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Analysis of Non-motorised Transport and Public Transport Facilities Using Bicycle Compatibility Index and Stop Coverage Ratio, in Vijayanagar, Bengaluru

Lingaraju Megha[1*], Seelam Srikanth[1]

[1] School of Civil Engineering, REVA University, Kattigenahalli, Yelahanka, 560064 Bangalore, Karnataka, India
[*] Corresponding author, e-mail: R19MTE09@ce.reva.edu.in

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Abstract

Transportation development is one of the parameters indicating the development of any country. Due to improper maintenance of infrastructure, non-eco-friendly designs and practices etc. have led to congestion, accidents and environmental depletion. These problems can be addressed by developing a structured transportation system integrated with sustainability and safety. The aim of this study is to analyze the existing facilities in the study area and to suggest integration of non-motorised transport and public transport through questionnaire survey. The bicycle compatibility index is calculated to find the bicycle level of service of the study area. The bus stop coverage analysis was done by calculating the ideal stop accessibility index, actual stop accessibility index and stop coverage ratio index. From bicycle compatibility index, it can be concluded that the compatibity of the surveyed region was moderately high for bicyclists. Based on bus-stop coverage analysis, Kalyan nagar bus stop is said to have good accessibility whereas ITI layout has poor accessibility.

Keywords

public transport, non-motorized transport, actual stop accessibility index, ideal stop accessibility index, stop coverage ratio index

1 Introduction

The whole globe is connected and interconnected through the thread of transportation. From household needs to business development, transport accessibility plays an important role. The transportation sector is one of the indicators of the successful functioning and development of the country. Indian transport infrastructure has been serving the nation for decades. Various studies have established the interdependence between the transportation and land use. This has created spaces for the urban environment. The rapidly urbanizing environment is a fertile ground for economic growth, hence it will lead to congestions in land space and infrastructures. Further, the mode shift from public transport to private transport by the public will be increased. Hence, there is a requirement to develop a structured transportation system integrated with sustainability and safety.

Sustainable development is conceptualized as the means of meeting the current needs, without affecting the future generation adversely. Sustainability is more about systems analysis rather than threat analysis (Juremalani and Chauhan, 2018). Non-motorised transport (NMT) and public transport (PT) have proved to be effective sustainable transports. The transport integration of those sustainable solutions, especially the integration of NMT and PT has a wide scope and many approaches to it. In this view, the integration of transport modes show the path of sustainability. Hence many researchers have undertaken this study and analyzed towards sustainability through various modes of transport. Among the different methods available, few evaluated NMT and PT through different factors like bicycle compatibility index (BCI), ideal stop accessibility index (ISAI), actual stop accessibility index (ASAI) etc. and others evaluated them based on development of different mathematical models.

Level of service (LOS) is the measure of operational conditions perceived by road users. LOS is designated from A to F (most desirable to least desirable) based on factors influencing the same. Usually, speed limit, traffic, roadway width, parking etc. affect the bicycle level of service. BCI is usually evaluated through qualitative analysis, which in turn depends on real-time human perceptions towards riding a bicycle. Hence a survey needs to include designated questions about human perceptions.

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Buses play a major role as a sustainable transport mode. Hence their analysis and upgradation play a major role in the integration of transport modes. One of the ways to analyse the bus-stop coverage is ISAI, ASAI and stop coverage ratio index (SCRI). These indexes not only provide the values for understanding the accessibility of pedestrian road networks to bus stops but also help in the comparison analysis of ideal coverage and actual coverage of road networks by buses.

This paper thus attempts for analysing the existing facilities in the study area and for suggesting integration by assessing the demand and desires of people through questionnaires. The evaluation of bicycle and bus stop facilities avaiable in the study area was done by calculating BCI, ISAI, ASAI and SCRI.

The paper is organized as follows: Section 2 presents the literature review related to analysis of bicycle facilities and public transport facilities. Section 3 presents the details about the study area. In Section 4, study methodology is shown in a flow chart and calculation of BCI, ISAI, ASAI and SCRI also discussed. Analysis of questionnaire, bicycle facilities and public transport facilities are discussed in Section 5. Finally, conclusions are drawn in Section 6.

2 Literature review

Literature review throws the light on the study and provides direction to it. In this section, literature review related to integration of PT and NMT, analysis of bicycle facilities and public transport facilities are discussed. Hidayat and Sari (2020) analyzed the traffic conditions and the conflicts between the pedestrians and motorcycles at the educational district, Indonesia. Pedestrians' and motorcycles' conflicts have always led to losses in accidents in this area. Hence the study tries to solve the problem by qualitative analysis of the data collected. Pedestrian and motorcycle volumes were collected and analyzed. From the results, it is concluded that roads that are shared for the movement of motorized vehicles and pedestrians need to be separated to reduce conflicts and increase pedestrian comfort to improve safety. Mutiarasari et al. (2020) analysed the pedestrian facilities and the various factors affecting pedestrians at Jalan Sabang and Jalan Jaksa in Jakarta. Pedestrian centres are vital elements of urban design. The basic expectation of pedestrians is that safety, ease and circulation are fulfilled. Ahmad and Chang (2020) recommended different policies for guiding sustainable transportation systems in developing countries like India. Authors revealed that demand-based policies are required to improve India's transport system.

Safitri and Amelia (2019) evaluated pedestrian facilities based on the walkability index. According to walkability index value, pedestrian facilities are not good enough for walking in the study area. Yu et al. (2018) analyzed the impacts of the bus stops on adjacent non-motorised transportation. Data was collected by placing cameras in middle and upstream sections of the non-motorized lanes, which were analysed and basic statistics regarding conflict points were tabulated. Through Greenshields model, the analysis of the impact on adjacent non-motorized lane capacity for each bus stop was tabulated and compared using a flow-density curve. Li and Zhang (2014) established a scientific path for planning non-motorized traffic by dividing areas into cellular zones. The threshold value of non-motorized traffic is determined by residential trip characteristics. The characteristics of the non-motorized cellular zone is analyzed by the Intensity model for shopping trips. Salleh et al. (2014) presented the different strategies for sustainable planning of transport through frameworks. The authors addressed the problem of lack of infrastructure for PT and NMT in Malaysia. The study is divided into various parts to address the solution through pictorial representation. Hence providing suitable measures for integration of NMT and PT through a framework and case studies.

Agarwal (2013) provided the importance of cycling and the bicycle LOS. The indexes of LOS and their explanations are given. Factors affecting the bicycle LOS are also mentioned. The process of preparing the questionnaire for bicycle LOS is discussed and the formula for BCI is explained and calculated in the area of Rourkela. Nayak (2013) discussed about the three main factors affecting bicycle LOS, stress levels, roadway condition index and capacity based LOS and also discussed about methodologies and formulas of cluster partitions, hard partition, fuzzy partition etc.

Gahlot et al. (2013) carried out a study to analyse the public transit coverage in Jaipur city, with a focus on the buses. The study attempts to give an introduction to ASAI and ISAI and their differences. The difference is well illustrated through a diagram from ArcGIS. The formula for ASAI and ISAI is also discussed. Later the indexes are calculated for 15 bus stops in Jaipur, which are ranked and the results are discussed, based on indexes. To address the first-last mile challenge, Lesh (2013) developed policies and strategies and also proposed operational strategies and technologies to meet the mobility needs of a growing population. Foda and Osman (2010) discussed about the ISAI, ASAI and SCRI. The methodology is given with a flow chart to calculate these factors with the help of ArcGIS. The model is evaluated by bus stops around the roadway of Gamal Abd-Elnaser. Later the indexes are calculated, ranked and results are discussed, around the bus stops of roadway of Gamal Abd-Elnaser, based on indexes. To address the challenge of providing financially viable and affordable public bus transit service, Badami and Haider (2007) proposed a disaggregated approach based on the needs and motivations of different groups in relation to public transit, as well as improved operating conditions and policies to internalise costs of personal motor vehicle use.

3 Study area - Vijayanagar, Bengaluru

Bangalore is endowed with a ring radial road network. Vijayanagar is a neighbourhood in Southwest Bangalore, India. It derives its name from the Vijayanagara empire that flourished in the South Republic of India throughout the fifteenth and sixteenth centuries. It's bounded by Mysore Road and Magadi Road, with Chord Road cutting through. It's the north area in South Bangalore.

Bengaluru has 198 wards and 7 zones. Vijayanagar area has many assembly constituencies and wards, but few were selected for study to facilitate snow-ball sampling and for convenient sampling as shown in Fig. 1. The selected wards and their populations are given in Table 1.

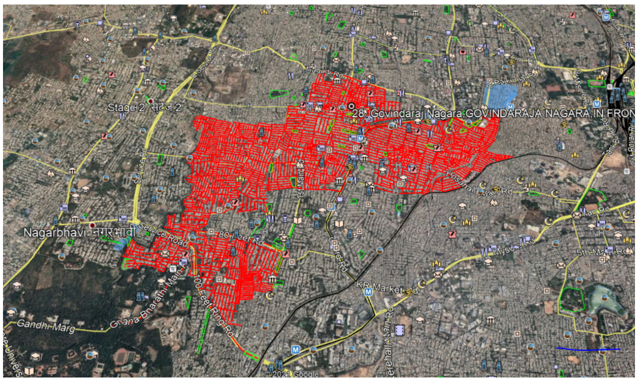

Fig. 1 Study area

Table 1 Wards selected for study

Ward number	Ward name	Population
123	Vijaya Nagar	17,068
124	Hosahalli	16,662
125	Marenahalli ward	20,068
126	Maruthi Mandir	21,784
127	Modalapalya	24,487
128	Nagarabhavi	10,408
104	Govindaraj Nagar	25,773

Source: Bruhat Bengaluru Mahanagara Palika

4 Study methodology

The present study was performed at different stages and the flow chart is as shown in Fig. 2.

A single questionnaire which had elements for cyclists, public transport users, private vehicle users and pedestrians were prepared. The questions framed were easy and self-understandable for the people. The check questions were also asked to eliminate the unreal data. There are many formulas, factors and methods to decide on sample size. Cochran's formulation is one among those, that is considered particularly suitable in conditions with huge populations. The sample size is 500 in total. The opinion survey was conducted through household interviews, phone interviews and snow-ball sampling.

4.1 BCI

According to Piyush Agarwal (2013), the equation for estimating the BCI for bicycle facility is given in Eq. (1):

$$\text{BCI} = A \times Y_1 + B \times Y_2 + C \times Y_3 + D \times Y_4 + \ldots, \quad (1)$$

where $A, B, C, D \ldots$ are the mean of the observation, Y_1, Y_2, Y_3, $Y_4 \ldots$ are inverse variance of the observations.

These are the steps for calculating LoS according to BCI:

1. Calculation of the BCI of the facility based on Eq. (1).
2. Assignment of the value (BCI_{min}) assuming Ideal (most compatible) Road conditions.
3. Assignment of the value (BCI_{max}) assuming Unfavourable Road conditions.
4. Calculation of the class interval (CI) size by using $[\text{BCI}_{max} - \text{BCI}_{min}]$/Number of class intervals.
5. Calculation of the ranges for different LoS based on CI size and BCI_{min} values.
6. Estimation of the LoS of the facility based on calculated BCI.

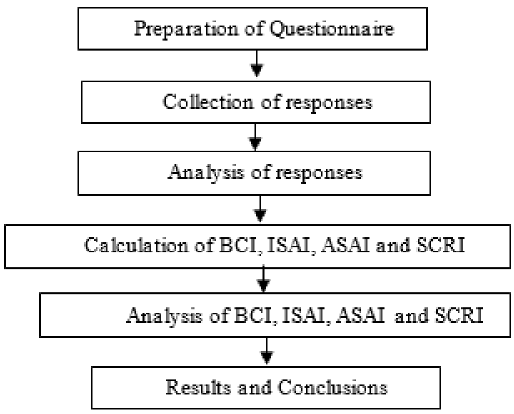

Fig. 2 Study methodology

4.2 Estimation of ISAI, ASAI and SCRI

In this study, the buffer distance is fixed to 500 m based on an opinion survey. The circular buffer and polygons are created accordingly.

According to Gahlot et al. (2013), the equation for estimating the ISAI is given in Eq. (2):

$$\text{ISAI} = L_c / A_c \,, \tag{2}$$

where ISAI is the Ideal Stop-Accessibility Index in km/km^2, L_c is the total length of road networks accessed by pedestrians within the ideal buffer distance and A_c is the Ideal Area within the buffer radius in km^2.

These are the steps for calculating ISAI by using ArcGIS:

1. Street ID maps and bus-stop locations are imported into ArcGIS through CSV/KML format files.
2. Creation of a circular Buffer of 500 m around the bus stop, using Buffer tool from Geo-processing as shown in Fig. 3.
3. Clipping the road network around and each bus stop to find the length of roads (L_c) within each circular buffer by exporting the lengths from attribute table.
4. Calculation of the area of 500 m circle buffer, this will give A_c.
5. Calculation of the total length of road network, this will give L_c.
6. Calculation of ISAI = L_c / A_c.

The buffer of 500 m radius may contain zig-zag/haphazard distances which may sum up to give the walking distance of more than 500 m. Thus, to eliminate this error of ISAI index, ASAI index which gives actual value of accessibility of pedestrian network to bus stops may be considered. The dis-advantage of this index is that the denominator is not constant, the polygon area may vary. The equation for estimating the ASAI is given in Eq. (3):

$$\text{ASAI} = L_p / A_p \,, \tag{3}$$

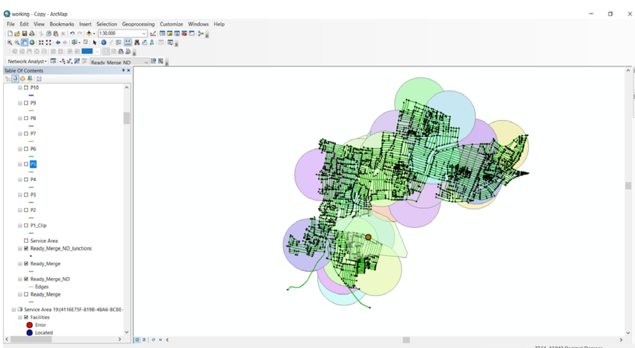

Fig. 3 500 m buffer around bus-stops

where ASAI is the Actual Stop-Accessibility Index in km/km^2, L_p is the total length of road networks accessed by pedestrians within the polygon and Ac is the Actual area within the polygon with road networks within the distance of 500 m (in km^2).

These are the steps for calculating ASAI by using ArcGIS:

1. Street ID maps and bus-stop locations are imported into ArcGIS through CSV/KML format files.
2. New network data set has to be created for this network/Street IDs, this will add three new layers to the file containing points at intersections, edges and network. Fig. 4 represents the same.
3. Selection of network analyst tool from Customise—Extension—Network Analyst toolbar will appear.
4. Check of network analysis in windows as well as arc catalogue.
5. Selection of new service area from the Network analyst tool.
6. A new Service area will be created in the table of contents, selection of the settings of the area and 500 m default breaks in analysis settings and polygon settings as shown in Fig. 5.
7. Clipping the road network around and each bus stop to find the length of roads within each polygon (L_p) by exporting the lengths from attribute table.
8. Calculation of the area of 500 m polygon buffer, this will give A_p.

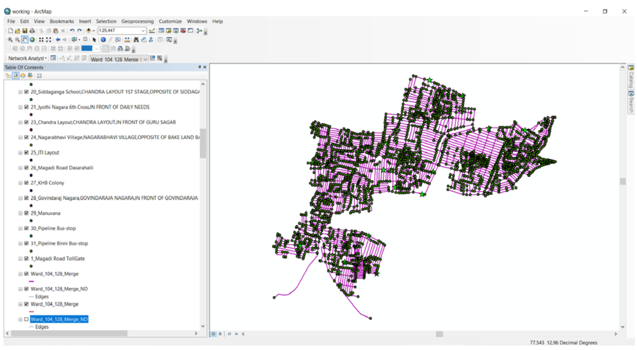

Fig. 4 Intersection, edges and network of the study area

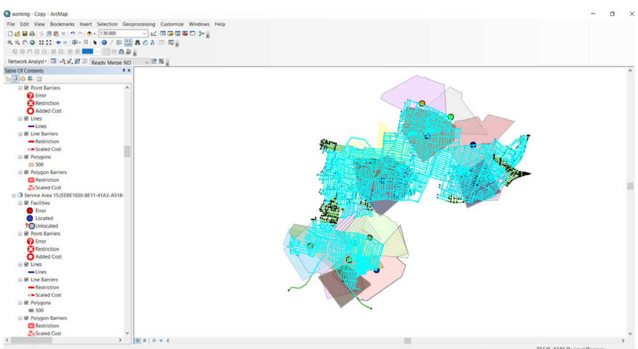

Fig. 5 500 m polygon buffer around bus stops

9. Calculation of the total length of road network, this will give L_p.
10. Calculation of ASAI = L_p/A_p.

SCRI is the ratio between the Area of Polygon (A_p) and the Area of 500 m buffer (A_c). It is a dimensionless unit that gives the value denoting actual coverage of accessibility to bus stops given the ideal coverage. The equation for estimating the ASAI is given in Eq. (4):

$$\text{SCRI} = A_p / A_c \ , \quad (4)$$

where SCRI is the Stop Coverage Ratio Index, A_p is the Area of polygon in km^2 and A_c = Area of circular buffer in km^2.

5 Results and discussions

5.1 Analysis of public opinion survey

The provision of facilities eases the travel behaviour of the people, but before the provision of the facility, the demand for a particular facility and behaviour of the people in the particular area has to be analysed. Thus, this section briefs about the outcomes of a public opinion survey.

5.1.1 Public transport usage

From public opinion survey, it is observed that 16%, 15% and 36% of respondents were only bus-users, only metro-users and both buses & metro respectively as given in Table 2. Out of total respondents, 67% of respondents used either bus or metro, whereas 33% of respondents did not use both. The majority of users used either metro or buses, hence the integration of these modes are important.

5.1.2 End-mile transport for accessing the bus stops and metro station

From Table 3, it is observed that walking is major mode of end mile transport for accessing either bus stops or metro station. The pedestrian facilities to reach bus stops must be improved to provide comfort to the users. Cycles, cars, cabs and private vehicles parking infrastructure facilities must be improved to integrate these modes with public transport. 20% of respondents used another type of parking (i.e. parking in front of houses/shops or service roads near metro stations) other than using metro parking, this is a potential obstruction to a pedestrian by the encroachment of private vehicles. Only 3% of respondents used metro parking facilities due to lack of parking space and higher pricing for parking in metro stations.

Table 2 Public transport choice of respondents

Mode choice	Transport Choice of Respondents (%)
Only Bus users	16
Only Metro users	15
Both bus and metro users	36

Table 3 End mile transport for accessing the bus stops and metro station

End-mile transport (%) for accessing the bus stops		End-mile transport (%) for accessing the metro station	
Walk	70	Walk	53
Cycle	7	Car/Cab	24
Car/Cab	10	Metro parking lot	3
Parking the car/bike near bus stops	13	Other parking	20

5.1.3 Impact of COVID situations on use of NMT

From public opinion survey, it is observed that 61% of respondents believe that existing COVID situations has encouraged people to use non-motorised transport modes as shown in Fig. 6. This existing psychological motivation has to be empowered with improvement of various non-motorised infrastructure facilities for the development of sustainable transport models.

5.1.4 Public transport fare and parking fare factor

From Table 4, it is observed 64% of respondents feel reasonable public transport fares are enough, 12% of respondents desired zero public transport fares and 24% of respondents were not affected by the pricing system. The parking fare mechanism affects the Park and Ride behavior of the people. It is observed that 82% of respondents desire for parking fare of Rs.0-10/hour. Thus reduced parking fare would help in the integration of public transport and private transport systems.

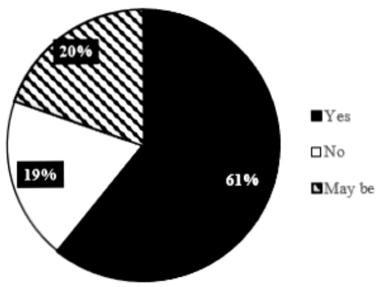

Fig. 6 Impact of COVID on use of NMT

Table 4 Public transport fare and parking fare factor

Public transport fare (%)		Parking fare (%)	
Reasonable public transport fare	64	Rs.0-10/hour	82
Zero public transport fare	12	Rs.10-25/hour	6
Not affected by the pricing system	24	Rs.25-30/hour	12

5.1.5 Distance factor

From Fig. 7, it is evident that the demand for situating bus stops <500 m is the highest. The distance from 500 m to 1 km is also acceptable. The distance range above 1 km is not desirable by the public. The summation of the distance ranges of 500 m–1 km and 1 km–3 km is also higher, which is less preferred by the public. Having compared the actual and ideal conditions, <500 m buffer from bus stations are desirable. From Table 5 , it is observed that 46% of respondents travel for more than 10 km to reach their workplace. Thus integrated public transport facilities can make travel cost-effective and sustainable for the citizens.

5.1.6 Infrastructure factor

From public opinion survey, 77.20% of respondents feel the need for a separate cycle lane. Regarding footpath facilities, 12% of respondents feel that existing footpaths can cater the demand, 25% of respondents feel the need for a footpath in heavy traffic area and 63% of respondents need footpaths.

5.1.7 Technology (Apps to find out about the time and seat availability)

Though there is an existing app, still 83% of people feel the need for an efficient app, which can ease transportation. While 12% feel it would make things difficult, thus technology aids can be provided for them as shown in Fig. 8. From survey, it is observed that 90.15% of respondents feel the seamless transport would make the public transport system more comfortable.

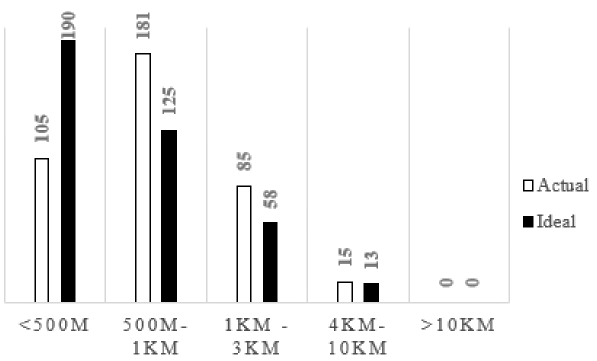

Fig. 7 Actual (existing) and Ideal (desirable) distance range

Table 5 Distance from residence to workplace

Distance from residence to work place	Respondents (%)
<500 m	1
500 m to 1 km	11
1 km to 3 km	7
3 km to 10 km	35
>10 km	46

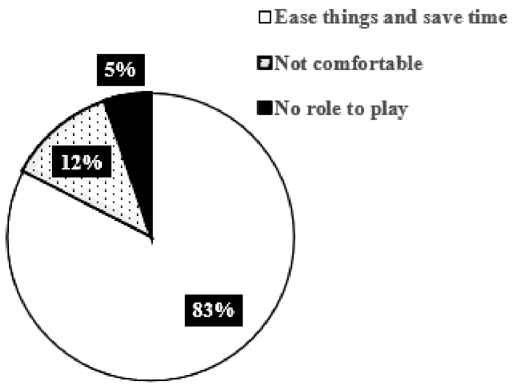

Fig. 8 Role of App in public transport

5.1.8 Safety factor

Regarding Pedestrian Accidents during walking, it is observed that 57.51% of respondents have never met with an accident, 35.22% rarely meet with accidents and 7.25% were prone to accidents frequently. Which implies that walking space for people is safe to a considerable extent. But the walking spaces should be made safer and comfortable by providing suitable pedestrian facilities.

5.2 Analysis of bicycle facilities

Bicycling and walking functionally are not different from other modes of transportation. The identical basic assumptions may be carried out to bicycling and pedestrians which permit planners to expect the final results of delivery choices for different modes. To arrive at the Level of Service for NMT, Bicycle Compatibility Index (BCI) is to be calculated which gives an overall view of the road and cyclists' condition.

The calculated BCI value by using Eq. (1) for the present wards is 6.11. BCI_{min} is taken as 3.42 by assuming ideal road conditions whereas BCI_{max} is taken as 9.97 by assuming unfavourable road conditions. The calculated class interval size is 1.06. Therefore, computing table for LOS with 1.09 as class interval is given in Table 6. The calculated BCI value lies in the LOS C range.

From the survey and analysis, it can be concluded that based on human perceptions the compatibility of the surveyed region was "moderately high" for bicyclists lying

Table 6 LOS according to BCI

LOS	BCI Range	Compatibility
A	4.51–3.42	Extremely High
B	5.60–4.51	Very High
C	**6.69–5.60**	**Moderately High**
D	7.78–6.69	Moderately Low
E	8.87–7.78	Very Low
F	9.97–8.87	Extremely Low

in the LOS C range. Further, the LOS can be improved to LOS A i.e. extremely high compatibility by implementing the following changes:

- Introducing specific bicycle lanes in and around the region to achieve higher levels of satisfaction during utilitarian cycling.
- Introducing traffic lights at the intersection to achieve higher levels of satisfaction concerning safety.
- Introducing street lights or some other source of light in the bus-stop region to achieve higher levels of satisfaction concerning visibility at night etc.

5.3 Analysis of public transport facilities (Bus stop coverage)

Bus stop coverage analysis was done by calculating the ISAI, ASAI and SCRI of the bus stops present in the study area and the calculated values are given in Table 7.

5.3.1 Results based on ISAI in the selected wards

From Table 7, it is concluded that ISAI is highest for

1. Pipeline Bus-stop, Vijayanagar
2. Kalyananagara, Moodalapalya, New Baldwin Public School
3. Chandra Layout 14th Cross, Chandra Layout
4. Govindaraj Nagara.

Table 7 ISAI, ASAI and SCRI of the Bus-stops in the study area

Bus-stops	L_c km	A_c km	ISAI	L_p km	A_p km	ASAI	SCRI
Magadi Road Tollgate	17.7	0.8	22.5	10.0	0.7	14.0	0.9
Vijayanagara	25.2	0.8	32.1	25.6	0.8	33.9	1.0
Maruthi Mandira	19.4	0.8	24.7	19.7	0.8	23.8	1.1
Vijayanagara, Indraprastha Hotel	25.2	0.8	32.1	25.6	0.8	33.9	1.0
Saraswathi Nagara	25.6	0.8	32.6	29.4	0.9	34.6	1.1
Prashanthanagar	18.5	0.8	23.6	15.4	0.6	25.1	0.8
Marenahalli	28.1	0.8	35.8	25.4	0.7	36.3	0.9
Saraswathi Nagara	22.2	0.8	28.2	22.4	0.8	27.1	1.1
Vijayanagara TTMC	9.6	0.8	12.2	11.4	0.8	14.6	1.0
Gkw Layout	28.3	0.8	36.1	29.5	0.9	34.2	1.1
Vinayaka Layout	17.3	0.8	22.0	15.0	0.7	21.9	0.9
Bridge Nagarabhavi	15.0	0.8	19.1	13.1	0.7	19.4	0.9
Kalyananagara	30.3	0.8	38.6	25.0	0.6	39.5	0.8
Moodalapalya Circle	27.5	0.8	35.0	23.0	0.6	35.9	0.8
Priyadarshini Layout	25.2	0.8	32.0	24.6	0.7	33.8	0.9
Nagarabhavi Village	13.8	0.8	17.6	8.7	0.6	14.6	0.8
Gangondahalli Water Tank	12.6	0.8	16.0	23.0	1.3	18.4	1.6
Chandra Layout	24.7	0.8	31.4	30.3	1.0	31.5	1.2
Chandra Layout 1st Stage	19.1	0.8	24.3	23.6	1.1	21.3	1.4
Siddaganga School, Chandra Layout 1st Stage	24.9	0.8	31.7	30.3	1.0	31.4	1.2
Jyothi Nagara 6th Cross	21.5	0.8	27.4	13.9	0.6	23.3	0.8
Chandra Layout 14th Cross	28.3	0.8	36.1	29.5	0.9	34.2	1.1
Chandra Layout in Front Of Guru Sagar	14.4	0.8	18.4	11.8	0.8	14.2	1.1
Nagarabhavi Village Opp. of Bake Land Bakery	14.1	0.8	17.9	17.1	0.7	23.5	0.9
Iti Layout	10.7	0.8	13.6	4.6	0.4	10.6	0.5
Magadi Road Dasarahalli	11.7	0.8	14.9	28.1	1.2	23.5	1.5
Khb Colony	11.7	0.8	14.9	9.5	0.8	12.0	1.0
Govindaraj Nagara	28.2	0.8	35.9	24.1	0.7	35.6	0.9
Manuvana	16.3	0.8	20.8	14.9	0.9	17.2	1.1
Pipeline Bus-Stop	30.4	0.8	38.7	27.9	0.7	39.0	0.9
Pipeline Binni Bus-Stop	28.0	0.8	35.7	16.7	0.4	37.8	0.6

ISAI is the lowest for
1. Vijayanagara TTMC
2. ITI Layout, Nagarbhavi
3. Magadi Road Dasarahalli
4. KHB Colony
5. Gangondahalli Water Tank, Gangadhara-Halli.

The accessibility and infrastructure facilities have to provide for the respective bus stops based on ranks from higher to lower. Here, Pipeline Bus-stop has the highest accessibility to the bus stop whereas Vijayanagara TTMC has the lowest value indicating poor accessibility.

The bus stops with higher ISAI can be provided with good pedestrian facilities to attract more pedestrians. Good infrastructure such as shelter, parking etc, can attract NMT users and private vehicle users to sustainable public transport, thus creating efficient integration of networks.

The bus stops in order of lowest ISAI can be made more accessible to the public by either creating transit stops or providing end mile transport i.e feeder transport arranged by the government.

5.3.2 Results based on ASAI in the selected wards

From Table 7, it is concluded that ASAI is highest for
1. Kalyananagara bus stop
2. Pipeline Bus-stop
3. Pipeline Binni Bus-stop
4. Marenahalli, Vijayanagara.

ASAI is the lowest for
1. ITI Layout
2. KHB Colony
3. Magadi Road Tollgate
4. Chandra Layout
5. Vijayanagara TTMC.

Here Kalyananagara bus stop has the highest accessibility whereas ITI Layout has the lowest value indicating poor accessibility.The integration solutions remain the same as mentioned above in the case of ISAI.

5.3.3 Results based on SCRI in the selected wards

The SCRI is the highest for Gangondahalli Water Tank, Gangadhara Halli, but this value is lower than ASAI and ISAI. The area buffer for this bus stop is more, but the number of networks to reach the bus stop is small, hence it has to be considered under the lower coverage scoring zone only, similarly to other cases of bus network scoring greater than one. Considering the results of ISAI, ASAI and SCRI, Kalyan nagar bus stop is said to have good accessibility and ITI layout has the lowest rating.

6 Conclusions and limitations

The following conclusions were drawn from this study:
- Based on human perceptions, the calculated BCI value of the study area is 6.11. According to BCI Value, the study area belongs to LOS C i.e moderately high for bicyclists. This LOS can be improved by introducing specific bicycle lanes and traffic lights in and around the study area.
- The bus-stop coverage analysis was done based on ISAI, ASAI and SCRI. Based on these results as a summary Kalyan nagar bus stop is said to have good accessibility and ITI layout has the lowest rating. The lowest index indicates a lesser pedestrian connectivity network hence end-mile accessibility has to be strengthened.
- For End mile transport, if feeder facilities are sponsored by the government, 74% of people are willing to shift to PT. From Vijayanagar to Pattergarpalya, GKW Layout and other similar areas mostly cars are used, hence integrated pricing system and availability of end mile at a reasonable cost would encourage the shift towards PT.
- From public opinion survey, it is observed that 61% of respondents believe that existing COVID situations has encouraged people to use non-motorised transport modes. This existing psychological motivation has to be empowered with improvement of various non-motorised infrastructure facilities for the development of sustainable transport models.

These are the limitations and future scope:
- The project proposes an area-specific solution model, and in that sense is spatially limited and hence does not yield a macro sustainable integration model.
- The context within which the survey was conducted, during the pandemic, limited the scope of the study in terms of accessibility to research subjects, government reports, etc.
- Network analysis based on elevation can be carried out to decide the allocations for infrastructures for Public Transport
- Even after the pandemic, we will continue to live in the post-corona world. The study is thus early in the field to offer insights into how the pandemic has effected transportation behaviour.

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