Urban Studies and Public Administration
Vol. 3, No. 3, 2020
www.scholink.org/ojs/index.php/uspa
ISSN 2576-1986 (Print) ISSN 2576-1994 (Online)

Original Paper

Reviving the Urban Core: Ludhiana City, Punjab, India

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Received: May 27, 2020 Accepted: June 6, 2020 Online Published: June 18, 2020

doi:10.22158/uspa.v3n3p1 URL: http://dx.doi.org/10.22158/uspa.v3n3p1

Abstract

The urban cores are considered as the most crucial clusters of the contemporary urban cities as they are the foremost economic growth poles that cater to the needs of the city population. These clusters are facing urban development issues like congestion, longer travel distances and time, pollution, etc., hence, transforming into a non-livable environment. Smart development has been identified as a world-wide solution to the existing urban development issues which focuses on promoting a sustainable and livable environment with the integration of ICT; acts as an implementation tool. Ludhiana; regarded as the Manchester of India, is the most industrialized city of the northern India. The city has a strong economic base due to the presence of commercial hub and small and large manufacturing industries which have acted as a catalyst for rapid urbanization. The city has witnessed immense population growth over the last 5 decades which has led to issues such as pollution, environment degradation,, emergence of slums and failure of physical and social infrastructure; thus failing to be a livable city. The paper intends to identify the urban development issues in Ludhiana city core and provide appropriate strategies based on the Smart Development principles.

Keywords

urban core, deteriorating environment, revitalization, smart development

1. Introduction

Ludhiana city, one of the largest metropolitan city of the state Punjab (India) is situated on the south banks of the river Satluj and is the largest city in the state. The municipal city is spread over an area of 159.37 sqkm accommodating a population of 1.6 million. The city has witnessed immense growth in the last few decades due to rapid industrialization. Commonly, the city is referred as the “Manchester of India”, “Hub of the Indian Hosiery Industry”, and “Industrial capital of Small Scale Industries” in India as the city is famous for its manufacturing based industries that produce hosiery goods, woolen

garments and leather items. Also, over the years the city has witnessed growth of motor parts industries which are exported across the country.

The above phenomenon on one hand has facilitated the economic growth but on the other hand has a lot of negative implications on the city. The city is witnessing a high rate of urban sprawl due to the polluted environment caused by the small and heavy industries located within the city; all the waste generated from these industries are disposed into the Buddha River. Only about 1.32% of the city area is utilized for recreational purpose which is far below the Indian city standards for open areas. Also, over the years, there has been an immense growth of slums all around the city (around 209 slums with 15% of the total population). The city also faces issues related to physical infrastructure in terms of water supply (degraded quality), sewerage (coverage and disposal management), drainage (coverage) and solid waste management.

The majorly affected regions within the city as per the various government and private stakeholders are Ludhiana City Core, Jawahar Nagar, Sarabha Nagar, Ghumar Mandi, Janta Nagar and Focal Point (Industrial Area). Though these locations have similar density development pattern which is towards the higher side as compared to other parts but each has its own unique character associated with them like Ludhiana City Core is dominated by mix land-use, Jawahar Nagar witnesses urban issues due to the presence of ISBT (Inter State Bus Terminal), Janta Nagar has a predominant industrial and residential land-use etc. For this particular paper Ludhiana Core has been chosen as the study area on the basis of secondary data and city pilot study where it was evident that the region experiences major share of the urban development issues.

Figure 1. Affected Regions in Ludhiana City as Per the Secondary Data and City Pilot Study

(1: Ludhiana City Core, 2: Jawahar Nagar, 3: Sarabha Nagar, 4: Ghumar Mandi, 5: Janta Nagar. 6: Focal Point)

Ludhiana City Core, the earliest settlement of the city situated at the banks of Buddha River (gradually converted into a Nala) is the center of commercial activities attracting tourists not only from the neighboring cities but from across the country. The core is famous for whole sale markets of hosiery goods, jewelry, woolen goods, etc., which are locally manufactured and are sold at very cheap rates. Some of the famous markets of the city core that pronounces the core as the economic center of the city are Chaura Bazaar, Wool Bazaar, Sarafan Bazaar and Books Market. Over the years, with such strong economic base, the city core has transformed into a high density region and with addition to narrow roads and heavy vehicular traffic, the core witnesses a lot of traffic congestion at various locations throughout the day. Also, it has been observed that the physical infrastructure within the core is either degraded or is unable to meet the present demand of the residing population.

2. Objective of the Study

The paper intend to identify the urban development issues of the Ludhiana city core and based on the findings, provide appropriate development strategies to improve the quality of life within the core; strategies to be formulated will be based on the concept of Smart Development.

3. Data Collection

Due to non-availability of secondary data to understand the existing scenario of the city core, primary data collection and analysis was opted. The intent of the primary analysis was to, firstly; identify the urban development issues related to livability in the city core and secondly, understand people's interpretation of the concept, i.e., smart development. The solutions to these would aid in adopting appropriate smart development strategies which are indigenous to the context.

3.1 Approach Adopted

The approach adopted to carry out the surveys as intended consists of four methods:

Reconnaissance Survey: method was utilized towards understanding the urban profile of the city core and identify existing urban development issues.

Land Activity Mapping: method was utilized to capture the prevailing land-use based activities occurring with the city core through well-structured inventories.

Open Ended Interviews with Government and Private Professionals: undertaken to identify existing urban issues that need to be paid foremost attention.

Schedules: undertaken for the purpose of surveying the local and working population of the city core to understand the urban development issues from their perspective.

3.2 Data Sampling

The data sampling approach was purely based on the characteristics of the different zones in the city core. Sectors with different land-uses, commercial activities, road characteristics, etc., were some of the criteria of locating the samples in the different sectors. The total number of samples surveyed were 124, out of which 10 were tourists, 40 were the working force and 75 were residents in the study area.

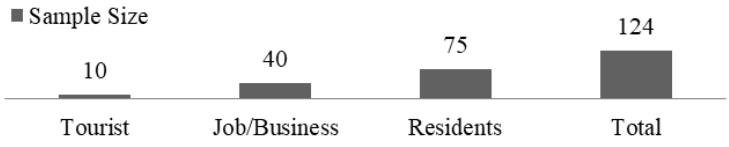

Figure 2. Types and Numbers of Samples for the Primary Surveys in the Study Area

Also, the samples were chosen on the bases of land-use; evidently as the core is dominated by mixed-use character, maximum samples were taken from the same category, followed by commercial and then residential.

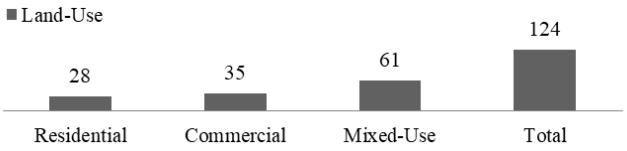

Figure 3. Samples Based on Land-use within the Study Area

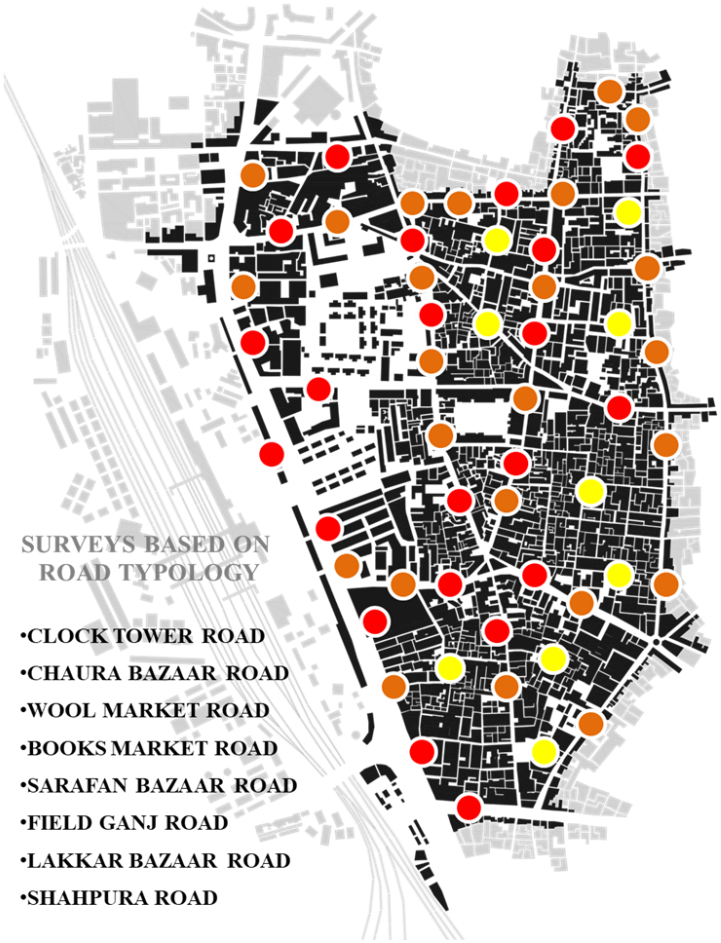

Figure 4. Locations Where Samples Were Surveyed within the Study Area

3.3 Schedules

Specific schedules were prepared for the primary survey in order to understand the urban development issues from the local population's perspective; as to promote public participation in the planning process. To achieve the above mentioned goal, 2 schedules were prepared with different concepts.

The first schedule aimed at collecting data related to the individual sample that consisted Locational Data, Respondent Data and Pre-Conditions & Preferences. Locational data was about the location where the survey was conducted like the ward number, locality, road and the land-use. Respondent data consisted of household, economic and travel characteristics; and Pre-condition & Preferences were related to identification of urban development issues and prioritization of these issues based on the perspective of the local population.

The second schedule aimed at understanding the concept of smart development with local population's perspective. The schedule consisted of three major dimensions; Perception, Sustainability Scoring and Smart Development Sectoral Scoring. The Perception dimension focused on understanding whether smart development is perceived as Effective which is result based, Efficient which is performance based, Equitable which is in reach of everyone or Rational which based on return policy. Sustainability Scoring dimension focused on understanding the local population's understanding of sustainability dimensions among Environment, Economy and Equity. And, Smart Development Sectoral Scoring dimension focused on identifying smart development strategies which are to be adopted specifically for the respective sectors.

4. Study Area Profile

4.1 Introduction

The oldest settlement of the metropolitan city Ludhiana that originated at the banks of Budha River (now, Budha Nala) expanded to the west and south direction due to occurrence of natural barriers like river on the north and west and the natural slope towards east. As the city was spatially growing towards the west direction, the foundation of the Ludhiana Railway Junction was laid on the immediate side, hindering the further growth of the city towards that direction. Further, establishment of the railway junction laid the foundation of a new planned residential colony for the railway staff, known as G.T. Colony.

The buffer among the two zones was the G.T. Road that connected the city to Delhi in the south and Amritsar in the north. Over the years, the road witnessed a high rise in through traffic towards Ambala and Amritsar, leading to construction of an elevated road corridor of about 3 km for the through traffic. Chaura Bazaar (also known as the Old Ludhiana) and Dal Bazaar are the oldest settlements of the city. Both the bazaars became the economic growth poles for the city as their growth was supplemented by the railway junction.

Due to this accelerated growth, new settlements came up like Naya Mohala, Karimpura, Field Ganj, Islam Ganj, etc., expanding the city to the south direction. Residential land-use with commercial and

industrial activities had facilitated a live-work culture; people living in surrounding neighborhoods like Gandhi Nagar, Madhopuri, Prem Nagar, Harbanspura, etc., generally seeked employment in the commercial or manufacturing activities in the core.

4.2 Major Nodes and Sectors

The study area consists of various nodes and sectors that have emerged over the time. Various sectors like Chaura Bazaar, Dal Bazaar and Karimpura are the commercial dominated sectors whereas G.T. Colony and Naya Mohala are residential denominated sectors. Commercial activities taking place in these sectors mainly consists of clothing retail shops, restaurants, offices, hotels, guestrooms, etc. Chaura Bazaar is famous for hosiery retail shops, eatery joints and religious and institutional nodes.

Though Dal Bazaar is famous for similar activities but has a specific market for jewelry and cosmetics. Karimpura has seen growth of hotels and guestrooms with mechanic shops along all the major roads. In some of these sectors major identified nodes are Ludhiana Railway Junction (Utility), MCL Office (Municipal Corporation of Ludhiana) (Utility) and Government Senior Secondary School (Institutional) in Chaura Bazaar and Raikhy Cinema (Commercial) in Karimpura. Government School (Institutional) in Chaura Bazaar constitutes a considerable amount of open and built land area in the respective zone.

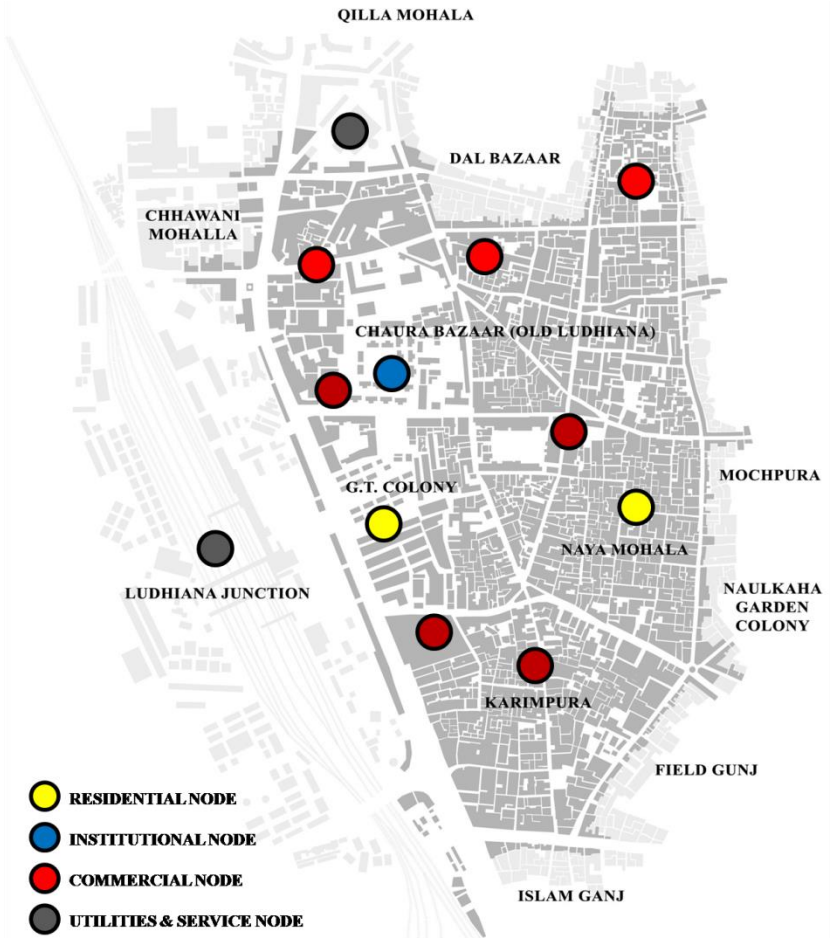

Figure 5. Major Nodes and Sectors in the Study Area

4.3 Administrative Division

The area identified for the study lies between the following roads; G.T. Road (Clock Tower Road) on the west, Field Ganj on the south, Wool Market on the east and Chaura Bazaar on the north side. The study area is about 67 hectares with population over 14,000 (2011). The population density is about 210 person per hectare. Administratively, the zone lies in the wards, i.e., 35 (48.9% area of total ward), 36 (66.9% area of total ward) and 37 (16.4% area of total ward).

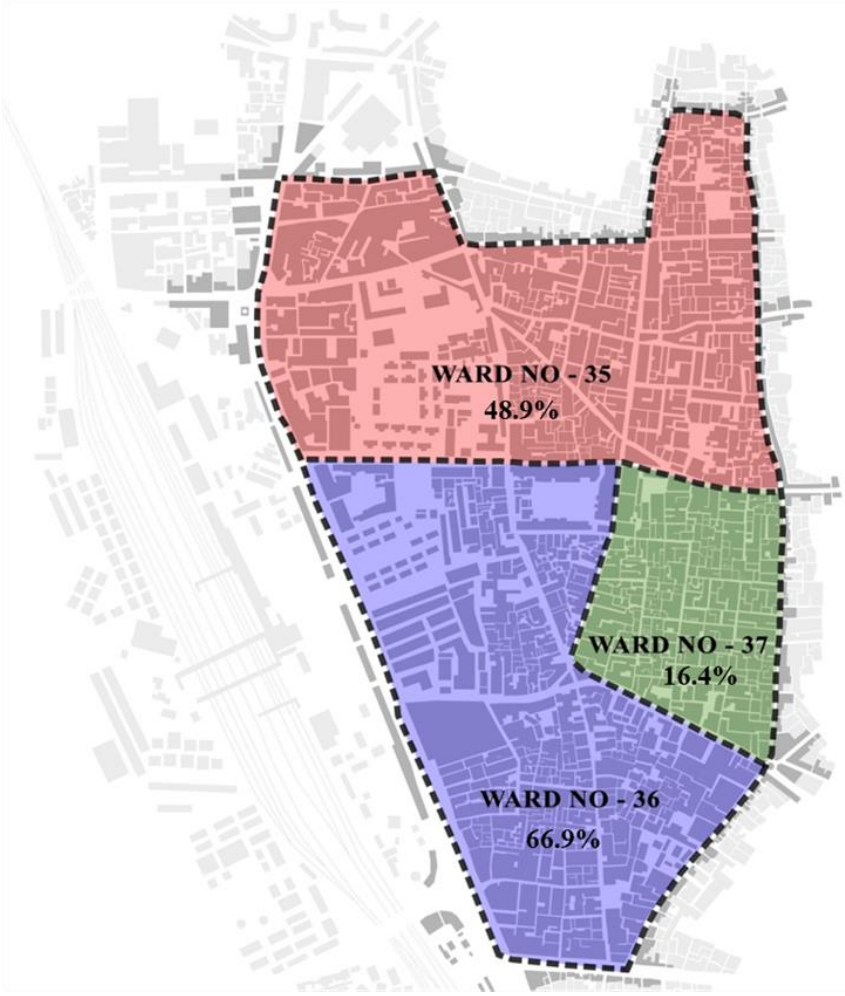

Figure 6. Administrative Division of the Identified Study Area

4.4 Activity Pattern

As no such specific land-use map has been prepared for the identified study area by the urban local authorities (the zone has been declared as mixed commercial land-use), land-use activity mapping was conducted. The intention was to locate the different typology of activities performed in the study area that influence the urban development pattern. The exercise included demarcation of land-use activity for each plot in the sectors on the understanding of reconnaissance survey.

The study area is dominated by mixed land-use character where commercial, institutional and small scale industries are part of the residential land-use. The economic growth of the population is due to this transition from residential to mixed-use character. It was evident from the survey that all the major road edges are dominated by commercial activities, i.e., retail shops, restaurants, hotels, etc.

The Ludhiana Junction on the west direction has accelerated the development of hotels and restaurants on the Clock Tower Road and Karimpura Road; being adjacent to the junction. Even a commercial mall has been constructed on the same road for leisure activities for the visiting and local population. A general trend was identified for the city core, where all the edges of the sectors are either of mixed character or of commercial use, whereas the inner part of the sectors are residential.

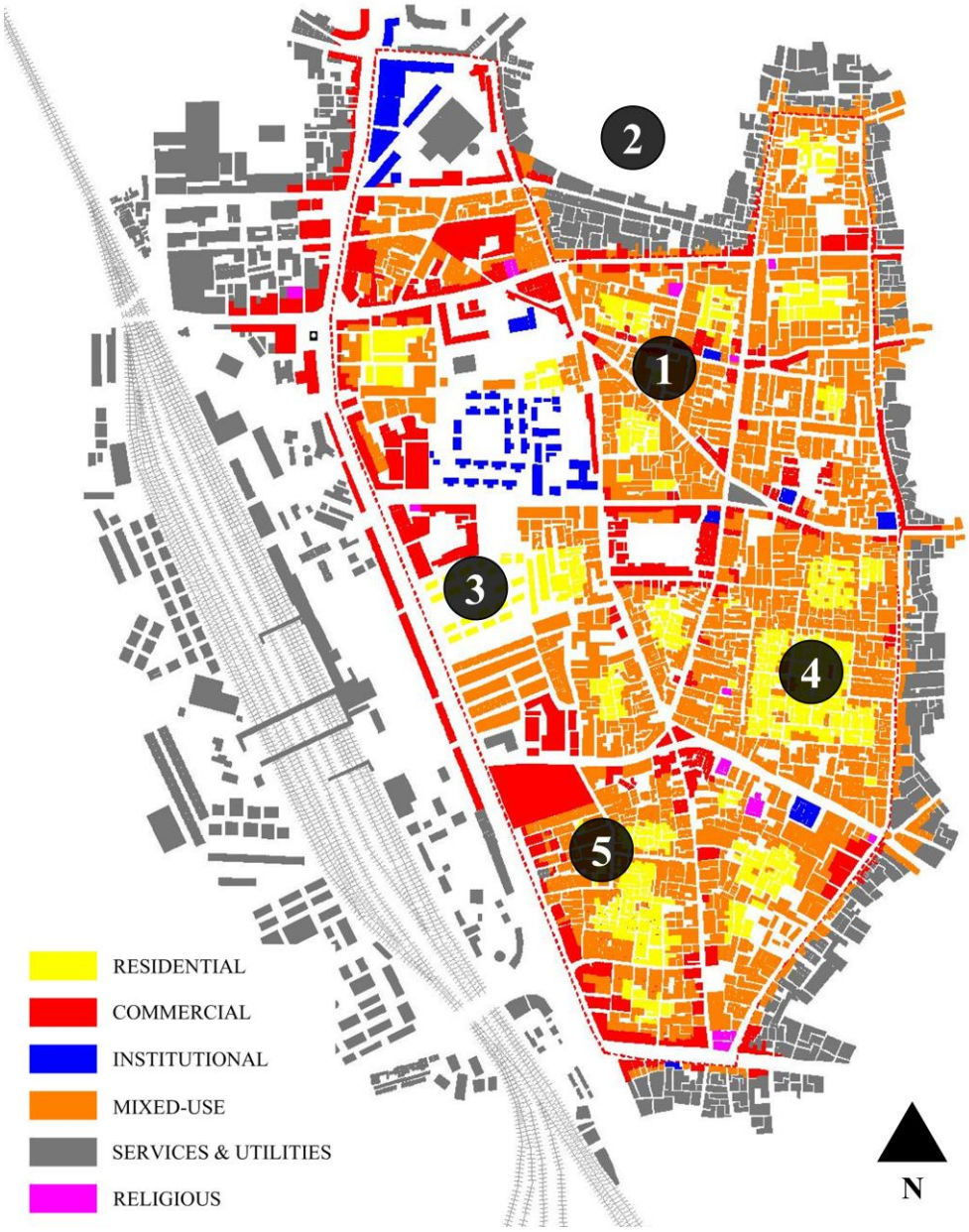

Figure 7. Activity Pattern Based on Land-Use in the Study Area

1). Chaura Bazaar: The sector has seen maximum growth in the amount of mixed use development over the years. All the roads at the edges has commercial based activities whereas the inner regions are dominated by mixed land-use. The sector also consists of a major institutional node, i.e., Government Secondary School that serves as an open space to the sector. Some traces of small schools and religious nodes have also been identified. The sector is generally congested throughout the day due to high density footfall in the narrow lanes of the sector.

2). Dal Bazaar: The bazaar has similar characteristics as the Chaura Bazaar, where the road edges are of commercial character whereas the rest is of mixed land-use. Due to existence of narrow streets with high density development has resulted in traffic congestion and does not promote a pedestrian friendly environment.

3). G.T. Colony: A planned residential colony (owned by the Indian Railways) for the railway staff has not much changed over the years; though this sector has attracted people from nearby areas in search for household related job opportunities.

4). Naya Mohalla: It was originally a residential sector that came up due to the organic expansion of the city core. Soon to improve the socio-economic profile, the population started to transform their houses into commercial land-use. It is evident that the sector has a mixed land-use character at the periphery and still has pure residential land-use at the core of the sector. The conversion could not take place at the center due to congested access lanes.

5). Karimpura: The extended part of the city core has witnessed growth of number of hotels and guest houses at the road edges. Also, the zone is dominated by commercial activities related to mechanic workshops and retail outlets. Similar to the other sectors, the center of the section has residential character whereas the periphery has mixed and commercial land-use.

4.5 Road Network

The road network can be regarded as a grid based pattern with north-south and east-west axis. The road hierarchy ranges from 1-3 m in the dense residential sectors to 9-12 m along the commercial road edges. Clock Tower Road, the western edge of the study area is the major road providing city connectivity with RoW of 35-50 m, whereas Chaura Bazaar Road, Gokal Road, Brown Road and Field Ganj Road are the Collector Roads carrying the local traffic. Roads ranging from 1-3 m provide accessibility to the residential units located inside the neighborhoods.

Figure 8. Photographs of the Road Network Hierarchy within the Study Area

About 10 major roads serve in regulating the traffic. As discussed the layout of the road network is based on north-south and west-east axis; north to south axis are Clock Tower Road, Lakkar Road, Sarafan Bazaar Road, Lalu Mal Street, Wool Market Road and Shahpura Road; and the east to west axis are Chaura Bazaar Road, Gokal Road, Brown Road and Field Ganj Road.

Table 1. Road Network Hierarchy within the Study Area

No.	Road	Axis	Typology	RoW (m)
1	Clock Tower Road	North-South	Sub-Arterial	35-50
2	Lakkar Road	North-South	Collector	15-18
3	Sarafan Bazaar Road	North-South	Local	9-12
4	Lalu Mal Street	North-South	Local	9-12
5	Wool Market Road	North-South	Local	12-15
6	Shahpura Road	North-South	Collector	9-12
7	Chaura Bazaar Road	West-East	Collector	9-12
8	Gokal Road	West-East	Collector	12-15
9	Brown Road	West-East	Collector	12-15
10	Field Ganj Road	West-East	Collector	18-24

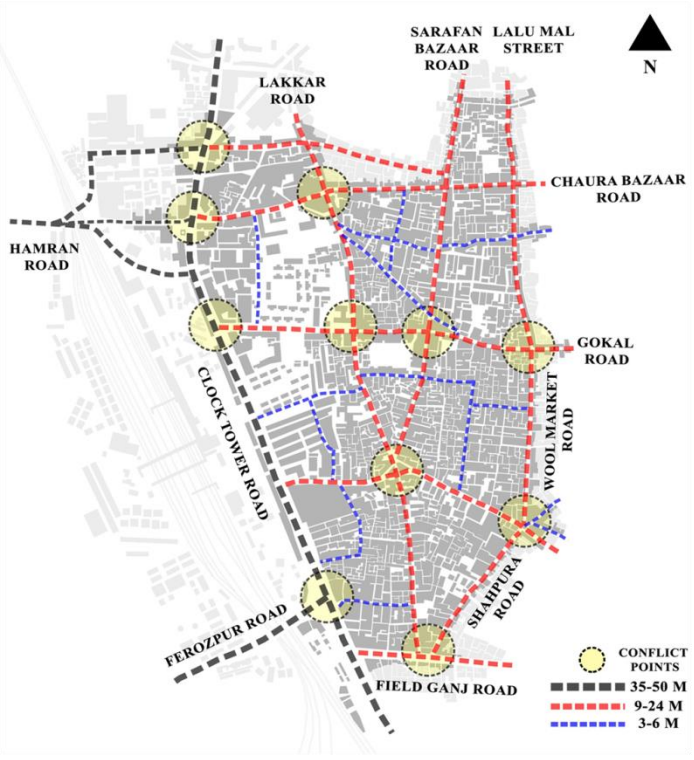

Figure 9. Road network within the study area

All the major roads within the study area i.e. collector roads, intersect at 12 different locations and are dominated by commercial activities. Almost all the junctions witness congestion as they are incapable to handle the present traffic flow.

Table 2. Major Road Intersections within the Study Area

No.	Intersection	Interesting Roads
1	Mata Rani Chowk	Clock Tower Road & Mata Rani Road
2	Raikhy Cinema Chowk	Clock Tower Road &d Gokal Road
3	Meena Bazaar Road	Lakkar Road & Mata Rani Road
4	Girha Ghar Chowk	Lakkar Road & Chaura Bazaar Road
5	Kesarganj Chowk	Lakkar Road & Raikhy Cinema Road
6	Lakkar Bazaar Chowk	Lakkar Road & Brown Road
7	Sarban Bazaar Road	Sarafan Road & Chaura Bazaar Road
8	Doctor Kalicharan Chowk	Lalu Mal Street & Chaura Bazaar Road
9	Maleri Chowk	Lalu Mal Street & Talab Mandir Road
10	Dal Bazaar Chowk	Wool Market Road & Gokal Road
11	Subhani Building Chowk	Wool Market Road, Brown Road & Shahpura Road
12	CMC Chowk	Shahpura Road & Field Ganj Road

4.6 Traffic and Transportation

Being the economic hub to the city and in vicinity to Ludhiana Railway Junction has resulted in heavy traffic movement in and around the study area. The study area witnesses all types of transport modes from auto-rickshaws to cargo trucks. The heavy amount of vehicular traffic hinders the pedestrian movement and also due to lack of adequate road infrastructure, the condition is worsening.

In order to understand the existing traffic movement around the city core, the roads were divided in various categories, i.e., Public Bus Routes and Mixed Traffic, Mixed Traffic, Pedestrian dominated Mixed Traffic and Residence approaching roads; mixed traffic has been categorized as all private vehicles ranging from cycles to cargo vehicles.

Table 3. Traffic Typology within and around the Study Area

No.	Intersection	Interesting Roads
1	Clock Tower Road	Public Bus Routes and Mixed Traffic
2	Hamran Road	Public Bus Routes and Mixed Traffic
3	Ferozpur Road	Public Bus Routes and Mixed Traffic
4	Chaura Bazaar	Pedestrian Dominated Mixed Traffic
5	Gokal Road	Pedestrian Dominated Mixed Traffic
6	Brown Road	Mixed Traffic
7	Field Ganj Road	Mixed Traffic
8	Lakkar Road	Mixed Traffic
9	Sarafan Bazaar Road	Pedestrian Dominated Mixed Traffic
10	Wool Market Road	Pedestrian Dominated Mixed Traffic
11	Lalu Mal Street	Pedestrian Dominated Mixed Traffic
12	Iqbal Road	Pedestrian Dominated Mixed Traffic

The traffic composition of the city core is dominated by two-wheelers, followed by cars and pedestrian in the existing narrow roads, resulting in traffic congestion. Even, cargo vehicles contribute to the

above problem. IPT is the mode choice of the tourists approaching the study area, whereas public transport is chosen by the working population traveling from other parts of the city.

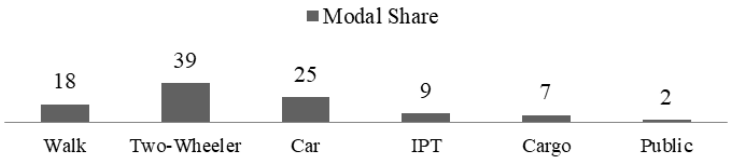

Figure 10. Modal Share within the Study Area

Figure 11. Photographs Showing the Modal Share within the Study Area

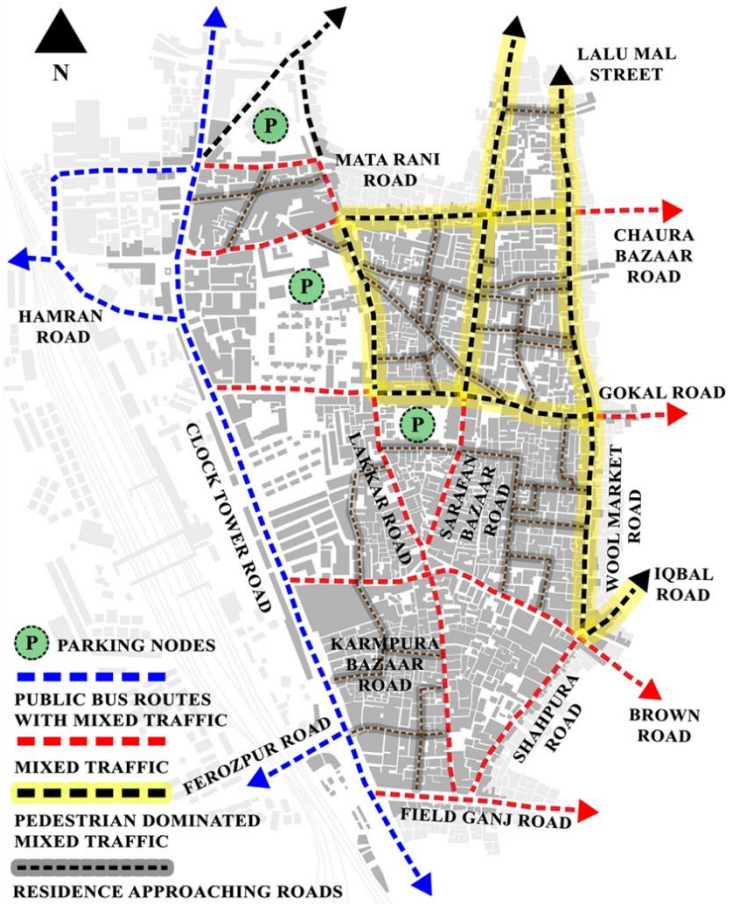

Figure 12. Traffic and Transportation Management in the Study Area

Parking is a major issue prevailing in the study area. With major share of parking on the streets, roads are insufficient to handle the present traffic demand. Currently, the off-street parking demand is catered by 3 parking spots; multi-level parking near LMC (it is in deteriorating condition due to low maintenance), paid informal parking area at the Chaura Bazaar and on the Gokal Road. Though, some private plots have been converted into parking areas and charge on hourly basis, but are inadequate to handle the overall demand.

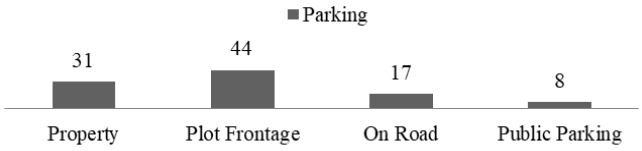

Figure 13. Parking Situation within the Study Area

Figure 14. Photographs Showing the Parking Situation in the Study Area

4.7 Road Sections vs Land Use vs Plot Size

Land-use and road widths are witnessed to be in direct relation to each other. The change in land-use is evident from the road width as more of commercial character is observed along the roads having RoW of 15-18 m; the commercial activities are retail shops, restaurants, hotels, guest houses, shopping complexes, etc. The roads having RoW of 9-12 m have a combination of commercial and mixed use land-use. And as the road width decreases, the transition in land-use is observed from mixed use to purely residential due to lack of accessibility. The roads with RoW 1-3 m have high density residential development.

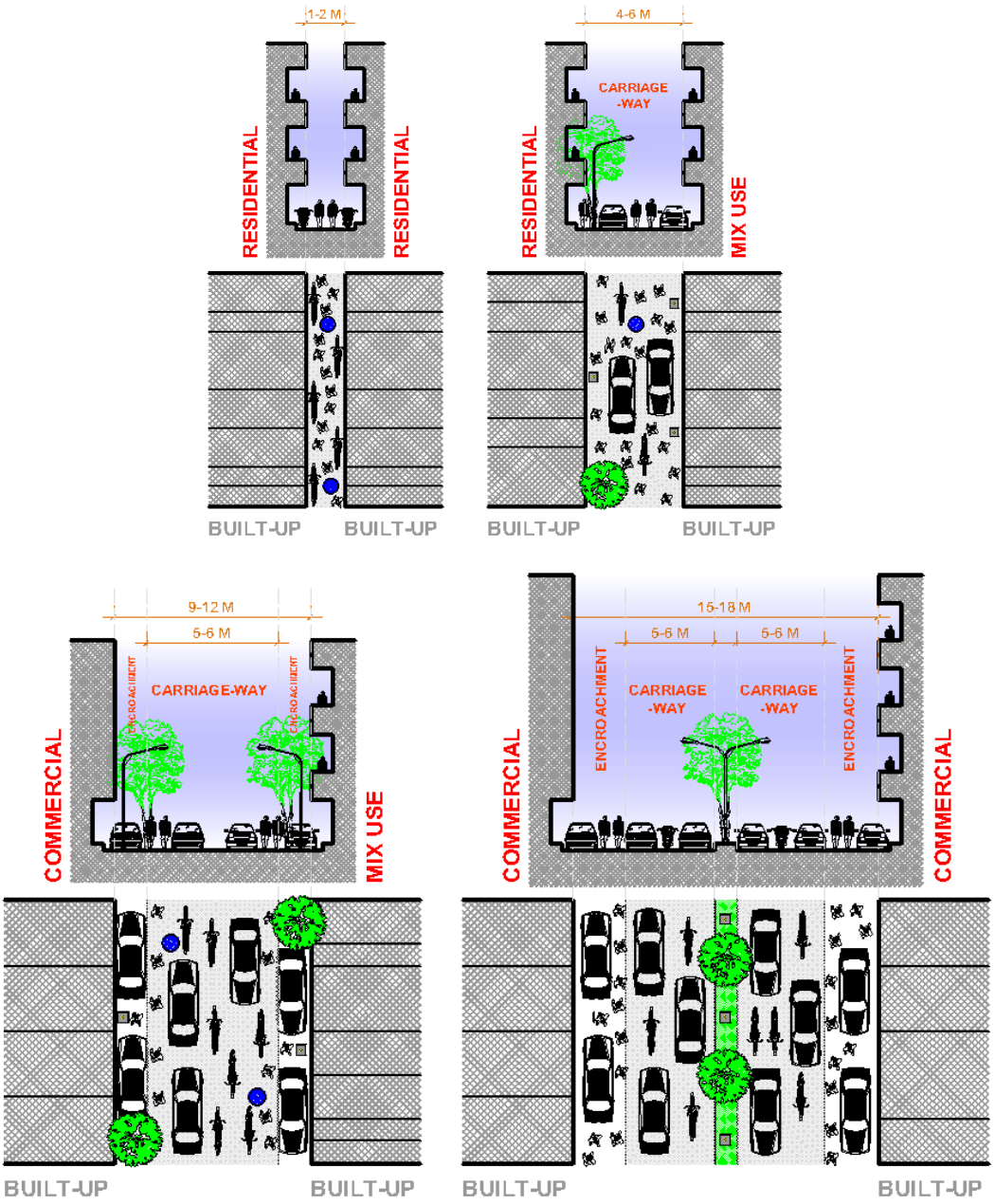

Figure 15. Road Sections with Relation to Land-Use and Plot Sizes within the Study Area

Entire core has organic development with high intensity of activities and heavily built up areas. Buildings are constructed on plots ranging from 30 to 300 sqm and ground coverage is homogeneous (close to 100%). They are constructed adjacent to each other, sharing walls and their heights vary from 3 to 6 floors. Another observation related to plot size and land-use is with the alignment; residential plots with variable sizes are not aligned whereas commercial plots with regular sizes are aligned.

4.8 Physical Infrastructure

The city core faces issues related to degrading physical infrastructure; though the demand and supply gap is of satisfactory nature. The operations and maintenance are under the supervision of MCL which includes water supply, sewerage disposal, storm water drainage and solid waste management.

Water Supply: The demand is fulfilled by the MCL by various tube wells and overhead tanks. Ground is the source of water supply. Due to degrading ground water quality (mixture of industrial waste that seep down the aquifer), there has been dissatisfaction among the residents. Also, there is a gap in demand and supply in some of the sectors.

Sewerage: **The waste is directed towards the STP's located along the stretch of Budha Nala, through underground pipes constructed and maintained by MCL. All the pipes have been laid beneath the road and not on footpaths; also manholes are generally on the carriage way. Due to clogged sewerage lines,** water gets collected on the roads

Drainage: No drainage network has been laid out till date, thus affecting the core at peak monsoons. The natural drainage slope is towards Budha Nala. Also, no water harvesting techniques has been adopted by the residents to conserve water and recharge the ground water levels.

Solid Waste: All the solid waste generated within the study area is collected and disposed of by MCL. Composition is dominated by waste based on textile and packaging. No segregation is done at the source level; conducted at disposal nodes.

Figure 16. Photographs of Physical Infrastructure Situation in the Study Area

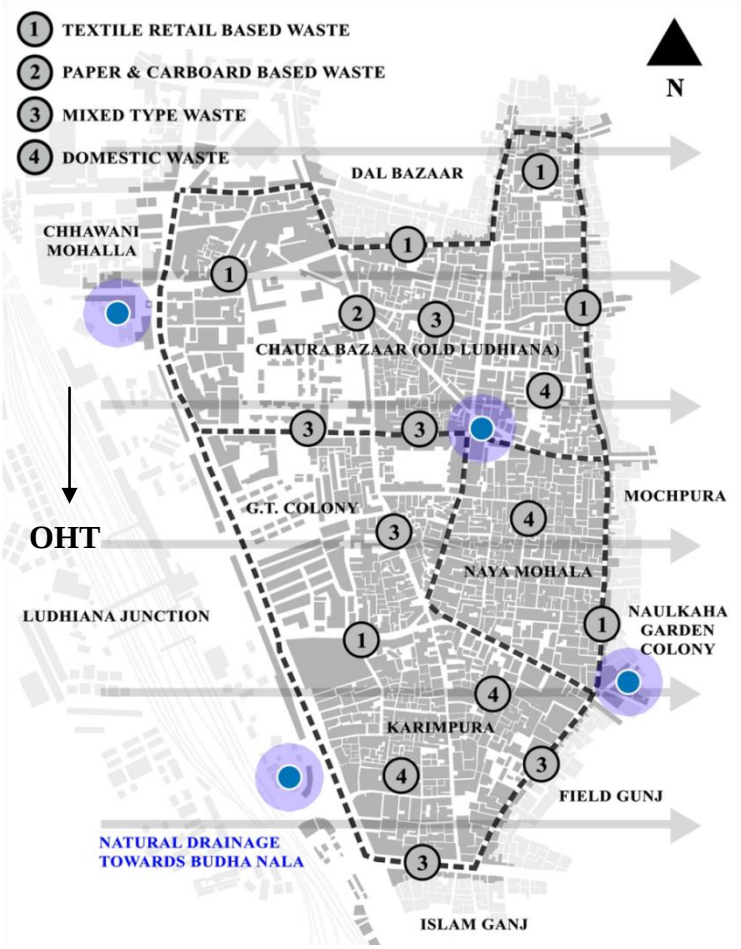

Figure 17. Physical Infrastructure Services within the Study Area

To understand the people's perception of the physical infrastructure scenario within the study area, survey was conducted through schedules where specific issues were identified. About 94% of the sample size has adequate supply of water, but the issues lies in the non-satisfaction of the residents towards the quality of water. Sewerage network is better off in terms of coverage and quality. Absence of storm drainage network promotes unhealthy living environment. Solid waste though collected and disposed by MCL, does not get segregated at the source.

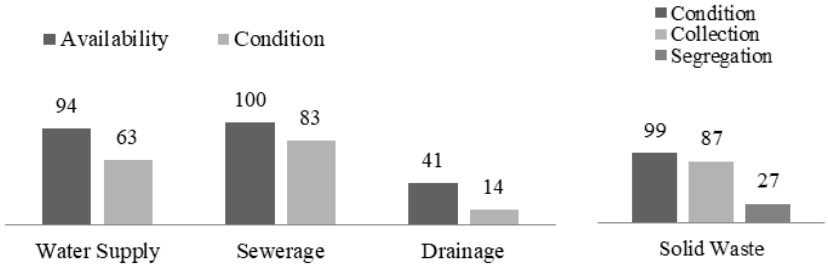

Figure 18. Local Population's Perception of Physical Infrastructure within the Study Area

4.9 Social Infrastructure

The study area has adequate facilities related to social infrastructure, though there are objections towards the quality. Degrading infrastructure is the major reason for the above issue; also the core lacks adequate open spaces for the residing population. The social infrastructure has been divided into Education, Healthcare, Utilities and Services and Religious Nodes. Another dimension to the study is walkability to these facilities with a distance of of 600 m.

Educational Facilities: The city core consists of 10 schools and 4 colleges providing education from primary to college level. 90% of the study area is within the walkable distance of these facilities.

Table 4. Educational Facilities within the Study Area

No.	Name	Education Level
1	Arya Senior Secondary School	Nursery to 10+2
2	Master Tara Singh Memorial School	Primary to Graduation
3	Government Senior Secondary School	Nursery to 10+2
4	Arya Girls Senior Secondary School	Primary to 10+2
5	S.D.P Senior Secondary School	Primary to 10+2
6	Jain Girls Senior Secondary School	Primary to 10+2
7	N.M. Jain High School	Primary to 10
8	Hotel Management College	Graduation
9	S.D. Girls Senior Secondary School	Primary to 10+2
10	Kalgidhar Khalsa Girls High School	Nursery to 10
11	Sikh Missionary College	Graduation
12	Sargodha Khalsa High School	Nursery to 10
13	Christian Medical College	Graduation

Healthcare Facilities: The Ludhiana core city consists of 7 nursing homes (4 within the study area) and 3 hospitals and 70% of the study area is within the walkable distance of these facilities.

Table 5. Medical Facilities within the Study Area

No.	Name	Type
1	Dr. B.L. Kapur Memorial Hospital	Hospital
2	Gurmail Medical Hall	Nursing Home
3	Shri Ratan Muni Jain Hospital	Nursing Home
4	Hora Hospital	Nursing Home
5	Malhotra Hospital	Nursing Home
6	CMC Hospital	Hospital
7	Civil Hospital	Hospital
8	Life Line Hospital	Nursing Home

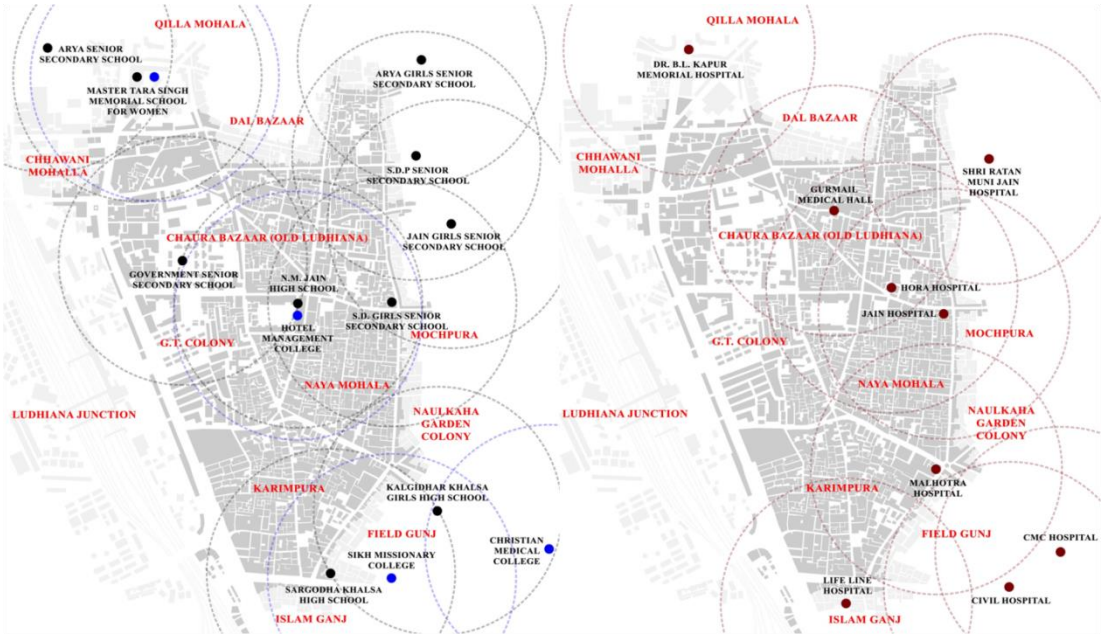

Figure 19. Educational and Healthcare Facilities within the Study Area

Utilities and Services: The study area has 3 police stations and a police post in the vicinity; one being located in the Chaura Bazaar flea market. Also, there are 4 post offices for the convenience of the residing population. Also, a fire station has been constructed on the Clock Tower Road, just adjacent to the Ludhiana Junction.

Table 6. Utilities within the Study Area

No.	Name	Number
1	Police Station	3
2	Police Post	1
3	Post Office	4
4	Fire Station	1

Religious Nodes: Study area is culturally rich and has a variety of religious nodes like Gurudwaras, Temples and Mosques.

Table 7. Religious Nodes within the Study Area

No.	Name	Number
1	Temple	10
2	Gurudwara	5
3	Mosque	1
4	Church	-

Urban Amenities Ratio: The adequacy of social infrastructure in an area can be evaluated using the urban amenities ratio, where the existing urban amenities are related to the city standards. The formula can be described as Number of Existing Amenities / Standard as per authorities. It is evident that all the social infrastructure facilities are in surplus, except open spaces, as currently all the recreational activities occur on the streets.

Table 8. Religious Nodes within the Study Area

No.	Name	As per URDPFI	Existing	Amenity Ratio
1	Senior Secondary School	1 / 75000	4	21
2	College	1 / 125000	1	8.9
3	Nursing Home	1 / 45000 - 100000	4	12.8
4	Hospital	1 / 100000	-	-
5	Post Office	1 / 50000	1	3.56
6	Police Station	1 / 90000	1	6.4
7	Fire Station	1 / 120000	1	14.24

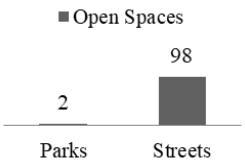

Figure 20. Open Spaces within the Study Area

4.10 Housing

The housing typology is dominated by mixed-use where over the years the residential units have gone through a transition from residential to commercial use. The ground floors are used for commercial purposes whereas the upper floors are used for residential uses.

Pattern of Use: Residential units in the study area are used as shops. Some residential units have also being converted into offices and workshops. Few guest houses are also been observed in the residential land-use. Few of the residential units are not in use and are kept vacant and are in deteriorated condition due to lack of maintenance.

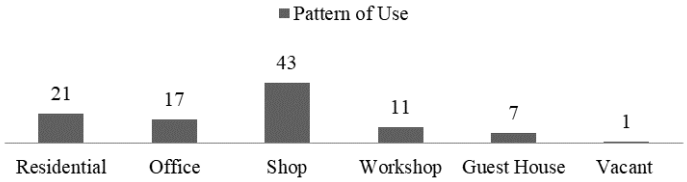

Figure 21. Pattern of Use of Housing Stock within the Study Area

Structure and Age: As observed, 98% of the total houses are pakka (permanent) in nature whereas 2% are kachaa (temporary) houses. These units are observed along the commercial sectors. Also, the average age of the housing units is about 21 years.

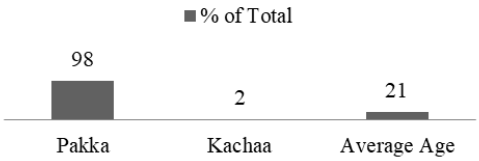

Figure 22. Structure Characteristics of the Housing Stock within the Study Area

Figure 23. Photographs of Housing Stock Situation in the Study Area

4.11 Heritage

Many old heritage buildings exist in the study area that are neglected by the users and are not maintained. These structures are more than 40 years old and are randomly distributed in the study area; maximum units have been identified in Chaura Bazaar and Dal Bazaar whereas some were found along the Wool Market Road, Lakkar Road and Brown Road.

Figure 24. Photographs of the Heritage Units in the Study Area

5. Road Based Identification of Issues

Based on reconnaissance and inventory surveys, urban development issues were identified along the major roads in the study area. This exercise provided an in-depth understanding of the issues. The roads taken up for the survey were Clock Tower Road (G.T. Road), Chaura Bazaar Road, Wool Market Road, Books Market Road, Lakkar Bazaar Road, Sarafan Bazaar Road, Brown Road and Gokal Road.

5.1 Clock Tower Road

The main access road to the city core which bifurcates the core and the Ludhiana Railway Junction. The road is divided into 2 levels; the elevated road is the Ambala-Jalandhar Road (G.T. Road) that carries the through traffic of the city and the lower one is the Clock Tower Road which provides accessibility to the study area and the railway junction. The establishment of the railway junction led to the rapid development of immediate areas, thus, presently, the road is dominated by high density commercial activities like retail shops, hotels, restaurants, etc., attracting both visitors and people around the city. The issues identified as per people's perception are mostly related to traffic congestion and lack of street services and utilities.

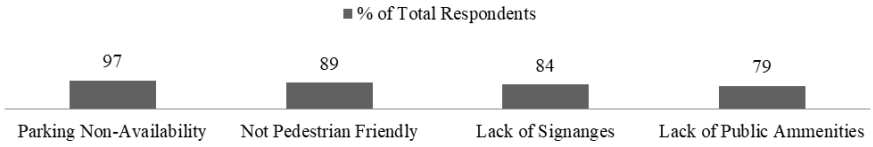

Figure 25. Identified Issues along Clock Tower Road Based on People's Perception

Figure 26. Pictures of Identified Issues along Clock Tower Road Based on People's Perception

5.2 Chaura Bazaar Road

One of the major east-west axis within the study area which acts as the backbone for the economic development of the region. The street witnesses mixed traffic, dominated by two-wheelers and pedestrians, creating traffic congestion at various nodes. The predominant land use is residential use with formal and informal commercial activities; ranging from textile, jewelry shops to restaurants and informal eateries. The major issues identified as per people's perception are mainly related to congestion, non-availability of parking spaces, not pedestrian friendly and lack of public amenities like toilets, information kiosks, etc.

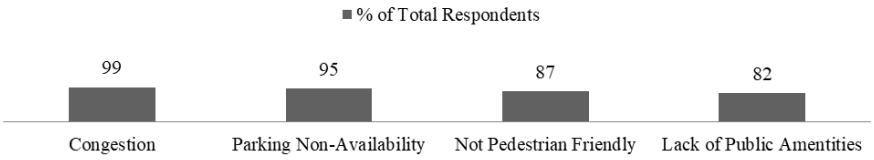

Figure 27. Identified Issues along Chaura Bazaar Road Based on People's Perception

Figure 28. Pictures of Identified Issues along Chaura Bazaar Road Based on People's Perception

5.3 Wool Market Road

Another major north-south axis within the study area which boosts the economic development of the region which is famous for woolen clothing retail shops. Narrow streets with on-street parking (two-wheelers) discourages pedestrian movement along the road. Predominant land use is commercial within the residential use; textile retail outlets dominate the commercial activities. The major issues identified are congestion, unhealthy street environment and lack of street services and utilities like footpaths, street lights, etc.

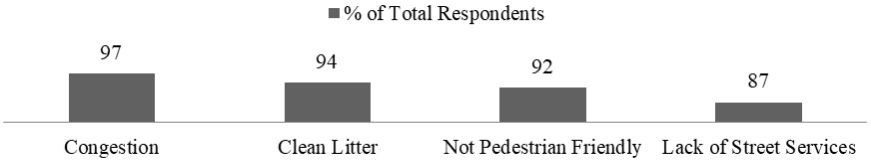

Figure 29. Identified Issues along Wool Market Road Based on People's Perception

Figure 30. Pictures of Identified Issues along Wool Market Road Based on People's Perception

5.4 Books Market Road

Road within the study area which is famous for books and stationery wholesale shops; often visited by students forming the primary footfall of the road, but is incapable to handle the present traffic demand. The predominant land use is formal and informal commercial activities within residential use. The deteriorating infrastructure services and utilities does not promote favorable environment in terms of safety. The major issue is of the packaging material and waste coming from these commercial activities which are not properly disposed off and thrown on the street creating an unhealthy environment.

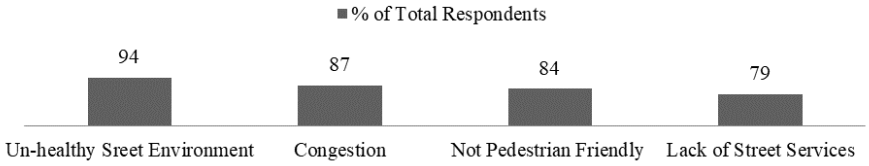

Figure 31. Identified Issues along Books Market Road Based on People's Perception

Figure 32. Pictures of Identified Issues along Books Market Road Based on People's Perception

5.5 Lakkar Bazaar Road

It is the north-south axis road which serves the major traffic flow within the study area. Its incapacity to handle present demand of activities is primarily due to encroachments, on-street parking, commercial shop spill overs, etc. The predominant land use is commercial within residential use; hardware and sewing machine shops dominate the commercial activities. The road has best in class road to building height ratio; providing an example of appropriate density development. The major issues identified are congestion, lack of public amenities, non-availability of parking and unhealthy street environment.

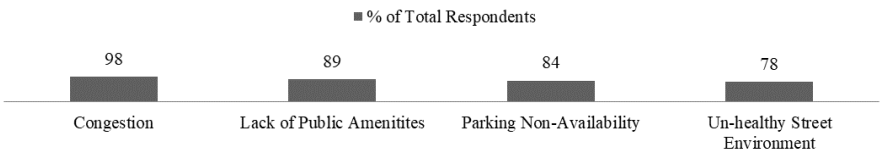

Figure 33. Identified Issues along Lakkar Bazaar Road Based on People's Perception

Figure 34. Pictures of Identified Issues along Lakkar Bazaar Road Based on People's Perception

5.6 Sarafan Bazaar Road

Another, north-south axis road that is dominated by pedestrians and two-wheelers traffic. The road is famous for woolen clothing retail shops witnessing heavy traffic, due to on-street parking, the street is congested in nature and is not able to handle the current traffic demand. The waste coming out from the commercial activities, i.e., packaging material is not disposed of and is thrown on to the streets. This practice makes the street unhygienic for the people residing here. The ground floor edges are commercial shops whereas the upper floors are dominated by residential units. Also, few commercial complexes have come up in between the residential units. The street lacks basic public amenities for the visiting people.

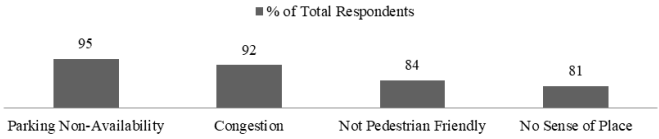

Figure 35. Identified Issues along Sarafan Bazaar Road Based on People's Perception

Figure 36. Pictures of Identified Issues along Sarafan Bazaar Road Based on People's Perception

5.7 Brown Road

East-west axis of the road hierarchy which carries through traffic from the Clock Tower Road towards the western located residential sectors in the study area. The road has a mixed character; from retail shops to hotels. The street towards the Clock Tower has more retail shops and as it passes through Karimpura, the transition is towards hotels and workshops. The plot sizes are much larger and planned as compared to Chaura and Dal Bazaar. Even the road width facilitates the traffic movement, but due to the informal commercial activities and on-street parking, there are huge amount of encroachments along the road.

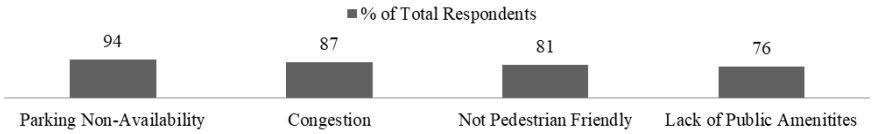

Figure 37. Identified Issues along Brown Road Based on People's Perception

Figure 38. Pictures of Identified Issues along Brown Road Based on People's Perception

5.8 Gokal Road

One of the gateways to the study area (other than Chaura Bazaar Road) which is also known as Raikhy Cinema Road due to existence of a very old cinema house. Recently a mall has been constructed on the opposite side of the road which attracts high footfall. The road is dominated by commercial activities within the residential units. The road also has the only public park which is situated at the junction of Gokal Road and Sarafan Bazaar Road.

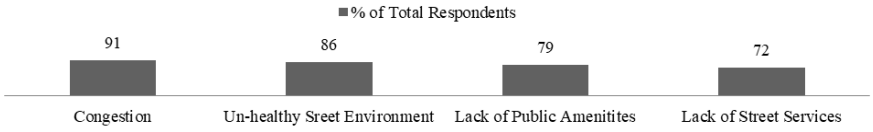

Figure 39. Identified Issues along Gokal Road Based on People's Perception

Figure 40. Pictures of Identified Issues along Gokal Road Based on People's Perception

6. Local Perception of Smart Development

The objective was to get an idea about smart development and its strategies in the city core through the perception of the local and visiting population. This also helped in understanding the priority of urban development issues that needs to be catered based on the response.

Firstly, the concept of smart development was understood, where, 82% and 73% of the respondents consider smart development as effective (result based) and equitable (equal for all); respectively; whereas 35 % of people want the development to be rational (return based policy). Only 10% of the respondents are bothered about the efficiency (performance) of the ongoing development.

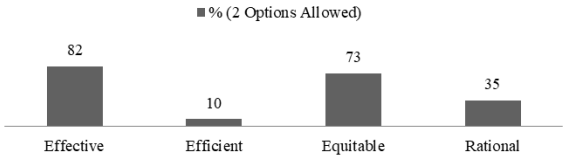

Figure 41. Understanding of Smart Development Based on People's Perception

Secondly, as for sustainability, 97% and 73% of the respondents consider environment and equity, as the two important dimensions towards achieving sustainability. Economy aspect has not been considered essential due to competiveness in businesses among the people.

Figure 42. Priority towards Sustainable Development Based on People's Perception

Lastly, the exercise concluded by listing down the urban development dimensions that need to be included in the smart development strategies based on people's perception. Availability of natural open spaces has been identified as the top priority, followed by transportation as an important necessity. Also, sense of place is considered as a cultural dimension. Ironically, mix land use development and inclusiveness has not been chosen an important dimension. Whereas, dimensions that are in dilemma are Governance, Public Participation and Health & Safety.

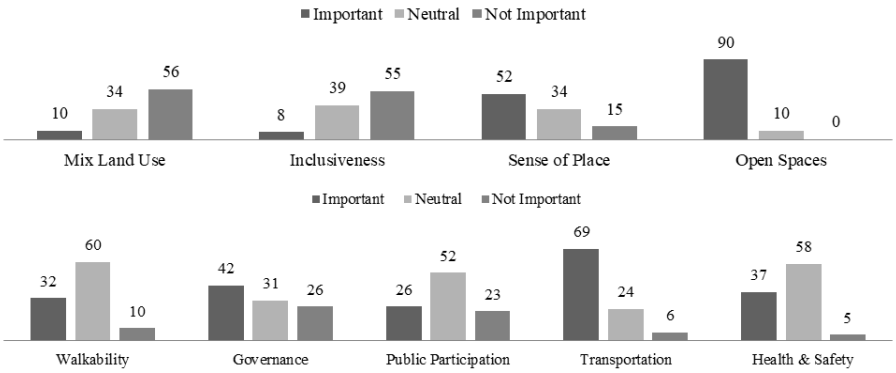

Figure 43. Smart Development Sectoral Scoring Based on People's Perception

7. Results and Discussion

Based on the above analysis, it is evident that urbanization had a positive impact on the study area as there has been an immense growth in economic profile; but with this there has been negative impacts too. Areas like Chaura Bazaar, Dal Bazaar, etc., have seen high density development over the years due to transition from residential to commercial. Due to rise in population, the infrastructure services and utilities are inadequate and as no measures has been taken for the up-gradation and maintenance, these facilities have deteriorated over the time. Currently, these two sectors have the maximum footfall for the commercial activities. But failure towards the physical infrastructure the scenario is not livable for the residing population. The later developments towards the south are more planned as compared to the above sectors. The variation can be measured through the road widths, plot sizes, density, etc. These prevailing conditions will worsen over the years, suggesting urgency towards taking appropriate measures towards urban development. Based on the above study and analysis the major findings identified are briefly described below.

7.1 Economic Growth Pole

The commercial streets of the core attract a huge footfall all over the year, as they are famous for their wholesale business of hosiery, garments, jewelry, restaurants etc. From the past, the study area has been famous for its small scale industries and further, the establishment of the railway junction accelerated the economic development of the zone. The core attracts buyers, business people, etc., from all over the state for its cheap rates of goods and services. Hence, the core can be regarded as the first and stil the major contributing economic growth pole to the Ludhiana City.

Figure 44. Photographs Showing the Economic Growth Factors within the Study Area

7.2 Medium to High Density Development

The current density development pattern is very typical; Chaura and Dal Bazaar have the highest density development with buildings reaching floors up to 6 due to its mixed land-use pattern, whereas the later developed sectors like Naya Mohalla and Karimpura are too of mixed use character but the density is towards lower side, as plot sizes, road, etc., are planned. The development along all the major roads is either of commercial or mixed-use character with high density; floors reaching to 5.

Figure 45. Photographs Showing the Density Pattern within the Study Area

The inner clusters of Karimpura and Naya Mohalla have medium density as they are dominated by residential use with few mixed use units. The average building heights of the residential units all over the core is 2-3, whereas in the commercial or mixed use sectors, the average height is 5. Also, the plot sizes in Chaura and Dal Bazaar are not uniform and are random in nature, whereas Naya Mohalla and Karimpura have planned and homogeneous plot division pattern.

7.3 Traffic Congestion

The road network within the study area has developed organically resulting in being narrow but were able to serve the traffic demand; but with urbanization there has been a significant growth in the vehicular traffic which has added further load on the existing road infrastructure. The core is witnessed by almost all type of modes of transport ranging from cycle rickshaws to cars, though are dominated by two-wheelers. The commercial streets are the source for traffic congestion as the narrow streets are not capable to handle the present traffic. The informal commercial activities and on-street parking are the two major factors for the congestions along all the major roads. The multi-story parking at MCL is not able to fulfill the parking demand because of its deteriorating condition. Also, the people do not prefer to use this facility as there is almost no accessibility options at nominal rates to their respective homes.

Figure 46. Photographs Showing Traffic Congestion within the Study Area

7.4 Lack of Open Spaces

Due to unplanned and haphazard growth of residential units in the study area has resulted in shortage of opens spaces for the residing population; over the years the scenario has been the same. Few traces of open spaces were identified but they were in the form of vacant plots. The population utilizes the streets for their informal meetings and recreational activities, which are unsafe in some of the cases; due to the heavy traffic movement. The only green open space found was at the junction of Sarafan Bazaar Road and Gokal Road, but currently is used by MCL for water supplying purpose; a water tank

and tube well are constructed at the site. This clearly indicates that the core lack opens spaces and the existing streets are utilized for recreational activities.

Figure 47. Photographs Showing Open Spaces within the Study Area

7.5 Lack of Sense of Space

There is an unsaid confusion among the people to remember the places they visit in the study area. Like, Chaura and Dal Bazaar are known for their commercial activities but there is no distinct character in terms of sense of space. None of the streets have its own unique character; though each is known for their goods and services they provide. Even it has been noticed that places where there is maximum footfall like the commercial nodes, no public amenities have been provided for the convenience of the visitors. Few locations were identified were the services were not needed; a public paid toilet is located at the end of the street whereas open toilets are provided in the main commercial sectors. Hence, it is evident the sectors within the study area have no unique identity and there is a major lack of sense of place.

Figure 48. Photographs Showing Lack of Sense of Space within the Study Area

7.6 Deteriorating Condition of Physical Infrastructure Services

Over the years as the population grew, the load on the infrastructure services kept on increasing. As no proper measures were taken, the present infrastructure is inadequate for the residing population. The water supply has not been an issue but the source has been. The study area receives it water supply from various water extracting units located within and around the core. The quality of water has been degrading over the years due to ground water pollution. The study area lacks a storm water drainage system and during monsoons the study area is generally flooded. Sewerage from the study area is disposed into the Budha Nala. The network has not been planned as all the manholes are on the carriage way and further hinders the vehicular movement. Solid waste management is best in class, as daily all

the waste generated is collected, segregated and disposed to the nearest treatment plants; but all this work is carried out by the MCL staff and no public participation is involved. Also, street furniture like light posts, electricity poles, benches, etc., along all the major roads are either absent or are of degraded quality and needs to be retrofitted.

Figure 49. Photographs Showing Deteriorating Physical Infrastructure within the Study Area

8. Strategies Identified by the Local Population

A survey was conducted to understand what people perceive of the existing urban development issues in the study area and as per them which require urgent rectification. It was observed that decongestion was the prime focus towards achieving a livable environment in the study area. On-street parking was identified as the second most important issue that needs improvement. Also, as most of the sectors are of mixed used character, people tend to walk to avoid traffic congestion but further due to lack of pedestrian infrastructure, the same is also an inconvenient transit mode choice.

Further, unhygienic environment within the study area was considered a major issue for which proper measures need to be introduced. The lack of public amenities and sense of place were the other issues identified by the local population surveyed.

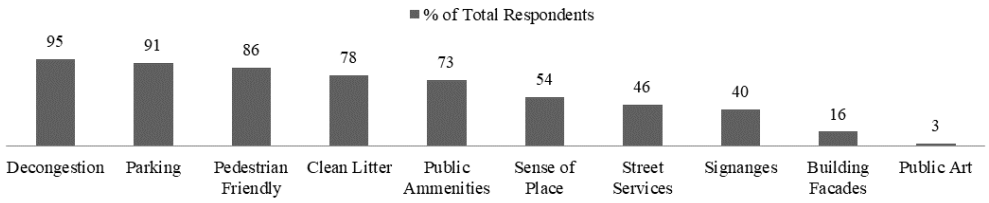

Figure 50. Identified Solutions towards Urban Issues as Per the Local Population in the Study Area

9. Recommendations

Based upon the identified issues, the recommendations that can be adopted to tackle the existing urban development issues are presented in this section. Use of ICT has been integrated in order to achieve similar approach as the smart development. Strategies that have been developed are context specific, and are applicable only in the applied specific zone. 5 major identified dimensions that involves

tackling the present urban development issues are Density Development, Mobility Plan, Cultural Development of Commercial Streets, Physical Infrastructure Services and ICT.

9.1 Density Development

Initiatives adopted to control and facilitate density development pattern of the city core are based upon various land regulations. The land regulations adopted are of 3 types, Restriction Method, Amenity Method and Scarcity Method and are described below:

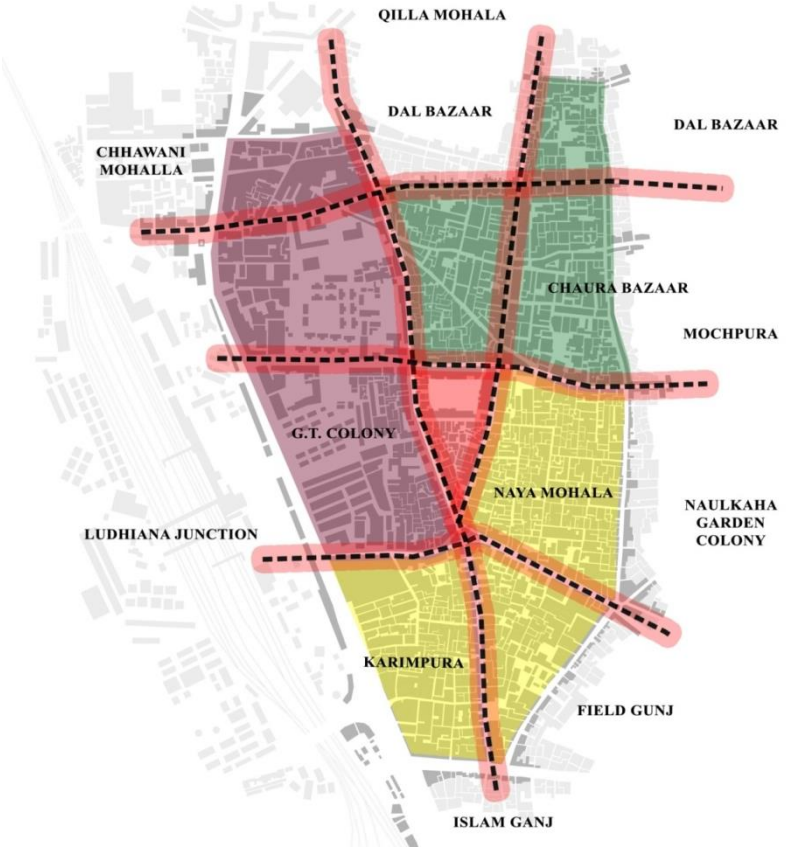

Figure 51. Recommendations Related to Density Development within the Study Area

(Red Color: Commercial Development, Green Color: Recreational Development, Yellow: Residential Development)

Restriction Method: conversion of residential land use in Chaura Bazaar and Dal Bazaar into commercial retails shops needs to be restricted. Sectors like Karimpura and Naya Mohalla which are dominated by residential use and are slowing converting into a mixed land-use sector; this transformation needs to be restricted as it will worsen the livability dimension due to over-crowding in the limited land area. Also, all the old dying residential structures need to be restricted for further change in land use and to be retrofitted in order to conserve the dying heritage.

Amenity Method: recreational land-use needs to be integrated in sectors like Chaura Bazaar and Dal Bazaar. These sectors lack open spaces that are essential for various recreational activities for the residing population. Also, the red marked sectors can be transformed into a commercial districts which are currently a mixed use dominated sectors.

Scarcity Method: this method can be adopted along all the major roads like Clock Tower Road and Lakkar Bazaar Road where high density commercial development can be promoted whereas low to medium density to be promoted in the rest of the core.

9.2 Mobility Plan

As it is evident that the study area is facing major traffic congestion along all the major roads and nodes. In order to facilitate smooth flow of traffic, a mobility plan needs to be implemented to achieve smooth and safe movement of various modal shares. The mobility plan prepared for this scenario includes, i.e., Traffic route management, parking, pedestrianization and redevelopment of street sections.

Traffic Route Management: On the basis of the survey conducted, the traffic route management plan has been prepared. The roads are divided into a hierarchy that consists three type of modal shares; Public Transit Routes (priority towards public transit modes), Mixed Traffic (priority to all transit modes) and Pedestrianization. The basic concept adopted is to divert the through traffic with an outer ring and further to improve the pedestrian experience.

Table 9. Recommendations for traffic route management in the study area

No.	Name	Recommendation
1	Clock Tower Road	Public Transit Routes and Mixed Traffic
2	Daresi Road	Mixed Traffic
3	Mata Rani Road	Mixed Traffic
4	Chaura Bazaar Road	Mixed Traffic & Pedestrianization
5	Raikhy Cinema Road	Mixed Traffic
6	Brown Road	Mixed Traffic
7	Field Ganj Road	Mixed Traffic
8	Meena Bazaar Road	Mixed Traffic
9	Gokal Road	Pedestrianization
10	Sarafan Bazaar Road	Pedestrianization
11	Wool Market Road	Pedestrianization
12	Karimpura Bazaar Road	Mixed Traffic
13	Shahpura Road	Mixed Traffic
14	Lakkar Bazaar	Mixed Traffic
15	Iqbal Ganj	Mixed Traffic

Parking: As per the existing situation, there are three major off-street parking lots i.e. multistory parking at LMC and informal open parking at Chaura Bazaar and Gokal Road. Few private plots have also been converted into parking lots but have limited capacity. So based upon the route

management, various parking spots within and near the core have been identified. The identified spots are majorly within Clock Tower Road and Lakkar Bazaar Road. Two other locations have been identified at Iqbal Ganj Road, which can cater the visiting population. The plots that are vacant or of degraded use can be converted into parking lots. On street parking within the study area should be fined under a tax scheme. Residents within the core can opt for these parking facilities and can use NMT to reach their individual houses. This would minimize the vehicular traffic and further, pollution levels immensely.

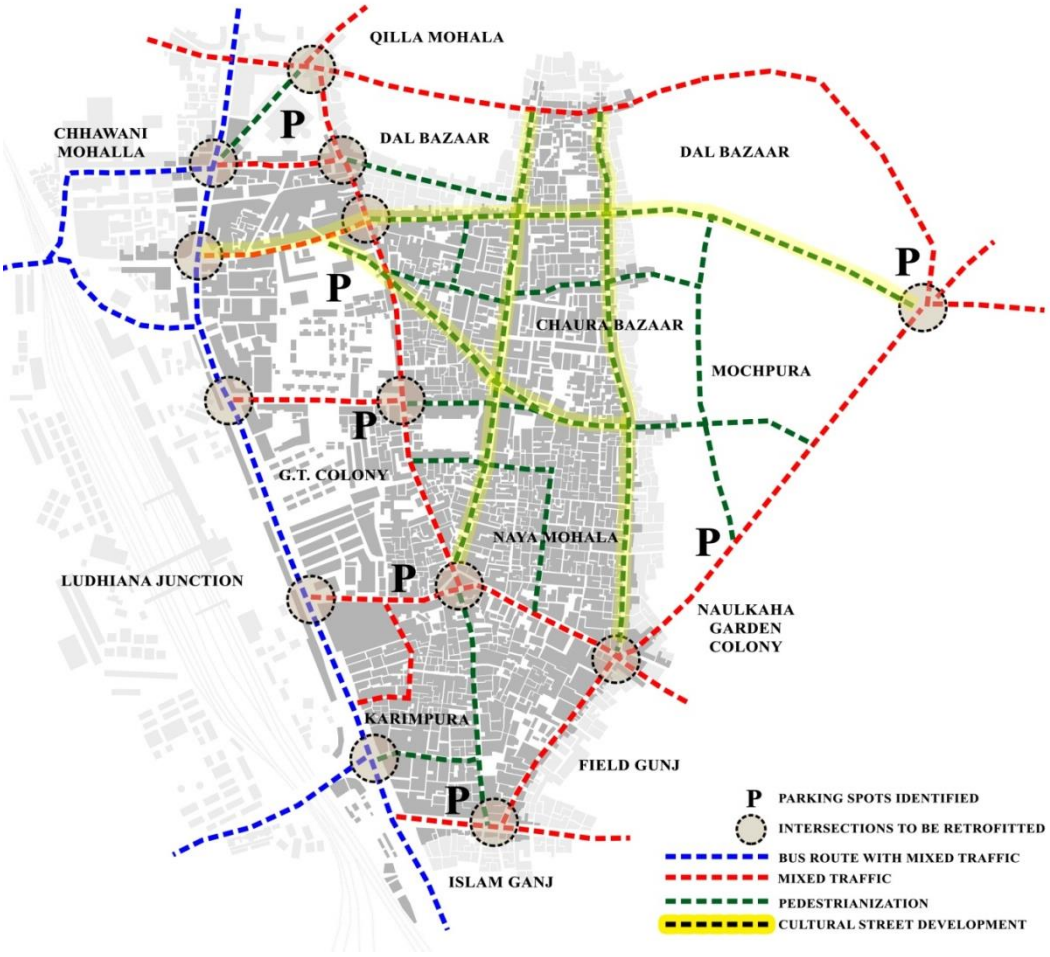

Figure 52. Recommendations Related to the Proposed Mobility Plan within the Study Area

Pedestrianization: Though the study area attracts high footfall not only from the city but also from neighboring cities, but does not provide a pedestrian friendly environment as most of the visited roads are highly congested. Streets have been identified that will solely cater to pedestrians and NMT and further would not allow any motor vehicle movement. These streets should have wider footpaths (1.5-3 m) for safe accessibility and the carriageway would be kept to minimum; only to cater the cargo vehicles accessing the retail shops. The heavy cargo

vehicles can station at the identified public parking locations for loading and unloading; limiting vehicular traffic within the study area. Also, all the required public amenities should be integrated with the roads for improving the overall experience.

Street Sections: Roads need to undergo redevelopment based upon the recommended strategies. Major roads carrying carry mixed traffic will have more carriageway while roads proposed under pedestrianization, will have provide safe accessibility to the pedestrians and almost negligible to the motor vehicles.

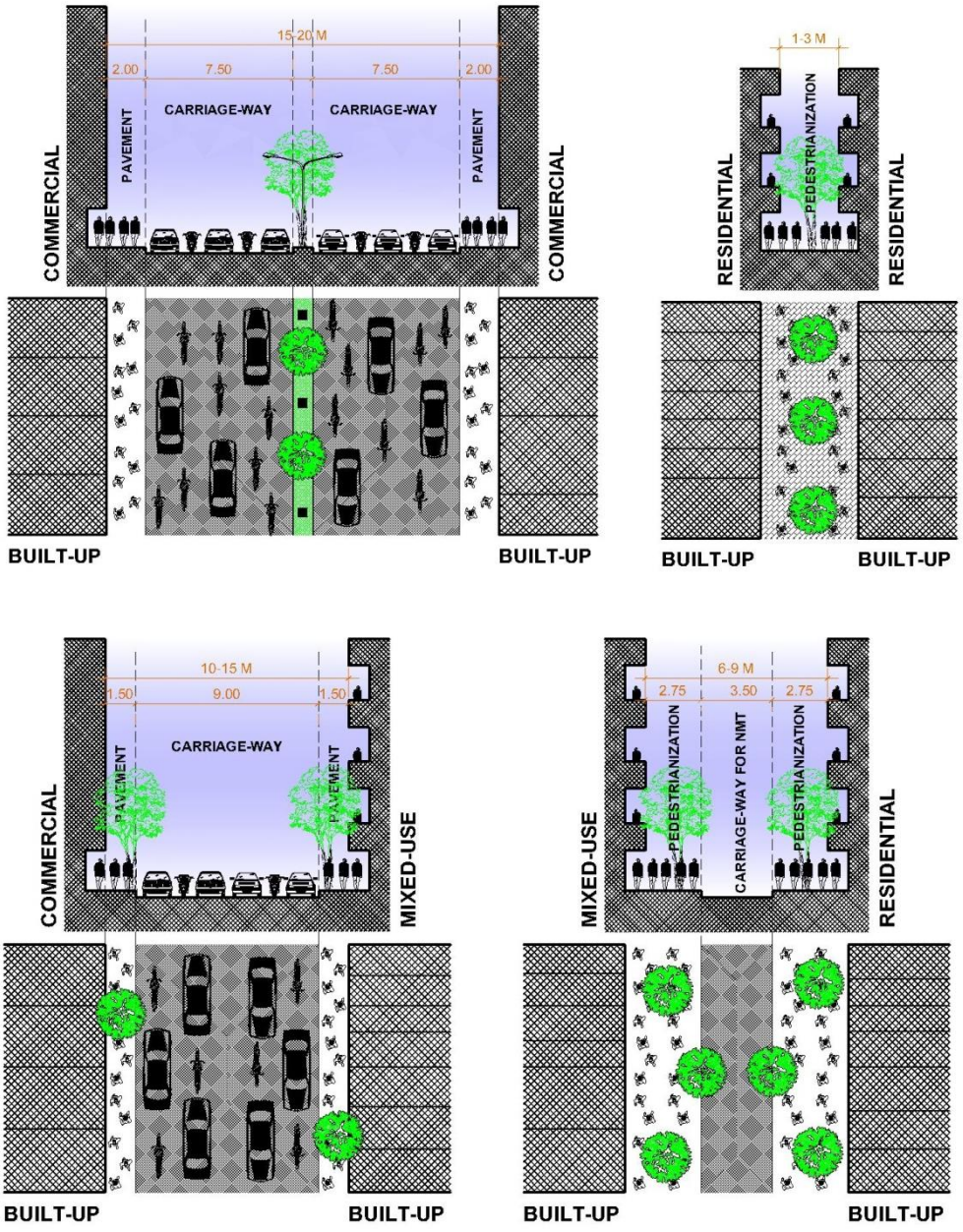

Figure 53. Recommendations Related to Proposed Street Sections within the Study Area

9.3 Cultural Street Development

One of the major interventions is the cultural development of the streets, i.e., Chaura Bazaar, Wool Market and Sarafan Bazaar Road. These streets witness the maximum footfall of population all over the year due to the goods and services provided by these streets. Each street has a different perception among the user; this difference in perception needs to be generalized and unique identities need to be provided to each street. Also, sense of place is an important dimension to this street development initiative. Sense of place is generally achieved by providing the required services and utilities based on the road typology. For example commercial streets are generally crowded with people that require basic amenities like public toilets, dustbins, etc.; these facilities need to exist adjacent to the related function. Further, streets can be retrofitted by developing similar façades with standard billboards sizes and wall color templates, therefore, providing a unique character to the roads.

Another dimension to this cultural dimension can be renovating the old dying structures. These residential units are now either left vacant or are under mixed-use development. The structures form an important part to the core's old heritage and can attract footfall, if converted into public-semipublic functions such as museums, exhibition centers, etc. This would not only generate revenue for the administration but will also generate employment.

Further, heritage walks can be organized regularly linking all the retrofitted heritage structures, old commercial nodes and religious nodes within the sectors through dedicated routes. This would generate awareness among the residents and the tourists regarding the heritage importance of the study area and further will be a revenue generating source for the urban local bodies.

9.4 Physical Infrastructure Services

The quality of physical infrastructure is in deteriorating condition and needs to retrofitted. Each of the infrastructure services have been described briefly below:

Water Supply: In the city core, quantity is the not issue, quality is. Strategies need to be adopted by the governing authorities to supply potable quality of water. Also, rain water harvesting techniques to be adopted at local and sectoral level in order to conserve water and recharge the ground source. Strategies can be formulated on the basis of plot sizes and water tanks to be added by the population to store the runoff water for which concessions can be provided by the local authorities.

Sewerage: No major issue has been identified other than existing degraded infrastructure. With redevelopment of the roads, manholes can be shifted to the footpaths with a common underground duct system.

Drainage: The study area lacks a drainage system and urgently needs to tackle the issue of water clogging in the months of monsoons. Again, drainage network can be integrated under the footpaths in a common underground duct system.

Solid Waste: This is the most efficient system in the physical infrastructure category, where waste in collected, segregated and disposed off by the MCL staff; though initiatives should be taken for

segregation of waste by residents at the generation source to minimize the wok and maximize the efficiency of the whole system. For this specific public awareness programs can be conducted by the local authorities.

Electricity: No issue related to electricity supplied by the MCL has been identified. But, the infrastructure is of degraded quality and is unsafe for the residing and visiting population. The electricity lines can be shifted underground along the roads having RoW less than 18 m whereas on rest of the roads, the lines can be retrofitted.

9.5 Role of ICT (Information and Communication Technology)

ICT can be an integral tool to the proposed urban development strategies. It can be integrated in various dimensions such as Public Service & Governance, Urban Administration, Urban Infrastructure, Environment and Energy, and Public Health and Safety. For this particular case the dimensions that has been considered are Mobility and Public Utilities. The strategies are as follows:

Integrated Operational Control Center: A centralized operational center to control and manage the traffic within the study area can be introduced. It will store all the data at a single location easing the use for urban authorities for efficient management of traffic.

Junction Electronic Eyes: A surveillance system that would monitor the traffic scenario at major traffic junctions. This system would capture real time data and send it to the operational center, from where adequate measures would be taken. Further, the system can aid in improving the safety within the study area.

Parking Guidance System: This system would provide real time information on parking space availability at the various identified parking lots. This aids in avoiding long waiting periods at single parking location and would distribute the traffic among the other lots.

Activity Identification Application: A software application can be developed that marks all the activities within the study area related to commercial, hospitals and various social infrastructure services in order to provide easy accessibility to the desired activity with the shortest approach. Also, the application will aid the population to identify the nearest parking spots with their respective destinations. The application would also showcase the availability of parking spaces within the core to divert the incoming traffic to other nodes to avoid traffic congestion. This application will be a holistic approach for accessibility within the core for the visiting population.

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