

LOCATIONAL AFFORDABILITY FOR HOUSING IN URBAN INDIA

A Jaipur Case Study of Transit Accessibility and Household Travel Burden

A Thesis Project
submitted in partial fulfilment of the requirements for
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Bachelor of Planning

By

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This is to certify that the declaration of Tanmay is true to the best of my knowledge and that the student has worked under my guidance for one semester in preparing this thesis.

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ABSTRACT

Affordable housing programmes in Indian cities have increased the supply of formal dwelling units, but the affordability of housing is not determined by unit cost alone. For low-income households, the location of housing in relation to work, public transport and everyday services affects the real cost of living. This thesis examines locational affordability for housing in Jaipur by assessing whether mapped housing projects are adequately connected to the city's public transport network and by evaluating the travel burden experienced by surveyed households.

The study uses a mixed-method approach. A GIS-based network analysis was carried out using the Jaipur Municipal Corporation boundary, mapped housing-project locations, JCTSL bus stops, Jaipur Metro Phase 1 stations and an OpenStreetMap-derived road network. Accessibility was assessed using a 500 m walking-network distance to bus stops and an 800 m walking-network distance to metro stations as planning thresholds informed by urban transport benchmarks and TOD policy. This was supported by a household survey of 150 anonymised respondents across BSUP, PMAY-U, CMJAY and RHB housing contexts, covering household profile, mode choice, travel time, transport cost, walking access and perceived transport burden.

The findings reveal a severe housing-transport gap. In the full housing-project inventory, 31 of 35 mapped projects are outside both the 500 m bus-stop threshold and the 800 m operational metro-station threshold. Within this wider inventory, the affordable-flagged subset carries the equity implication: 12 of 16 affordable-flagged projects are outside both thresholds. No mapped housing project is within 800 m walking-network distance of an operational metro station. The updated household survey reinforces the spatial finding: 48.7% of respondents report transport cost as a serious burden, 41.3% use bus or metro as their primary mode, 66.0% spend more than Rs. 1,000 per month on transport and 75.3% report one-way travel time of 30 minutes or more.

The thesis argues that housing approval should include a locational affordability check rather than treating housing delivery and mobility planning as separate concerns. It proposes a mobility screening tool for new housing projects, feeder transit improvements for existing gap clusters, targeted NMT upgrades to pedestrian access corridors,

inclusionary TOD measures for future supply and an annual monitoring framework linking housing agencies with transport and urban local bodies.

Keywords: locational affordability; housing-transport integration; affordable housing; public transport accessibility; Jaipur; household travel burden; GIS; NMT.

सार

भारतीय शहरों में किफायती आवास कार्यक्रमों ने औपचारिक आवास इकाइयों की आपूर्ति बढ़ाई है, लेकिन आवास की वास्तविक वहनीयता केवल मकान की कीमत से निर्धारित नहीं होती। कम आय वाले परिवारों के लिए आवास का स्थान, काम, सार्वजनिक परिवहन और दैनिक सेवाओं से उसका संबंध, जीवन-यापन की कुल लागत को प्रभावित करता है। यह शोध जयपुर में आवास परियोजनाओं की सार्वजनिक परिवहन तक पहुँच और परिवारों पर पड़ने वाले यात्रा-व्यय तथा समय के बोझ का मूल्यांकन करता है।

अध्ययन में मिश्रित पद्धति अपनाई गई है। जीआईएस आधारित नेटवर्क विश्लेषण के लिए जयपुर नगर निगम सीमा, आवास परियोजनाओं के बिंदु, JCTSL बस स्टॉप, जयपुर मेट्रो फेज 1 स्टेशन और OpenStreetMap आधारित सड़क नेटवर्क का उपयोग किया गया। बस पहुँच के लिए 500 मीटर और मेट्रो पहुँच के लिए 800 मीटर पैदल नेटवर्क दूरी को मानक माना गया। इसके साथ BSUP, PMAY-U, CMJAY और RHB आवास संदर्भों में 150 गुमनाम घरेलू सर्वेक्षण प्रतिक्रियाओं का विश्लेषण किया गया।

निष्कर्ष बताते हैं कि आवास और परिवहन के बीच स्पष्ट स्थानिक अंतर मौजूद है। सभी 35 मैप की गई आवास परियोजनाओं में से 31 परियोजनाएँ बस और मेट्रो दोनों मानकों से बाहर हैं। सस्ते-चिह्नित 16 परियोजनाओं के उप-समूह में 12 परियोजनाएँ दोनों मानकों से बाहर हैं। किसी भी मैप की गई परियोजना को परिचालित मेट्रो स्टेशन तक 800 मीटर पैदल नेटवर्क पहुँच प्राप्त नहीं है। सर्वेक्षण में 48.7 प्रतिशत उत्तरदाताओं ने परिवहन लागत को गंभीर बोझ बताया, 66.0 प्रतिशत प्रतिमाह 1,000 रुपये से अधिक परिवहन पर खर्च करते हैं और 75.3 प्रतिशत की एकतरफा यात्रा अवधि 30 मिनट या अधिक है।

शोध का निष्कर्ष है कि आवास अनुमोदन में स्थानिक वहनीयता की जाँच शामिल होनी चाहिए। इसके लिए भविष्य की आवास परियोजनाओं हेतु मोबिलिटी स्क्रीनिंग, मौजूदा परियोजनाओं हेतु feeder transit, पैदल पहुँच सुधार, TOD क्षेत्रों में किफायती आवास आरक्षण और वार्षिक GIS निगरानी ढाँचे का प्रस्ताव किया गया है।

मुख्य शब्द: स्थानिक वहनीयता; आवास-परिवहन एकीकरण; किफायती आवास; सार्वजनिक परिवहन पहुँच; जयपुर; परिवहन बोझ; जीआईएस।

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ABBREVIATIONS

Table P.1: List of Abbreviations

Abbreviation	Full form
AHP	Affordable Housing in Partnership
BLC	Beneficiary-Led Construction
BSUP	Basic Services to the Urban Poor
CMJAY	Chief Minister Jan Awas Yojana
CMP	Comprehensive Mobility Plan
CLSS	Credit Linked Subsidy Scheme
EWS	Economically Weaker Section
GIS	Geographic Information System
H+T	Housing plus Transportation
IPT	Intermediate Public Transport
IRC	Indian Roads Congress
ISSR	In-Situ Slum Redevelopment
JCTSL	Jaipur City Transport Services Limited
JDA	Jaipur Development Authority
JMC	Jaipur Municipal Corporation
JMRC	Jaipur Metro Rail Corporation
LIG	Low Income Group
MIG	Middle Income Group
MoHUA	Ministry of Housing and Urban Affairs
NMT	Non-Motorised Transport
NUTP	National Urban Transport Policy
OD	Origin-Destination
OSM	OpenStreetMap
PMAY-U	Pradhan Mantri Awas Yojana - Urban
PTAL	Public Transport Accessibility Level
RHB	Rajasthan Housing Board
TOD	Transit Oriented Development
UMTA	Unified Metropolitan Transport Authority

Source: Author.

CHAPTER 1: INTRODUCTION

1.1 Background

Where a city places housing relative to jobs, services and public transport is one of the most consequential planning decisions for low-income households. Housing that is cheaper at the point of purchase may become unaffordable in daily life if the household must spend more time, money and physical effort to reach work, education, health care or markets. This relationship is commonly discussed as locational affordability or the housing-transport trade-off. It extends the conventional housing affordability question beyond the price of the unit and asks whether the location allows residents to live affordably after occupation (Center for Neighborhood Technology, 2010; Guerra and Kirschen, 2016).

The conventional benchmark that treats housing as affordable when it consumes a defined share of income is administratively useful, but it is spatially incomplete. A central or transit-rich unit and a peripheral unit may appear comparable if their rent or sale price is similar, yet they can impose very different mobility costs. Accessibility literature has long argued that the value of a location comes from its ability to connect people to opportunities (Hansen, 1959; Geurs and van Wee, 2004; Litman, 2025). In Indian cities, this issue becomes sharper because low-income households often depend on walking, cycling, buses, shared autos, informal work networks and short trip chains that are highly sensitive to distance and service reliability.

Affordable housing programmes in India have made an important contribution by expanding formal housing supply. PMAY-U, BSUP, CMJAY and state housing board schemes have created or supported dwelling units for EWS and LIG households. However, the housing delivery system often prioritises land availability, project cost and administrative targets. Transport agencies, in contrast, plan bus or metro corridors according to ridership, engineering feasibility and corridor demand. When these two systems do not meet, the household pays the difference through longer walks, multiple transfers, higher fares, fuel costs, time loss and reduced job access (Lucas, 2012; Coelho, Mahadevia and Williams, 2022).

STUDY AREA - Jaipur



Map 1.1: Study Area - Jaipur Municipal Corporation Boundary

Source: Author, based on GIS study-area layer.

1.2 Need for Study

Jaipur provides a useful case for examining locational affordability because the city combines three conditions: a growing metropolitan footprint, a visible supply of formal housing projects and an operational but spatially limited public transport network. The city has expanded along major road corridors such as Ajmer Road, Tonk Road, Sikar Road and Delhi Road. Several housing projects, including BSUP, PMAY-AHP, CMJAY, RHB and mixed-income projects, are located in peripheral or semi-peripheral areas where formal public transport access may be weak.

Policy literature highlights the problem but does not provide a Jaipur-specific project-level answer. PTAL and accessibility methods have been applied in Ahmedabad, Surat, Hubli-Dharwad and Bhopal, showing that accessibility mapping can support planning decisions and reveal equity gaps (Shah and Adhvaryu, 2016; Adhvaryu, Chopde and Dashora, 2019; Adhvaryu and Mudhol, 2022; Saxena, Gupta and Shrivastava, 2021).

Housing-transport affordability studies in Lucknow show that peripheral low-income households may face a higher combined burden than suggested by housing price alone (Rao/Ahmad et al., 2023). Peripheral housing research in Ahmedabad and Chennai further shows that relocation and distant housing can reproduce exclusion when livelihood access is not protected (Coelho, Mahadevia and Williams, 2022).

This thesis addresses the gap by combining GIS-based walking-network analysis with a primary household survey in Jaipur. The study does not attempt a full service-weighted PTAL because route frequency and timetable data are not available at the required level. Instead, it uses a benchmark-aligned proximity screen: 500 m walking-network distance to mapped bus stops and 800 m walking-network distance to operational metro stations. The value of this approach is its reproducibility and its direct usefulness for housing approval and monitoring.

1.3 Problem Statement

Despite large-scale housing delivery in Jaipur through multiple schemes and agencies, the spatial accessibility of housing projects to public transport has not been systematically integrated into housing approval, project evaluation or post-occupancy monitoring. Low-income households residing in peripheral or weakly connected locations face transport costs, long travel times and unsafe walking environments that can undermine the affordability of formal housing. The absence of an integrated housing-transit screening mechanism creates access debt: a recurring mobility burden imposed by housing locations that are delivered before adequate public transport and pedestrian access are secured.

1.4 Aim

To assess the spatial accessibility of housing projects in Jaipur to public transport and evaluate household travel burden, with the objective of informing evidence-based planning proposals for integrated housing-transit development in the city.

1.5 Objectives

1. To examine the theoretical and policy context of locational affordability, public transport accessibility and housing-transport burden in Indian urban planning.

2. To profile Jaipur's housing inventory and public transport network, and develop a spatial database linking housing project locations to transit infrastructure.
3. To analyse the spatial accessibility of housing projects in Jaipur using GIS-based network analysis with 500 m bus and 800 m metro proximity thresholds.
4. To conduct a primary household survey assessing travel mode, travel time, transport cost, walking access and perceived transport burden among residents of selected housing schemes.
5. To identify gaps between housing location and transit access, interpret their household-level implications and derive planning priorities.
6. To develop planning proposals with implementation mechanisms, phasing, agency responsibilities and monitoring indicators for integrated housing-transit development.

1.6 Research Questions

Primary research question: What is the spatial accessibility of housing projects in Jaipur to public transport, and what is the household travel burden experienced by residents of selected housing schemes?

- What proportion of mapped housing projects falls within the 500 m bus-stop threshold and the 800 m metro-station threshold?
- How does the affordable-flagged subset compare with the full housing-project inventory?
- What are the travel mode, travel time and transport-cost patterns reported by surveyed households?
- What walking-access and safety problems affect practical transit use?
- What planning interventions can reduce current access gaps and prevent future disconnected housing?

1.7 Scope and Limitations

The geographic scope of the study is the Jaipur Municipal Corporation boundary. The spatial database includes 35 mapped housing projects as the main inventory and 16 affordable-flagged projects as a subset. The transit database includes mapped JCTSL bus

stops and 11 operational Jaipur Metro Phase 1 stations. The analysis uses project centroid points and does not model every housing gate or internal block.

The methodological scope is a benchmark-aligned accessibility screen rather than a full accessibility index. Walking-network distance is measured along an OSM-derived road network. The study does not compute service frequency, waiting time, crowding, fare integration, route reliability or travel-time isochrones. This limitation is important because a bus stop inside the threshold may still be weakly served, while a project outside the threshold may still use informal or intermediate transport.

The household survey contains 150 anonymised responses and is purposive rather than statistically random. The data therefore supports grounded planning interpretation but should not be over-generalised to every household in Jaipur. Self-reported travel time and cost are bracketed, not GPS-verified. The study is cross-sectional and does not track changes over time.



Fig. 1.1: Existing Land Use Plan of Jaipur

Source: Jaipur Master Development Plan 2025 / JDA map used for contextual interpretation.

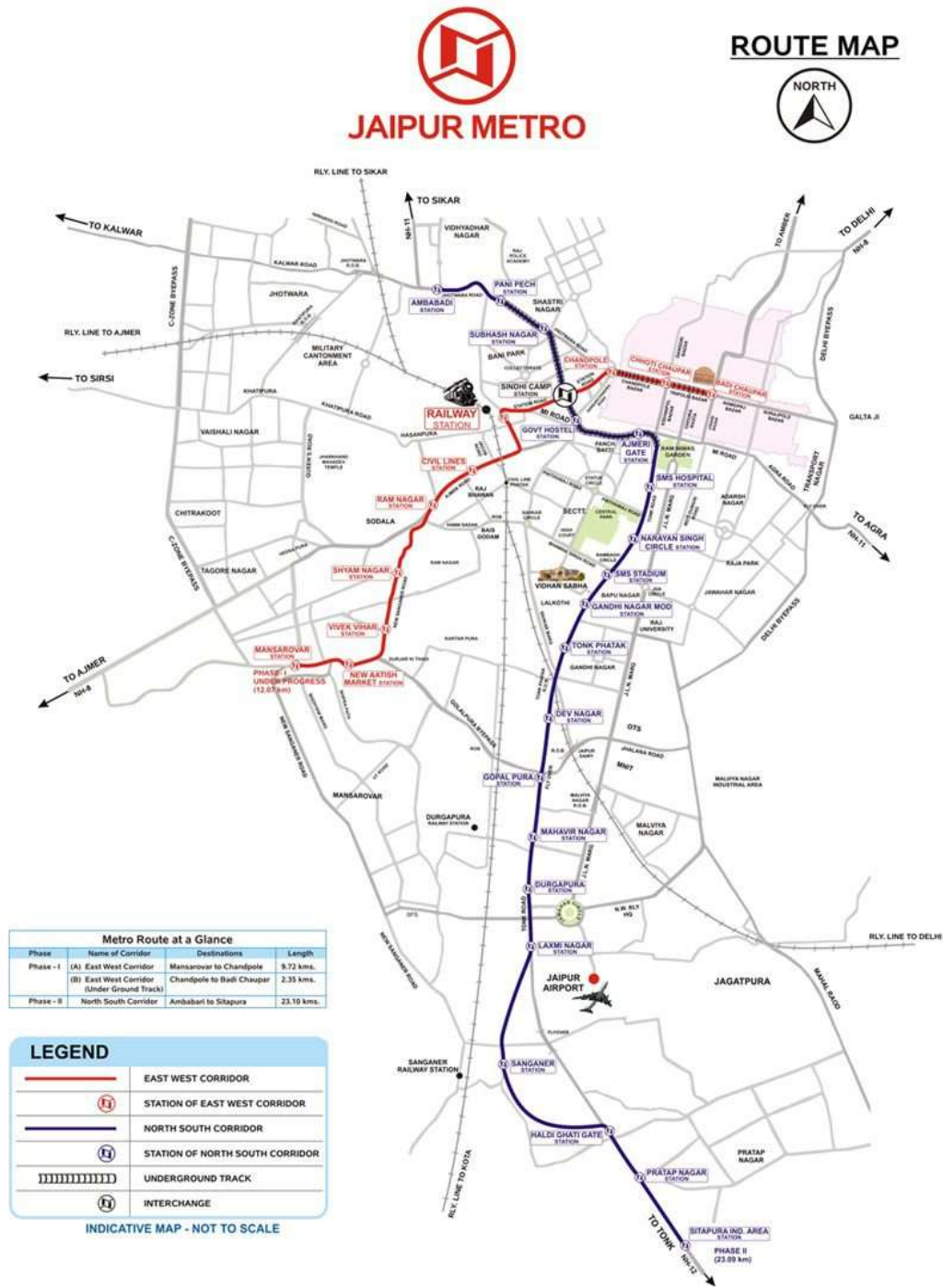


Fig. 1.2: Jaipur Metro Route Map

Source: Jaipur Metro route map compiled from public route information; used for contextual illustration.

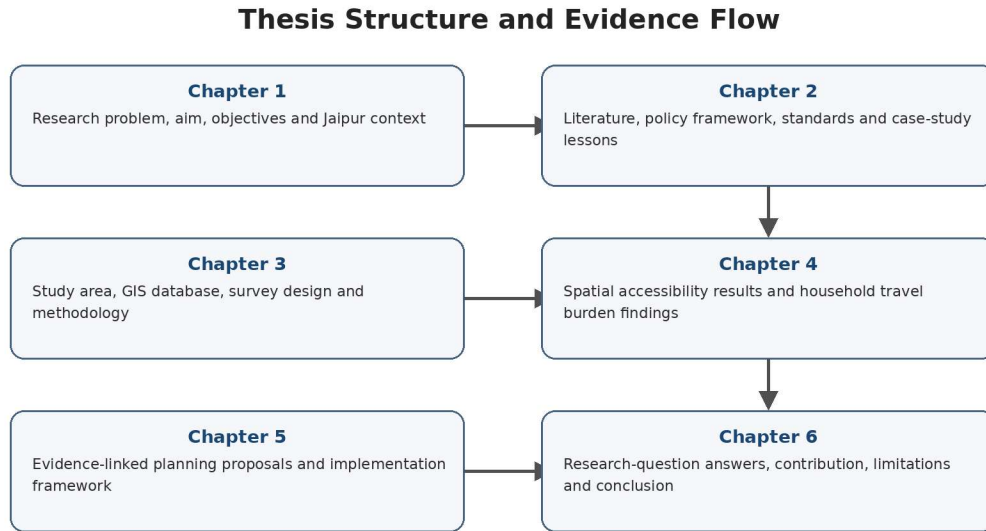


Fig. 1.3: Thesis Structure and Evidence Flow

Source: Author.

1.8 Thesis Structure

Chapter 1 introduces the research problem, aim, objectives, scope and limitations.

Chapter 2 reviews the literature, policy framework, standards and case studies. Chapter 3 presents the study area profile and methodology. Chapter 4 analyses spatial accessibility and household survey findings. Chapter 5 develops the planning proposals and implementation framework. Chapter 6 concludes by answering the research questions, summarising contributions and identifying limitations and future research needs.

CHAPTER 2: LITERATURE REVIEW AND POLICY FRAMEWORK

2.1 Introduction

This chapter establishes the conceptual and policy basis for the thesis. It reviews accessibility, H+T affordability, peripheralisation and transport-related exclusion; summarises relevant Indian and international literature; examines policy instruments; identifies standards and benchmarks; and distils case-study lessons for Jaipur. The purpose is not to list sources mechanically, but to locate the thesis within a defensible evidence base.

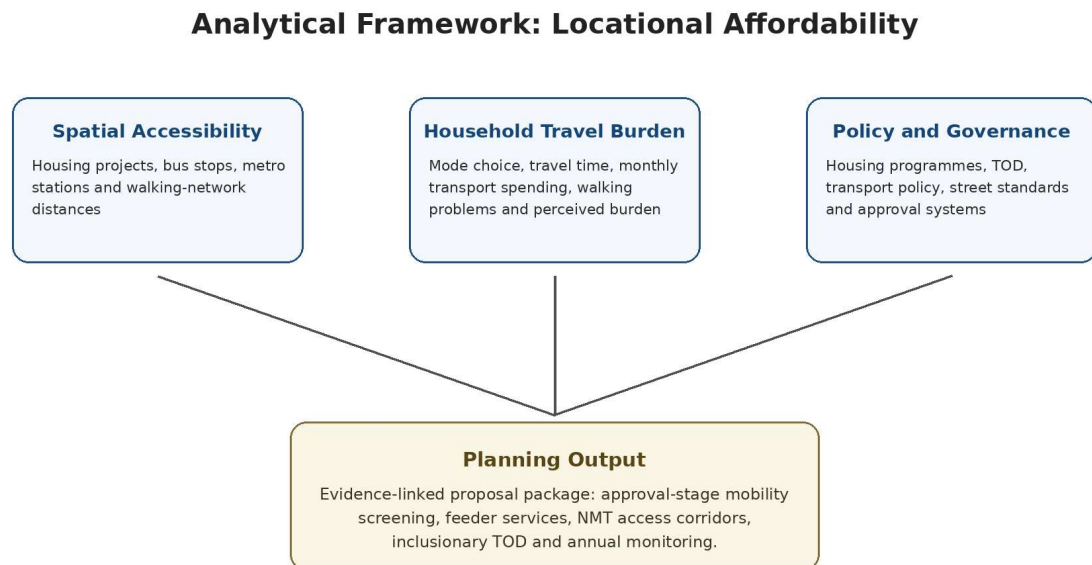


Fig. 2.1: Analytical Framework for Locational Affordability

Source: Author, adapted from accessibility and H+T literature.

2.2 Conceptual Background

2.2.1 Accessibility

Accessibility is the ability of people to reach activities, goods, services and opportunities. Hansen (1959) defined accessibility through the relationship between land use and

transport infrastructure. Geurs and van Wee (2004) later clarified that accessibility has spatial, temporal, individual and transport-system components. This is important for housing because a dwelling unit is not only a physical structure; it is a location from which daily life is organised. Preston and Raje (2007) also distinguish accessibility from mobility: the policy goal is not movement for its own sake, but the ability to reach opportunities without excessive burden.

2.2.2 Housing-Transport Affordability

The Housing + Transportation approach developed by the Center for Neighborhood Technology (2010) argues that transport is a structural cost of location, not merely an individual household choice. Guerra and Kirschen (2016) caution that H+T indices are data-intensive, but they remain valuable because they reveal the illusion of housing affordability in peripheral locations. In the Indian context, Rao/Ahmad et al. (2023) demonstrate the relevance of the H+T lens by showing how transportation costs affect affordability for low-income households in Lucknow.

2.2.3 Peripheralisation and Exclusion

Peripheralisation literature shows that formal housing can reproduce exclusion when it is disconnected from livelihood networks. Coelho, Mahadevia and Williams (2022) describe the peripheralisation of low-income housing in Ahmedabad and Chennai, where formal units were provided but access to work, services and social infrastructure weakened. Lucas (2012) links transport disadvantage to social exclusion, showing that transport cannot be treated as a separate technical sector when land-use decisions determine access.

2.2.4 TOD and Inclusion

TOD literature argues for compact, mixed-use and walkable development around transit nodes. Cervero et al. (2004) and the ITDP TOD Standard emphasise density, diversity and design near transit. However, TOD can also become exclusionary when rising land values push low-income households away from transit-rich zones. For Jaipur, the issue is therefore not only to promote TOD but to ensure that affordable housing is captured within transit influence areas rather than displaced from them.

2.3 National Literature Synthesis

Table 2.1: National Literature Synthesis Matrix

Author / Source	City / Context	Method / Focus	Key finding	Relevance to Jaipur
Shah and Adhvaryu (2016)	Ahmedabad	PTAL-style public transport accessibility mapping	Accessibility can be spatially mapped and compared across neighbourhoods.	Supports GIS-based accessibility screening.
Adhvaryu, Chopde and Dashora (2019)	Surat	PTAL and planning application	Accessibility mapping can inform land-use planning and transit investment.	Shows Indian applicability beyond metropolitan megacities.
Adhvaryu and Mudhol (2022)	Hubli-Dharwad	Accessibility visualisation for planning policy	Maps are useful only when communicated clearly to decision-makers.	Supports use of maps as governance tools in Chapter 5.
Saxena, Gupta and Shrivastava (2021)	Bhopal slums	Equity-focused PTAL application	Vulnerable settlements often face low public transport accessibility.	Links accessibility analysis with low-income housing equity.
Rao/Ahmad et al. (2023)	Lucknow	Housing + transport affordability	Peripheral households may face high combined burden despite lower housing costs.	Direct Indian evidence for locational affordability.
Coelho, Mahadevia and Williams (2022)	Ahmedabad and Chennai	Peripheralisation of low-income housing	Peripheral formal housing can deepen exclusion.	Supports the access-debt framing.
Lakra and Dubey (2024)	Indian cities	Accessibility parameter review	Safety, affordability, comfort and infrastructure quality matter beyond proximity.	Explains why survey evidence is needed with GIS.

Source: Author, based on reviewed literature.

2.4 International Literature

International literature provides the conceptual vocabulary for the thesis but cannot be copied mechanically into Jaipur. Hansen (1959), Geurs and van Wee (2004), Lucas (2012), Preston and Raje (2007) and Litman (2025) frame accessibility as a multi-dimensional relation between people, places, transport systems and opportunities. CNT (2010) and Guerra and Kirschen (2016) establish the H+T problem, while Boeing (2017) supports the use of OSM-derived street networks for reproducible spatial analysis.

Saghapour, Moridpour and Thompson (2016) and Transport for London's PTAL guidance show why a full service-weighted accessibility measure would require more than stop proximity.

This thesis uses international methods selectively. It does not claim to compute a formal PTAL, a complete H+T affordability index or a service-weighted transit score. Instead, it uses a transparent proximity screen and household survey evidence. This methodological restraint is important because the available Jaipur data does not include reliable frequency and waiting-time attributes for all JCTSL routes.

2.5 Policy Framework

Table 2.2: Policy Integration Gap Matrix

Policy / document	Main focus	Integration mandate	Gap for locational affordability
National Urban Transport Policy, 2006	Urban mobility and public transport priority	Promotes moving people, not vehicles; supports land-use and transport integration.	Advisory policy; not directly tied to housing approvals.
National TOD Policy, 2017	Transit-oriented development	Defines transit influence areas and promotes compact development.	Does not by itself reserve affordable housing in high-access zones.
Metro Rail Policy, 2017	Metro project planning and approval	Emphasises multimodal integration, TOD and value capture.	Metro corridors may still bypass low-income housing clusters.
PMAY-U Guidelines, 2015/2024	Housing delivery	Supports EWS/LIG housing through multiple verticals.	No mandatory transit-distance criterion for project approval.
Rajasthan TOD Policy, 2025	State-level TOD framework	Creates state-level hook for TOD corridors and higher-intensity development.	Needs inclusionary safeguards to avoid transit-rich but unaffordable zones.
Jaipur Master Development Plan 2025	Land use and city growth	Provides statutory spatial planning baseline.	Peripheral residential growth is not automatically tied to transit delivery.
Comprehensive Mobility Plan for Jaipur, 2010	Urban transport strategy	Provides city mobility context and public transport planning basis.	Housing project approvals are not automatically screened against CMP priorities.
Rajasthan Township Policy / housing policy documents	Township and housing development	Supports planned urban development and housing supply.	Road access can be treated as sufficient even where public transport access is weak.

Source: Author, based on policy review.

2.6 Standards and Benchmarks

Table 2.3: Standards and Benchmarks Matrix

Standard / benchmark	Relevant threshold / concept	Use in this thesis	Caution
MoHUA Service Level Benchmarks for Urban Transport	Convenient access to public transport commonly assessed using walking distance to stops.	Supports the 500 m bus access screen.	The thesis does not compute full SLB scoring.
National TOD Policy, 2017	Transit influence zones around mass transit stations.	Supports the 800 m metro access screen.	Station influence is not the same as confirmed service quality.
SDG 11.2.1 metadata	Convenient public transport access as a global monitoring indicator.	Frames access as a basic urban equity measure.	Global indicator is not a local implementation tool.
IRC:103-2012	Pedestrian facility design principles.	Supports NMT access corridor and footpath proposals.	Final dimensions require site ROW survey.
Complete Streets guidance / ITDP / NIUA	Safe, inclusive and complete street design.	Supports footpath, crossing, lighting and public-realm retrofits.	Needs local agency maintenance commitment.
TfL PTAL guidance	Service-weighted public transport accessibility including walking and frequency.	Used as a methodological reference.	Formal PTAL is not computed due to missing frequency data.
ITDP TOD Standard	Compact, mixed-use, walkable transit areas.	Supports inclusionary TOD proposal.	TOD without affordability safeguards can become exclusionary.

Source: Author, based on standards and benchmark review.

2.7 Case Study Lessons

Table 2.4: Case Study Summary Matrix

Case	Planning lesson	Relevance to Jaipur
Ahmedabad PTAL and BRT cases	Accessibility mapping and BRT can support corridor planning but resettlement sites can remain disconnected.	Use mapping for housing approvals, not only transit corridors.
Surat PTAL/BRT	PTAL-style mapping can be applied in Indian cities and used for planning communication.	Supports use of simple accessibility maps for decision-makers.
Bhopal slum accessibility	Low-income settlements may face weaker public transport access even within urban boundaries.	Justifies equity focus of affordable-housing subset.
Lucknow H+T affordability	Peripheral housing may appear affordable but become unaffordable after transport cost is included.	Directly supports locational affordability argument.

Case	Planning lesson	Relevance to Jaipur
Savda Ghevra, Delhi	Peripheral relocation can trigger livelihood shocks and long commute burdens.	Warns against treating shelter delivery as rehabilitation if access is absent.
Singapore HDB + MRT	Housing, land use and transport are coordinated through strong institutions.	Shows the importance of institutional integration and transit-oriented new towns.
Curitiba BRT	Land-use intensity follows public transport corridors and a strong bus system.	Supports feeder/trunk corridor logic rather than scattered peripheral approvals.
Jakarta pedestrian accessibility	Walking-time service areas can identify underserved urban areas.	Supports network-based rather than straight-line interpretation.

Source: Author, based on reviewed case studies.

2.8 Research Gap

The review identifies four gaps that this thesis addresses. First, Jaipur lacks a housing-project-specific GIS analysis that links mapped housing locations with public transport access. Second, Indian H+T evidence exists in other cities but has not been operationalised into a simple approval-stage screening tool for Jaipur. Third, policy documents promote integration but do not create a binding relationship between housing approvals and transit access. Fourth, proximity analysis alone is insufficient; household travel burden and walking conditions must be assessed alongside spatial distance.

2.9 Chapter Summary

The literature and policy review establishes that accessibility is central to affordability, that peripheralisation can transform formal housing into a daily mobility burden, and that Jaipur needs a practical housing-transit screening mechanism. These conclusions provide the conceptual foundation for the methodology in Chapter 3 and the proposals in Chapter 5.

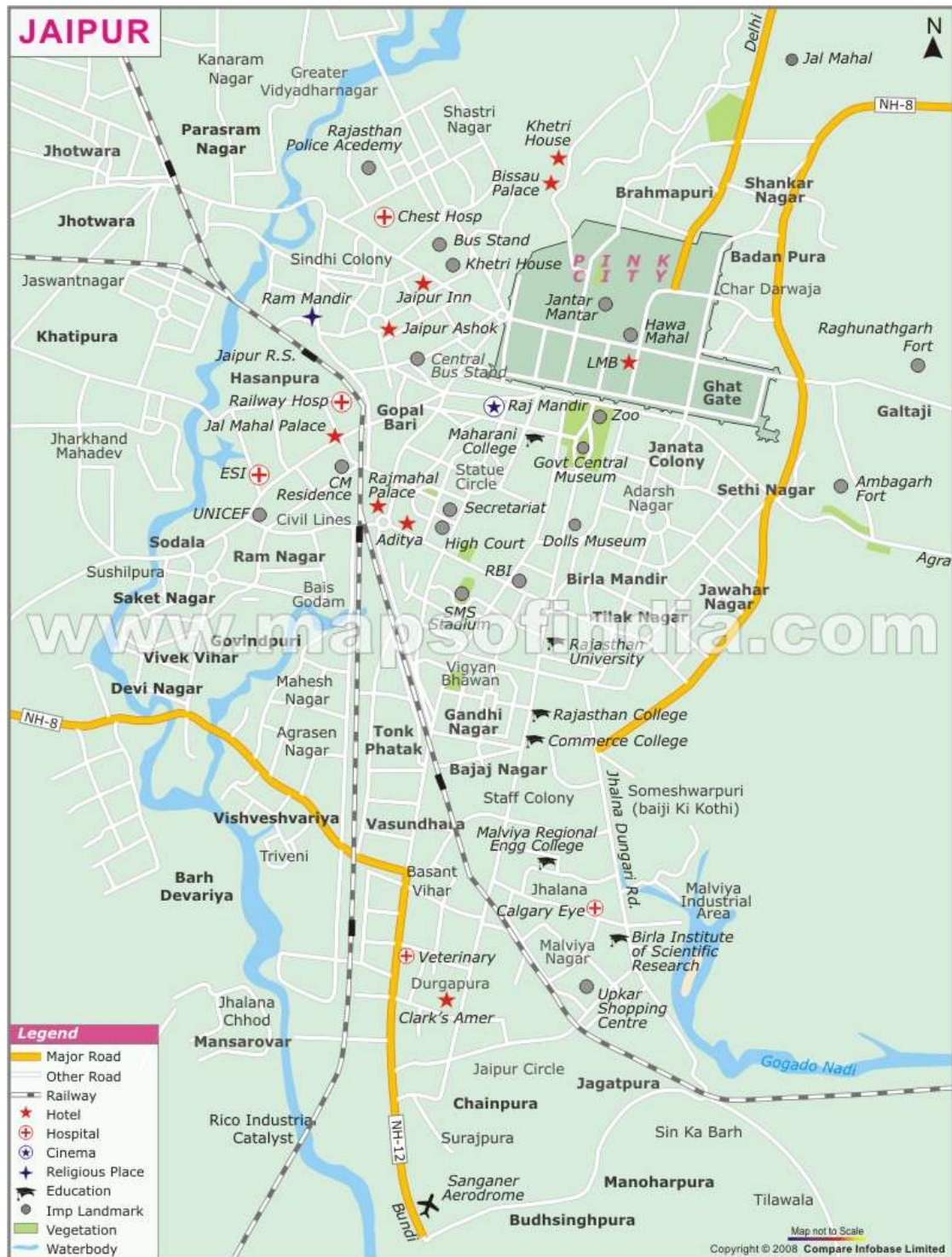
CHAPTER 3: STUDY AREA PROFILE AND METHODOLOGY

3.1 Introduction

This chapter describes the study area, spatial database, survey method and analytical procedure used in the thesis. The method is designed to be reproducible: it uses explicit data layers, clear thresholds, stated assumptions and transparent limitations. The main inventory includes all 35 mapped housing projects, while the affordable-flagged 16-project subset is used to interpret equity implications.

3.2 Jaipur City Profile

Jaipur is the capital city of Rajasthan and a major urban centre in north-western India. The city has a historic planned core, later planned extensions and continuing peripheral growth along major transport corridors. Its morphology includes the Walled City, established residential areas such as Mansarovar and Vaishali Nagar, industrial and employment areas such as Sitapura and VKI, and peripheral housing growth along Ajmer Road, Tonk Road, Sikar Road and Delhi Road. The Jaipur Master Development Plan 2025 and the Comprehensive Mobility Plan provide the broader planning context for the study area.



Map 3.1: Jaipur City Context Map

Source: Public city map used for location context.

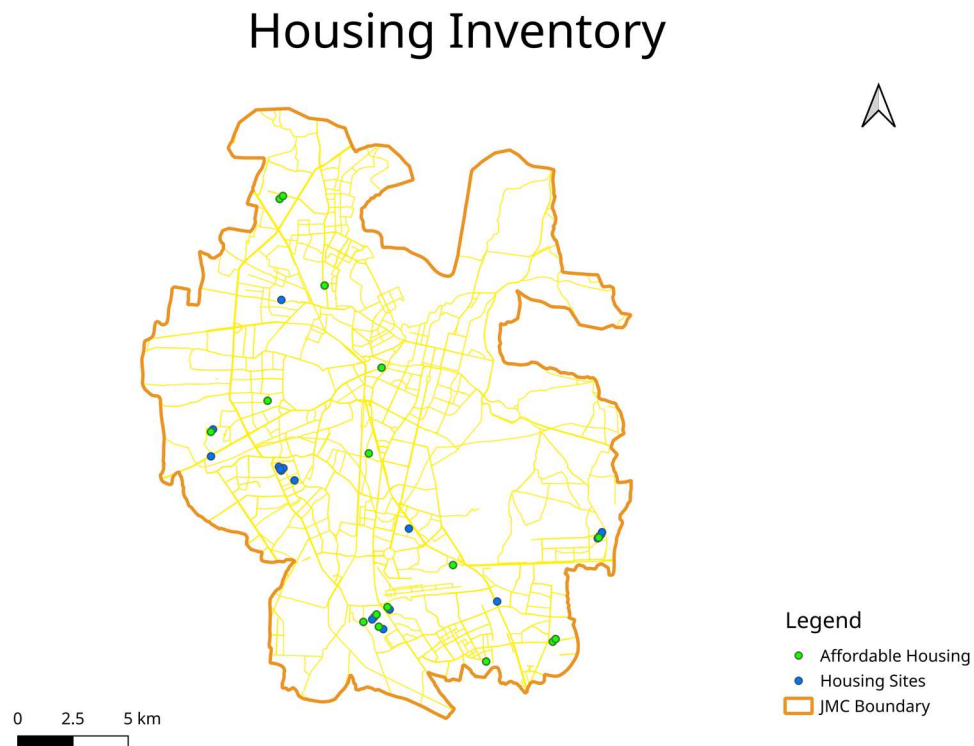
Table 3.1: Jaipur City Profile for Thesis Analysis

Indicator	Description / value used in thesis
Administrative focus	Jaipur Municipal Corporation boundary
Urban form	Historic walled city with radial expansion along arterial corridors
Key employment/service areas	Walled City, MI Road/C-Scheme, Mansarovar, Malviya Nagar, Sitapura, VKI, Pratap Nagar and institutional corridors
Public transport assets	JCTSL bus network and operational Jaipur Metro Phase 1
Housing focus	35 mapped housing projects, with 16 affordable-flagged projects as subset
Analytical boundary	Housing-transit accessibility within JMC, not the full JDA region

Source: Author, based on GIS database and planning documents.

3.3 Housing Inventory

The housing database used for the thesis contains 35 mapped housing project points. These represent the main inventory for spatial analysis. Within this wider dataset, 16 projects are flagged as affordable or affordability-linked through BSUP, PMAY-U AHP, CMJAY, RHB EWS/LIG or similar low-income housing markers. The distinction is important: the full inventory reveals the wider housing-transit pattern, while the affordable subset carries the equity implication.



*Map 3.2: Housing Project Inventory within JMC Boundary**Source: Author, based on housing project GIS layer.**Table 3.2: Housing Inventory Structure*

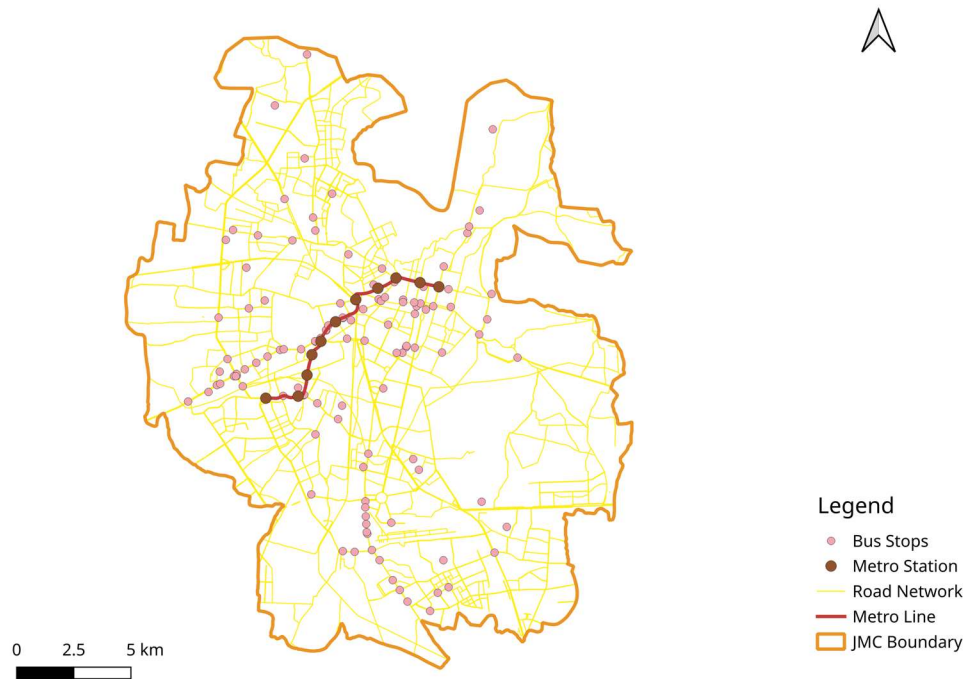
Category	Number of projects	Role in thesis
All mapped housing projects	35	Main spatial inventory for citywide housing-transit pattern.
Affordable-flagged subset	16	Equity-focused subset used to interpret EWS/LIG and affordability-linked implications.
Non-affordable / mixed-context projects	19	Context layer; helps show whether access gap is wider than affordable labels alone.

Source: Author, based on housing GIS layer.

3.4 Public Transit in Jaipur

The public transport database includes mapped JCTSL bus stops and operational Jaipur Metro Phase 1 stations. The metro station list used in this thesis includes Mansarovar, New Aatish Market, Vivek Vihar, Shyam Nagar, Ram Nagar, Civil Lines, Railway Station, Sindhi Camp, Chandpole, Chhoti Chaupar and Badi Chaupar. Jaipur Metro Phase 1 operates as a corridor between Mansarovar and Badi Chaupar; future metro extensions are discussed as planning opportunities but are not included in the present operational accessibility screen.

Transport Network



Map 3.3: Transit Base Layer - Bus Stops and Metro Stations

Source: Author, based on transit GIS layers.

Table 3.3: Transit Infrastructure Summary

Layer	Features	Use in analysis	Limitation
JCTSL bus stops	119 mapped points	500 m walking-network access screen	Formal/mapped stop layer; does not include informal stops or service frequency.
Jaipur Metro Phase 1 stations	11 operational stations	800 m walking-network access screen	Future/approved stations are excluded from current access analysis.
OSM road network	46,701 line features	Walking-network distance computation	OSM-dependent; every segment was not field-verified.

Source: Author, based on transit and road-network GIS layers.

3.5 Research Design

The thesis uses a mixed-method design with three linked stages. The first stage is desk-based literature, policy and standards review. The second stage is spatial analysis using

GIS and walking-network distances. The third stage is primary household survey analysis. The final stage triangulates spatial and household evidence to frame proposals.

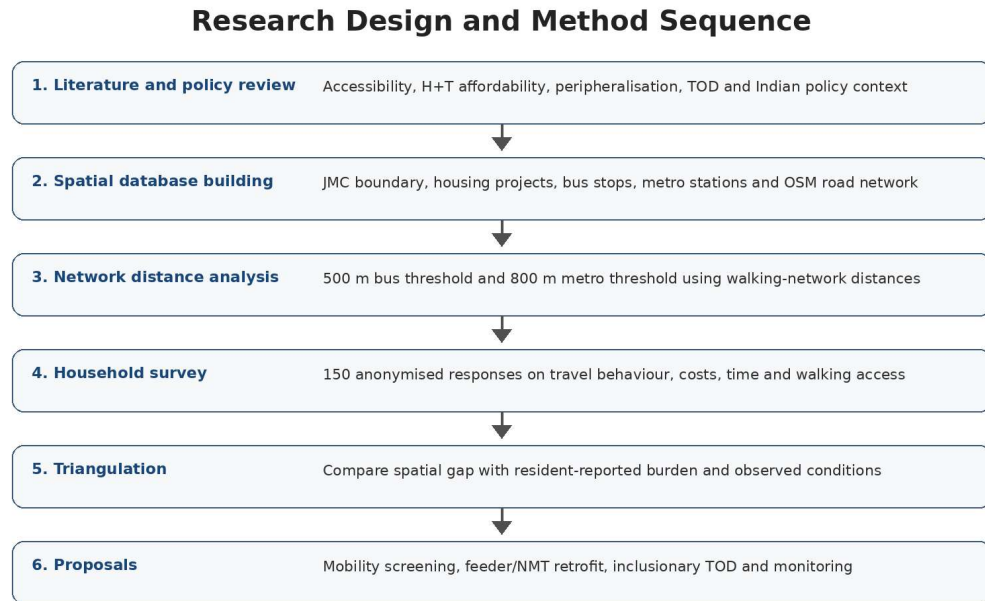


Fig. 3.1: Research Design and Method Sequence

Source: Author.

3.6 GIS Database and Network Analysis

Table 3.4: GIS Data Layers Summary

Layer	Geometry	Features	Source / role	Main caveat
JMC boundary	Polygon	1	Study area boundary and clipping layer	Administrative boundary may not represent functional commute region.
Housing sites	Point	35	Main housing inventory	Centroids used; internal gates not modelled.
Affordable housing subset	Point	16	Equity-focused subset	Affordability flag based on project metadata.
Bus stops	Point	119	Bus access points	Frequency, waiting time and informal stops not included.
Metro stations	Point	11	Operational Phase 1 station access points	Future extensions excluded from current screen.

Layer	Geometry	Features	Source / role	Main caveat
Road network	Line	46,701	OSM-derived walking network	Network topology and actual pedestrian usability may differ on ground.

Source: Author, based on GIS geodatabase processed in QGIS.

Network distances were computed from each housing centroid to transit access points along the road network. The analysis used WGS84 (EPSG:4326) for storage and UTM Zone 43N (EPSG:32643) for distance computation. The pedestrian speed assumption of 5 km/h is used only for interpreting walking time; final accessibility classification is based on distance bands. Because the network is based on OSM geometry, results should be interpreted as planning-level proximity evidence rather than field-certified walking audit results (Boeing, 2017).

3.7 Accessibility Thresholds

Table 3.5: Accessibility Classification Thresholds

Mode	Served	Near-miss	Moderate gap	Severe gap	Planning meaning
Bus	≤ 500 m	501-1000 m	1001-2000 m	> 2000 m	500 m reflects a basic walking access benchmark; longer distances require NMT, feeder or route intervention.
Metro	≤ 800 m	801-1500 m	1501-2500 m	> 2500 m	800 m reflects mass-transit influence logic; beyond this distance direct walking access is weak.
Combined	Bus and/or metro threshold met	One mode near threshold	Both outside but one correctable	Both far outside	Used to prioritise interventions.

Source: Author, based on MoHUA SLB/TOD benchmark logic and thesis classification scheme.

3.8 Survey Design and Sampling

The household survey contains 150 valid anonymised responses. It was administered across BSUP, PMAY, RHB and CMJAY housing contexts. The survey captured

household profile, tenure, income bracket, occupation, main destination, primary travel mode, travel time, one-way travel cost, monthly transport spending, bus and metro access, walking/access problems, perceived transport burden and enumerator observations.

Table 3.6: Survey Site Distribution

Survey site	Responses	Share
BSUP Sanganer	38	25.3%
PMAY Mansarovar	38	25.3%
RHB Pratap Nagar	37	24.7%
CMJAY Jagatpura	37	24.7%

Source: Author's household survey, N=150.

Table 3.7: Survey Variable Groups

Section	Variables	Purpose
A. Household profile	A1-A14	To understand scheme, tenure, household size, earners, income and housing context.
B. Transport access and mobility	B1-B16	To assess mode choice, travel time, cost, bus/metro access, walking problems, burden and desired improvements.
O. Enumerator observations	O1-O4	To record visible road, footpath, public-transport stop and safety/comfort conditions.

Source: Author.

3.9 Ethics and Data Handling

The survey was anonymised and no personal identifiers are reported. Respondents were informed about the academic purpose of the study and their voluntary participation. The analysis reports aggregate results only. Household identifiers, if used during cleaning, are treated as anonymised survey codes.

3.10 Chapter Summary

The methodology is intentionally transparent and bounded. It can support claims about benchmark-aligned walking proximity, household-reported travel burden and planning implications. It cannot support claims about full service quality, formal PTAL scores, exact H+T ratios or all households in Jaipur. These limits are carried into the interpretation of Chapter 4.

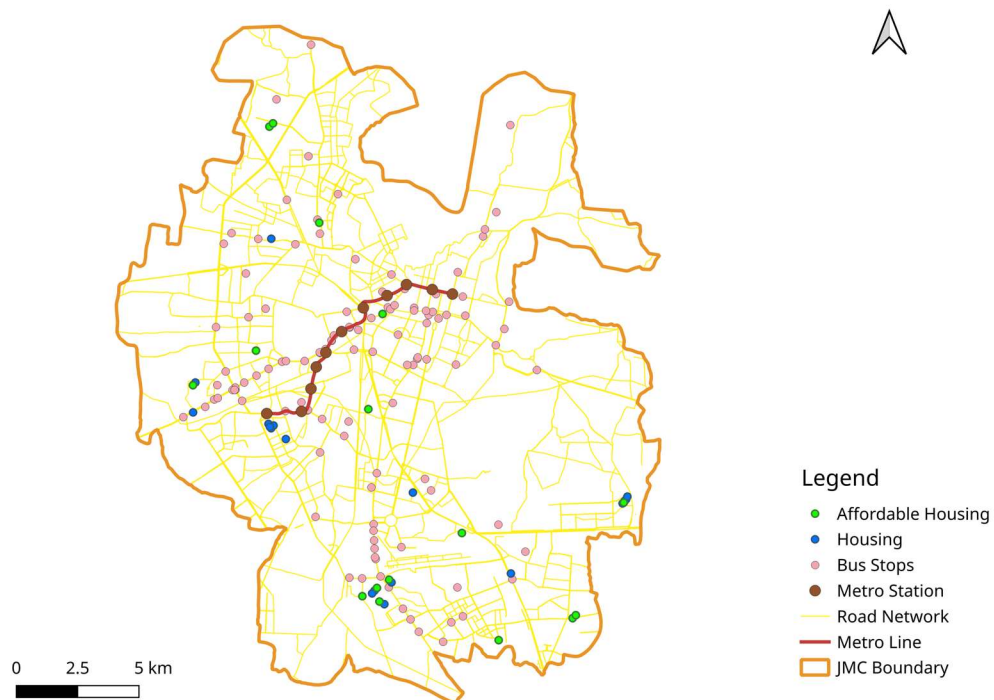
CHAPTER 4: DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents the empirical evidence from the GIS analysis and the household survey. The spatial analysis uses all 35 mapped housing projects as the main inventory and treats the 16 affordable-flagged projects as a subset. The household analysis uses 150 anonymised responses. The two evidence streams are interpreted together rather than in isolation.

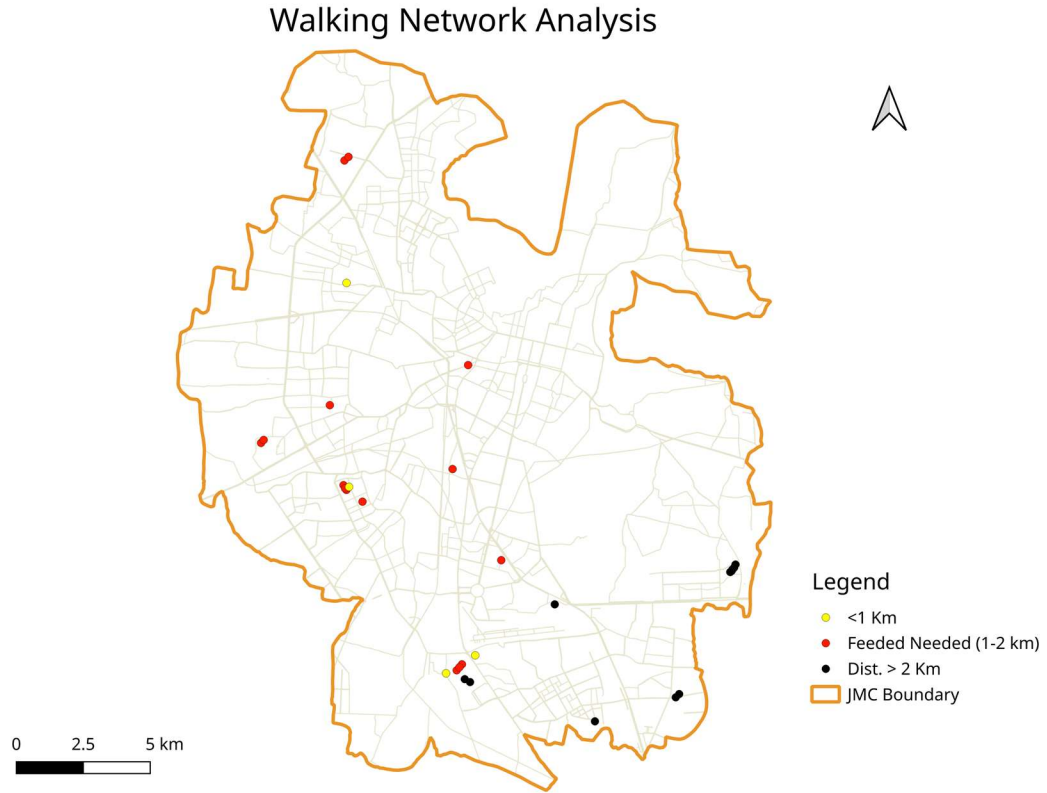
4.2 Spatial Accessibility Analysis

Housing Transit Overlay



Map 4.1: Housing-Transit Overlay with 500 m Bus and 800 m Metro Catchments

Source: Author, based on housing, bus stop, metro station and JMC boundary layers.



Map 4.2: Walking-Network Access Severity for Housing Projects

Source: Author, QGIS walking-network analysis.

4.2.1 Bus Accessibility

The bus-access result shows that formal mapped bus access is weak even in the wider housing inventory. Only 4 of 35 mapped housing projects fall within 500 m walking-network distance of a mapped bus stop. Within the affordable-flagged subset, 4 of 16 projects meet the 500 m threshold. This means that most projects in both groups are outside the basic walking-access benchmark.

Table 4.1: Housing-to-Bus Accessibility Classification

Classification	Affordable subset (N=16)	Share	All housing projects (N=35)	Share
Within 500 m (served)	4	25.0%	4	11.4%
501-1000 m (near-miss)	3	18.8%	4	11.4%
1001-2000 m (moderate gap)	5	31.3%	7	20.0%

Classification	Affordable subset (N=16)	Share	All housing projects (N=35)	Share
Beyond 2000 m (severe gap)	4	25.0%	20	57.1%
Outside 500 m threshold	12	75.0%	31	88.6%

Source: Author, QGIS network analysis.

4.2.2 Metro Accessibility

The metro-access result is more severe. None of the 35 mapped housing projects is within 800 m walking-network distance of an operational Jaipur Metro Phase 1 station. The same is true for the affordable-flagged subset. This does not mean that the metro is irrelevant to Jaipur; it means that the current mapped housing inventory is not directly served by the operational metro corridor under the 800 m walking threshold.

Table 4.2: Housing-to-Metro Accessibility Classification

Classification	Affordable subset (N=16)	Share	All housing projects (N=35)	Share
Within 800 m (served)	0	0.0%	0	0.0%
801-1500 m (near-miss)	0	0.0%	0	0.0%
1501-2500 m (moderate gap)	2	12.5%	4	11.4%
Beyond 2500 m (severe gap)	14	87.5%	31	88.6%
Outside 800 m threshold	16	100.0%	35	100.0%

Source: Author, QGIS network analysis.

4.2.3 Combined Accessibility

Because no project falls inside the operational metro threshold, combined accessibility is determined by the bus threshold. In the full inventory, 4 projects are bus-only and 31 projects fall outside both thresholds. In the affordable subset, 4 are bus-only and 12 fall outside both thresholds. The headline result is therefore not only a metro gap; it is a wider housing-transit integration gap.

Table 4.3: Combined Transit Accessibility Classification

Combined status	Affordable subset (N=16)	Share	All housing projects (N=35)	Share
Served by bus and metro	0	0.0%	0	0.0%

Combined status	Affordable subset (N=16)	Share	All housing projects (N=35)	Share
Served by bus only	4	25.0%	4	11.4%
Served by metro only	0	0.0%	0	0.0%
Outside both thresholds	12	75.0%	31	88.6%

Source: Author, combined classification from bus and metro network-distance outputs.

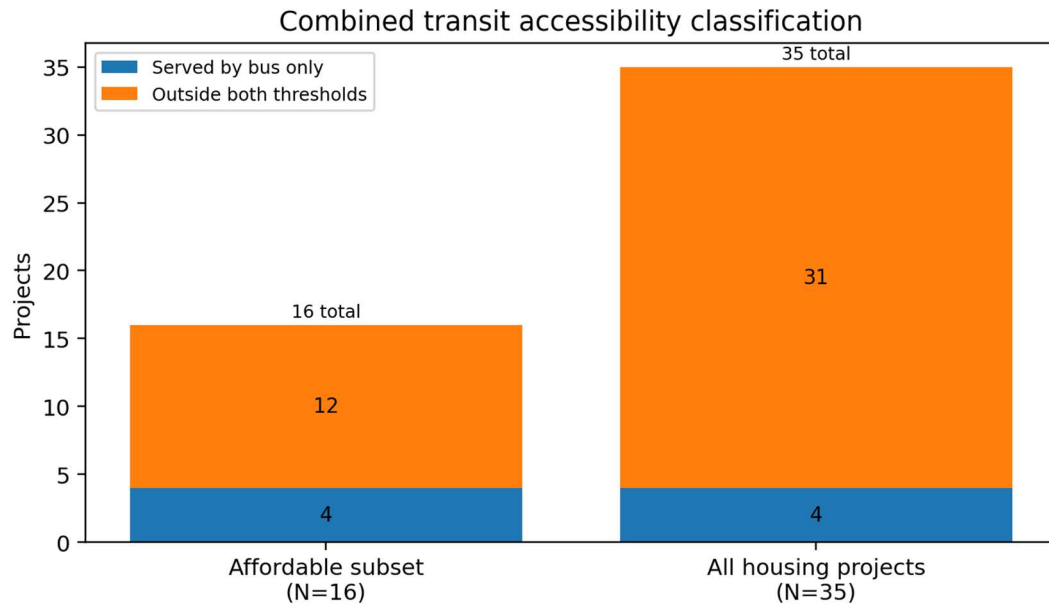


Fig. 4.1: Combined Transit Accessibility Classification

Source: Author, based on QGIS accessibility outputs.

4.3 Household Profile

The household survey supports the equity framing of the study. 136 respondents, or 90.7%, reported monthly household income of Rs. 25,000 or below. The survey therefore captures a strongly low-income housing user group, although it remains purposive and not statistically representative of all Jaipur households.

Table 4.4: Monthly Household Income Distribution

Monthly household income	Respondents	Share
<₹10,000	55	36.7%
₹10,000–15,000	55	36.7%
₹15,001–25,000	26	17.3%
₹25,001–40,000	14	9.3%

Source: Author's household survey, variable A10, N=150.

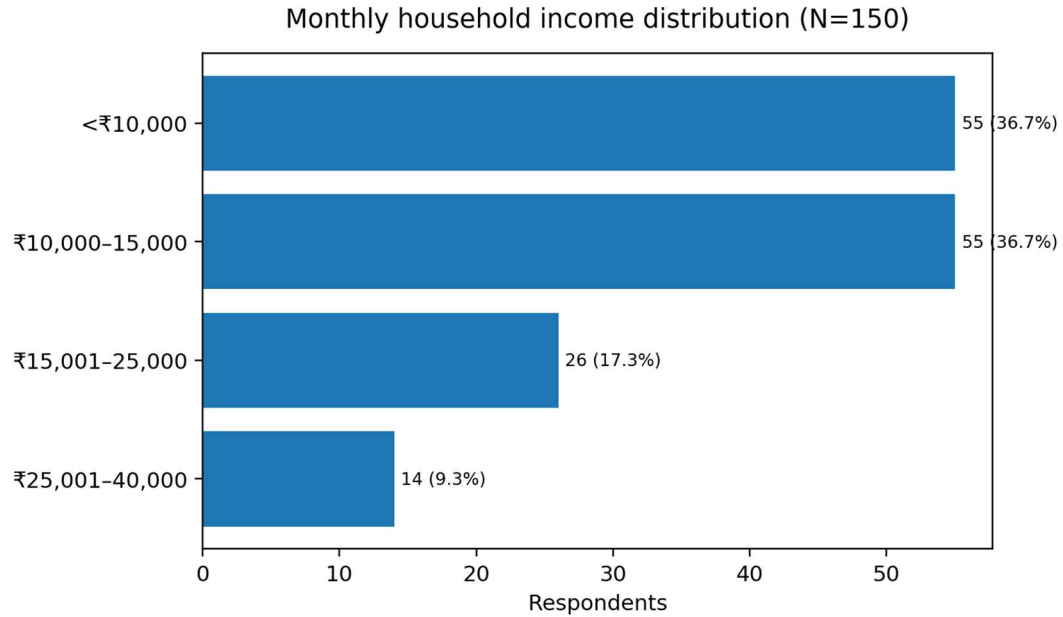


Fig. 4.2: Monthly Household Income Distribution

Source: Author's household survey, N=150.

Table 4.5: Selected Household Profile Indicators

Indicator	Category	Respondents	Share
Tenure	Owner	98	65.3%
Tenure	Rented	36	24.0%
Residence duration	More than 5 years	50	33.3%
Household size	3-4 members	77	51.3%
Household size	5-6 members	73	48.7%
Earning members	One earner	77	51.3%
Earning members	Two or more earners	73	48.7%

Source: Author's household survey, N=150.

4.4 Travel Patterns

Bus is the most common formal public transport mode, but bus and metro together account for only 62 respondents (41.3%). Shared auto/e-rickshaw and private two-wheeler use remains substantial, indicating that residents manage access gaps through intermediate and private modes.

Table 4.6: Primary Travel Mode

Primary mode	Respondents	Share
Walk	15	10.0%
Cycle	6	4.0%
Bus	50	33.3%
Metro	12	8.0%

Primary mode	Respondents	Share
Shared auto/e-rickshaw	35	23.3%
Private two-wheeler	32	21.3%

Source: Author's household survey, variable B2, N=150.

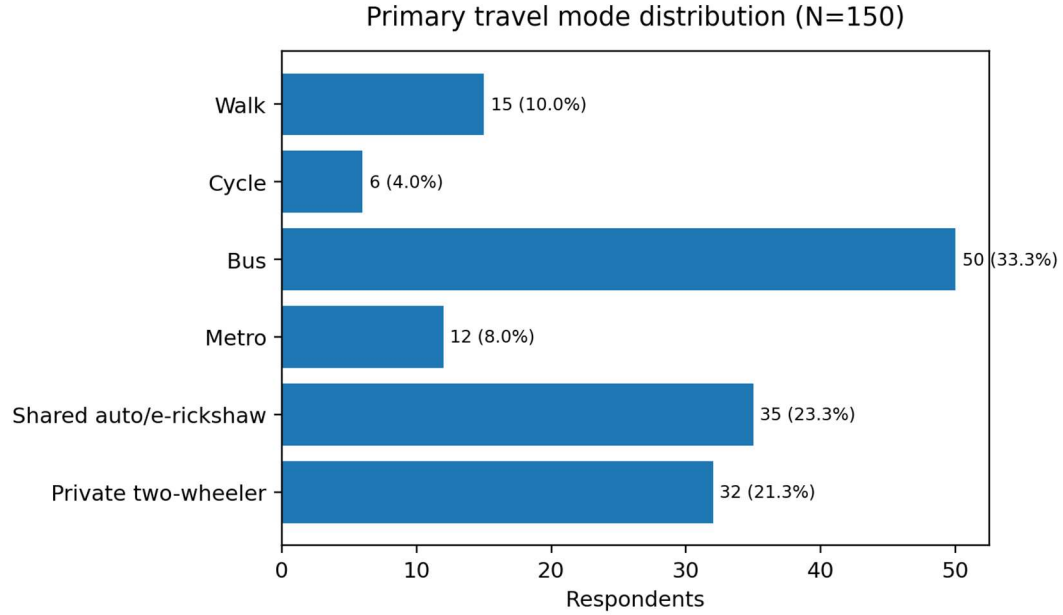


Fig. 4.3: Primary Travel Mode Distribution

Source: Author's household survey, N=150.

Table 4.7: One-Way Travel Time

One-way travel time	Respondents	Share
<15	5	3.3%
15–30	32	21.3%
30–45	47	31.3%
45–60	45	30.0%
60–90	15	10.0%
>90	6	4.0%

Source: Author's household survey, variable B3, N=150.

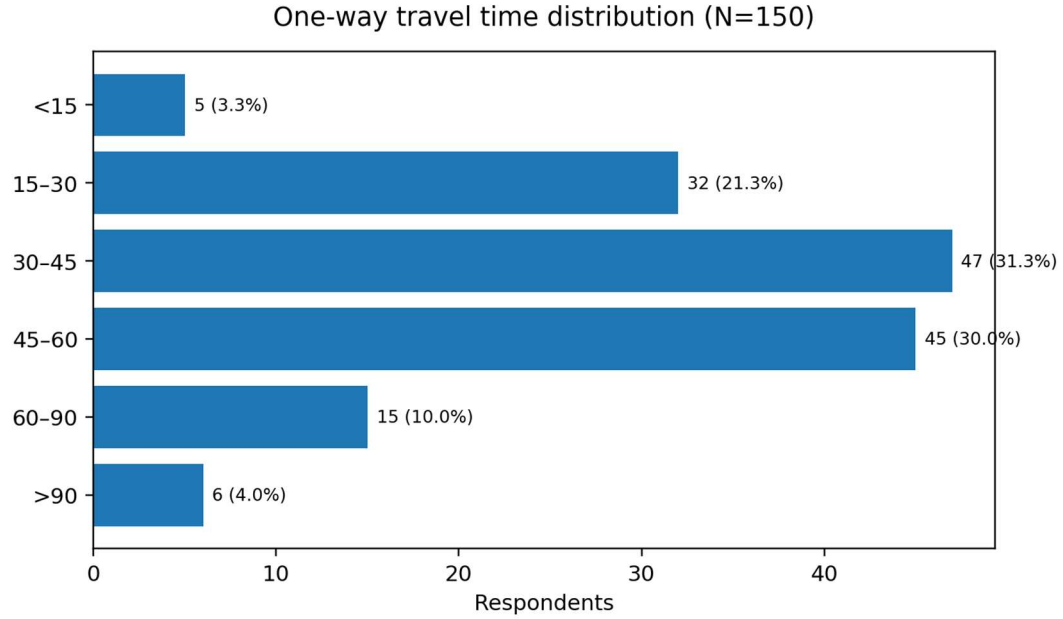


Fig. 4.4: One-Way Travel Time Distribution

Source: Author's household survey, N=150.

Travel time is a major part of the locational-affordability burden. 113 respondents (75.3%) report one-way travel time of 30 minutes or more. For low-wage and informal workers, this is not only a time loss but also a reduction in feasible job choice and household care time.

Table 4.8: Monthly Transport Spending

Monthly spending	Respondents	Share
₹0–500	9	6.0%
₹501–1,000	42	28.0%
₹1,001–2,000	56	37.3%
₹2,001–4,000	38	25.3%
>₹4,000	5	3.3%

Source: Author's household survey, variable B5, N=150.

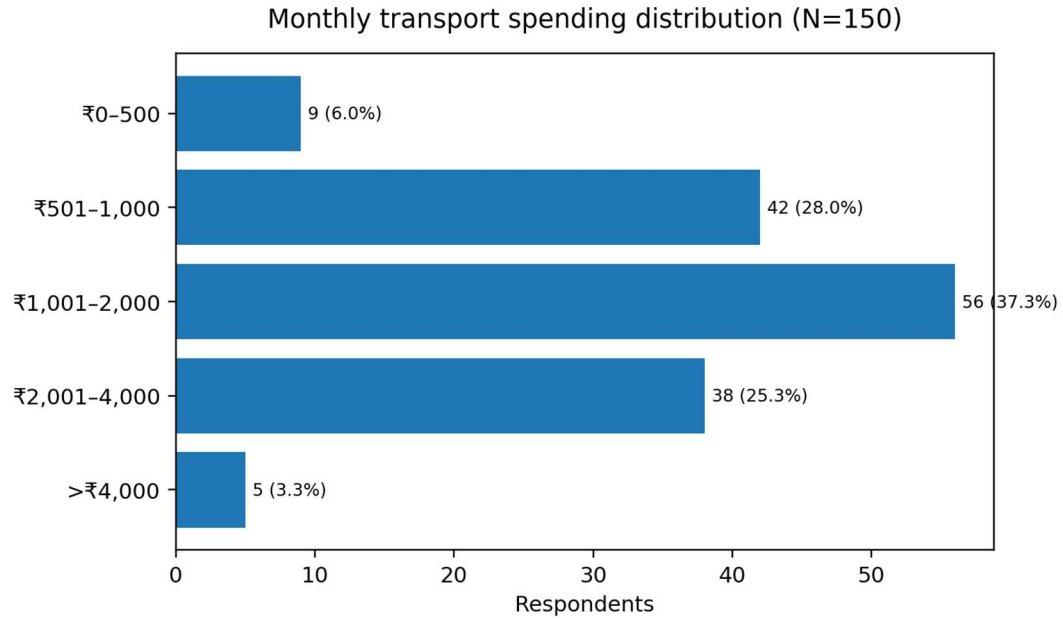


Fig. 4.5: Monthly Transport Spending Distribution

Source: Author's household survey, N=150.

Transport spending is also significant: 99 respondents (66.0%) spend more than Rs. 1,000 per month on transport. This supports the thesis claim that low housing cost cannot be evaluated without recurring transport expenditure.

4.5 Transit Access Assessment

Table 4.9: Bus and Metro Access Indicators

Indicator	Category	Respondents	Share
Walk time to nearest bus stop	Less than 10 minutes	66	44.0%
Walk time to nearest bus stop	10 minutes or more / no usable stop	84	56.0%
Bus service usefulness	Yes / sometimes	117	78.0%
Bus service usefulness	No / no bus nearby	29	19.3%
Metro access time	Up to 30 minutes	94	62.7%
Metro access time	30 minutes or more / cannot access	56	37.3%

Source: Author's household survey, variables B6-B8, N=150.

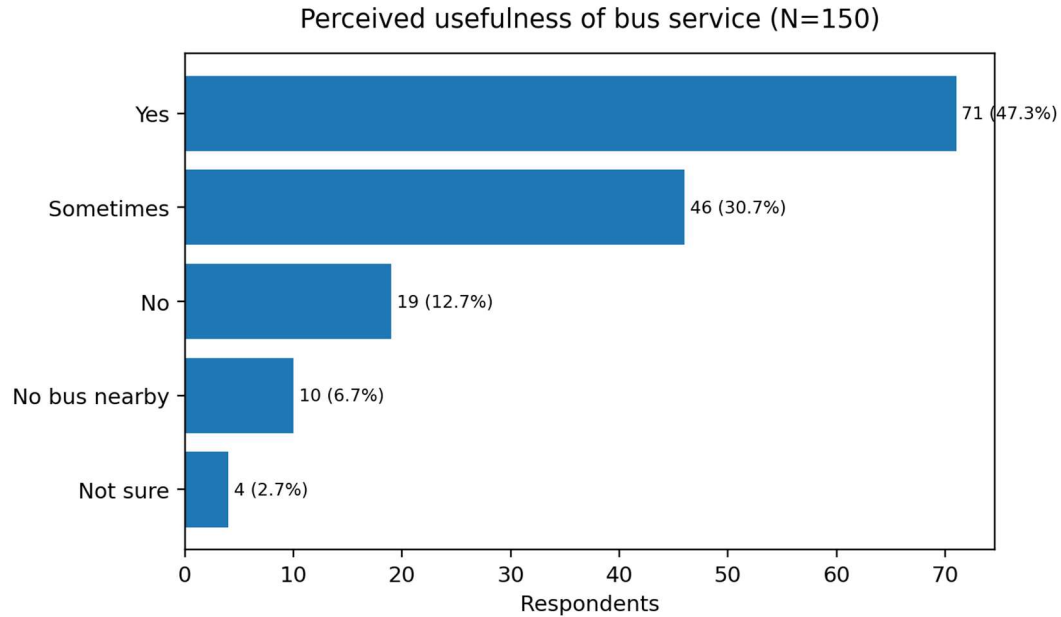


Fig. 4.6: Perceived Usefulness of Bus Service

Source: Author's household survey, N=150.

4.6 Walking Infrastructure and Site Observations

The walking/access problem question is treated as a multi-response field because respondents could mention more than one issue. This corrects a common reporting error: the percentage of mentions should not be interpreted as mutually exclusive household shares. The most frequent problem mentions are safety concern, poor lighting and unsafe crossing.

Table 4.10: Walking and Access Problems Near Home (Multi-response)

Issue mentioned	Mentions	Mentions per 100 respondents	Share of all mentions
Safety concern	41	27.3%	13.7%
Poor lighting	40	26.7%	13.3%
Unsafe crossing	39	26.0%	13.0%
Bad road condition	34	22.7%	11.3%
Encroachment	34	22.7%	11.3%
No shade	33	22.0%	11.0%
No problem	31	20.7%	10.3%
Waterlogging	28	18.7%	9.3%
No footpath	20	13.3%	6.7%

Source: Author's household survey, variable B10, N=150 respondents and 300 mentions.

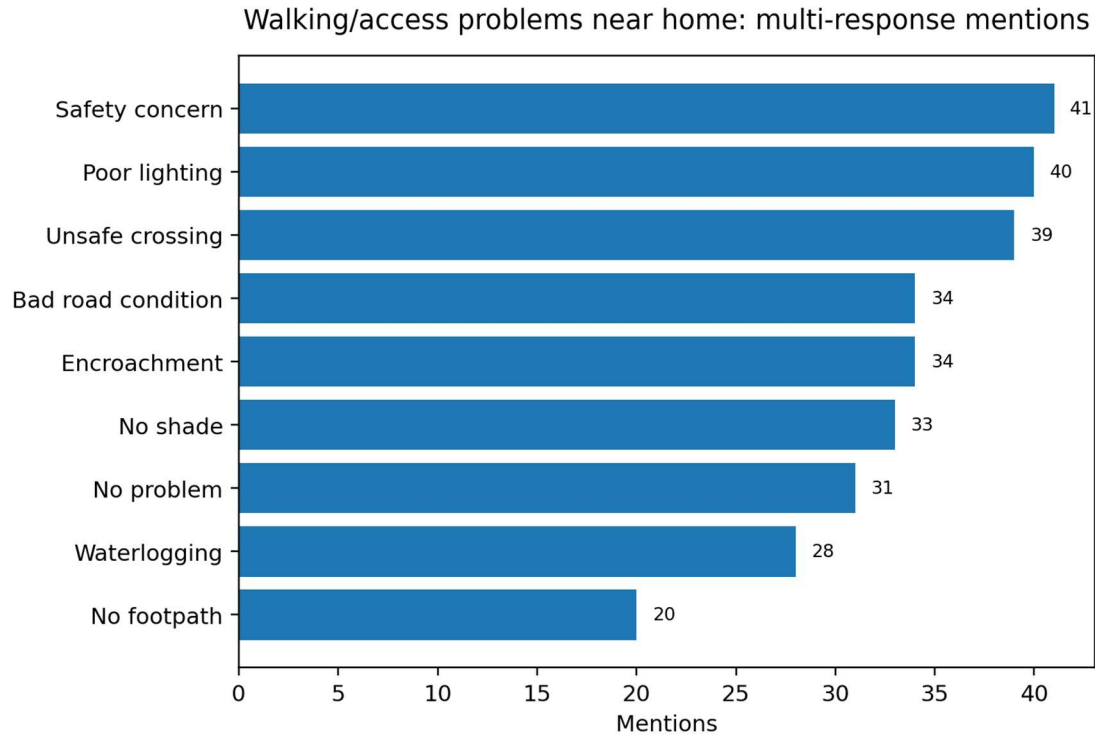


Fig. 4.7: Walking and Access Problems Near Home

Source: Author's household survey, N=150.

Table 4.11: Enumerator Observations on Access Conditions

Observation	Category	Respondents / observations	Share
Road condition	Good	44	29.3%
Road condition	Average	51	34.0%
Road condition	Poor	55	36.7%
Footpath availability	Continuous	57	38.0%
Footpath availability	Partial	55	36.7%
Footpath availability	No	38	25.3%
Visible public transport stop	Yes	51	34.0%
Visible public transport stop	No / not sure	99	66.0%

Source: Author's field observations, N=150.

4.7 Transport Burden and Opportunity Effects

The central household finding is perceived transport burden. 73 respondents (48.7%) describe transport cost as very serious or somewhat serious. This does not mean all households are equally distressed; it means that nearly half the survey sample experiences transport cost as a serious affordability issue.

Table 4.12: Transport Burden Self-Assessment

Burden category	Respondents	Share
Not a burden	34	22.7%
Manageable	43	28.7%
Somewhat serious	35	23.3%
Very serious	38	25.3%

Source: Author's household survey, variable B14, N=150.

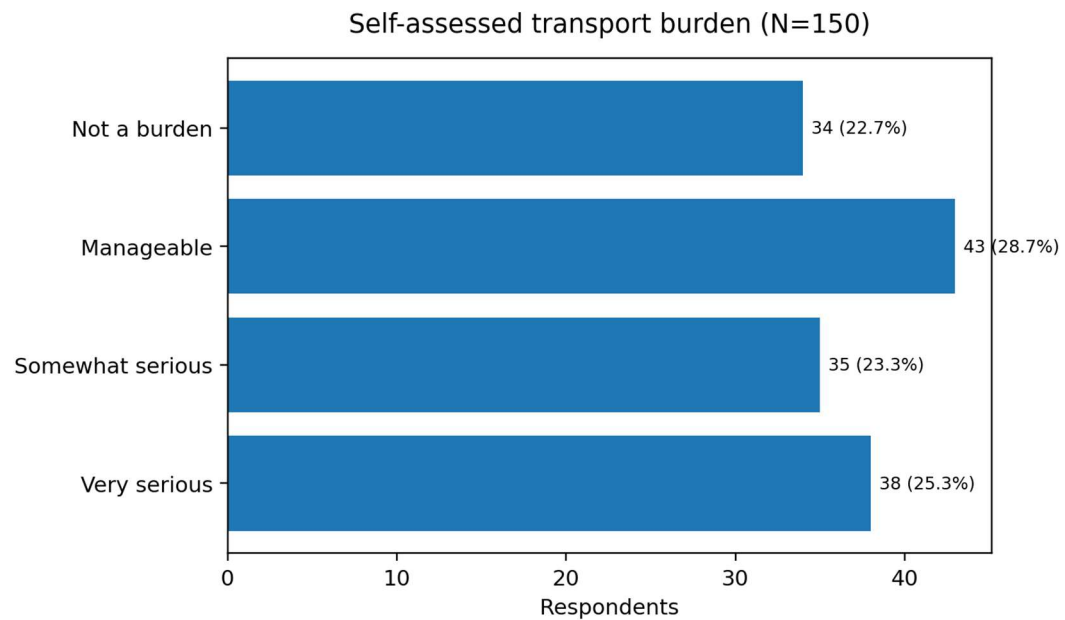


Fig. 4.8: Self-Assessed Transport Burden

Source: Author's household survey, N=150.

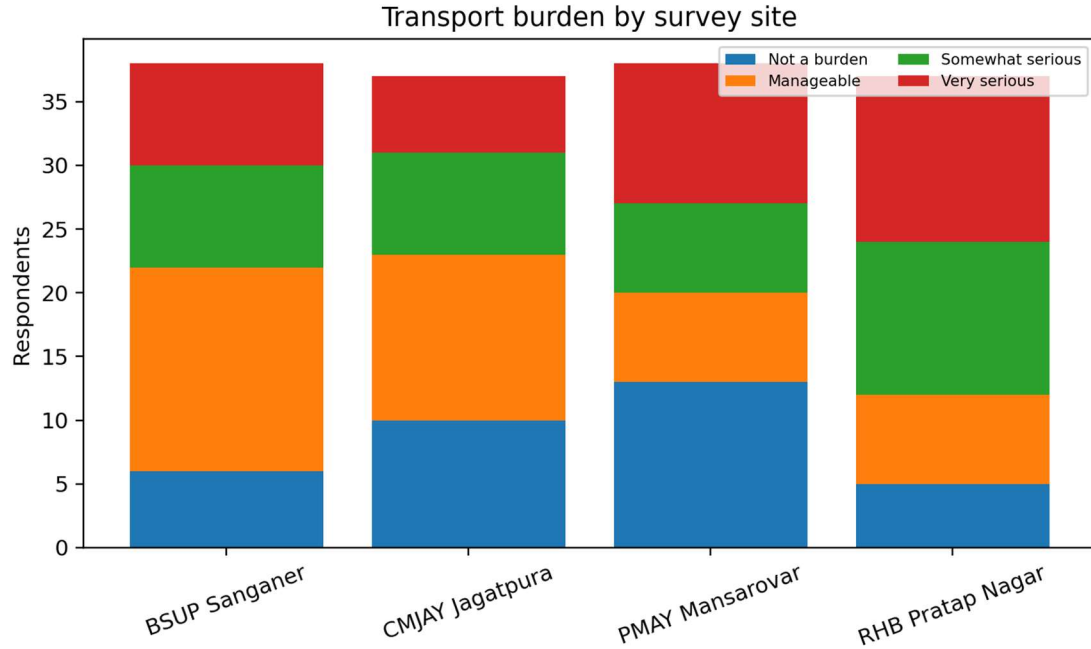


Fig. 4.9: Transport Burden by Survey Site

Source: Author's household survey, cross-tabulation of A2 and B14.

Table 4.13: Work, School and Opportunity Effects

Indicator	Category	Respondents	Share
Travel affects work/school/health access	Sometimes / frequently	67	44.7%
Travel affects work/school/health access	Never / rarely	83	55.3%
Avoided job/school/service due to travel	Yes / not sure	109	72.7%
Avoided job/school/service due to travel	No	41	27.3%

Source: Author's household survey, variables B12-B13, N=150.

Table 4.14: Priority Improvements Suggested by Respondents (Multi-response)

Improvement suggested	Mentions	Mentions per 100 respondents	Share of all mentions
Better metro connection	37	24.7%	12.3%
Better bus shelter	37	24.7%	12.3%
Safer crossing	34	22.7%	11.3%
Street lights	29	19.3%	9.7%
Closer bus stop	29	19.3%	9.7%
More buses	25	16.7%	8.3%
Feeder e-rickshaw	25	16.7%	8.3%

Improvement suggested	Mentions	Mentions per 100 respondents	Share of all mentions
Shade	23	15.3%	7.7%
Direct route to work	22	14.7%	7.3%
Cheaper fare	21	14.0%	7.0%
Better footpath	18	12.0%	6.0%

Source: Author's household survey, variable B15, N=150 respondents and 300 mentions.

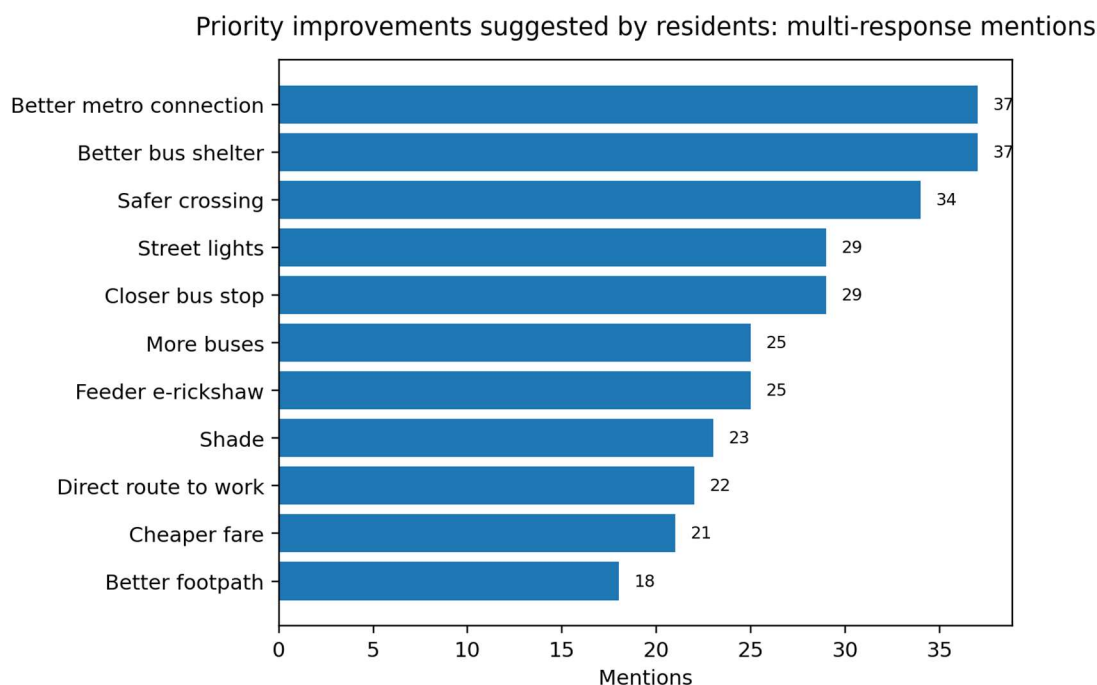


Fig. 4.10: Priority Improvements Suggested by Respondents

Source: Author's household survey, N=150.

4.8 Gap Assessment and Triangulation

Table 4.15: Spatial-Survey Triangulation Matrix

Evidence theme	Spatial evidence	Survey evidence	Planning implication
Transit proximity	31 of 35 projects outside both thresholds; 12 of 16 affordable projects outside both thresholds.	Bus/metro primary mode share is only 41.3%.	Housing approval should include transit-distance screening.
Metro gap	No mapped housing project falls within 800 m of operational metro.	Metro access time is often 30 minutes or more or not possible.	Future TOD policy must include affordable housing reservation and feeder integration.
First/last-mile gap	Network distances exceed comfortable walking thresholds for most projects.	56.0% report 10 minutes or more to bus stop or no usable stop.	NMT corridors and feeder stops are required.

Evidence theme	Spatial evidence	Survey evidence	Planning implication
Cost burden	Peripheral and weakly served locations require additional travel effort.	48.7% report serious transport burden and 66.0% spend more than Rs. 1,000/month.	Transport cost must be considered in housing affordability decisions.
Walking environment	Network analysis assumes walkability but cannot judge comfort.	Safety concern, poor lighting and unsafe crossings are top problem mentions.	Footpaths, crossings and lighting must be treated as transit infrastructure.

Source: Author, synthesised from GIS analysis and household survey.

4.9 Key Findings Summary

Table 4.16: Key Findings from Chapter 4

No.	Finding	Evidence base
1	The full mapped housing inventory is weakly aligned with formal transit access: 31 of 35 projects are outside both thresholds.	QGIS network analysis
2	The affordable-flagged subset carries an equity issue: 12 of 16 projects are outside both thresholds.	QGIS network analysis
3	No mapped housing project is within 800 m walking-network distance of an operational metro station.	QGIS network analysis
4	Bus and metro together account for 41.3% of primary travel modes.	Household survey, B2
5	75.3% of respondents report one-way travel time of 30 minutes or more.	Household survey, B3
6	66.0% of respondents spend more than Rs. 1,000 per month on transport.	Household survey, B5
7	48.7% of respondents describe transport cost as a serious burden.	Household survey, B14
8	Walking-access problems are concentrated around safety, lighting and crossings.	Household survey and observations

Source: Author.

CHAPTER 5: PLANNING PROPOSALS AND IMPLEMENTATION STRATEGY

5.1 Introduction and Proposal Vision

The proposals respond directly to the evidence in Chapter 4. The spatial result shows that most mapped housing projects, including most affordable-flagged projects, are outside public-transport walking thresholds. The survey result shows that residents absorb this gap through travel time, transport expenditure, reliance on shared/autos two-wheelers and unsafe walking environments. The vision is a Jaipur where housing delivery is not considered complete until residents have safe, affordable and usable access to public transport and daily services.

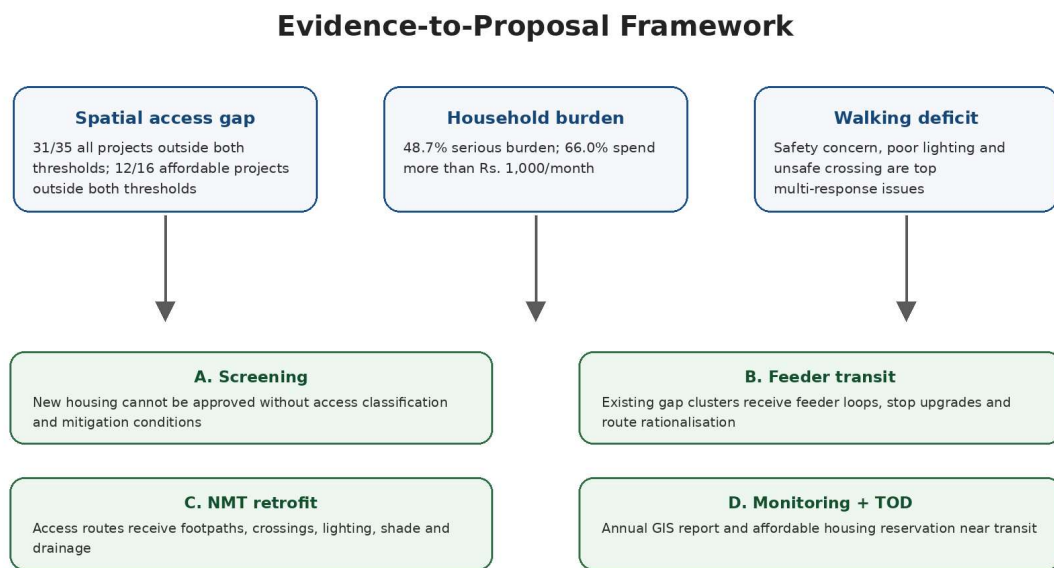


Fig. 5.1: Evidence-to-Proposal Framework

Source: Author.

5.2 Proposal A: Locational Affordability Screening for Housing Approvals

Proposal A is preventive. It requires every new large housing project, and every affordable-housing project in particular, to submit a locational affordability screening note at approval stage. The screening should classify the site according to walking-

network distance to mapped bus stops and operational or committed mass-transit points. If the site falls in a near-miss, moderate or severe gap category, the approval file should include a funded mobility mitigation plan. This aligns housing approval with the integration principles of NUTP and TOD policy without requiring an immediate full PTAL model.

Locational Affordability Screening Workflow

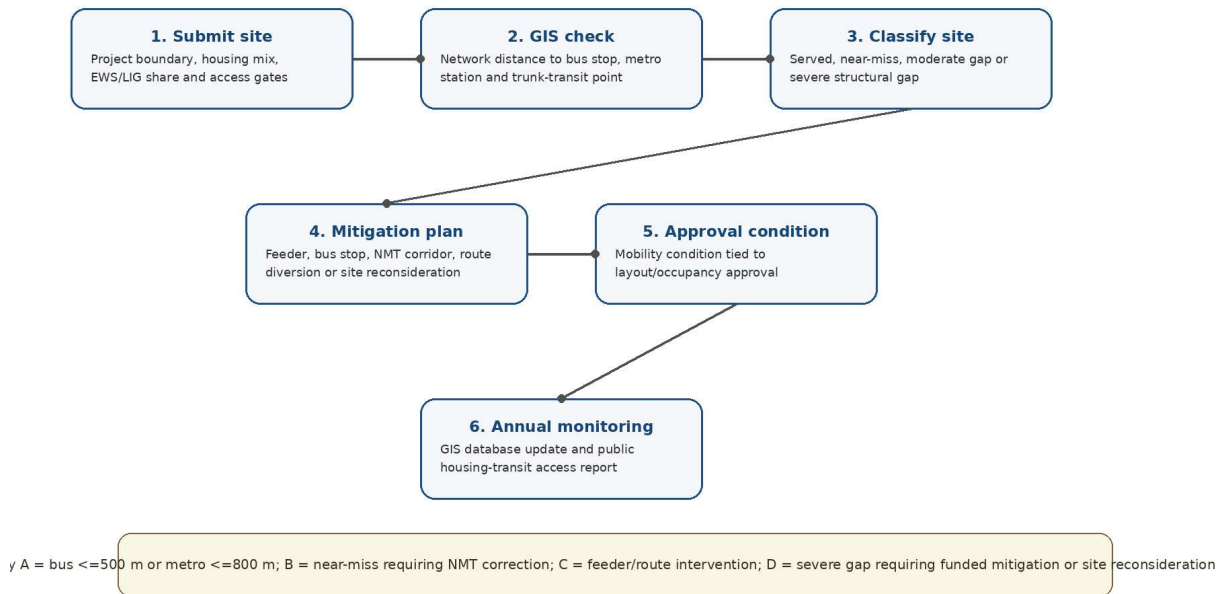


Fig. 5.2: Locational Affordability Screening Workflow

Source: Author.

Table 5.1: Proposed Screening Categories and Approval Conditions

Category	Access condition	Approval condition
A: Served	Bus within 500 m or metro within 800 m walking-network distance.	Normal approval with pedestrian-safety check.
B: Near-miss	Bus 501-1000 m or metro 801-1500 m.	Approval conditional on continuous footpath, lighting and crossing improvements.
C: Moderate gap	Bus 1001-2000 m or metro 1501-2500 m.	Mobility Mitigation Plan required: feeder, stop addition or route diversion.
D: Severe gap	Bus beyond 2000 m and metro beyond 2500 m.	Affordable housing site should be reconsidered or approved only with funded feeder/NMT works before occupancy.

Source: Author.

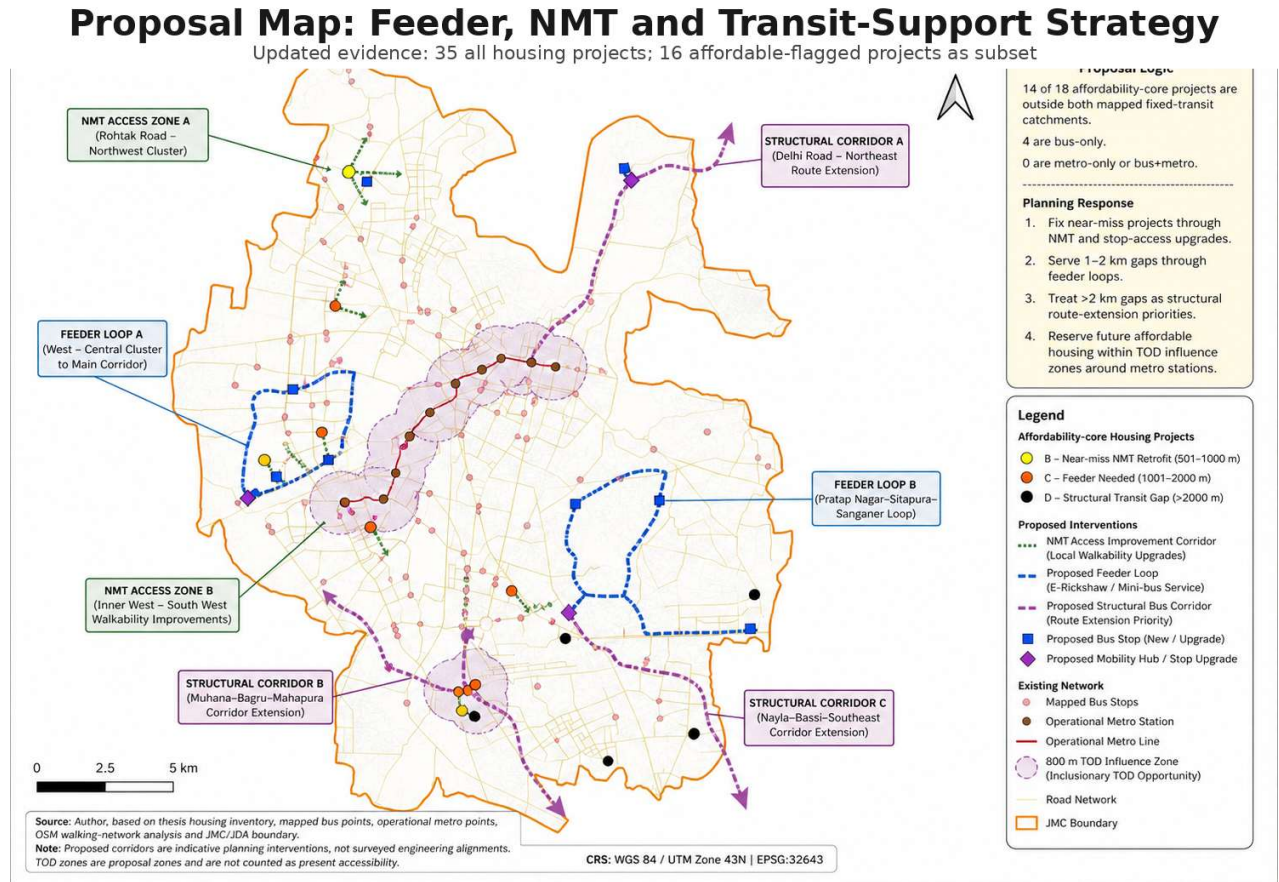
5.3 Proposal B: Feeder Transit and Bus-Stop Retrofit

Proposal B addresses existing housing clusters that cannot be relocated. Feeder planning should begin with pilot corridors where multiple housing sites can be connected to trunk bus corridors, metro stations or employment/service nodes. The feeder proposal should not be treated as a generic e-rickshaw suggestion; it should be contracted, monitored and integrated with JCTSL/JMRC where feasible.

Table 5.2: Proposed Feeder Transit Packages

Package	Target cluster	Indicative connection	Service specification
F1: Pratap Nagar-Sitapura-Sanganer loop	RHB/CMJAY Pratap Nagar and Sitapura-side housing demand	Connect housing pockets to Sitapura employment areas and trunk bus/metro transfer points.	Mini-bus/e-bus or formal feeder every 10-15 minutes in peak and 20 minutes off-peak.
F2: Mansarovar Extension-Ajmer Road feeder	PMAY/Mansarovar Extension/Ajmer Road-side projects	Connect peripheral housing to Mansarovar/New Aatish Market metro and trunk bus corridor.	Timed feeder with integrated ticket/pass where feasible.
F3: North-west/Sikar Road-Jhotwara access route	BSUP Sikar Road, Jhotwara/Sikar Road and IG Nagar-side housing	Connect to Sikar Road trunk bus, local markets and central transfer direction.	Route rationalisation and stop consolidation with shelters and crossings.
F4: Jagatpura-Anand Vihar-Shaurya Nagar feeder	Eastern and south-eastern AHP/CMJAY clusters	Connect to Jagatpura/Sanganer/Agr a Road movement and service nodes.	Peak fixed-route feeder; demand-responsive extension in low-demand hours.

Source: Author, based on spatial gap patterns and survey travel destinations.



Map 5.1: Feeder, NMT and Transit-Support Strategy

Source: Author, updated from thesis GIS proposal map and Chapter 4 evidence.

Table 5.3: Bus and Feeder Stop Retrofit Specification

Element	Minimum specification	Reason linked to findings
Stop spacing	400-500 m in housing access areas where safe stopping space exists.	Matches 500 m access benchmark.
Waiting area	Raised paved waiting space with seating where feasible.	Improves practical usability of stops.
Lighting	Lighting at stop and along approach path at about 25-30 m intervals in high-use corridors.	Responds to poor lighting and safety concern.
Crossing	Raised zebra crossing or refuge near stops across wide/high-speed roads.	Responds to unsafe crossing findings.
Information	Route board, stop name, route number and first/last trip where feasible.	Improves service legibility and user confidence.
Fare integration	Discounted/common pass for feeder transfer where operationally possible.	Controls household transport cost burden.

Source: Author.

5.4 Proposal C: NMT Access Corridors

The survey shows that transit access is not only a distance problem. A route can be short and still unusable if it lacks lighting, crossings, footpaths or drainage. Proposal C therefore treats NMT access as part of the public transport system. Priority corridors should be the walking routes from housing gates to the nearest bus/feeder stop, school, market and service node.

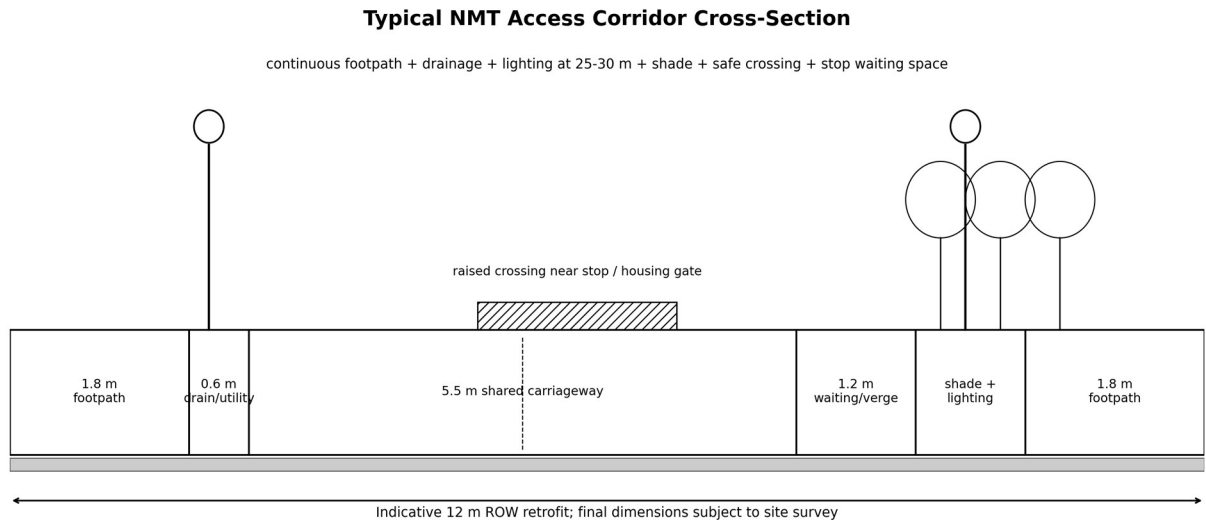


Fig. 5.3: Typical NMT Access Corridor Cross-Section

Source: Author, based on IRC:103 and complete-street principles; final dimensions subject to ROW survey.

Table 5.4: NMT Corridor Intervention Schedule

Package	Target condition	Interventions	Implementation priority
C1: Stop approach corridors	Housing gates to bus/feeder stops.	Continuous walking zone, kerb repair, obstruction removal and edge definition.	Year 1 quick-win package.
C2: Crossing safety	Road crossings to stops, schools and shops.	Raised crossings, refuge islands where ROW permits and warning signage.	Prioritise unsafe/high-speed locations.
C3: Lighting	Dark or isolated access routes.	Street lights at 25-30 m intervals and lighting at stops/junctions.	Direct response to survey safety concerns.
C4: Drainage and surface	Waterlogged or broken access paths.	Side drains, pothole repair and hard all-weather walking surface.	Monsoon resilience package.
C5: Shade and comfort	Long exposed walks and waiting points.	Tree planting, lightweight shelters and	Heat and comfort package.

Package	Target condition	Interventions	Implementation priority
		seating at high-use stops.	
C6: Wayfinding	Large housing colonies and unclear stop visibility.	Directional signage, stop boards and distance markers.	Service legibility package.

Source: Author.

5.5 Proposal D: Inclusionary TOD and Future Housing Siting

Retrofit measures are necessary, but they cannot substitute for better future siting. Since no mapped housing project is within the 800 m operational metro threshold, future TOD policy must be linked with affordable housing reservation. Otherwise, transit-rich areas may become more valuable but not more inclusive. The proposal is to use TOD influence zones, trunk bus corridors and public land inventories to reserve EWS/LIG, rental and worker housing in accessible locations.

Table 5.5: Future Housing Siting and Inclusionary TOD Actions

Action	Mechanism	Safeguard
Affordable housing preference zone	Prioritise EWS/LIG projects within 800 m of operational or committed transit nodes.	Do not displace existing low-income residents without nearby rehabilitation.
Density bonus for inclusion	Permit additional FAR/TDR where affordable units are delivered in accessible locations.	Tie incentives to completed and occupied affordable units.
Transit-access condition	No new affordable project in moderate/severe gap without mobility mitigation funding.	Link mitigation to occupancy certificate.
Public land inventory	Map government/JDA/RHB land within transit influence zones.	Review public land disposal against social-housing need.
Mixed-use local service nodes	Reserve small commercial/community spaces near housing.	Keep rents/allotment affordable for local services.

Source: Author, based on TOD and inclusionary planning principles.

5.6 Proposal E: Institutional Framework and Monitoring

The housing-transit gap is also an institutional gap. JDA, RHB, JMC, JCTSL and JMRC each control one part of the solution. A small Housing-Transit Accessibility Cell or joint working group should maintain the GIS database, run the screening tool, track mitigation conditions and publish an annual access report.

Table 5.6: Proposal-Agency Responsibility Matrix

Component	Lead agency	Supporting agencies	Primary responsibility
Screening tool	JDA	JMC, JCTSL, JMRC, RHB	Make accessibility note mandatory in housing approvals.
Feeder pilots	JCTSL	JMRC, JDA, operators	Plan, contract and monitor feeder routes.
Bus-stop retrofit	JCTSL / JMC	JDA, ward offices	Provide shelters, lighting, waiting space and route information.
NMT corridors	JMC	JDA, traffic police, utilities	Construct and maintain footpaths, crossings, lighting and drainage.
Inclusionary TOD	JDA	RHB, UDH, JMRC	Reserve affordable housing near transit and apply inclusion tools.
Annual report	Housing-Transit Accessibility Cell	All agencies	Update GIS layers, classify projects and report unresolved access gaps.

Source: Author.

Table 5.7: Monitoring Indicators

Indicator	Unit	Target direction
Share of all housing projects within 500 m bus threshold	Percentage	Increase
Share of affordable projects within 500 m bus threshold	Percentage	Increase faster than full inventory
Projects within 800 m metro/trunk transit threshold	Number and percentage	Increase through future siting and feeder integration
Projects in severe bus gap (>2000 m)	Number	Decrease
Feeder ridership from housing clusters	Average boardings/day	Increase after pilot, then stabilise
Average access time to nearest usable stop	Minutes	Decrease
Reported serious transport burden	Percentage of surveyed households	Decrease in follow-up surveys
Walking-access problem index	Composite of lighting, footpath, crossing, safety and drainage issues	Decrease

Source: Author.

5.7 Phasing and Cost Framework

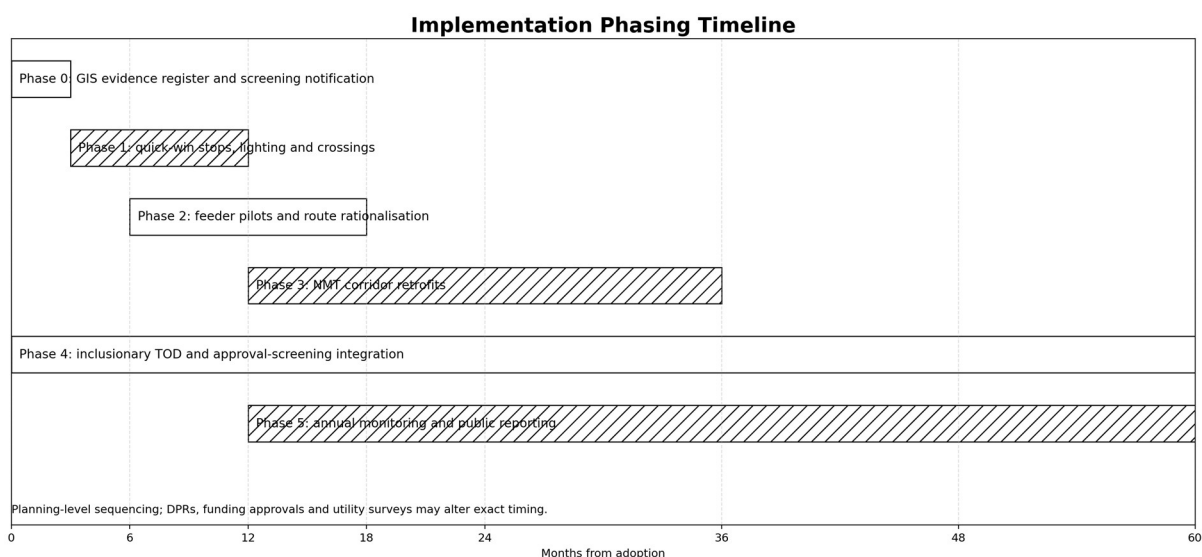


Fig. 5.4: Implementation Phasing Timeline

Source: Author.

Table 5.8: Planning-Level Cost Estimate

Component	Quantity assumption	Indicative unit / annual estimate	Cost range	Notes
GIS screening setup	One-time setup, templates and staff training	Rs. 10-15 lakh setup + Rs. 5 lakh/year maintenance	Rs. 15-25 lakh over 3 years	Can be absorbed into JDA planning workflow.
Feeder route DPRs	Four priority feeder packages	Rs. 5-8 lakh per package	Rs. 20-32 lakh	Field survey and route design required.
Feeder pilot support	Four pilot packages for 12-18 months	Rs. 25-35 lakh per route per year	Rs. 1.0-1.4 crore/year during pilot	Subject to fleet, contract and subsidy model.
Stop upgrades	20-25 priority stops	Rs. 2-3 lakh per stop	Rs. 40-75 lakh	Includes shelter/signage/lighting/waiting space.
NMT access corridors	10-12 km Phase 1 corridors	Rs. 25-40 lakh/km	Rs. 2.5-4.8 crore	Excludes major widening and utility shifting.
Monitoring and policy support	Annual GIS update and audit	Rs. 10-15 lakh/year	Rs. 30-45 lakh over 3 years	Can be technical-cell or outsourced annual audit.

Source: Author, planning-level estimate; DPR required before implementation.

5.8 Expected Impact and Safeguards

The proposals should not be oversold. They cannot immediately eliminate all transport burden or make every peripheral site fully location-efficient. Their expected impact is more specific: prevent future approvals from ignoring access, reduce the worst first/last-mile gaps in existing clusters, improve the safety and comfort of walking routes, and create annual accountability for unresolved access debt. The strongest planning impact is institutional: housing delivery begins to include public transport access as a condition of complete habitat delivery.

Table 5.9: Expected Impact and Safeguards

Proposal	Expected impact	Risk	Safeguard
Mobility screening	Prevents new disconnected housing approvals.	Checklist becomes paperwork.	Tie mitigation to approval/occupancy condition.
Feeder transit	Reduces first/last-mile cost and improves trunk access.	Low ridership if alignment ignores actual destinations.	Pilot with user feedback and fare integration.
NMT corridors	Improves walking access and safety for residents.	Poor maintenance/encroachment.	Assign ward-level maintenance and audit.
Inclusionary TOD	Directs future affordable housing toward accessible locations.	TOD becomes high-income only.	Tie incentives to occupied affordable units.
Annual monitoring	Keeps housing-transit access visible in planning.	GIS layer becomes outdated.	Annual update and public report requirement.

Source: Author.

CHAPTER 6: CONCLUSION

6.1 Answering the Research Questions

6.1.1 Spatial Accessibility of Housing Projects

The primary spatial finding is that Jaipur's mapped housing projects are weakly aligned with formal public transport access. In the full 35-project inventory, 31 projects are outside both the 500 m bus and 800 m metro thresholds. Only 4 projects are served by bus within the benchmark distance and none is served by metro. This answers the first research question by showing that the access gap is not confined to a single project or scheme label; it is a wider housing-transit planning issue.

6.1.2 Affordable Subset and Equity Implication

Within the full inventory, the affordable-flagged subset carries the equity implication. Of 16 affordable-flagged projects, 12 are outside both thresholds. The affordable subset performs slightly better than the full inventory in bus access, with 4 projects inside 500 m, but the majority remains outside both thresholds. The equity concern remains because lower-income households have less capacity to absorb transport cost, transfer cost and long walking distance.

6.1.3 Household Travel Burden

The household survey confirms that the spatial gap has everyday consequences. 48.7% of respondents reported transport cost as a serious burden; 66.0% spend more than Rs. 1,000 per month on transport; 75.3% report one-way travel time of 30 minutes or more; and only 41.3% use bus or metro as their primary mode. The survey therefore supports the locational affordability argument: cheaper or subsidised housing cannot be evaluated without the cost of reaching work and services.

6.1.4 Walking Access and Practical Transit Use

The study also shows that access is not only a matter of distance. Walking conditions affect whether transit is usable. The multi-response walking-access question identifies safety concern, poor lighting and unsafe crossing as leading issues. Enumerator observations reinforce that road condition, footpath continuity and visible public

transport stops vary across sites. These findings justify the NMT retrofit and stop-access proposals in Chapter 5.

6.1.5 Planning Interventions

The appropriate planning response is a layered package, not a single infrastructure project. For future housing, the thesis proposes mandatory locational affordability screening at approval stage. For existing projects, it proposes feeder service pilots, bus-stop retrofits and NMT access corridors. For long-term supply, it proposes inclusionary TOD and public-land prioritisation near transit. For governance, it proposes an annual housing-transit accessibility report.

6.2 Contribution of the Thesis

The thesis contributes to planning practice in five ways. First, it creates a housing-project-specific spatial accessibility evidence base for Jaipur using all mapped housing projects and an affordable-flagged subset. Second, it combines spatial analysis with household survey evidence, allowing the study to connect project location with resident experience. Third, it avoids overstating the method: it uses a benchmark-aligned proximity screen and clearly states that it is not a full PTAL or H+T index. Fourth, it translates findings into implementable planning instruments: screening, feeder routes, NMT corridors, inclusionary TOD and monitoring. Fifth, it frames access debt as a planning accountability problem, not merely a household inconvenience.

6.3 Limitations

The study has important limitations. Bus stops are mapped points and do not include frequency, timetable reliability, crowding or informal stopping practices. Metro analysis is limited to operational Phase 1 stations. Housing projects are represented by centroids rather than all gates and internal paths. The household survey is purposive and cross-sectional, so it does not represent every household in Jaipur and cannot measure changes over time. Transport costs and times are self-reported in brackets, which prevents exact household-level H+T ratio computation. These limitations are not hidden; they define the boundary of the thesis claims.

6.4 Scope for Future Research

- A full service-weighted PTAL for Jaipur using route frequency, wait time and timetable data.
- A longitudinal study tracking households before and after relocation or feeder-service introduction.
- A larger comparative survey including central-city, peripheral and transit-rich housing locations.
- A full H+T affordability model using detailed income, rent/EMI, maintenance, fuel, fare and time-cost data.
- Workplace mapping and destination-based accessibility analysis for informal and formal workers.
- A cost-benefit assessment of feeder routes, bus-stop upgrades and NMT corridor investments.
- Comparative studies across Indian cities using the same housing-transit screening method.

6.5 Closing Statement

Housing that is nominally affordable but located where transit is absent or inadequate is not truly affordable. True locational affordability requires integrating housing siting and public transport planning so that residents can reach employment, services and opportunities without bearing disproportionate transport costs and time burdens. This thesis provides the evidence and the planning framework for beginning that integration in Jaipur.

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ANNEXURE A: SURVEY INSTRUMENT

This annexure presents the survey instrument used for collecting anonymised household-level mobility data. The survey was administered as a structured interview. Response categories were coded for analysis.

Table A.1: Household Profile Questions

Variable	Question / item	Response type
A1	Household survey code	Anonymised code
A2	Survey site / housing project	Categorical
A3	Ward / local area	Categorical/text
A4	Housing scheme / type	Categorical
A5	Tenure status	Owner / rented / allotted / informal
A6	Duration of residence	Categorical
A7	Household size	Number
A8	Number of earning members	Number
A9	Main occupation	Categorical
A10	Monthly household income	Income bracket
A11	Monthly housing payment / cost	Cost bracket
A12-A14	Other household/housing details	Categorical / note

Source: Author's survey instrument.

Table A.2: Transport Access and Mobility Questions

Variable	Question / item	Response type
B1	Main daily travel destination	Categorical
B2	Primary travel mode	Categorical
B3	One-way travel time	Time bracket
B4	One-way travel cost	Cost bracket
B5	Monthly transport spending	Cost bracket
B6	Walk time to nearest bus stop	Time bracket
B7	Whether bus service is useful	Yes / sometimes / no
B8	Metro access time	Time bracket
B9	Reason for non-use or limited use of bus/metro	Categorical
B10	Walking/access problems near home	Multi-response
B11	Group facing most difficulty	Categorical
B12	Whether travel affects work/school/health access	Frequency category
B13	Avoided job/school/service due to travel	Yes / no / not sure
B14	Transport cost burden relative to housing cost	Burden category
B15	Priority improvements suggested	Multi-response
B16	Open comment	Text category

Source: Author's survey instrument.

Table A.3: Enumerator Observation Items

Variable	Observation item	Response type
O1	Road condition near site	Good / average / poor
O2	Footpath availability near entrance	Continuous / partial / no
O3	Visible public transport stop near site	Yes / no / not sure
O4	Safety or comfort issue observed	Categorical

Source: Author's survey instrument.

ANNEXURE B: GIS LAYER DESCRIPTION

This annexure records the GIS layer structure used in the spatial analysis. The layers were processed in QGIS. The analysis was performed as a planning-level network-distance screen, not as a certified field accessibility audit.

Table B.1: GIS Layer Metadata

Layer	Geometry	Features	CRS / processing	Purpose	Caveat
JMC boundary	Polygon	1	WGS84; projected for analysis	Study-area boundary	Administrative boundary only.
Housing sites	Point	35	WGS84 / UTM 43N distance analysis	Main inventory	Project centroid representation.
Affordable subset	Point	16	WGS84 / UTM 43N distance analysis	Equity subset	Affordability flag based on project metadata.
Bus stops	Point	119	WGS84 / UTM 43N distance analysis	Bus access screen	No frequency or service quality data.
Metro stations	Point	11	WGS84 / UTM 43N distance analysis	Metro access screen	Only operational Phase 1 considered.
Road network	Line	46,701	OSM-derived, processed for shortest path	Walking-network distance base	OSM topology and field conditions may differ.

Source: Author, based on GIS database.

Table B.2: Network Analysis Outputs and Interpretation

Output	Interpretation	Used in thesis
Housing-to-bus nearest distance	Shortest walking-network distance from housing centroid to nearest mapped bus stop.	Bus accessibility classification.
Housing-to-metro nearest distance	Shortest walking-network distance from housing centroid to nearest operational metro station.	Metro accessibility classification.
Combined classification	Whether bus and/or metro thresholds are met.	Main spatial finding and proposal prioritisation.
Severity band	Served, near-miss, moderate gap or severe gap.	Intervention type selection.

Source: Author.

ANNEXURE C: ADDITIONAL DATA TABLES

Table C.1: Affordable-Flagged Project-Wise Accessibility Detail

ID / project	Scheme / type	Bus distance (m)	Metro distance (m)	Bus within 500 m
H02 BSUP Flats - Sikar Road	BSUP/JNNURM	144	4932	Yes
H08 RHB CMJAY - Sec 8 Chetak Magar Pratap Nagar	CMJAY/RHB	531	9442	No
H06 RHB CMJAY - Sec 3 Zone 32 Pratap Nagar	CMJAY/RHB	786	10383	No
H01 BSUP Flats - Ajmer Road	BSUP/JNNURM	1174	1197	No
L04 JDA AHP Shaurya Nagar (GH-4 & GH-5)	PMAY-U AHP / CMJAY	1367	9960	No
H25 RHB Mahala Ph-1 Ajmer Road	RHB housing	1397	4747	No
H04 Sanjay Nagar Colony	BSUP/JNNURM	1495	3500	No
L03 JDA AHP Shaurya Nagar (GH-1 to GH-3)	PMAY-U AHP / CMJAY	1498	10094	No
H05 RHB CMJAY - Sec 28 Pratap Nagar	CMJAY/RHB	1514	3506	No
H07 RHB CMJAY - Sec 26 Pratap Nagar	CMJAY/RHB	1772	9980	No
L09 JDA AHP Khera Jaganathpura Scheme	PMAY-U AHP / CMJAY	2024	15238	No
H09 RHB Samriddhi Apartment - Sec 22 Pratap Nagar	RHB housing	2357	10566	No
H35 Pari Residency CMJAY EWS/LIG	CMJAY/private affordable	3035	9630	No
L02 JDA AHP Anand Vihar (GH- 1 & GH-2)	PMAY-U AHP / CMJAY	3414	15575	No
L01 JDA AHP Anand Vihar (GH- 5 & GH-6)	PMAY-U AHP / CMJAY	3456	15617	No

ID / project	Scheme / type	Bus distance (m)	Metro distance (m)	Bus within 500 m
H23 RHB LIG 144 Flats - Sec 9 IG Nagar	RHB housing	5679	16550	No

Source: Author, QGIS network-distance outputs. Note: table records affordable-flagged subset only.

Table C.2: Residence Duration

Category	Respondents	Share
<1 year	18	12.0%
1–3 years	44	29.3%
3–5 years	38	25.3%
>5 years	50	33.3%

Source: Author's household survey, $N=150$.

Table C.3: Household Size

Category	Respondents	Share
3	43	28.7%
4	34	22.7%
5	37	24.7%
6	36	24.0%

Source: Author's household survey, $N=150$.

Table C.4: Earning Members

Category	Respondents	Share
1	77	51.3%
2	43	28.7%
3	15	10.0%
4	15	10.0%

Source: Author's household survey, $N=150$.

Table C.5: Main Destination

Category	Respondents	Share
Walled city	30	20.0%
Other	29	19.3%
Local area	25	16.7%
Sitapura	19	12.7%
Pratap Nagar	19	12.7%
Industrial area	14	9.3%
Domestic work areas	14	9.3%

Source: Author's household survey, $N=150$.

Table C.6: Metro Access Time

Category	Respondents	Share
<10	29	19.3%
10–20	30	20.0%
20–30	35	23.3%
30–45	30	20.0%

Category	Respondents	Share
>45	13	8.7%
Cannot access metro	13	8.7%

Source: Author's household survey, N=150.

Table C.7: Reason for Non-Use / Limited Use of Bus or Metro

Category	Respondents	Share
nan	71	47.3%
First-last mile costly	13	8.7%
Prefer private vehicle	12	8.0%
Too many transfers	11	7.3%
Stop too far	10	6.7%
Infrequent service	10	6.7%
Unsafe walking route	8	5.3%
Route not useful	8	5.3%
Expensive	7	4.7%

Source: Author's household survey, N=150.

Table C.8: Group Facing Most Difficulty

Category	Respondents	Share
No one	25	16.7%
Everyone	21	14.0%
Elderly	20	13.3%
Students	18	12.0%
Children	17	11.3%
Working men	17	11.3%
Working women	16	10.7%
Persons with disability	16	10.7%

Source: Author's household survey, N=150.

Table C.9: Travel Impact on Work/School/Health Access

Category	Respondents	Share
Never	36	24.0%
Rarely	47	31.3%
Sometimes	34	22.7%
Frequently	33	22.0%

Source: Author's household survey, N=150.

Table C.10: Avoided Job/School/Service due to Travel

Category	Respondents	Share
Yes	56	37.3%
No	41	27.3%
Not sure	53	35.3%

Source: Author's household survey, N=150.

Table C.11: Open Comment Category

Category	Respondents	Share
Too many transfers	22	14.7%

Category	Respondents	Share
Police presence needed	20	13.3%
Long travel time	20	13.3%
Heavy traffic	20	13.3%
Need metro extension	19	12.7%
Roads are bad	17	11.3%
Fuel cost is too high	16	10.7%
No bus after 9 pm	16	10.7%

Source: Author's household survey, N=150.

Table C.12: Road Condition Observation

Category	Respondents	Share
Good	44	29.3%
Average	51	34.0%
Poor	55	36.7%

Source: Author's household survey, N=150.

Table C.13: Footpath Availability Observation

Category	Respondents	Share
Yes continuous	57	38.0%
Partial	55	36.7%
No	38	25.3%

Source: Author's household survey, N=150.

Table C.14: Visible Public Transport Stop Observation

Category	Respondents	Share
Yes	51	34.0%
No	50	33.3%
Not sure	49	32.7%

Source: Author's household survey, N=150.

Table C.15: Safety/Comfort Observation

Category	Respondents	Share
nan	34	22.7%
Isolated area	30	20.0%
Encroachment	28	18.7%
No lighting	22	14.7%
High-speed road	20	13.3%
No crossing	16	10.7%

Source: Author's household survey, N=150.

ANNEXURE D: CASE STUDY NOTES

Ahmedabad PTAL and Resettlement

Ahmedabad provides both an accessibility-method precedent and a cautionary housing precedent. PTAL-style analysis shows how transport access can be mapped; the experience of peripheral resettlement warns that formal housing without livelihood access can deepen exclusion.

Surat PTAL / BRT

Surat demonstrates that public transport accessibility mapping can be connected to land-use and corridor planning. The lesson for Jaipur is to use accessibility outputs as planning evidence rather than as decorative maps.

Hubli-Dharwad PTAL Planning

Hubli-Dharwad shows the communication value of accessibility mapping. A simple and readable accessibility map can support planning-policy discussion where a complex technical score may not be understood by decision-makers.

Bhopal Slum Accessibility

Bhopal's slum accessibility work shows that low-income and vulnerable settlements require equity-focused analysis. This supports the decision to analyse the affordable-flagged subset separately within the full housing inventory.

Lucknow H+T Affordability

Lucknow provides a direct Indian precedent for housing plus transport affordability. It shows why peripheral low-cost housing can become less affordable after transport expenditure is included.

Savda Ghevra, Delhi

The Delhi resettlement case is a warning about livelihood shock. Relocation may improve formal shelter but reduce economic access, especially for women and informal workers.

Mumbai Transit Disparity

Mumbai shows that even dense cities can have unequal access where low-income areas are poorly connected to reliable transit or suffer poor last-mile conditions.

Singapore HDB + MRT

Singapore demonstrates strong institutional coordination between housing and transport. The transferable lesson is not the exact model but the principle that housing locations should be planned with transit delivery.

Curitiba BRT

Curitiba links land-use intensity with transit corridors and feeder structure. Jaipur can apply this logic by aligning future affordable housing and density incentives with trunk corridors.

Jakarta Pedestrian Accessibility

Central Jakarta pedestrian accessibility work demonstrates the value of service-area and walking-time mapping for identifying underserved areas in Asian urban contexts.

ANNEXURE E: VISUAL AND MAP ASSET REGISTER

Table E.1: Visual Asset Register Integrated in the Report

Asset	Used as	Purpose
p1_study_area.png	Map 1.1	Study area boundary and urban context.
Existing land-use plan	Fig. 1.1	Land-use context.
Jaipur Metro route map	Fig. 1.2	Metro corridor context.
p2_housing_inventory.png	Map 3.2	Housing inventory distribution.
P3 transit base bus metro.png	Map 3.3	Bus and metro base layer.
P4 housing transit overlay.png	Map 4.1	Housing-transit overlay.
p5_network_analysis_housing.png	Map 4.2	Network severity analysis.
p6 final proposal.png / corrected overlay	Map 5.1	Feeder/NMT proposal strategy.
Generated survey charts	Chapter 4 figures	Income, mode, spending, burden and walking-problem analysis.
Generated proposal diagrams	Chapter 5 figures	Screening workflow, NMT cross-section and phasing.

Source: Author.

Representative context images used during study-area review:

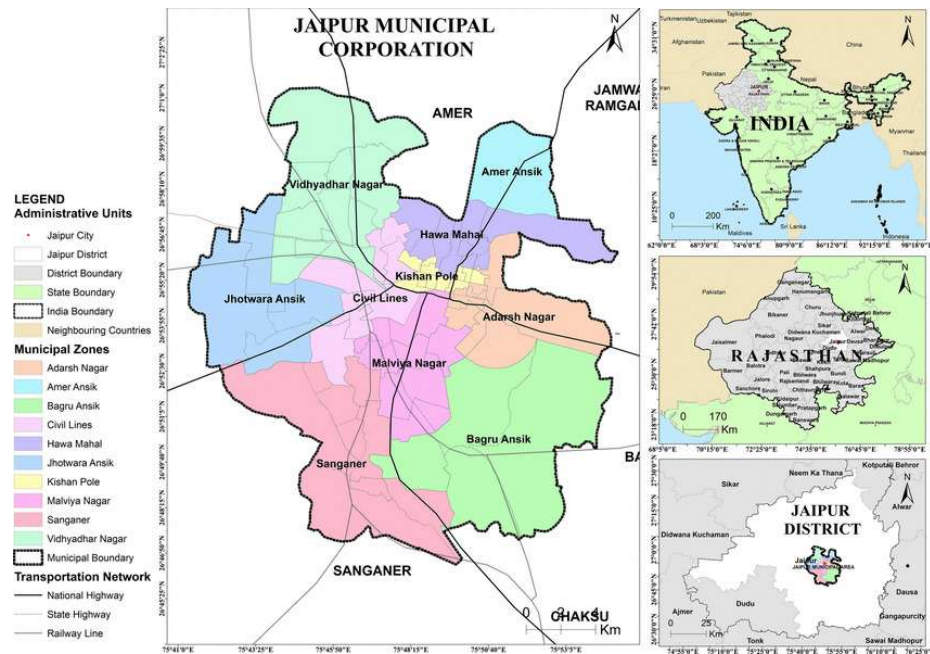


Fig. E.1: Study-Area Context Image 1

Source: Project source image, used for context only.

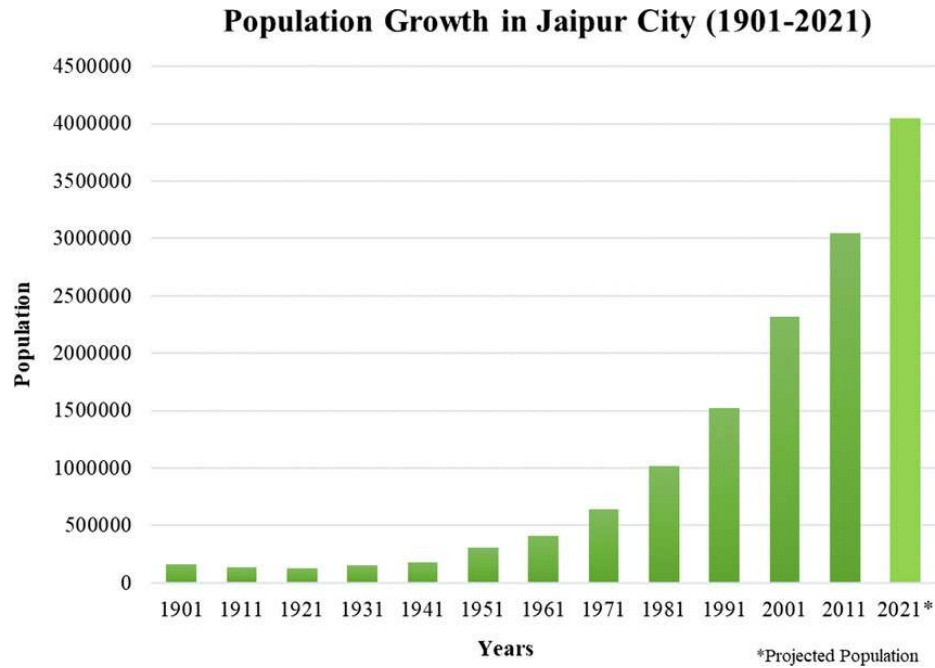


Fig. E.2: Study-Area Context Image 2

Source: Project source image, used for context only.

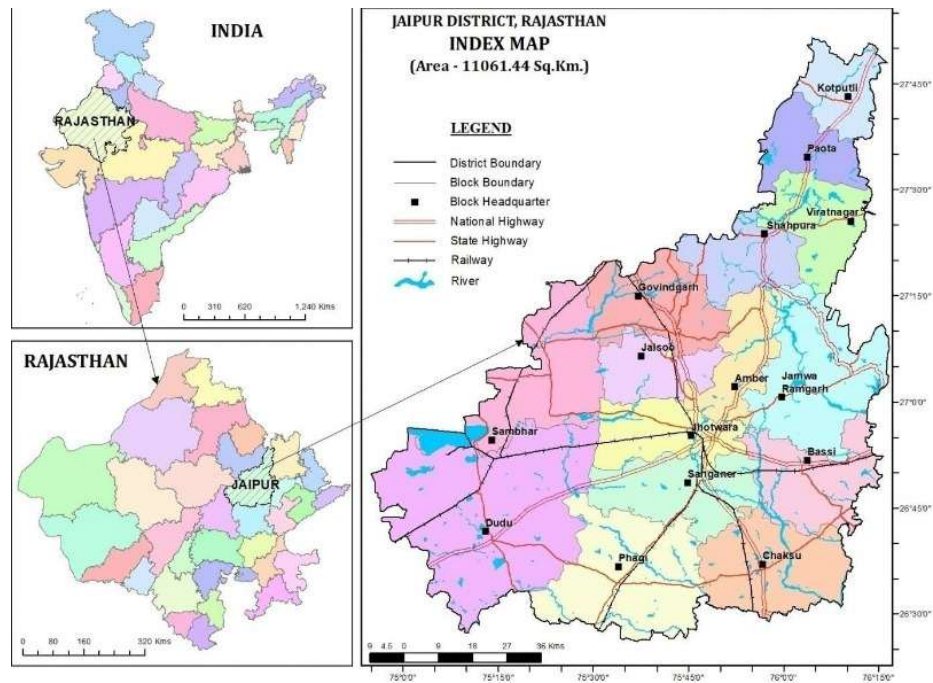


Fig. E.3: Study-Area Context Image 3

Source: Project source image, used for context only.

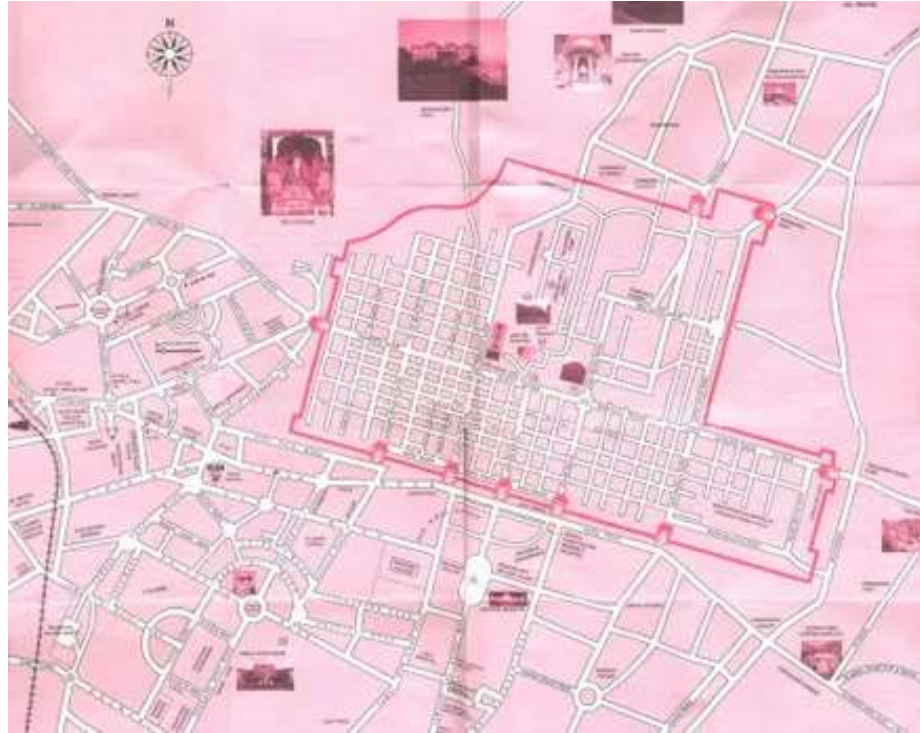


Fig. E.4: Study-Area Context Image 4

Source: Project source image, used for context only.

ANNEXURE F: PROPOSAL IMPLEMENTATION TEMPLATES

This annexure provides implementation-oriented templates that can be converted into approval forms, field-audit sheets or internal agency checklists. They are included to make the proposal chapter operational rather than only conceptual.

Table F.1: Locational Affordability Screening Form Template

Field	Required entry	Planning use
Project identification	Name, promoter/agency, plot area, project type, total units, EWS/LIG units, expected population	Identifies whether stricter affordable-housing conditions apply.
Site geometry	Boundary polygon, site centroid and pedestrian gate coordinates	Allows network-distance calculation and avoids vague location descriptions.
Transit access result	Nearest mapped bus stop, walking-network distance, nearest operational metro	Assigns served / near-miss / moderate / severe classification.

Field	Required entry	Planning use
	station, walking-network distance	
Walking route condition	Footpath continuity, lighting, crossing, drainage, shade, high-speed-road barriers	Checks whether mapped proximity is practically usable.
Mobility mitigation requirement	Stop addition, route diversion, feeder service, NMT corridor or site reconsideration	Connects access result to a planning condition.
Agency commitment	JDA/JMC/JCTSL/JMRC/RHB responsibility, budget source and timeline	Prevents unassigned conditions.
Occupancy trigger	Whether works must be completed before occupancy or in first year after allotment	Prevents residents occupying disconnected sites.

Source: Author.

Table F.2: Field Verification Checklist for Existing Housing Projects

Audit item	Observation to record	Why it matters
Housing gate location	Main pedestrian gate and informal access points	Centroid analysis may miss actual walking route.
Nearest stop condition	Shelter, seating, signage, lighting, waiting space and route board	A mapped stop may not be a usable stop.
Pedestrian route	Continuity of footpath/edge, encroachment, surface condition and drainage	Determines whether walking access is safe and all-weather.
Crossing condition	Presence and quality of crossing to stop or local services	Unsafe crossing can break access even where distance is short.
Women/elderly/disabled access	Perceived safety, ramps, kerbs, lighting and resting points	Ensures access is inclusive.
Service observation	Observed buses/feeder/IPT availability during field visit	Adds service reality to point-distance result.
Resident quick feedback	Three quick questions on time, cost and difficulty	Checks whether infrastructure matches user experience.

Source: Author.

ANNEXURE G: FEEDER ROUTE OPERATING ASSUMPTIONS

The feeder proposals in Chapter 5 require detailed DPR work before procurement. This annexure records the planning-level operating assumptions used to frame the pilots. The values are not final engineering estimates; they are a transparent starting point for JCTSL/JMRC/JDA coordination.

Table G.1: Feeder Route Pilot Operating Assumptions

Parameter	Planning assumption	Reason / caveat
Pilot duration	12 to 18 months	Long enough to observe ridership adaptation and seasonal variation.
Peak headway	10 to 15 minutes	Needed for reliable work trips; lower frequency weakens transfer confidence.
Off-peak headway	20 to 30 minutes	Controls operating cost during low-demand hours.
Stop spacing	400 to 500 m in housing-access sections	Aligns with the 500 m access benchmark and reduces excessive walking.
Fleet type	Mini-bus, e-bus or contracted formal feeder where feasible	Final choice depends on ROW, demand, depot and contract model.
Fare approach	Discounted feeder transfer or common pass where feasible	Necessary because 48.7% reported serious transport burden.
Performance indicators	Ridership, wait time, transfer cost, women/elderly use, complaints and missed trips	Prevents pilot from being judged only by gross ridership.

Source: Author.

Table G.2: Priority Feeder Package Readiness Test

Question	Pass condition	If not passed
Does the corridor connect multiple housing sites or a dense cluster?	At least two sites or one large high-burden cluster.	Hold as lower priority or merge with adjacent package.
Does it connect to a trunk bus/metro/employment node?	Clear terminal or transfer node identified.	Rework alignment; feeder must have a useful anchor.
Can vehicles operate safely on available ROW?	No major bottleneck that prevents reliable service.	Use smaller fleet type or modify corridor.
Is there stop/waiting space?	Basic waiting area and safe crossing possible.	Include stop retrofit before launch.
Is there evidence of household burden or demand?	Survey/site feedback indicates time, cost or access problem.	Conduct demand audit before operating subsidy.

Source: Author.

ANNEXURE H: NMT DESIGN AND MAINTENANCE DETAILS

The NMT proposal is framed as an access-to-transit package. The aim is not to redesign entire arterials but to make the short approach routes from housing gates to transit and services safe, visible and usable.

Table H.1: NMT Design Detail Schedule

Element	Preferred specification	Minimum acceptable condition	Maintenance note
Footpath clear zone	1.8 m clear walking width where ROW permits	1.5 m continuous hard edge in constrained streets	Monthly obstruction and surface audit.
Lighting	25-30 m spacing in high-use access corridors	Lighting at stops, junctions and crossings at minimum	Fault-repair register with ward office.
Crossing	Raised zebra crossing / refuge where ROW permits	Marked crossing with signage and speed calming	Refresh markings and keep crossing unobstructed.
Drainage	Continuous side drain or graded edge to avoid ponding	Pothole-free and non-waterlogged walking surface	Monsoon pre-check.
Shade	Tree line or lightweight shaded waiting element	Shade at high-use stops and long exposed walks	Tree survival and shelter maintenance plan.
Universal access	Kerb ramps, tactile cues at key crossings and accessible waiting area	No abrupt level difference at main access points	Repair ramps after utility cuts.

Source: Author, based on IRC:103 and complete-street principles.

Table H.2: NMT Corridor Prioritisation Rule

Priority level	Condition	Action
Priority 1	Route links housing to nearest bus/feeder stop and has safety/lighting/crossing issue.	Take up in Year 1 quick-win package.
Priority 2	Route is within 1 km of stop but has surface, drainage or encroachment issues.	Take up with ward-level maintenance and street improvement package.
Priority 3	Route is longer than 1 km but can be corrected through feeder stop relocation.	Coordinate with feeder pilot and stop placement.
Priority 4	Route is beyond walking correction and requires motorised feeder.	Shift from NMT-only solution to feeder/route planning.

Source: Author.

ANNEXURE I: CLAIM DISCIPLINE AND EVIDENCE HIERARCHY

This annexure records the wording discipline followed in the final thesis so that the report does not overstate the evidence. The thesis is strongest when it is precise about what the method proves and what it does not prove.

Table I.1: Claim Discipline for Final Thesis

Use this wording	Avoid this wording	Reason
Mapped housing projects in the thesis database	All housing projects in Jaipur	The inventory is a mapped thesis dataset, not an official exhaustive citywide register.
Affordable-flagged subset	All affordable housing in Jaipur	The subset is based on project metadata and affordability markers.
Walking-network distance to mapped bus stops	Actual bus service accessibility	Frequency, reliability, crowding and informal stops are not measured.
Operational Jaipur Metro Phase 1 stations	Future metro accessibility	Future/approved stations are not included in current access results.
Benchmark-aligned proximity screen	Formal PTAL or full H+T index	Service weighting and detailed household cost ratios are not computed.
Planning-level cost estimate	DPR cost	Engineering survey and agency DPR are required before implementation.

Source: Author.

The evidence hierarchy used in the thesis is: first, GIS network-distance outputs and the household survey; second, official policies and standards; third, reviewed literature and case studies; fourth, contextual maps and photographs. Assertions that require field validation are marked as planning-level interpretations rather than final certified results.

ANNEXURE J: CONTEXT PHOTO PLATE

The following images are retained as contextual study-area visuals. They are not used as measured evidence; they support understanding of the urban setting and field context.

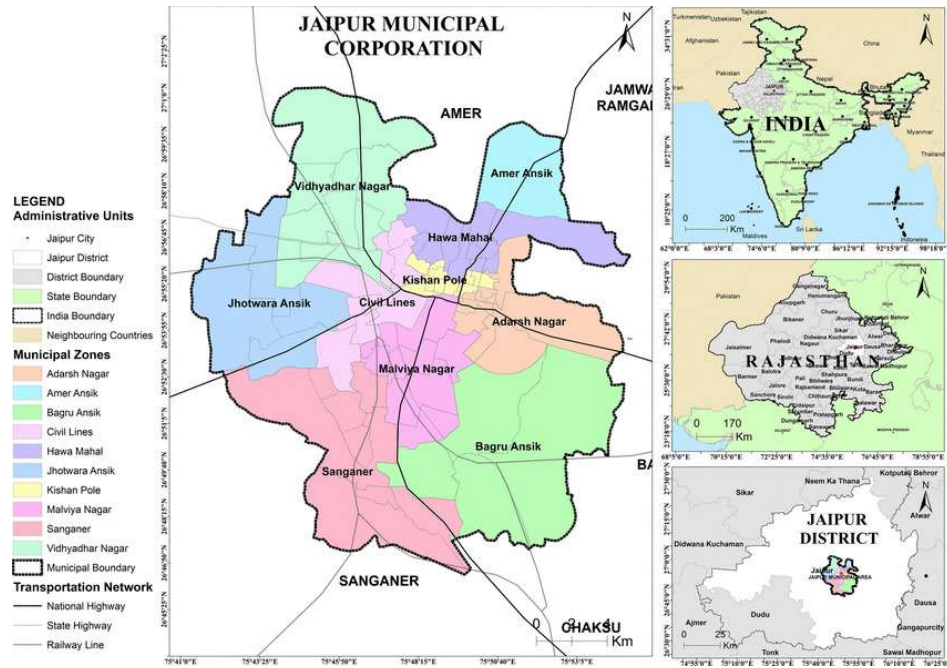


Fig. J.1: Context Image from Jaipur Study Material

Source: Project source image, used for contextual illustration only.

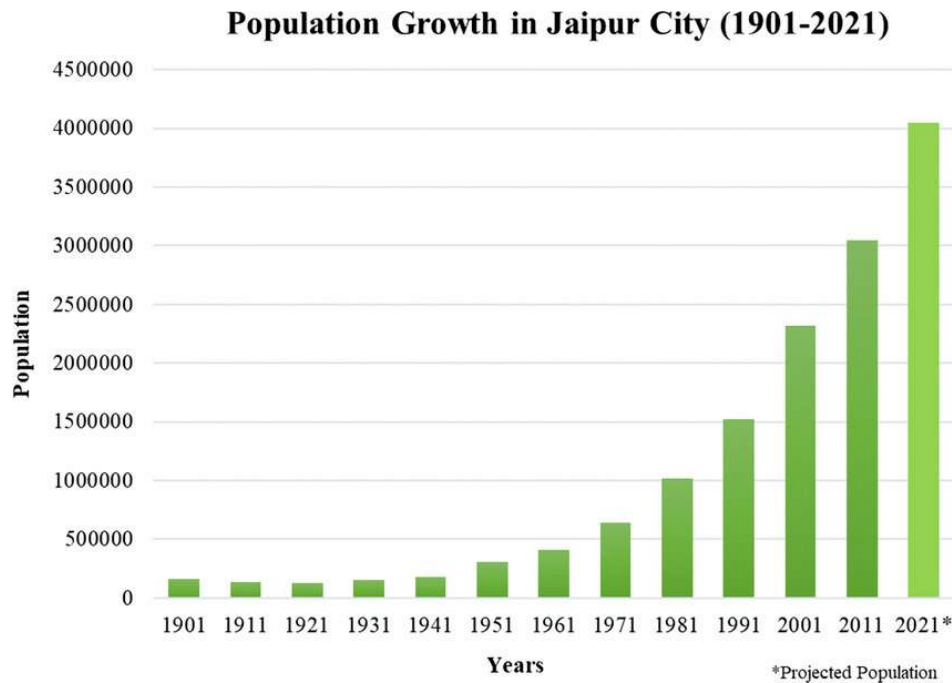


Fig. J.2: Context Image from Jaipur Study Material

Source: Project source image, used for contextual illustration only.

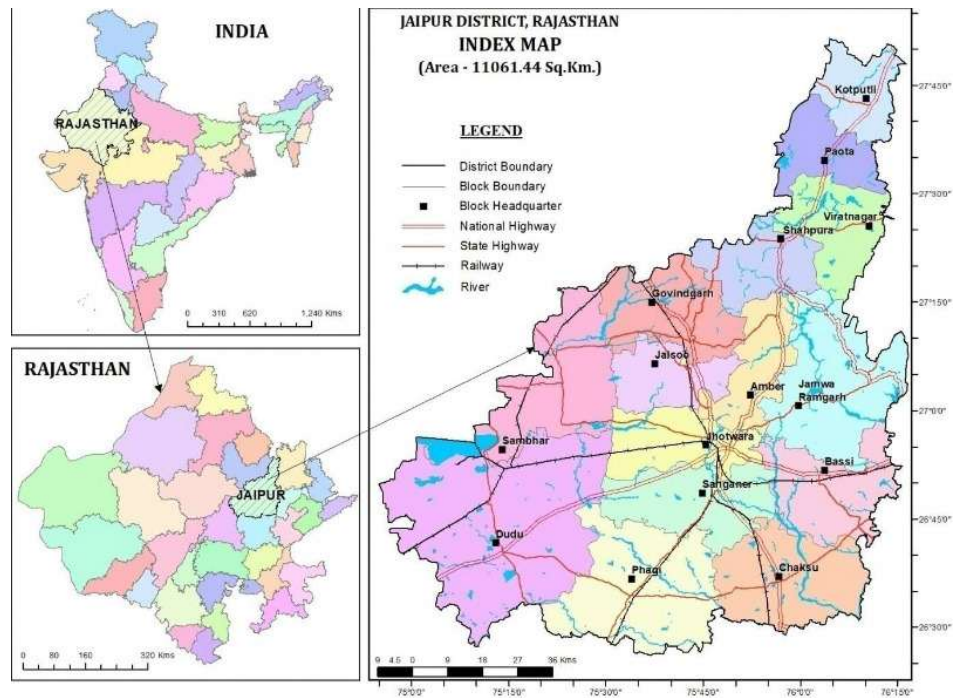


Fig. J.3: Context Image from Jaipur Study Material

Source: Project source image, used for contextual illustration only.

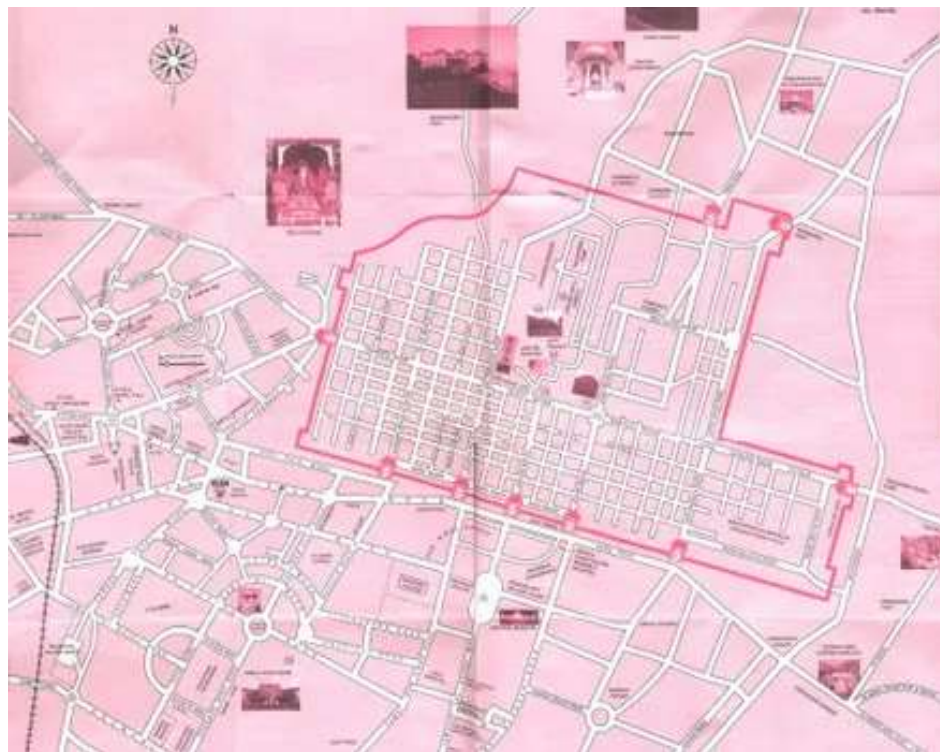


Fig. J.4: Context Image from Jaipur Study Material

Source: Project source image, used for contextual illustration only.

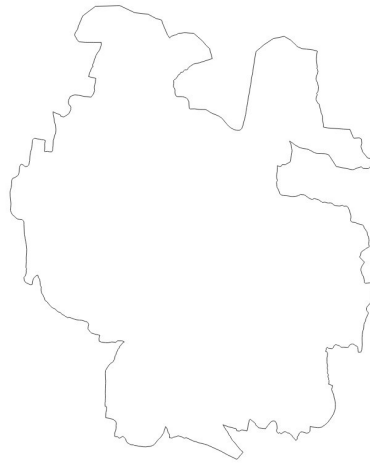


Fig. J.5: Context Image from Jaipur Study Material

Source: Project source image, used for contextual illustration only.