAL For slums in Bhopal

Source- Primary survey

The Public transport accessibility level (PTAL) for slum areas in Bhopal city is less than 5 in many of the areas, which corresponds to the 'poor' category. Although, PTAL for the posh neighborhood areas is also not appreciable but comparatively better. The highest PTAL for slums and a formal settlement was evaluated as 7.9 and 10 respectively, both lie in the core area of the city near CBD. In the peri-urban areas, The PTAL level for both, the posh neighborhood areas and slums were found to be very low with poor connectivity and accessibility to public transit. The average waiting time for public transit services was estimated at around 6 minutes during peak hours with a frequency of 10 buses per hour. The majority of the slums are spatially in proximity to bus stops but the travel impedance affects their accessibility due to lack of pedestrian infrastructure, whereas for most of the posh neighborhood areas, the accessibility level was comparatively higher.

Understanding the Mobility Needs of the Slum Dwellers in Bhopal

As per the qualitative study conducted during the primary data collection, it was assessed that slum dwellers were unhappy with the reliability and location of transit stops from their residence. Some of the slum dwellers owned 2-wheelers and use it for daily commute as they were not satisfied with the Public transport services, even though this increase their cost of traveling directly, which affects the cost of living. Slum-dwellers were even ready to pay a hiked fare price if the current services improve and were ready to shift towards public transit against their prevailing private mode of travel. Most of the slums are located near expensive residential areas but the setting of the bus stop was near to residential colonies. The major issues for slum dwellers were the frequency, scheduling, and service quality of public transit.

Scheduling of route, Timing, frequency of bus services, and service quality which relates to maintaining ace of bus services is also an important aspect for them. Even if the paying capacity of a different class of people differs, their expectation for good services still plays a vital role when selecting a mode to travel.

Conclusion

The present study concluded that through GIS mapping, the availability of public transit on spatial perspective is not a major issue as most of the slums were close to public transport services, but on the contrary part, the lack of pedestrian infrastructure increases there walking time and travel impedance, frequency of buses, Scheduling, Routing and service quality are some of the other major parameters which affect their mode choice. These parameters need to be emphasized for improving the accessibility level of public transport and encourage inclusivity.

The PTAL was found to be quite low for all the residential areas in Bhopal, but, comparatively residents of posh residential colonies experience better accessibility towards public transit services as compared to slum dwellers.

The maintenance system of buses is major lacunas that require lots of work to be undertaken by the authorities to ensure a more efficient and comfortable ride. Scheduling and routing is another major issue that was observed during the primary survey. The route rationalization plan needs to be modified to minimize the travel time for slum dwellers by keeping their purpose, trip length, and place of attraction into account.

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