Varsha Chauhan

Exploring Parking as a Contributor to Financial Sustainability of Urban Transpo

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Exploring Parking as a Contributor to Financial Sustainability of Urban Transport

Master of Planning
(Transport Planning and Logistics Management)

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NEELBAD ROAD, BHAURI, BHOPAL (MP)-462030
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Exploring Parking as a Contributor to Financial Sustainability of Urban Transport

Thesis submitted in partial fulfillment of the requirements for the award of the degree of

Master of Planning

(Transport Planning and Logistics Management)

By

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Under the guidance of

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Declaration

I **Varsha Chauhan**, Scholar No. **2022MTPLM001** hereby declare that the thesis titled **"Exploring parking as a contributor to financial sustainability of urban transport"** submitted by me in partial fulfilment for the award of **Master of Planning**, at the School of Planning and Architecture, Bhopal, India is a record of bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

Signature of the Student

Date: _____

Certificate

This is to certify that the declaration of **Varsha Chauhan** is true to the best of my knowledge and that the student has worked under my guidance in preparing this thesis.

RECOMMENDED

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Mr. Paulose N. Kuriakose (Asst. Professor)

(Thesis Guide)

ACCEPTED

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Prof. Saurabh Popli

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Varsha Chauhan

Abstract

As the world gets more urbanized by the day, legislators and urban planners are becoming increasingly concerned about efficient parking management. This study, which focuses on a particular Municipal Corporation of Delhi (MCD) zone, is to investigate the possibilities of parking as a revenue-generating instrument in urban transport planning. Managing parking resources has become an essential part of urban development, rather than only a logistical task, as private vehicle ownership and urbanization have increased. It is essential to comprehend how pricing techniques affect parking management dynamics in order to advance financial sustainability and improve the standard of urban living.

Analysing current parking issues and trends, comprehending the connection between accessibility of public transportation and parking demand, pinpointing important variables affecting parking demand and usage patterns, and formulating plans to maximize parking as a source of income and encourage modal shift in urban transportation planning are some of the goals of the study. These goals will be met by doing a comprehensive study of the parking environment, looking into problems unique to the chosen MCD zone, and researching innovative management strategies. Major parking issues arise in large cities due to the quick growth in parking generation rate that comes with continued expansion. The study will offer insights into the financial viability of parking projects by evaluating current parking policies and financial models. Along with examining the effects of shared parking arrangements and dynamic pricing, it will provide intelligent recommendations for boosting revenue generation and easing traffic congestion.

The study has been conducted to examine parking features and gauge compliance with parking regulations. Eight portions in Delhi have had parking studies completed; these sections usually comprised PSP, commercial and residential land use. Focusing on several parking data metrics, the analysis of parking characteristics was carried out, both on-street and off-street. These included the number of cars parked in a space, the load of cars compared to the number of spaces available, the amount of time cars spends parked on average,

and the parking index, or efficiency of parking utilization. The investigation showed that traffic problems persisted even in places where there appeared to be adequate parking. This was frequently linked to ineffective parking management techniques, such as a lack of effective parking tactics, a lack of properly marked parking places, and a lack of the required signage to guide cars to available spaces. These results emphasize how crucial efficient parking management is in cities. In order to reduce traffic and enhance the entire parking experience for drivers, parking efficiency measures including improved signage, clearly marked spaces, and creative parking solutions can be put into practice.

The purpose of the study is to determine whether parking can be used as a reliable source of income and as a way to relieve traffic in cities. It aims to show how parking may be managed to reduce problems with urban transportation and make a major contribution to the financial elements of urban transportation planning through thorough study and evaluation. The study's inclusion of various scenarios for parking price justification based on land value, metro-set minimum costs, and public willingness to pay for rising amounts is critical for understanding parking management dynamics. The goal in studying these scenarios is to provide insights into how parking might be managed successfully to decrease congestion and contribute to long-term urban growth. For example, higher parking fees in high-value neighbourhoods or near metro stations might encourage the use of public transportation or shared mobility options, lowering the number of private automobiles on the road and alleviating congestion.

The results of this study will, in general, add to the body of knowledge on urban mobility planning and offer useful suggestions to help planners and policymakers better manage parking resources, encourage sustainable urban growth, and improve urban quality of life.

Keywords: parking management, urban mobility planning, parking pricing rationale, land value, congestion reduction, willingness, policy recommendations.

सार

जैसे.जैसे दुनिया दिन.प्रतिदिन अधिक शहरीकृत हो रही हैए विधायक और शहरी योजनाकार पार्किंग प्रबंधन के बारे में अधिक चिंतित हो रहे हैं। यह अध्ययनए जो एक विशेष दिल्ली नगर निगम ;डब्ब्द्ध क्षेत्र पर केंद्रित हैए शहरी परिवहन योजनानुसार पार्किंग को आय उत्पन्न करने का एक साधन के रूप में जांचने के लिए है। पार्किंग संसाधनों का प्रबंधन शहरी विकास का एक महत्वपूर्ण हिस्सा बन चुका हैए न केवल एक लॉजिस्टिकल कार्य के रूप मेंए बल्कि निजी वाहन स्वामित्व और शहरीकरण बढ़ गए हैं। वित्तीय स्थिरता को आगे बढ़ाने और शहरी जीवन के मानकों को सुधारने के लिए पार्किंग के मूल्य निर्धारण तकनीकों का कैसे प्रभाव पार्किंग प्रबंधन गतिकी में महत्वपूर्ण हैए इसे समझना अत्यावश्यक है।

वर्तमान पार्किंग समस्याओं और प्रवृत्तियों का विश्लेषण करनाए सार्वजनिक परिवहन की पहुंचने और पार्किंग मांग के बीच संबंध को समझनाए पार्किंग मांग और उपयोग पैटर्न को प्रभावित करने वाले महत्वपूर्ण चरणों की पहचान करनाए और पार्किंग को आय के स्रोत के रूप में अधिकतम करने और शहरी परिवहन योजनानुसार मोडल शिफ्ट को प्रोत्साहित करने की योजनाएं बनाना अध्ययन के कुछ उद्देश्य हैं। ये उद्देश्य पार्किंग परिवेश का विस्तृत अध्ययन करकेए चुने गए डब्ब क्षेत्र की विशेष समस्याओं का ध्यान रखकरए और नवाचारी प्रबंधन रणनीतियों की अनुसंधान करके पूरे किए जाएंगे।

बड़े शहरों में मुख्य पार्किंग समस्याएं उत्पन्न होती हैं क्योंकि पार्किंग उत्पन्न दर की तेजी से वृद्धि के साथ विस्तार के साथ आती है। यह अध्ययन वित्तीय मॉडलों और वर्तमान पार्किंग नीतियों का मूल्यांकन करके पार्किंग परियोजनाओं की वित्तीय व्यावस्था का मूल्यांकन करेगा। साझा पार्किंग व्यवस्थाओं और गतिशील मूल्य निर्धारण के प्रभाव का अध्ययन करने के साथ. साथए यह रुचिकर प्रभावी सुझाव देगा कि आय का वृद्धि कैसे हो सकती है और यातायात जाम को कैसे सुधारा जा सकता है। यह अध्ययन पार्किंग की विशेषताओं की जाँच करने और पार्किंग विनियमन का अनुपालन करने के लिए किया गया है। दिल्ली में आठ क्षेत्रों में पार्किंग के अध्ययन किए गए हैं; ये खंड आमतौर पर पीएसपी, वाणिज्यिक और आवासीय भूमि का शामिल होते थे। कई पार्किंग डेटा मैट्रिक्स पर ध्यान केंद्रित करते हुए, पार्किंग विशेषताओं का विश्लेषण किया गया था, सड़क किनारे और सड़क के बाहर। इसमें उन कारों की संख्या शामिल है जो एक स्थान पर पार्क की गई हैं, कारों की संख्या की तुलना में उपलब्ध स्थानों की भार, कारों का औसत

रूप से पार्क होने का समय, और पार्किंग सुधार की प्रभावीता या पार्किंग उपयोग की दक्षता। जांच ने दिखाया कि जहां पर्याप्त पार्किंग होने की दिखाई दी, वहां भी यातायात समस्याएं बनी रहीं। यह अक्सर असफल पार्किंग प्रबंधन तकनीकों से जुड़ा हुआ था, जैसे कि पार्किंग तकनीकों की कमी, सही ढंग से चिह्नित पार्किंग स्थलों की कमी, और आवश्यक संकेत बोर्डों की कमी जो गाड़ियों को उपलब्ध स्थानों के लिए मार्गदर्शन करते हैं। ये परिणाम दिखाते हैं कि शहरों में दक्ष पार्किंग प्रबंधन कितना महत्वपूर्ण है। यातायात को कम करने और ड्राइवर्स के लिए पार्किंग अनुभव को बेहतर बनाने के लिए, पार्किंग की दक्षता के उपायों में सुधार किया जा सकता है, जैसे कि सुधारी गई साइनेज, स्पष्ट चिह्नित स्थान, और रचनात्मक पार्किंग समाधान।

इस अध्ययन का उद्देश्य यह निर्धारित करना है कि क्या पार्किंग को एक विश्वसनीय आय स्रोत के रूप में और शहरों में यातायात से छुटकारा पाने का एक तरीका के रूप में उपयोग किया जा सकता है। यह दिखाने का उद्देश्य है कि पार्किंग को कैसे प्रबंधित किया जा सकता है ताकि शहरी परिवहन समस्याओं को कम किया जा सके और यह शहरी परिवहन योजनानुसार वित्तीय महत्व को बढ़ाने में महत्वपूर्ण योगदान दे सके। इस अध्ययन में विभिन्न पार्किंग मूल्य न्यायार्थ जैसे कि भूमि मूल्य, मेट्रो-सेट न्यूनतम लागत, और लोगों की वृद्धि के लिए चुकाने के लिए सार्वजनिक इच्छुकता पर आधारित विभिन्न परिस्थितियों का समावेश होना महत्वपूर्ण है। इन परिस्थितियों के अध्ययन करने का उद्देश्य पार्किंग प्रबंधन गतिविधियों को समझने में मदद करना है कि कैसे पार्किंग सफलतापूर्वक प्रबंधित की जा सकती है ताकि जाम को कम किया जा सके और लंबे समय तक शहरी विकास में योगदान किया जा सके। उच्च मूल्य वाले परिसरों या मेट्रो स्टेशन के पास अधिक पार्किंग शुल्क उचित उदाहरण हैं, जो सार्वजनिक परिवहन या साझा गतिविधियों का उपयोग बढ़ा सकते हैं, सड़क पर निजी वाहनों की संख्या को कम करते हैं और जाम को कम करते हैं।

इस अध्ययन के परिणाम सामान्य रूप से शहरी गतिशीलता योजनानुसार ज्ञान को योगदान देंगे और परियोजना निर्माताओं और नीति निर्माताओं को पार्किंग संसाधनों को बेहतर प्रबंधित करने, परिस्थितिक शहरी विकास को प्रोत्साहित करने, और शहरी जीवन की गुणवत्ता में सुधार करने के लिए मददगार सुझाव प्रदान करेंगे।

कीवर्ड: पार्किंग प्रबंधन, शहरी गतिशीलता योजना, पार्किंग मूल्य न्यायार्थ, भूमि मूल्य, जाम कमी, इच्छुकता, नीति सुझाव

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CHAPTER 1: INTRODUCTION

1.0 Background

Rising urbanization has definitely aggravated parking issues in major cities throughout the world. The number of vehicles on city streets has increased as more people move to metropolitan areas in quest of greater economic possibilities and a higher quality of life. With significant effects on both urban people and the environment, this increase in vehicles has created a continuous supply-demand gap for parking spaces. The extreme traffic congestion that plagues big cities is one of the most direct and visible consequences of this supply-demand imbalance. Inadequate parking infrastructure causes cars to circle the streets in search of parking spaces, causing traffic jams and aggravating commuting delays. As a result of vehicles being idle or moving slowly due to traffic congestion, travel durations are lengthened and fuel is wasted. The economic output of major cities is also hampered by parking issues. In some cases, a shortage of sufficient parking might result in greater staff turnover rates as the daily journey becomes more difficult.

A vital aspect impacting commuter mode choices as well as the financial dynamics of municipal authorities is the effective management of parking spaces, which is always changing in the dynamic field of urban transport planning. Inadequate planning for parking can lead to several significant issues, including the reduction of available road space and open areas, as these spaces are increasingly occupied by parked vehicles. Parking spaces, covering aspects like their classification, cost, pricing, and profitability. In cities heavily reliant on private vehicles, the lack of well-thought-out planning for parking facilities has exacerbated the problem. The issue now extends beyond mere scarcity of parking spaces; it also pertains to the inefficient use of available spaces. In many cases, parking spaces are haphazardly located on roads, footpaths, or even on designated cycle tracks. Such ad-hoc parking arrangements not only disrupt the flow of traffic but also fail to generate the necessary revenues to cover the associated costs. Parking management is no longer a periphery issue but an essential component in the complex tapestry of urban planning and sustainability.

1.1 Need of the Study – Scenario of Delhi

Delhi, the capital city of India, is a sprawling metropolis with a total area of 1,484 sq. km. It serves as the centre of political, cultural, and economic activities in northern India. However, rapid urbanization and population growth have led to

various challenges, including congestion, air pollution, and parking shortages. As of March 2020, Delhi had the highest number of registered motor vehicles (118.93 lakh) among Indian cities. The city's urbanized area is already heavily used by cars, consuming 10% of the total urbanized area, while the forest cover stands at 11.5%. To address these challenges and manage parking demand effectively, a comprehensive parking policy is essential.

The dramatic increase in the number of registered motor vehicles in India, from 0.3 million in March 1951 to 326.3 million as of March 2020, has had significant implications for urban areas, particularly regarding parking infrastructure and management. This exponential growth has led to a surge in demand for parking spaces, posing challenges such as congestion, pollution, and inefficient land use. Addressing these challenges requires a comprehensive approach that considers various aspects of parking policy and urban planning.

One of the key issues resulting from the increase in motor vehicles is the shortage of parking spaces in urban areas. As the number of vehicles has grown rapidly over the years, the existing parking infrastructure has struggled to keep up with the demand. This has led to illegal parking, congestion on roads, and conflicts over parking spaces. To address this, cities need to develop efficient parking policies that prioritize the use of parking spaces and discourage illegal parking.

Moreover, the increase in motor vehicles has also led to a change in the way parking is perceived and managed. In the past, parking was often seen as a free or low-cost amenity provided by the government. However, with the increase in demand for parking spaces, there has been a shift towards a more market-based approach to parking management. This includes the introduction of paid parking, dynamic pricing, and the use of technology to manage parking spaces more efficiently.

Another important aspect of the increase in motor vehicles is its impact on urban planning and development. The rapid growth in the number of vehicles has put pressure on cities to rethink their approach to urban planning. This includes the need to allocate more space for parking, integrate parking facilities with public transport systems, and promote alternative modes of transport such as cycling

and walking. Cities also need to consider the environmental impact of increased vehicle use and the need to reduce greenhouse gas emissions.

In conclusion, the increase in the number of registered motor vehicles in India has had significant implications for parking infrastructure and management. To address these challenges, cities need to develop comprehensive parking policies that prioritize the use of parking spaces, discourage illegal parking, and promote alternative modes of transport. By doing so, cities can create more sustainable and liveable urban environments for their residents.

Figure 1 Total vehicle Registration
Source: Office of state Transport Commissioners, 2020

Parking charges vary significantly across cities globally, reflecting differences in urban planning, transportation policies, and economic factors. Bengaluru, known for its burgeoning IT industry and rapid urbanization, has emerged with the most expensive daily parking rates among Indian cities. In contrast, Delhi, India's capital and a densely populated metropolitan area, offers comparatively cheaper parking rates. Understanding these differences sheds light on the diverse approaches to parking management and the impact on urban mobility and sustainability.

Bengaluru's high daily parking rates can be attributed to several factors. The city's rapid growth has led to increased congestion and a higher demand for

parking spaces, especially in commercial and business districts. Additionally, Bengaluru's status as a technology hub attracts a large number of commuters, further intensifying the demand for parking. To manage this demand and discourage private vehicle use, authorities have implemented high parking fees as a deterrence measure.

On the other hand, Delhi's relatively cheaper parking rates may be due to several factors. Despite being one of India's most populous cities with a high number of registered vehicles, Delhi has a larger urbanized area compared to Bengaluru. This allows for more dispersed parking options, which may contribute to lower parking charges. Additionally, Delhi's public transport network, including the metro system and extensive bus services, provides commuters with viable alternatives to driving, reducing the demand for parking.

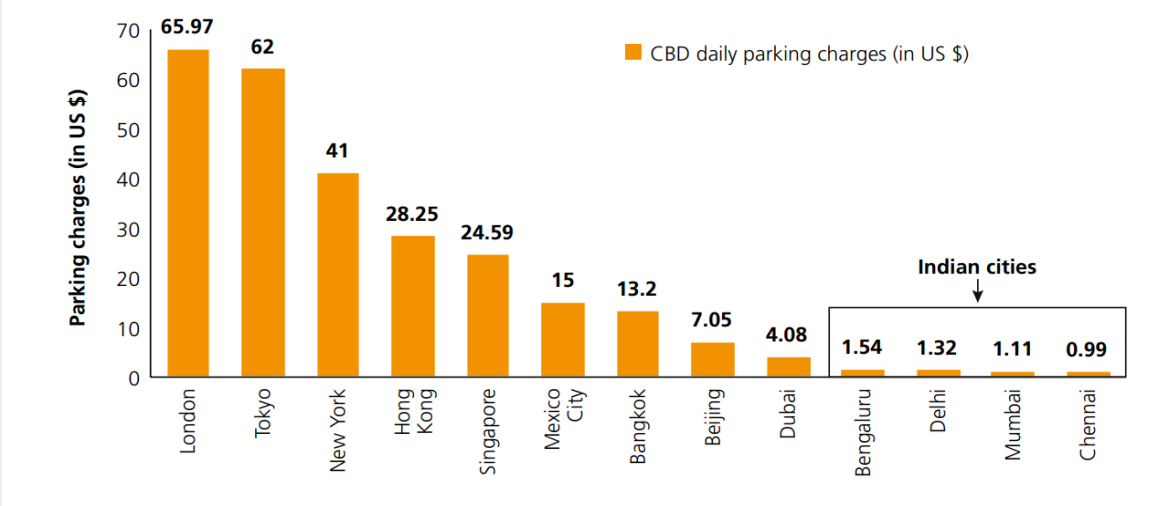


Figure 2 Daily parking charges in cities across the globe
Source: Handbook of Urban Statistics, 2016, MoUD

The disparity in parking rates between Bengaluru and Delhi highlights the importance of context-specific parking policies. In Bengaluru, where congestion and parking demand are high, higher parking charges can help manage demand, reduce congestion, and promote sustainable transport modes. However, in Delhi, where urban sprawl and a relatively well-developed public transport system exist, lower parking charges may be sufficient to meet parking demand without significantly impacting congestion levels.

It is essential for cities to consider various factors, including land use, transportation infrastructure, and economic conditions, when determining parking rates. Effective parking management requires a balance between pricing strategies, infrastructure development, and sustainable transport policies to ensure efficient use of urban space and promote a shift towards more sustainable modes of transportation. By understanding the factors influencing parking rates and adopting context-specific policies, cities can better manage parking demand and contribute to a more sustainable urban environment.

The dominance of non-transport vehicles in the registration numbers of cities, as of 31st March 2020, signifies a significant trend in urban mobility and transportation planning. This trend is particularly pronounced in cities like Delhi, where over 90 percent of registered vehicles fall under the non-transport category. This phenomenon is indicative of several underlying factors that shape the transportation landscape and urban development patterns in these cities.

One of the key factors contributing to the dominance of non-transport vehicles is the rapid urbanization and economic growth experienced by cities like Delhi. As urban populations grow and economic activities expand, there is a corresponding increase in the demand for personal mobility, leading to a surge in the registration of private vehicles. This trend is further fuelled by the aspirational nature of car ownership, which is often seen as a symbol of status and mobility.

Additionally, the lack of robust public transportation systems in many cities, including Delhi, contributes to the reliance on personal vehicles for daily commuting. Inadequate public transport options, coupled with issues such as last-mile connectivity and reliability, compel individuals to opt for private vehicles as their primary mode of transportation. This further exacerbates issues related to congestion, pollution, and parking shortages in urban areas. Furthermore, the affordability and availability of financing options for purchasing private vehicles play a significant role in the proliferation of non-transport vehicles. Easy access to loans and favourable interest rates makes car ownership more accessible to a larger segment of the population, contributing to the increasing number of private vehicles on the roads.

The dominance of non-transport vehicles also reflects broader challenges related to urban planning and sustainable development. The over-reliance on private vehicles has significant implications for air quality, traffic congestion, and overall quality of life in cities. It underscores the need for comprehensive and sustainable transportation policies that prioritize public transport, walking, and cycling infrastructure over private vehicle use.'

The Compound Annual Growth Rate (CAGR) of 9.83 percent in total registered vehicles in India between 2010 and 2020 reflects the rapid expansion of the country's vehicle fleet. This growth has been driven by various factors, including economic development, rising disposable incomes, and urbanization. As a result, cities across India have witnessed a surge in the number of vehicles on their roads, leading to congestion, pollution, and parking challenges.

One potential strategy to address these challenges is the implementation of parking pricing mechanisms. By increasing the cost of parking, cities can influence the Average Generalized Cost (AGC) of private vehicle use, which includes not just the monetary cost but also factors like time spent searching for parking and the stress of driving in congested areas. A rise in parking pricing can significantly impact the AGC, making public transport a more attractive option for commuters.

The concept of AGC considers the overall cost associated with a particular mode of transport, including travel time, out-of-pocket expenses, and other factors. When parking prices increase, the AGC of private vehicle use also rises, making public transport comparatively more cost-effective. This shift in the AGC can incentivize commuters to choose public transport over private vehicles, leading to a modal shift and reducing congestion on roads. Implementing higher parking prices can have several positive impacts on urban mobility and sustainability. Firstly, it can help reduce the number of private vehicles on the roads, leading to a decrease in traffic congestion and improved traffic flow. This, in turn, can reduce travel times for commuters and enhance the overall efficiency of the transport system.

Secondly, higher parking prices can encourage the use of more sustainable modes of transport, such as public transport, cycling, and walking. This can lead to a reduction in greenhouse gas emissions, improved air quality, and a healthier urban environment. However, it is essential to consider the potential challenges and limitations of implementing higher parking prices. Higher parking fees may disproportionately affect low-income individuals who rely on private vehicles due to limited access to public transport. To address this issue, cities can consider implementing targeted policies such as discounted public transport fares for low-income groups or investing in improved public transport infrastructure to make it a more viable option for all residents.

In conclusion, the rise in parking pricing can significantly influence the AGC of private vehicle use, potentially enabling a modal shift towards more sustainable modes of transport. By carefully implementing parking pricing strategies and complementary policies, cities in India can address the challenges associated with growing vehicle fleets and move towards a more sustainable and efficient urban transport system.

1.2 Aim

To assess the potential of parking as a revenue generator tool urban transport planning.

1.3 Objectives

1. To analyse the current challenges and trends in parking supply and demand.

2. To understand the relationship between public transport accessibility and parking demand.

3. To identify key factors influencing parking demand and usage patterns.

4. Develop strategies to optimize parking as a revenue stream and a catalyst for inducing modal shift urban transport planning.

Research question – Can parking serve as a revenue generation tool in India's urban transport planning, and how does it impact mode choices

1.4 Scope

1. Conducting a comprehensive analysis of parking supply and demand dynamics in Delhi to determine the financial viability of parking initiatives.
2. Studying different financial models for parking projects and comparing them to recommend strategies for maximizing parking-related income.
3. Examining the applications of parking facilities and the economic factors surrounding them to develop well-informed strategies for income generation.
4. Focusing on a specific MCD zone in Delhi to understand local urban transport planning dynamics, particularly related to parking infrastructure, mode choices, and public transportation usage.
5. Identifying obstacles and evaluating the financial sustainability of parking initiatives in the selected MCD zone to provide focused recommendations for optimizing income generation through creative solutions.

1.5 Limitations

1. The research may not fully address the political, legal, social, cultural, and environmental aspects that affect parking dynamics.
2. A temporal constraint may be introduced by the dynamic nature of urban surroundings and changing transportation trends, as the study only records a single point in time.
3. Availability and quality of data may present difficulties, affecting the accuracy of evaluations of parking situations, regulations, and how this affect mode selection.
4. Due to the study's dependence on already published works and readily available data, biases inherent in such sources may potentially be introduced.
5. The study may not have fully captured the intricacies of the various socio-economic aspects impacting each person's choice of transportation, therefore conclusions should be interpreted cautiously.
6. Generalization of research results to larger urban planning contexts should be done with caution.

7. Outside variables not fully investigated within the parameters of this study may have a significant impact on parking initiatives.
8. There may be obstacles in obtaining and using particular financial data pertaining to parking projects, which could restrict the scope and precision of the financial analysis carried out in this research.

1.6 Methodology

In order to comprehend the dynamics and problems related to parking supply and demand that now exist, the study will start with a detailed analysis of the parking scenario and difficulties in the study region. In order to gather data for this phase, surveys, interviews, and on-site observations will be used. In order to improve future operations and plans, it is critical to assess the current parking facilities at the strategic planning level and define a service level. Numerous methods have been developed in the past to assess the efficiency of the current parking system while taking various parking features into account. This study will look at both established and emerging parking management trends. It will include quantitative assessments of prospective income generation based on the various parking policies and management practices under consideration. With an emphasis on revenue generation and its effects on mode choices and public transportation ridership, the approach used in this thesis is intended to methodically address the study objectives and give a thorough knowledge of the function of parking in urban transport planning. The study begins with a thorough analysis of the body of prior research, which functions as a first step in identifying gaps and laying a solid foundation for further investigation. Through its insights into established theories, methodology, and conclusions, this literature review contributes significantly to our understanding of the current level of knowledge surrounding parking in urban transport planning. After the evaluation of relevant literature, the research moves on to the problem identification stage, when a methodical analysis is conducted to determine the present parking situation in the chosen study region.

The research uses secondary data collection techniques to accomplish this, drawing from a variety of sources to compile in-depth data. Census data becomes an essential element, providing demographic information about the populace and possible drivers of parking demand. A detailed picture of the

population's demographic makeup, including family size, age distribution, socioeconomic characteristics, and the ratio of residential to commercial space, may be obtained from census data. The aforementioned components jointly influence the parking demand landscape in urban settings, providing guidance for later study phases that aim to identify obstacles, devise methods, and optimize parking-related revenue generation within the framework of urban transport planning. Another important component of the secondary data collection process is the traffic and transportation data. Understanding the current traffic patterns, the transportation infrastructure, and how these elements interact with parking demands is made easier with the use of this data. Furthermore, data regarding Central and State Government Schemes is gathered in order to understand the regulatory environment, current practices, and prospective interventions or incentives that could affect parking dynamics.

Moreover, budget documents serve as a valuable resource in the secondary data collection phase. These documents offer a thorough summary of all financial expenses and allocations, making an evaluation of own source revenue possible. Own Source Revenue is the term used to describe the local funds created by the research area, providing insight into the financial environment and decision-making autonomy. Through an examination of budgetary distributions, the research obtains understanding of the relative importance of parking initiatives in relation to the overall financial structure. This method not only helps to identify existing issues and trends, but it also establishes the framework for later stages of the study, like primary data collecting and in-depth analysis. Essentially, the utilization of secondary data furnishes an extensive contextual framework for the investigation, influencing the ensuing research phases and facilitating a knowledgeable and refined examination of parking as a source of income in urban transportation planning.

Following this, primary data collection methods are employed to delve deeper into the parking scenario. A crucial part of this phase is conducting parking surveys, which entail collecting data on the demands and difficulties that already exist in the research area in an organized and methodical manner. Acquiring data about the selected parking facilities in the study area using various methods such as surveys, interviews, and document reviews. A detailed

inventory of all parking facilities in the study region, including their locations, capacities, and types (for example, street parking, garages, and lots).

Analysing the collected data to discover common parking concerns, such as:

- Peak demand periods for parking.
- Certain facilities are overcrowded or underutilized.
- User feedback and preferences.
- Issues with regulatory compliance.

This information would include parking facility details, occupancy rates, parking turnover, price structures, and existing rules. Along with primary surveys secondary sources data would be used from sources like Master Plan, CMP. DCR, Transport policy. Real estate value details, etc. Evaluating the accessibility of public transportation services in various study zone locations is the goal of this spatial research. Accessibility to public transportation and parking demand can be correlated by superimposing PTAL maps with parking data. Another spatial method for visualizing and understanding population and activity concentration is density mapping, which makes it easier to identify locations that require more parking. Combining information from parking surveys, density mapping, PTAL mapping, and expressed preference surveys enables a thorough examination of the variables influencing parking decisions and the dynamics of demand for parking. Relationships between variables are investigated through statistical analysis and geographical modelling.

After assessing parking possibilities and challenges, the research will look into the financial viability of parking projects in the study area. This evaluation considers the effects of rules on parking availability and occupancy rates, the effectiveness of pricing structures in revenue generation, compliance and enforcement measures, and user happiness and feedback. Furthermore, the study investigates the possibility of generating revenue through parking fees and fines, linking economic considerations with parking management tactics. This analysis offers a comprehensive picture of policy performance and their compatibility with local economic realities. Obtaining essential data on the present parking policies and practices in the study area. This would include:

- Reviewing existing parking regulations and policies.

- Conducting surveys or interviews with local authorities, parking facility operators, and users to understand the effectiveness of current policies.

Using a Geographic Information System (GIS), construct precise spatial maps of the research region, displaying the geographical distribution of parking facilities, transportation routes, and congestion hotspots. Use GIS overlays to find regions where parking demand overlaps with commercial and residential zones, identifying possible hotspots with varied levels of parking stress. Additionally, the potential for novel solutions such as dynamic pricing, shared parking arrangements will be assessed in order to establish their ability to increase revenue while decreasing congestion. Revenue projection models can aid in estimating possible revenue growth based on various scenarios, taking into account factors such as pricing adjustments and demand fluctuations.

The emphasis will be on determining the viability of implementing dynamic pricing in the context of the local community. This will include a thorough analysis of local demand patterns and economic situations, with special attention paid to issues such as time of day and demand swings. The project will use mathematical models to anticipate possible income increases from the use of dynamic pricing tactics. The Shared Parking Arrangements Evaluation will then identify potential partners or businesses interested in participating in shared parking efforts. This phase will include the creation of revenue-sharing models as well as a thorough examination of the benefits of such collaborative partnerships.

Following that, a thorough Cost-Benefit Analysis will be performed on each proposed solution to determine its financial viability. This analysis will take into account the initial setup expenses, continuing maintenance costs, and prospective income benefits connected with the offered techniques. Allocation of pricing strategies determine appropriate pricing schemes and their hierarchical structure by superimposing maps of parking facilities and congestion hotspots. Based on the observed spatial patterns, this technique identifies places with the greatest potential for revenue creation. Following that, distribute appropriate price structures to these places, taking into account characteristics such as proximity to key destinations, demand patterns, and congestion levels.

This strategy will not only optimize revenue generation, but will also ensure that pricing techniques are adjusted to the individual demands of different locations within the study region, thus improving the overall effectiveness of the parking management plan. Three distinct rationales have been developed to determine the increased revenue collection based on escalating parking charges. Firstly, the rationale is established on the land value of the area, considering the economic worth of the land as a factor influencing the pricing structure. Secondly, the minimum price charged is calculated to cover a distance equivalent to Delhi's average trip length, ensuring that parking charges align with the average cost of a typical journey in the city. Lastly, the willingness survey rationale relies on public feedback to gauge the acceptable pricing range, ensuring that the pricing strategy is aligned with the preferences and affordability of the users. These rationales collectively provide a comprehensive framework for determining parking charges that are both economically viable and acceptable to the public. The research will give well-substantiated recommendations for increasing income production through parking based on the insights gained from these analyses. In addition, an implementation strategy will be developed, including the critical procedures, a detailed schedule, and the allocation of resources required for the execution of each recommended solution. In conclusion, this thorough methodology uses a combination of primary and secondary data gathering together with advanced data analysis tools to address the study objectives in a comprehensive manner and provide insightful information to the field of urban transport planning.

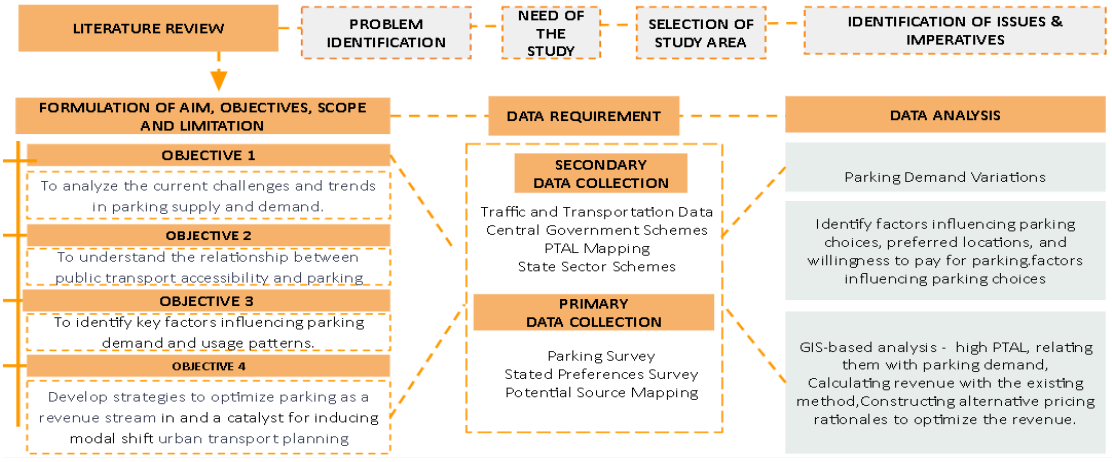


Figure 3 : Research Methodology

Source: Author

CHAPTER 2: LITERATURE REVIEW

Parking is undeniably a critical aspect of the transportation system in urban areas. Cities are experiencing an ever-increasing influx of residents as urbanization intensifies, which exacerbates issues related to traffic congestion and the need for adequate parking infrastructure. Private vehicle ownership is increasing, and the resulting increase in the number of cars on the road exacerbates the challenges associated with providing suitable parking solutions. When individuals reach their destinations, their vehicles are parked, often for the majority of the day. The way that cities are being planned is changing quickly, making it necessary to have an in-depth grasp of parking management techniques and how they relate to revenue generation and mode selection. Effective planning for parking facilities is a fundamental requirement during town planning stages.

Consequently, the global market for smart parking systems is expected to expand significantly, particularly in India, where it is anticipated to rise at a CAGR of 11.6% from 2023 to 2029. Increased traffic congestion, an increase in vehicle ownership, and a shortage of parking spaces all contribute to this expansion. This rise is primarily caused by a number of connected variables that highlight the need for creative parking solutions in metropolitan centres. The growing issue of traffic congestion is one of the main drivers of this upsurge. The number of vehicles on the road has increased in tandem with city growth and urbanization, causing gridlock during rush hours. Effective parking solutions are required to reduce these problems because the congestion not only costs commuters' time but also increases fuel consumption and environmental pollution *(Smith et al., 2022)*. Furthermore, the limitations of traditional parking management methods have highlighted the need for smarter, technology-driven solutions. Smart parking systems use IoT sensors, real-time data analytics, and mobile applications to provide users with real-time information on parking space availability. These systems streamline the parking process by directing drivers to available spots and allowing cashless transactions, alleviating the challenges associated with traditional parking methods *(Li & Wang, 2020)*.

Recent research studies have underscored the significance of proper parking planning and its economic implications. According to the findings of a study published in the "Journal of Transport Economics and Policy," it was revealed that the lack of efficient parking management results in increased congestion, reduced road space for vehicles in motion, and a detrimental impact on overall transportation efficiency *(Smith, J., 2019)*. Moreover, a report by the "International Parking Institute" highlights how well-planned

parking facilities can enhance urban development, reduce traffic congestion, and contribute to local economies *(IPI, 2020)*. The problems arising from inadequate parking provisions go beyond mere inconvenience, extending to environmental and economic concerns. Thus, the efficient allocation and management of parking spaces are pivotal in addressing urban mobility challenges and promoting sustainable urban development.

In transportation planning, the idea of Average Generalized Cost (AGC) is essential to comprehending the whole travel cost, which comprises both the financial and time costs related to traveling from one place to another. Previous research frequently indicates that private transportation options typically have lower average gross traffic counts (AGCs) than public transportation modes. Travelers' preferences for modes of transportation may be influenced by this disparity in AGC, favouring private versus public transportation. Studies have examined the overall perception of expenses and travel time associated with private car travel vs public transportation. This is frequently linked to the comfort, adaptability, and apparent time savings that come with using a private vehicle.

One strategy for encouraging people to use public transportation is to raise the AGC for private modes, making them less economically appealing than public transportation. High parking rates are one efficient way to achieve this transition. High parking costs function as a financial deterrent for private vehicle users, adding to a rise in the perceived cost of private transportation. Several studies give evidence that high parking costs are beneficial in influencing mode switches. *(Shoup, 1997)* found that implementing market-based pricing for on-street parking in particular regions reduced parking demand while increasing the usage of other commuting modes. Similarly, *(Litman, 2006)* underlines the importance of parking price schemes in regulating travel demand and supporting sustainable mobility options. In conclusion, relevant literature and empirical evidence support the policy of boosting AGC for private modes, particularly through the imposition of high parking rates.

2.1 IRC SP-12

Indian Roads Congress Special Publication 12, or IRC SP 12, offers recommendations for the layout and design of parking spaces. These rules are essential for encouraging sustainable urban growth and guaranteeing the effective use of urban land for parking. The categorization of parking facilities based on their location and function is an essential stage in transportation engineering and urban planning that guarantees effective and efficient design and

planning. Multi-level, off-street, and on-street parking facilities are the three main categories of parking facilities, as described in the Indian Roads Congress Special Publication 12 (IRC SP 12). Every category has unique functions and unique design considerations.

Multi-level parking structures, which are mainly located in densely populated urban areas, offer parking spots on several floors and are frequently incorporated into residential or commercial buildings. Careful planning is needed for these facilities to maximize space use and guarantee easy access for cars. On the other hand, parking spaces that are distant from the major roads—like lots or garages—are referred to as off-street parking facilities. Since these facilities are made to hold a lot of cars, effective internal traffic flow management is frequently necessary.

As the name implies, on-street parking facilities are found beside roadways and are crucial for offering temporary parking choices close to residential or commercial areas. But aspects like traffic flow, pedestrian safety, and space availability need to be taken into account during design. In general, IRC SP 12's classification of parking facilities is very important because it helps engineers and urban planners create parking solutions that are tailored to the unique requirements of various urban contexts, making the best use of available space and managing traffic. Ensuring the safe and effective accommodation of automobiles is greatly dependent on parking structure design criteria. Comprehensive guidelines for the design of parking facilities are provided by the Indian Roads Congress Special Publication 12 (IRC SP12), which covers minimum parking spot sizes, layout considerations, and allowances for pedestrian circulation and access. These regulations are crucial for guaranteeing that parking facilities fulfill the required safety requirements and are operational. Designers and engineers may make parking facilities that make effective use of available space, can handle a variety of vehicle types, and guarantee easy movement for both pedestrians and cars by following IRC SP12. This enhances not only the general user experience but also the effectiveness and safety of urban transportation networks.

The importance of granting all users comprehensive access to parking spots is emphasized by IRC SP 12, which also highlights the concerns of

walkers, cyclists, and people with impairments. Installing ramps, elevators, and parking places specifically designated for individuals with disabilities is necessary to ensure accessibility. These rules support fair access to parking spaces for all people, in line with the ideals of universal design. Urban planners and developers can improve the accessibility and circulation of urban spaces by creating surroundings that are more user-friendly and inclusive by following these guidelines.

The criteria set forth by reputable organizations such as the Indian Roads Congress (IRC)—especially those included in their publication IRC SP-12—is crucial to guaranteeing the security and safety of parking spaces. These rules provide a strong emphasis on a number of important topics, such as theft and vandalism deterrent tactics. Sufficient lighting is essential because well-lit spaces deter crime and improve user visibility. In order to promote effective management and user safety, signage that clearly displays parking laws, regulations, and emergency contact information is essential. Additionally, it is advised that surveillance systems, like CCTV cameras, be used to keep an eye out for and discourage unlawful activity, giving users a sense of security. Parking facilities can successfully raise their security and safety standards and contribute to a safer urban environment by adhering to these rules.

The code places a strong emphasis on the use of energy-efficient lighting systems, including those made possible by LED technology, which not only consumes less energy but also saves operating expenses and improves safety. Furthermore, in order to lessen the burden on municipal water resources and lower the risk of floods, IRC SP 12 promotes the installation of rainwater harvesting devices in parking spaces. In addition, the code emphasizes how crucial it is to incorporate green spaces—like landscaped areas or green roofs—into parking facilities in order to improve air quality, boost aesthetics, and offer thermal comfort.

In urban planning, parking lots should be seamlessly integrated into the surrounding environment. This is not only practical, but also a vital way to improve the area's appearance and use. The Indian Roads Congress Special Publication 12 (IRC SP12) sets criteria that highlight the significance of this integration by stressing the necessity to take neighboring land uses, architectural

design, and landscaping into account. In addition, the general operation of the region depends on compatibility with neighboring land uses. Parking lots should be conveniently situated in relation to the locations they serve and constructed so as not to impede the flow of traffic, either pedestrian or vehicle.

Guidelines for parking management plans with an emphasis on effective parking space usage are provided by IRC SP 12. It highlights the necessity of putting in place parking price strategies to encourage turnover and deter long-term parking, such as dynamic pricing and time-based parking rates. The paper also suggests using technology to give real-time parking availability information and simplify payment options, such as smart parking systems and smartphone applications. Furthermore, in order to guarantee a comprehensive approach to parking provision and lessen the detrimental effects of excessive car use on urban areas, IRC SP 12 emphasizes the significance of integrating parking management with overall urban planning initiatives.

PARKING MANAGEMENT STRATEGIES	
Based on Design	Improve parking facility design and operations to help solve problems and support parking management
Prices based	Parking fees can be done according to zone, peak hour demand, weekdays and weekends, etc. by charging higher rates during peak hour with progressive increase in rates per hour
TOD based	Substantially replace ECS with cycle, Para-transport and HOV parking in high PTAL zones
Unbundle Parking	Provide parking facilities separately from building space
Improve User Information and Marketing	Convenient and accurate information should be provided on parking availability and price
Parking Pricing	Motorists must be directly and efficiently charged for using parking facilities
Mobility Management	More efficient travel patterns, like changes in mode, destination, timing, and trip frequency must be encouraged
Smart Growth	More compact, multi-modal development must be encouraged to allow more parking development

Walking and Cycling Improvements	Walking and cycling conditions must be improved
Improve Pricing Methods	To make pricing more convenient and cost effective use improved techniques
Parking Regulations	Parking Regulations must be properly designed and strictly enforced
Increase Capacity of Existing Facilities	Parking supply can be increased by using, otherwise wasted space
Financial Incentives	In order to shift mode, provide financial incentives
Improved Enforcement	Ensure that the regulations are strictly enforced
Member controlled associations	Establish organizations that provide transport and parking management services
Parking Tax Reform	Develop tax policies in support of parking management objectives.
Overflow Parking Plans	Proper plans must be developed to manage peak parking demands.
Address Spillover Problems	In order to address spillover problems use management, enforcement and pricing
More Accurate and Flexible Standards	Parking standards must accurately reflect demand in a particular situation

Figure 4 Parking Management strategies

Source: IRC SP - 12

In conclusion, thorough guidelines for the planning and design of parking facilities in India are provided by the Indian Roads Congress Special Publication 12 (IRC SP 12). By following the guidelines provided in IRC SP 12, lawmakers and urban planners can make sure that parking facilities are designed to efficiently satisfy user needs, encourage sustainable urban expansion, and improve the general quality of urban life. The significance of taking location, capacity, layout, and accessibility into account while designing parking facilities is emphasized in this article. It also emphasizes how important it is to connect parking lots with other forms of transportation in order to encourage multimodal connectivity and lessen dependency on individual automobiles.

Urban planners and lawmakers can enhance the quality of urban living for both inhabitants and visitors in Indian cities by adhering to the criteria outlined in IRC SP 12. This will enable the design of parking facilities that are more efficient, user-friendly, and sustainable.

2.2 Establishment of Parking Benefit Districts (PBDs)

Congested urban areas or networks with insufficient parking supply and private vehicle encroachment are recommended to be identified by urban local bodies (ULBs). It is necessary to designate these regions, or particular municipal wards, as "parking benefit districts" (PBDs). PBDs are designed to encourage walking, bicycling, and public transportation while increasing the amount of on-street and off-street parking available. Through efficient planning, administration, and pricing techniques, they are intended to enhance parking turnover and, as a result, add more net available parking spaces to a given region. Along with parking for private automobiles, PBDs also provide extensive facilities for non-motorized transportation, cycle paths, vending zones, bus stations, parking for intermediate public transportation (IPT), and public amenities.

2.3 Planning and Development Of PBDs

Detailed PBD plans must be developed by ULBs in collaboration with local stakeholders and planning authorities. These plans involve strict enforcement procedures together with the actual layout and marking of parking spots on the ground. PBDs are intended to encourage environmentally friendly transportation options and increase parking availability. In addition, they help alleviate parking issues and traffic congestion by acting as a financing instrument for renovations in historic districts. The money raised from parking fees in PBDs is immediately put back into features like walkways, landscaping, and other amenities that make the district more visually appealing.

2.4 Implementation and Administration

In most cases, PBDs are implemented by ULBs. Proposals for PBDs can be started by either community groups or the ULB. Education and involvement of local companies are critical to the success of PBDs. Businesses must understand and market their location's particular attributes, as well as be actively involved in establishing plans for the use of parking meter revenues. Local administration, planning, public works, and economic development agencies provide critical staff

support for PBD planning, administration, and documentation. Starting with PBDs requires early outreach to businesses and neighborhoods, as well as careful consideration of boundaries, pricing levels, and other parking laws. Once installed, staff are responsible for overseeing operations and allocating monies to desired improvements.

2.5 The Average Car Parking Space

With a direct impact on land use, transportation infrastructure, and overall urban growth, parking is a crucial component of urban planning. The UTTIPEC statistic, which shows that a car parks in three different locations daily on average, emphasizes how dynamic city parking behavior is. This conduct not only increases the amount of urban area that is utilized, but it also creates obstacles for efficient parking management.

Urban regions require effective space use strategies because an average car uses 69 square meters of land each day, mostly on public land. A valuable resource, public land can be used for a variety of things, including parks, pedestrian paths, and commercial places. But the widespread use of public space for parking limits the amount of space available for these other uses, which negatively affects a city's ability to remain sustainable and livable.

In order to tackle these issues, legislators and urban planners must implement tactics that facilitate effective parking management. To maximize parking space use, this involves putting smart parking technologies—like sensors and real-time data analytics—into practice. In addition, encouraging other forms of transportation including walking, bicycling, and public transportation can lessen the need for parking spaces and lessen the dependency on automobiles. Overall, the fact that cars use a large quantity of urban land and park in different locations every day emphasizes how difficult it is to manage parking in urban settings. Cities can efficiently manage parking demand, optimize land use, and create more livable and dynamic urban settings by putting creative solutions into practice and supporting sustainable transportation options.

Out of the 8760 hours in a year, autos are thought to run for about 400 hours, according to *(Kadiyali, 2013)*. According to this computation, there are about 8360 hours during which automobiles are parked, meaning that 95% of the

time, cars are on the street. This figure highlights how much parked autos affect how much urban roadway space is used. This high proportion of parked cars can lead to traffic jams, decreased mobility, and wasteful land use in metropolitan areas where parking demand outpaces supply. These results highlight the need for efficient parking management techniques to maximize street space use and improve urban mobility, such as the creation of parking benefit areas and the encouragement of alternate forms of transportation.

2.6 Parking as a Behavioural Influencer

Parking availability and cost, according to Litman (2006), have a significant impact on how people journey. Research highlighting the psychological and financial effects of parking decisions, including Shoup's seminal research on "The High Cost of Free Parking" (2005), highlights the necessity for efficient management techniques to favorably impact mode choices.

According to Todd Litman's 2006 assertion, parking costs and accessibility have a significant influence on the choices people make about their travel and commuting. The availability of convenient parking spots frequently acts as a motivator for the use of private vehicles. Conversely, a lack of parking or difficulty finding it can motivate people to look into other modes of transportation including walking, bicycling, or public transportation. Traveler behavior is significantly influenced by the cost of parking. Parking fees can discourage needless car use and encourage the use of more environmentally friendly transportation options, such carpooling or public transportation.

When priceless urban land is set aside for parking facilities without proper remuneration, it frequently results in a misallocation of resources. Free parking can incentivize consumers psychologically to choose private autos over more environmentally friendly and alternative forms of transportation. This has an impact on metropolitan areas' economic efficiency as well as the environmental problems brought on by an increase in traffic. Pricing has a significant impact on how often people park since it affects the cost-benefit analysis they do before using a facility. Efficient pricing strategies, including demand-responsive pricing or congestion-based pricing, can promote more economical parking spot utilization and deter needless car use.

2.7 Spatial Considerations In Parking Planning

The importance of comprehending the connection between land use, transportation patterns, and parking demand within urban regions is highlighted by the spatial considerations in parking planning. The spatial distribution of activities and the

resulting need for parking facilities are influenced by land use patterns, such as residential, commercial, or mixed-use buildings. For example, during business hours, a commercial area might need more parking places, whereas in the evenings, a residential neighborhood might need more spaces.

As Litman emphasizes, density mapping and PTAL mapping (Public Transport Accessibility Level) add even more spatial issues to parking planning. PTAL mapping evaluates a location's suitability for public transportation, which affects the choice of modes of mobility and, in turn, the demand for parking. Conversely, density mapping identifies high population density locations, suggesting possible parking hotspots.

2.8 Financial Viability And Cost-Benefit Analysis:

The Litman and Fitzroy (2005) study probably explores a number of topics, including the direct costs of construction and maintenance related to parking measures as well as the indirect costs and benefits of things like reducing traffic congestion, improving the environment, and increasing overall mobility.

2.8.1 Cost of Parking Lots

Parking lot costs are a multifaceted issue that affects parking financing and revenue, influencing both the expenses incurred and the potential cash earned by parking infrastructure.

(a) Land Area and Value:

Land costs account for a sizable amount of the total cost of developing parking infrastructure, particularly in urban locations with high real estate values. This acknowledgement emphasizes the critical balance that urban planners and decision-makers must achieve between allocating valuable space for parking and the potential cash generated by such parking lots (Rosales and Park, 2019). It is critical to balance land costs with revenue potential in order to achieve financial sustainability in parking infrastructure. Cities and property owners can maximize the financial return on their parking investments by adopting creative ways such as multi-level parking structures, mixed-use developments, and the integration of technology for dynamic pricing and space management. As a result, businesses will be able to make revenue from parking facilities while reducing the financial burden of designating valuable property just for parking.

(b) Construction Costs:

Effective cost management throughout the building phase is critical not just for managing expenses but also for improving the parking facility's overall financial performance. Parking operators and municipal planners can guarantee that the project remains financially feasible and that the return-on-investment fits with the project's aims and expectations by controlling construction costs efficiently. As a result, they can build parking facilities that contribute to income generation and the overall financial sustainability of urban or commercial districts.

(c) Operations and Maintenance Costs:

Effective operations and maintenance techniques can have a significant impact on the financial performance of parking facilities (Xie 2018). Parking facility maintenance and upkeep costs are reduced when operations are efficient and well-managed. Furthermore, these practices improve the overall user experience, leading to improved utilization rates and higher user satisfaction. As a result, parking financing and revenue are directly impacted. Users who find parking facilities that are well-maintained and user-friendly are more inclined to use them, resulting in increased revenue.

(d) Environmental Costs:

Environmental concerns are becoming increasingly important in parking finance and income. Environmental expenses associated with parking facilities include land use, stormwater management, and pollution (Mahmoudi 2020). Initial investments in environmentally friendly technology, infrastructure, and maintenance may be required for sustainable parking solutions. However, these investments frequently result in long-term cost reductions. Implementing energy-efficient lighting, stormwater management systems, and green roofs, for example, can minimize utility and maintenance expenses. These savings help to increase financial sustainability, which in turn improves the bottom line and return on investment for parking facilities.

When parking spaces are priced to reflect demand, cities can generate more revenue from the same physical infrastructure. This additional revenue can be reinvested in urban development, transportation initiatives, or other public services, helping to ensure the city's financial sustainability. By implementing responsive pricing strategies, cities can better allocate their resources, generate additional revenue, and promote financial sustainability while ensuring that parking serves the needs of both urban residents and visitors.

CHAPTER 3: SITE AREA & DATA COLLECTION

3.1 Site Selection

The selection of the MCD sites in context of a comprehensive examination of parking requirements is the main focus. The Public Transport Accessibility Level (PTAL) map of Delhi and land use data are combined in this analysis to determine parking locations. In this analysis, parking spots are defined by combining land use data with Delhi's Public Transport Accessibility Level (PTAL) map. locations are categorized on the PTAL map according to how easily accessible they are to public transportation; locations with higher PTAL values are considered more accessible. We can identify places with high parking demand and poor accessibility to public transportation by overlaying land use data over this image. This highlights the necessity for sufficient parking facilities in these locations.

Delhi's parking situation comes with a number of difficulties, such as a dearth of parking spots, a high car density, and escalating traffic congestion. The city's swift development has resulted in an increase in automobile ownership, worsening the parking issue.

It is crucial to carefully choose MCD locations for parking facilities in order to overcome these difficulties. In order to improve Delhi's general parking issue, this selection process should give priority to regions with high parking demand and limited accessibility for public transportation. The classification of parking spots according to the kind of parking they provide, such as parallel and perpendicular parking, is essential for comprehending the dynamics of parking in Delhi. Providing sufficient parking facilities is a major difficulty in Delhi, a heavily populated metropolitan city. Conversely, parking perpendicularly, which is usually found in parking lots and areas intended for that purpose, makes efficient use of available space and has a greater capacity for vehicles than parking parallelly. Understanding the quantity and distribution of perpendicular parking spaces might help determine how much space is available overall in Delhi's various neighbourhoods.

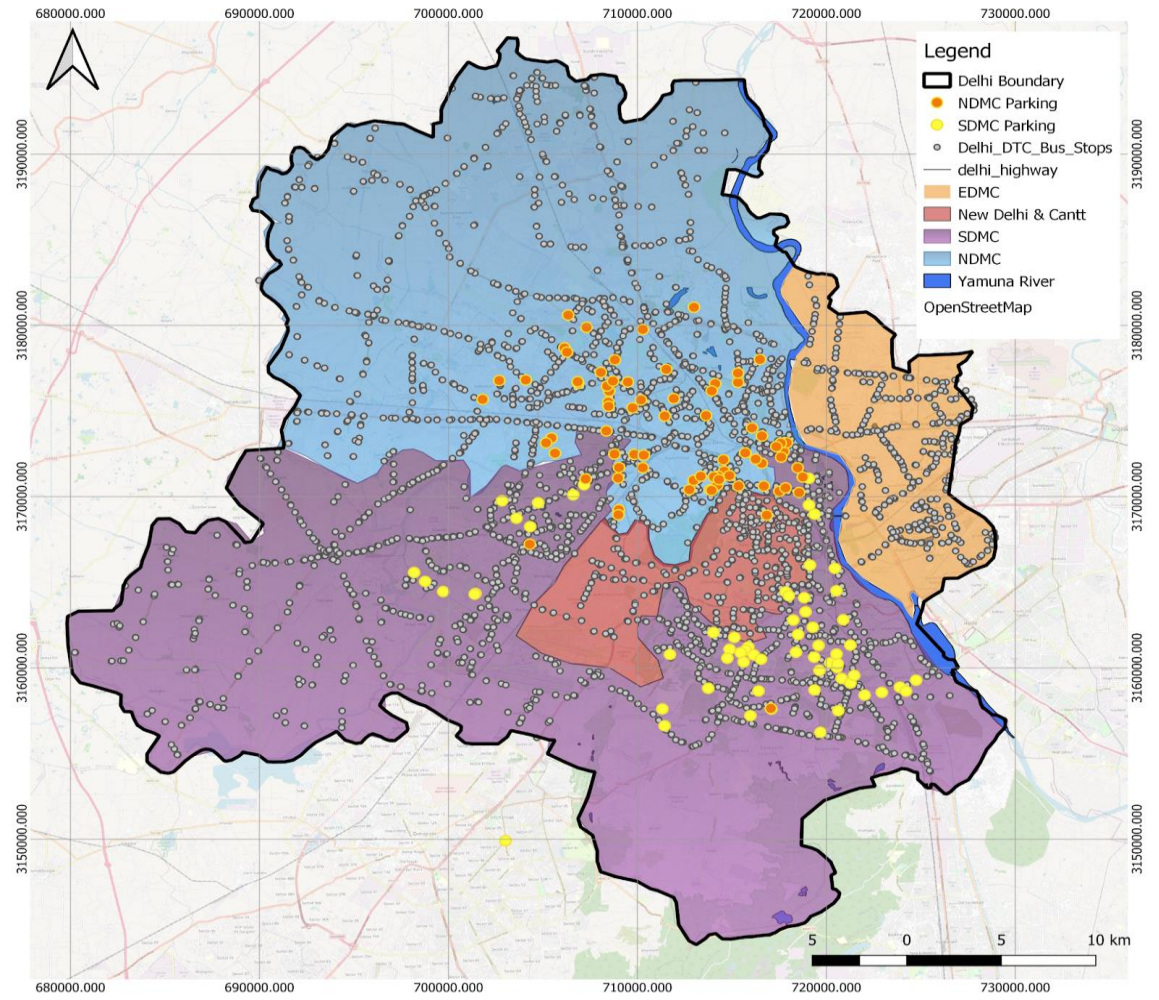


Figure 5: MCD Parking Sites, Delhi
Source: Author

By classifying parking locations according to the kind of parking they provide, we are able to evaluate the appropriateness and efficiency of various parking arrangements in Delhi's urban setting. For instance, parallel parking is frequently observed in constrained spaces and on small streets. It can be useful to determine regions that require additional parking facilities or alternative parking arrangements, like multi-level parking structures, by analysing the distribution and sufficiency of parallel parking spaces. Decisions about urban planning and policies that aim to enhance parking facilities, lessen traffic, and encourage environmentally friendly forms of transportation inside the city can be made with this information in mind.

3.2 Secondary Data Collection

Compiling secondary data from multiple sources is essential to comprehending Delhi's complex parking situation. A thorough picture of the parking situation in the city is

provided by the data compiled from many offices and internet resources, allowing for well-informed choices while choosing an MCD location. The data on MCD parking locations provides valuable insights into Delhi's current parking infrastructure by identifying places with high parking demand and potential gaps in parking facilities. This information is essential for determining the best places to build new parking lots or for maximizing the usage of ones that already exist. An additional useful tool for evaluating how accessible various locations is by public transportation is the Delhi PTAL map. Authorities can choose places for additional parking facilities by identifying regions with high parking demand and poor accessibility to public transportation by overlaying this map with MCD parking spaces.

Information on bus stops in Delhi offers valuable perspectives on the extent and density of the city's public transportation system. This data is crucial for pinpointing locations where parking lots might be placed thoughtfully to promote public transportation use and lessen dependency on private automobiles. Parking revenue information provides information about the financial aspects of parking management in Delhi. This information can be used to evaluate the financial feasibility of various parking options and to inform choices on the best MCD site based on budgetary constraints. In summary, obtaining a thorough grasp of Delhi's parking situation requires the gathering and examination of secondary data from a variety of sources. Making educated judgments on MCD site selection and creating efficient parking management plans for the city require this knowledge.

Table 1 Agency Wise Distribution of Roads

S. No.	Agency	Length (in Lane Km)
1	**MCDs** EDMC	270
	SDMC	9408
	NDMC	3118
2	New Delhi Municipal Council	1290

Source: Handbook of Urban Statistics, 2019, MoUD

Table 2 Details of existing parking facility under MCD

Sl.	Type of parking	Detail	South Delhi Municipal Corporation	North Delhi Municipal Corporation	East Delhi Municipal Corporation
1	Surface	Number of sites	106	95	63
		Capacity (ECS)	24500	24600	5882
2	Underground / Multilevel	Number of sites	7	8	39
		Capacity (ECS)	7164	6433	3855

Source: Handbook of Urban Statistics, 2019, MoUD

Table 3 Existing Parking Charges in Delhi

Type of Vehicle	Applicable fee for multi-level parking	Application fee for surface parking	Cost of monthly pass for multi-level parking only	Concessional monthly fees for multilevel parking only for association member/handicapped persons
Car	Rs. 20/- per hour subject to a maximum of Rs. 100/- per day	Rs. 30/- per hour	Rs. 2000/- per vehicle	Rs. 1500/- per vehicle
2 Wheeler	Rs. 10/- per hour subject to maximum of Rs. 50/- per day	Rs. 20/- per hour	Rs. 1000/- per vehicle	Rs. 750/- per vehicle
Commercial Vehicles (tempos, small carriers)	Rs. 50/- per hour subject to maximum of Rs. 250/- per day	Rs. 100/- per hour	Rs. 3000/- per vehicle	No concession

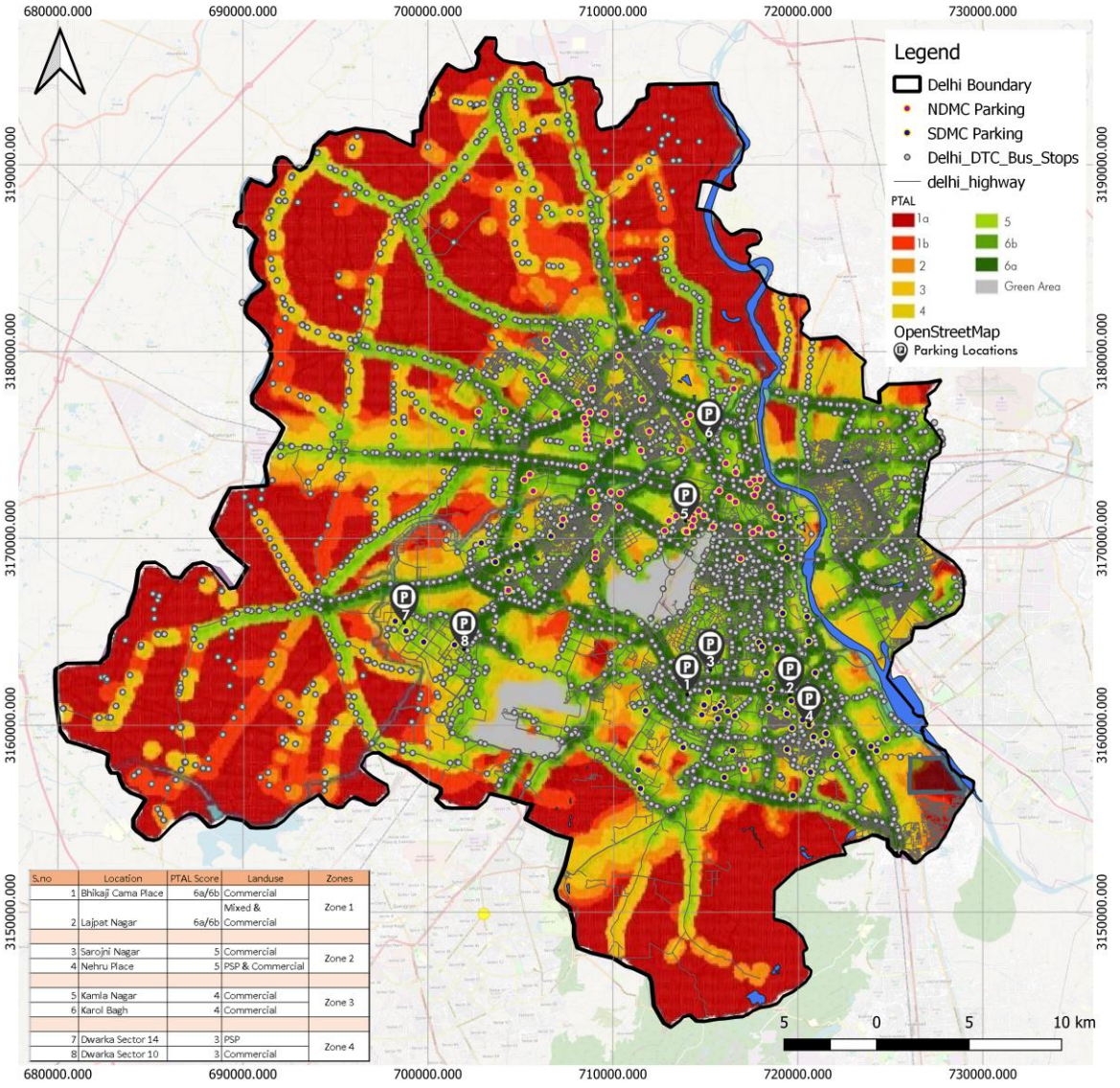
Source: Handbook of Urban Statistics, 2019, MoUD

3.3 Primary Data Collection

The parameters for primary data collection related to parking facilities are as follows:

1. **Surrounding Land Use:** This parameter describes the types of businesses or areas around the parking facility, such as residential areas, office districts, or shopping malls. Understanding the surrounding land use can provide insights into the potential demand for parking and the types of vehicles likely to use the facility.
2. **Accumulation:** This parameter indicates the number of vehicles using the parking facility at a specific time, often the peak period. It helps in understanding the peak demand for parking and can be used to determine the capacity requirements of the facility.
3. **Parking Load (Demand):** This parameter refers to the total amount of time vehicles occupy parking spaces within a specific timeframe, usually hourly. It is calculated by multiplying the accumulation by the average parking duration. This metric helps in assessing the overall demand for parking and can be used to optimize parking space allocation.
4. **Parking Capacity:** This parameter signifies the maximum number of vehicles the facility can accommodate at once. It is the supply side of the parking equation and is calculated as the available parking bays multiplied by the time period. Understanding the parking capacity is crucial for managing parking demand and ensuring adequate availability of parking spaces.
5. **Parking Index:** This parameter is a ratio expressed as a percentage and indicates the utilization of parking spaces. A higher index indicates better utilization of parking spaces, while a lower index suggests underutilization. The parking index is calculated as (parking load / parking capacity) x 100 and can help in optimizing parking operations.
6. **Average Parking Duration:** This parameter reflects the typical length of time a vehicle stays parked in the facility. It is important for understanding parking behavior and patterns, which can help in designing parking facilities and pricing strategies.

Collecting data on these parameters can provide valuable insights into parking demand, utilization, and behaviour, which are essential for effective parking management and planning.



S.no	Location	PTAL Score	Landuse	Zones
1	Bhikaji Cama Place	6a/6b	Commercial	Zone 1
2	Lajpat Nagar	6a/6b	Mixed & Commercial	
3	Sarojini Nagar	5	Commercial	Zone 2
4	Nehru Place	5	PSP & Commercial	
5	Kamla Nagar	4	Commercial	Zone 3
6	Karol Bagh	4	Commercial	
7	Dwarka Sector 14	3	PSP	Zone 4
8	Dwarka Sector 10	3	Commercial	

Figure 6 PTAL of Delhi with Selected Parking Sites
Source: Author

The selected sites for the study on parking include diverse areas within Delhi, each with its unique characteristics and challenges.

1. **Bhikaji Cama Place:** Located in Zone 1, Bhikaji Cama Place is a commercial hub with a PTAL score of 6a/6b, indicating good public transport accessibility. The area's high commercial activity is likely to result in significant parking demand from businesses and visitors.

2. **Lajpat Nagar:** This area, also in Zone 1, has a mixed and commercial land use with a PTAL score of 6a/6b. The mix of residential and commercial spaces suggests a diverse parking demand from both residents and visitors to the commercial establishments.
3. **Sarojini Nagar:** With a PTAL score of 5, Sarojini Nagar falls in Zone 2 and is primarily a commercial area. The relatively lower PTAL score indicates slightly lower public transport accessibility compared to the previous sites, potentially impacting parking demand.
4. **Nehru Place:** Nehru Place is a mix of Public and Semi-Public (PSP) and commercial zones with a PTAL score of 5. It serves as a major commercial and business center, likely resulting in high parking demand from office-goers and visitors.
5. **Kamla Nagar:** This area in Zone 3 is primarily commercial with a PTAL score of 4. The lower PTAL score suggests relatively lower public transport accessibility, potentially leading to higher reliance on private vehicles and increased parking demand.
6. **Karol Bagh:** Karol Bagh is a commercial area with a PTAL score of 4. Similar to Kamla Nagar, the lower PTAL score indicates potential challenges with public transport accessibility, influencing parking demand in the area.
7. **Dwarka Sector 14:** Located in Zone 4, Dwarka Sector 14 is primarily a PSP zone with a PTAL score of 3. The area's classification as a PSP zone suggests a mix of public and semi-public facilities, potentially resulting in varied parking demand.
8. **Dwarka Sector 10:** Another area in Zone 4, Dwarka Sector 10 is primarily commercial with a PTAL score of 3. The lower PTAL score and commercial nature of the area indicate potential challenges with public transport accessibility and higher parking demand.

3.4 Inventory & Willingness Survey

This provides a comprehensive overview of the findings from a survey conducted to understand parking behaviour and preferences in urban areas, with a focus on Delhi. The survey collected responses from individuals of various

demographics and parking habits, shedding light on key insights that can inform policy and planning decisions. Here's a detailed elaboration of the key points:

Parking Usage Patterns:

- The survey indicates that a significant portion of respondents use parking facilities either daily or occasionally, suggesting a high reliance on personal vehicles for transportation needs.
- There is a preference for street parking or a combination of street parking and parking lots, indicating a need for convenient and accessible parking options.
- The variation in average monthly spending on parking highlights the diverse economic backgrounds of respondents and their willingness to allocate different budgets for parking.

Opinions on Parking Charges:

- Respondents generally support the idea of adjusting parking charges based on factors like location, time of day, and vehicle type, indicating a recognition of the need for dynamic pricing to manage parking demand effectively.
- The willingness to pay slightly higher parking charges under certain conditions demonstrates a nuanced understanding of the relationship between pricing, infrastructure/service quality, and user experience.

Perceptions of Parking Facilities:

- The perception of parking facilities and services as fair to good suggests that while there is room for improvement, respondents generally find the current offerings acceptable.
- The belief that parking charges should reflect demand and influence behaviour indicates an awareness of the role pricing plays in managing parking supply and demand dynamics.

Impact of Parking Charges on Mode Choice:

- The potential for increased parking charges to influence mode choice highlights the importance of pricing as a tool for promoting sustainable transportation modes and reducing reliance on private vehicles.

Preferences for Fund Utilization:

- The willingness to pay increased parking charges if the funds are used for specific projects indicates a desire for transparency and accountability in the use of parking revenue for public benefit.

Overall Importance of Parking:

- The importance of affordable parking in influencing decisions to visit commercial areas underscores the role of parking policy in supporting economic activity and urban vibrancy.

Suggestions for Improvement:

- Suggestions for improving facilities, enhancing security, and providing additional amenities reflect a desire for better overall parking experiences and a recognition of the value-added by these enhancements.

In conclusion, the survey findings highlight the need for holistic and sustainable parking policies that take into account the diverse needs and preferences of urban residents. By understanding these dynamics, policymakers and urban planners can develop strategies to improve parking management, promote alternative transportation modes, and create more liveable and sustainable cities.

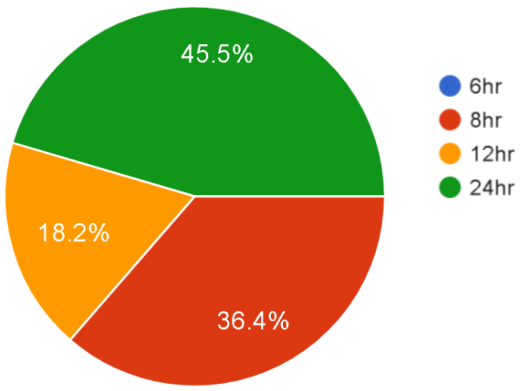


Figure 7 Standard Operating Hours
Source: Primary Survey

The data shows that a significant portion of parking facilities, 45.5%, operate round the clock, meaning they are open 24 hours a day. This indicates a high demand for parking that requires facilities to be available at all times to

accommodate users who may need to park during non-traditional hours, such as late at night or early in the morning.

Additionally, 36.4% of parking facilities operate for around the clock, which typically means they are open for most of the day but may have some period of closure, such as late at night or early in the morning. This suggests that while there is still a substantial need for parking during these hours, there may be some flexibility in terms of when these facilities need to be open.

The remaining 18.2% of parking facilities operate for a 12-hour duration, which could indicate that these facilities are typically located in areas with lower demand or where parking needs are more predictable, allowing them to operate for a shorter period each day.

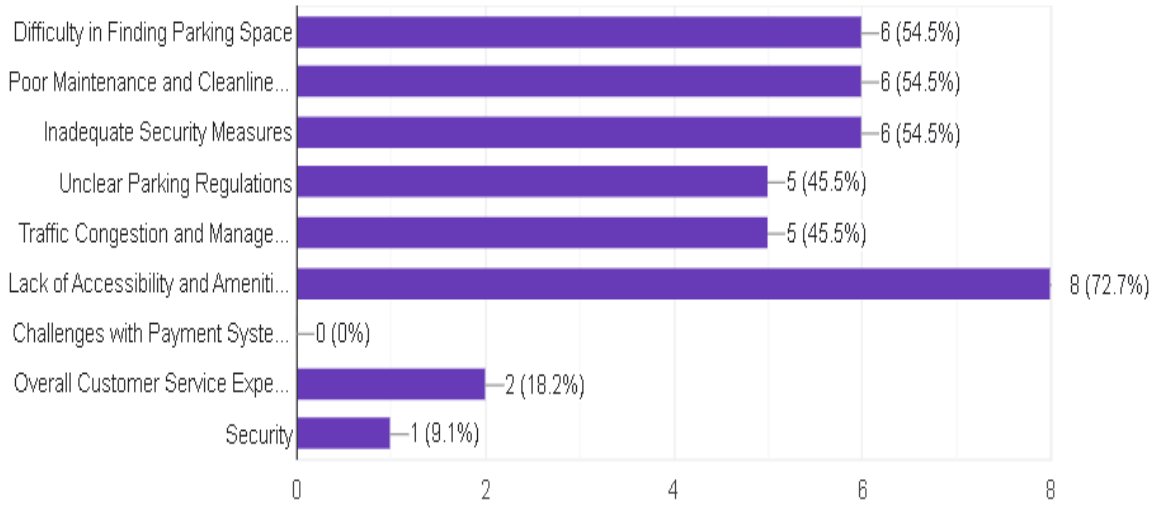


Figure 8 User Complaints
Source: Primary Survey

The data on customer satisfaction with parking spaces reveals a mixed picture. While respondents were generally satisfied with the lack of challenges with payment systems, with 0% dissatisfaction reported in this area, there are significant areas for improvement highlighted by the survey.

The most prominent issue identified is the difficulty in finding parking spaces, with 54.5% of respondents indicating dissatisfaction in this regard. This

suggests that there may be a lack of available parking spaces relative to the demand, leading to frustration among users who struggle to find parking when they need it.

Poor maintenance and cleanliness of parking spaces were also major concerns, with 54.5% of respondents expressing dissatisfaction. This indicates that there is a need for better upkeep of parking facilities to ensure they are clean, well-maintained, and safe for users.

Inadequate security measures were another key area of dissatisfaction, with 54.5% of respondents indicating that they were not satisfied with the security of parking spaces. This suggests that there is a need for improved security measures such as surveillance cameras, lighting, and security patrols to make parking facilities safer for users.

Furthermore, 45.5% of respondents were dissatisfied with unclear parking regulations and traffic congestion. This highlights the importance of clear signage and communication of parking rules to ensure that users understand where they can park and avoid congestion in parking areas.

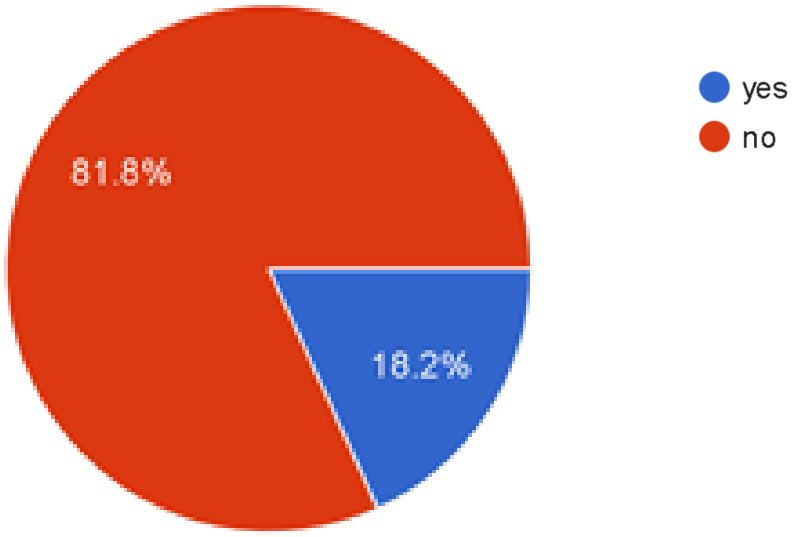


Figure 9 Amenities Present
Source: Primary Survey

The data indicates that a significant majority (81.8%) of the surveyed parking spaces do not have a restroom. This could be a significant inconvenience for users, especially those who may need restroom facilities during their parking duration. Lack of restroom facilities can impact the overall user experience and

may lead to dissatisfaction among users. Providing restroom facilities at parking spaces could enhance the user experience and make the parking facility more attractive to users.

The survey indicates that mobile apps are the most accepted payment method for parking, with 100% acceptance among the surveyed parking spaces. This suggests that parking facilities are increasingly adopting digital payment solutions to offer convenience to users. Additionally, cash is still widely accepted, with 90.9% of surveyed parking spaces accepting cash payments. This indicates that while digital payment methods are gaining popularity, there is still a significant portion of users who prefer or rely on cash for parking transactions.

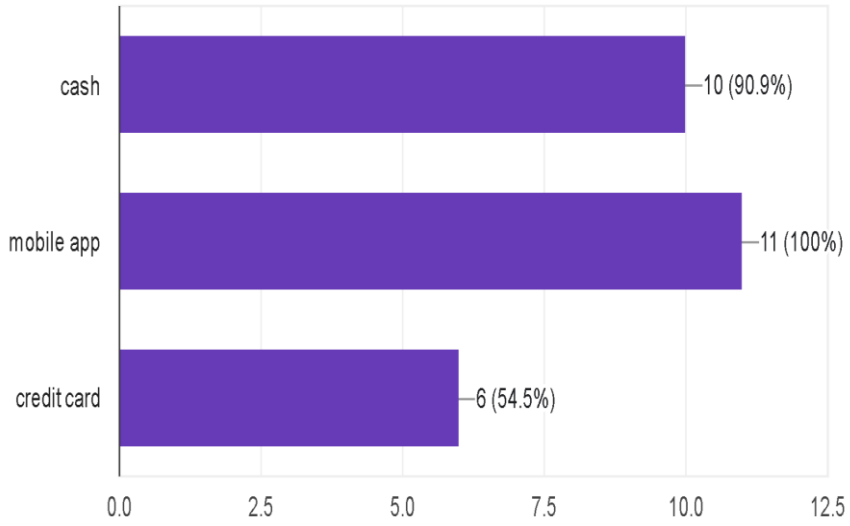


Figure 10 Accepted Payment Method
Source: Primary Survey

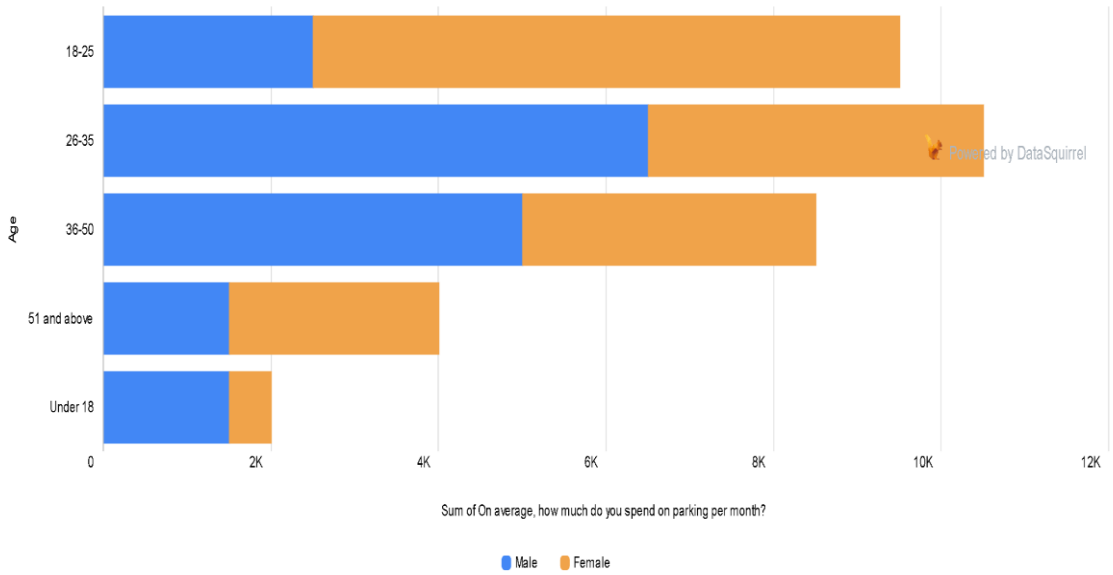


Figure 11 Money spent on Parking

Source: Primary Survey

The data suggests that parking costs tend to increase with age, and men tend to spend slightly more on parking than women across all age groups. These findings can be indicative of various factors such as differences in travel patterns, preferences, and financial capabilities among different demographic groups. It's important to further analyse these trends to understand the underlying reasons and implications for parking policy and urban planning.

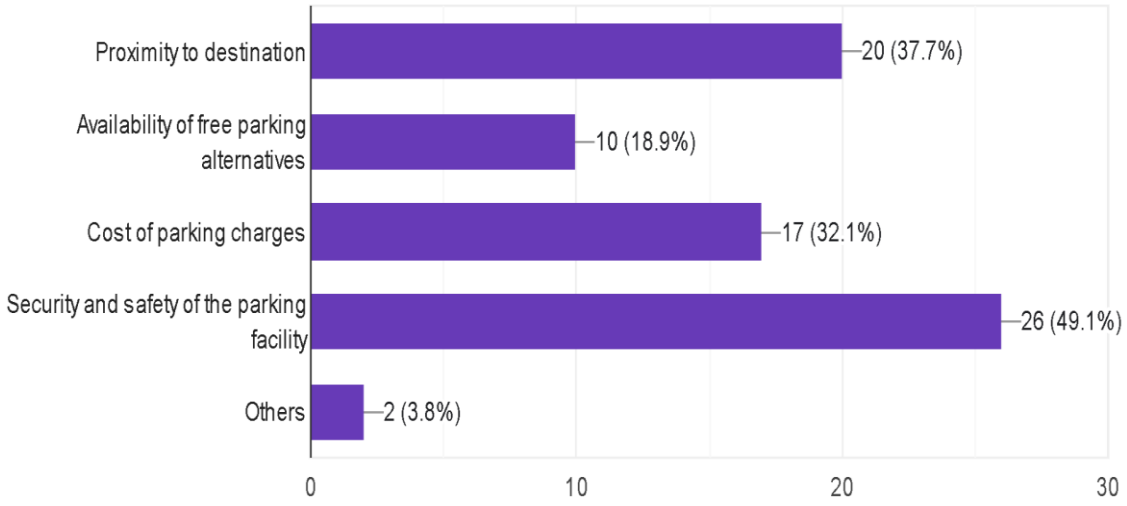


Figure 12 Factors Influencing

Source: Primary Survey

When deciding whether to use paid parking facilities, respondents consider several factors. The most important factor, cited by 49% of respondents, is safety. This includes aspects such as well-lit areas, security personnel, and surveillance cameras, which are crucial for ensuring the safety of vehicles and individuals using the parking facilities. Proximity to the destination is also a significant factor, with 37.3% of respondents indicating its importance. People prefer parking facilities that are conveniently located near their destination, reducing the need for long walks or additional transportation. Availability of free parking is another key consideration, with 32.1% of respondents citing it as a factor. This reflects a preference for free parking options when they are available, as it reduces the overall cost of the trip. Cost of parking, while still important, is cited by 18.9% of respondents. This suggests that while cost plays a role in decision-making, it is not the primary factor for everyone. People are willing to pay for parking if other factors, such as safety and proximity, meet their needs.

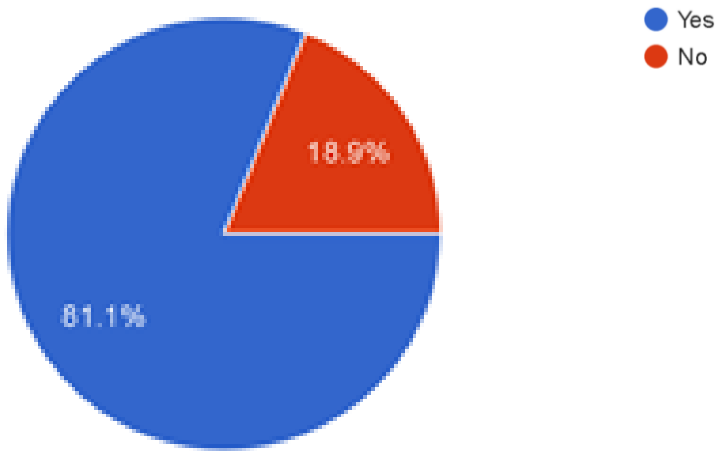


Figure 13 Percentage of people ready to shift mode
Source: Primary Survey

The data shows that 81% of people are willing to shift to other modes of commuting if parking pricing is increased. This suggests that pricing plays a significant role in influencing people's mode choice for commuting. Increasing parking charges could be an effective strategy to encourage the use of alternative

transportation modes, which could help reduce congestion, improve air quality, and promote sustainable urban mobility.

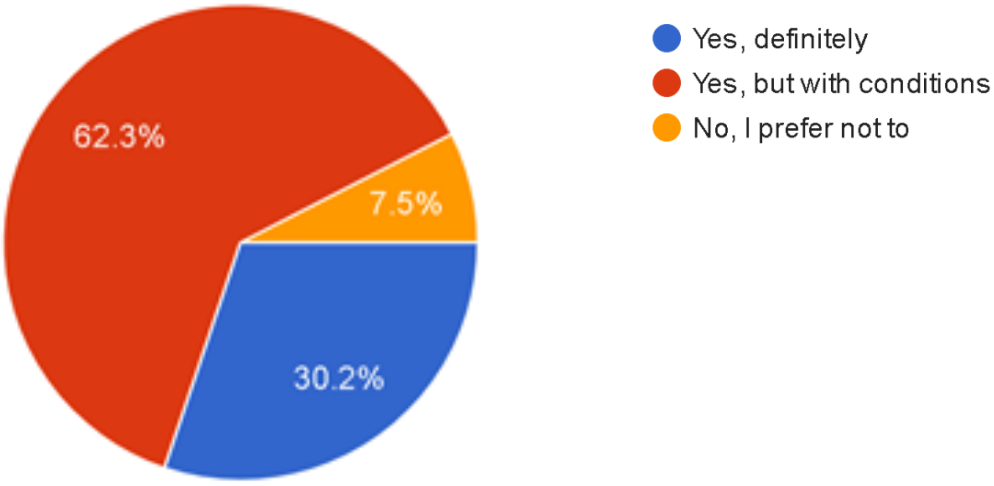


Figure 14 Percentage pf people willing to pay higher parking charges
Source: Primary Survey

The data indicates that 62.3% of people are willing to pay higher parking charges. This finding suggests that there is a willingness among a majority of respondents to accept increased parking costs, potentially indicating a recognition of the need for better parking facilities and services. It also implies that there might be some tolerance for increased pricing if it leads to improved infrastructure or services.

CHAPTER 4 Data Analysis

The data analysis chapter of the study focuses on examining the responses collected through surveys conducted to understand parking behaviour and preferences in urban areas, with a specific focus on Delhi. This chapter aims to provide a comprehensive analysis of the data gathered, including key insights, trends, and patterns related to parking usage, preferences, and opinions. The analysis begins by presenting descriptive statistics of the survey respondents, including their demographic information such as age, gender, and occupation. This provides a context for understanding the sample population and allows for demographic-based comparisons in parking behaviour. The chapter explores parking usage patterns, including the frequency of parking facility usage, preferred types of parking facilities, and average monthly spending on parking. It also examines factors influencing parking choices, such as availability of free parking alternatives, security, and proximity to the destination. The chapter further analyses opinions on parking charges, including perceptions of current parking charges, willingness to pay higher charges for better urban infrastructure, and preferences for fund utilization from increased parking charges.

Additionally, the analysis delves into perceptions of parking facilities, including the quality of facilities and services, satisfaction levels, and areas for improvement. It also investigates the impact of parking charges on mode choice for commuting or running errands.

Finally, the chapter concludes with a summary of the key findings from the data analysis, highlighting important trends and insights regarding parking behaviour and preferences in urban areas. These findings are valuable for policymakers and urban planners in developing effective parking policies that promote sustainable urban mobility.

4.1 Lajpat Nagar

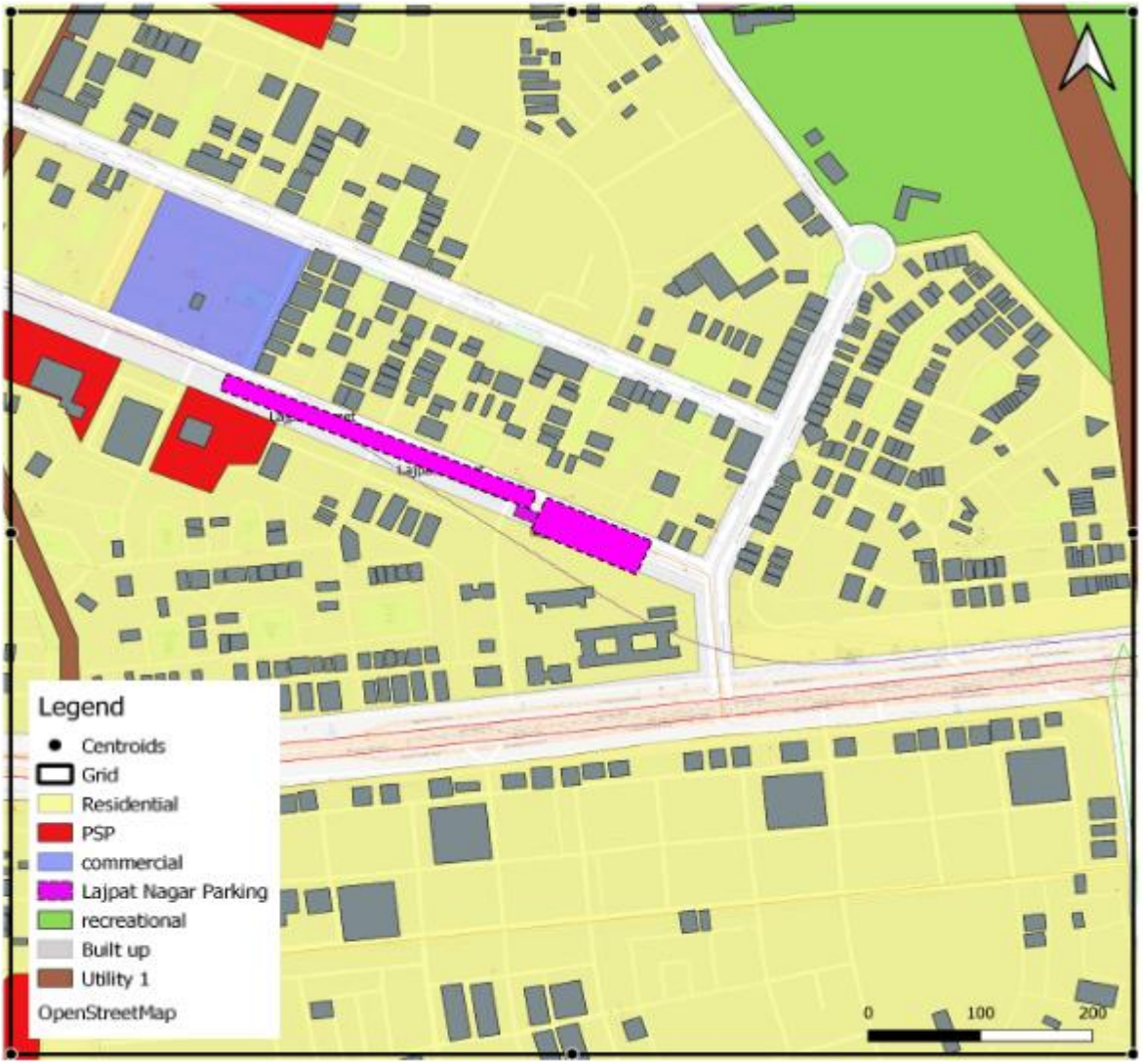


Figure 15 parking Site Lajpat Nagar

Source: Author

The analysis of the parking parameters for Lajpat Nagar (On Street) reveals several key insights.

The Right of Way (ROW) of 25 meters indicates a relatively wide road, which can accommodate parking spaces without significantly affecting traffic flow. The surrounding land use being Mixed Use suggests a diverse range of activities in the area, likely leading to varying parking demands throughout the day.

The length of the parking stretch is 200 meters, providing a considerable space for parking. The choice of perpendicular parking indicates efficient space utilization, allowing for more vehicles to be parked compared to parallel parking. The parking volume, which is the total number of Equivalent Car Spaces (ECS), is 70. However, the accumulation, which is the number of vehicles using the

parking facility at a specific time (often the peak period), is 361.95. This indicates a high demand for parking in the area, potentially leading to issues such as difficulty in finding parking spaces and congestion. The parking load, calculated by multiplying accumulation by average parking duration, is 90.45 ECS per hour. This shows the rate at which parking spaces are being occupied and vacated, highlighting the dynamic nature of parking demand in the area. The average parking duration of 1.29 hours indicates that vehicles parked in this area tend to stay for relatively short periods, possibly indicating a high turnover rate. The parking capacity, which signifies the maximum number of vehicles the facility can accommodate at once, is 135 ECS. The parking index, which is a ratio expressed as a percentage and indicates the utilization of parking spaces, is 67%. This suggests that the parking facility is moderately utilized, with room for improvement in optimizing space utilization.

In conclusion, the analysis of parking parameters for Lajpat Nagar (On Street) highlights a high demand for parking in the area, with the potential for optimization in space utilization to meet this demand more effectively. Strategies such as improving signage for parking availability, implementing smart parking technologies, and considering alternative parking arrangements could help address the parking challenges in the area.

4.2 Bhikaji Cama Place

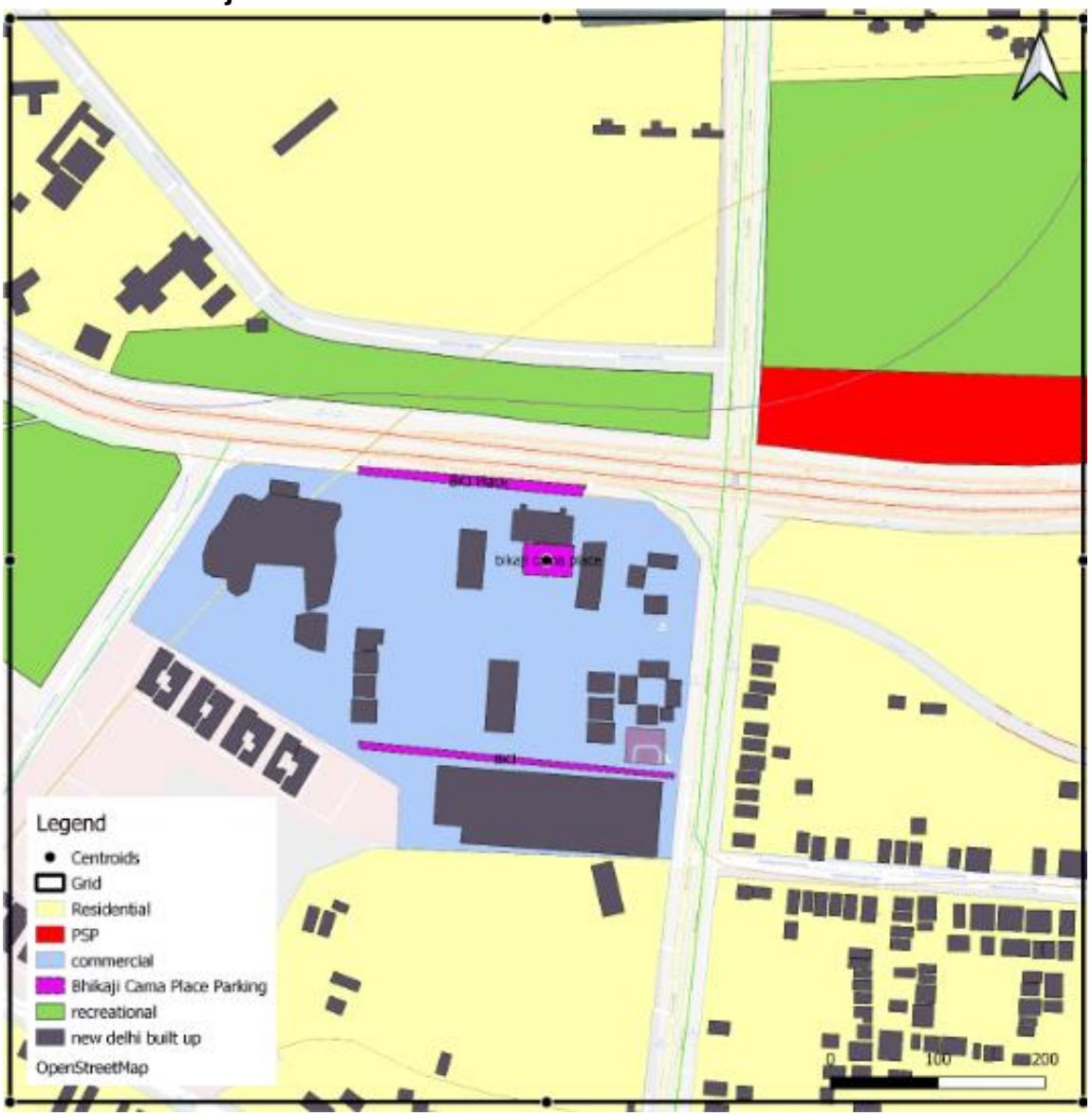


Figure 16 Parking Site Bhikali Cama Place
Source: Author

The data for Bhikaji Cama Place indicates a parking facility with a 15-meter right of way (ROW) and a length of 186 meters, primarily serving commercial and public service point (PSP) areas. The parking facility accommodates both 2-wheelers (2W) and 4-wheelers (4W) through parallel parking, with a total parking volume of 134.5 Equivalent Car Spaces (ECS). The accumulation, or peak usage, is 398 ECS, resulting in a parking load of 99.5 ECS per hour. The average parking duration is 1.16 hours, suggesting a relatively quick turnover of parking spaces. The parking capacity is 96 ECS, indicating that

the facility is often operating at or slightly above its maximum capacity. The parking index of 103.6% suggests that the facility is utilized efficiently, slightly exceeding its capacity at times. The parking turnover rate of 1.4 ECS per hour per bay indicates that each parking bay is used, on average, 1.4 times per hour. This metric is important as it reflects the efficiency of parking utilization and can help assess the need for additional parking infrastructure. In the case of Bhikaji Cama Place, the turnover rate suggests a moderate level of demand for parking, with spaces being used more than once per hour on average.

Overall, the analysis indicates that the parking facility at Bhikaji Cama Place is operating at a high level of utilization, with a high parking load and turnover rate. This suggests that there is a strong demand for parking in this area, possibly indicating a need for expansion or improvement of parking facilities to meet the needs of users. Additionally, the data highlights the importance of efficient parking management strategies to optimize the use of available parking spaces.

4.3 Sarojini Nagar

Figure 17 Parking Site Sarojini Nagar
Source: Author

The data for the Sarojini Nagar parking facility provides valuable insights into its operational dynamics. With a total parking volume of 53.2 Equivalent Car Spaces (ECS) and an accumulation of 221 ECS, the facility operates at a parking load of 55.45 ECS per hour. This indicates a high demand for parking in the area. The average parking duration of 1 hour suggests that the turnover rate is relatively high, with vehicles frequently entering and exiting the facility.

However, the parking index of 16.1% indicates that there is still underutilization of the available parking capacity, which stands at 90 ECS. This could be due to factors such as inadequate signage or unclear parking regulations, leading to inefficiencies in space utilization. The parking turnover rate of 0.5 ECS per hour per bay suggests that, on average, each parking bay accommodates half a vehicle per hour. This metric is crucial for understanding the efficiency of the parking facility in serving the demand.

Overall, while the Sarojini Nagar parking facility experiences high demand and turnover, there is room for improvement in optimizing its capacity utilization. Addressing factors that contribute to underutilization, such as improving signage and enforcing parking regulations, could enhance the facility's efficiency and better serve the parking needs of the area.

4.4 Nehru Place

Figure 18 Parking Site Nehru Place
Source: Author

The analysis of parking parameters for Nehru Place reveals several key insights. The area has a right of way (ROW) of 60 meters, indicating a relatively wide road that can accommodate parking infrastructure. The surrounding land use is primarily commercial, suggesting high demand for parking from businesses and customers. The length of the stretch for parking is 110 meters, which is a significant area for parking facilities. The parking type in Nehru Place is perpendicular, suitable for accommodating both two-wheelers and four-wheelers. The parking volume, which is the total number of Equivalent Car Spaces (ECS), is 90.9, indicating the capacity required to meet the parking demand in the area. The accumulation, which is the number of vehicles using the parking facility at a specific time, is 542.5 ECS, indicating a high demand for parking.

The parking load, calculated by multiplying accumulation by average parking duration, is 135.5 ECS/hr, indicating the total amount of time vehicles occupy parking spaces within a specific timeframe. The average parking duration is 1.49 hours, suggesting that vehicles typically stay parked for less than two hours.

The parking capacity, which is the maximum number of vehicles the facility can accommodate at once, is 117 ECS. The parking index, expressed as a percentage, is 115.8, indicating a high utilization of parking spaces in Nehru Place. The parking turnover, which is the ratio of parking volume to the number of bays available, is 0.7 ECS/hr/bay, suggesting that parking spaces are being used efficiently.

Overall, the analysis indicates that Nehru Place faces a high demand for parking, particularly due to its commercial land use. The area has a relatively high parking index, indicating that parking spaces are utilized efficiently. However, there are areas for improvement, such as increasing parking capacity to meet the high demand and improving parking duration to accommodate longer parking durations.

4.5 Kamla Nagar

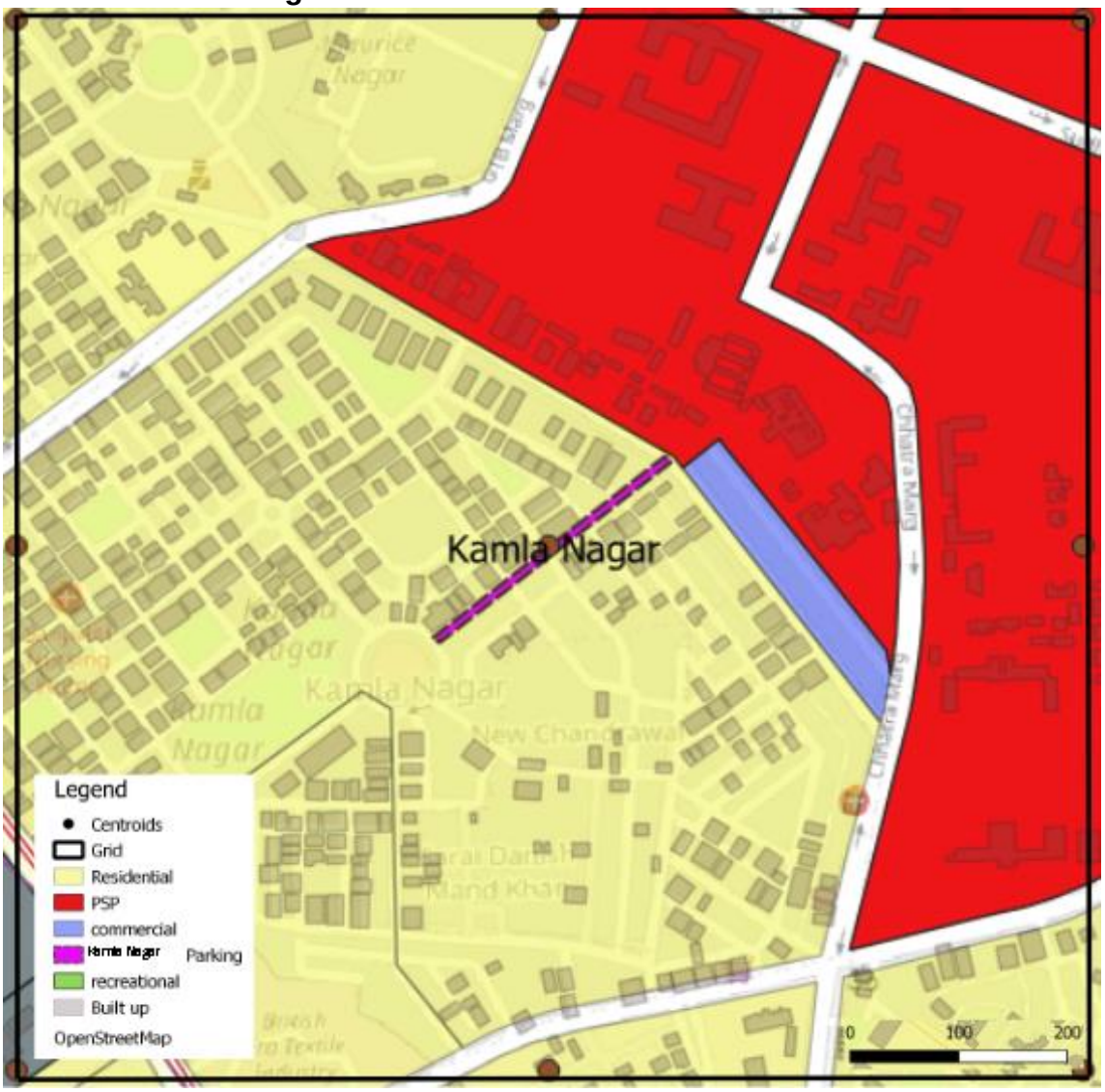


Figure 19 Parking Site Kamla Nagar
Source: Author

The analysis of the parking parameters for Kamla Nagar reveals several important insights. Firstly, the Right of Way (ROW) of 15 meters indicates a moderately wide road, which should theoretically allow for easier parking manoeuvres. However, the surrounding land use being commercial suggests high demand for parking spaces, potentially leading to congestion. The length of the stretch being 100 meters indicates a relatively short parking area, which could contribute to the difficulty in finding parking spaces, as indicated by the high accumulation of 144.75 Equivalent Car Spaces (ECS).

The parking type being parallel further adds to the complexity, as parallel parking typically requires more skill and time compared to other types of parking.

This is reflected in the relatively high average parking duration of 0.95 hours. The parking volume of 38 ECS suggests a considerable demand for parking in the area. However, the parking capacity of 135 ECS indicates that there are more available parking spaces than the total demand, which could mean that not all parking spaces are being utilized efficiently. The parking index of 32.17% indicates that the parking facility is being utilized at about one-third of its capacity, which suggests that there is potential to optimize the use of parking spaces more effectively.

Overall, the analysis suggests that while there is a significant demand for parking in Kamla Nagar, there are opportunities to improve the efficiency and utilization of parking spaces to better meet the needs of the area. This could include measures such as improved signage, better enforcement of parking regulations, and potentially reevaluating the parking layout to accommodate more vehicles efficiently.

4.6 Karol Bagh

Figure 20 Parking Site karol Bagh
Source: Author

The data for Karol Bagh indicates that it is a commercial area with a right of way (ROW) of 20 meters and a stretch length of 220 meters. The parking type is parallel, accommodating both 2-wheelers and 4-wheelers. The parking volume is measured at 80.81 Equivalent Car Spaces (ECS), with an accumulation of 584.25 ECS. The parking load, which is the total amount of time vehicles occupy parking spaces, is 146 ECS per hour. The average parking duration is 1.8 hours. The parking capacity, representing the maximum number of vehicles the facility can accommodate, is 111 ECS. The parking index, a ratio indicating the utilization of parking spaces, is high at 131.5%, suggesting that the facility is often

over capacity. The parking turnover rate, calculated as the parking volume divided by the number of bays available, is 0.7 ECS per hour per bay.

This data analysis reveals several key points. Firstly, the high parking index indicates that there is a significant demand for parking in Karol Bagh, potentially leading to challenges in finding available parking spaces. The high parking load further emphasizes this point, indicating that vehicles occupy parking spaces for a substantial amount of time. Additionally, the low parking turnover rate suggests that vehicles remain parked for relatively long periods, which could contribute to congestion and reduced availability of parking spaces for other users. Overall, this analysis highlights the need for effective parking management strategies in Karol Bagh to address the high demand for parking and improve the overall parking experience for users.

4.7 Dwarka Sector 14

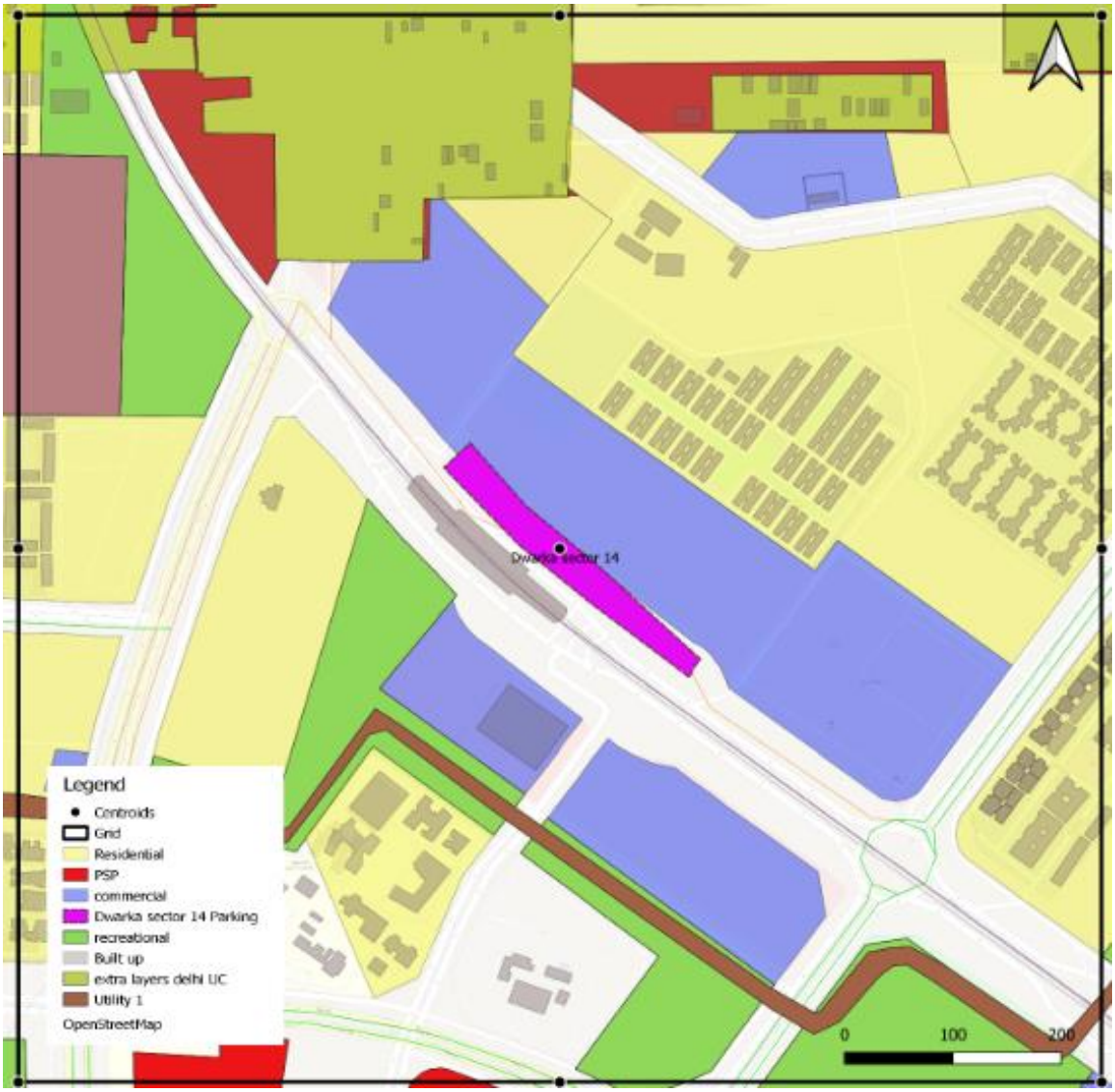


Figure 21 Parking Site Dwarka sector 14
Source: Author

The analysis of the parking parameters for Dwarka Sector 14 reveals several key insights into the parking scenario in this area. The Right of Way (ROW) of 60 meters indicates a relatively wide road, which should theoretically allow for easier parking access. However, the surrounding land use being Public and Semi-Public (PSP) suggests that there may be competing demands for space, potentially leading to parking challenges. The length of the stretch at 124 meters provides a decent amount of space for parking, but the type of parking indicated as parallel suggests that this space may not be fully utilized for parking due to restrictions on parallel parking compared to other types like perpendicular or angle parking. The parking volume of 33.25 ECS (Equivalent Car Spaces)

indicates the total capacity for parking in this area, while the accumulation of 115 ECS suggests the number of vehicles using the parking facility at a specific time, likely the peak period. The parking load of 28.75 ECS/hr indicates the total amount of time vehicles occupy parking spaces within a specific timeframe, usually hourly, highlighting the high demand for parking in this area.

The average parking duration of 0.86 hours indicates that vehicles tend to stay parked for less than an hour on average, which could be due to the high turnover rate of parking spaces. The parking capacity of 52.5 ECS signifies the maximum number of vehicles the facility can accommodate at once, indicating that the parking demand exceeds the available capacity, leading to potential congestion and competition for parking spaces. The parking index of 55% suggests that the parking facility is utilized at just over half of its capacity, indicating that there is still room for improvement in optimizing the use of available parking spaces. The parking turnover rate of 0.6 ECS/hr/bay indicates the rate at which vehicles enter and leave the parking facility, which is crucial for managing parking demand effectively.

Overall, the analysis highlights the high demand for parking in Dwarka Sector 14, with the existing parking capacity not fully meeting the needs of the area. This suggests a potential need for interventions to increase parking capacity or improve parking management strategies to better accommodate the parking needs of the area.

4.8 Dwarka Sector 10

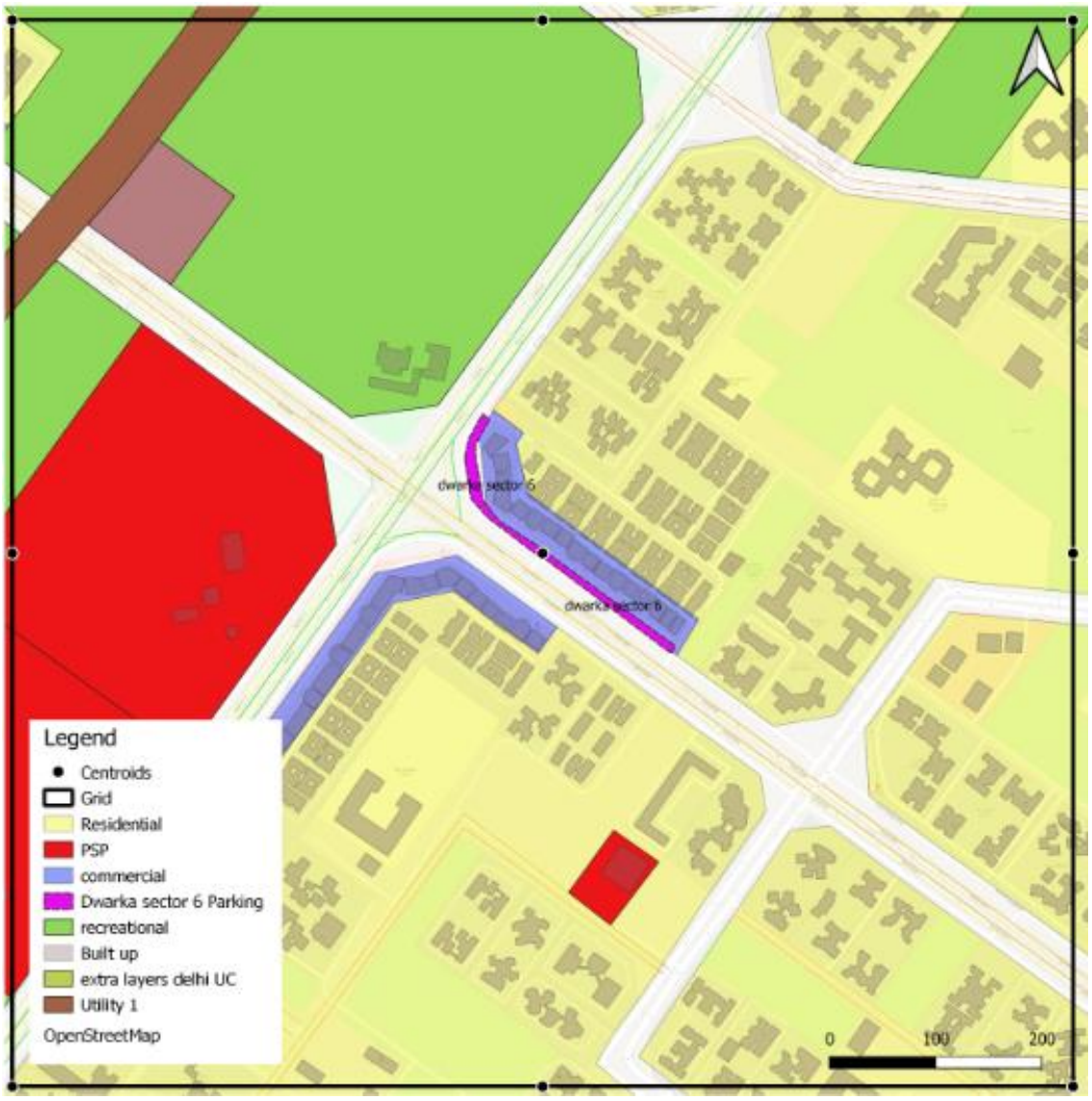


Figure 22 Parking Site Dwarka Sector 10
Source: Author

The analysis of parking parameters for Dwarka Sector 10 reveals several key insights. With a Right of Way (ROW) of 45 meters and a length of stretch of 350 meters, this area is designated for commercial land use. The parking type in this area is perpendicular, accommodating both 2-wheelers and 4-wheelers.

The parking volume, which represents the estimated number of Equivalent Car Spaces (ECS), is calculated at 55.25, indicating the capacity required to accommodate vehicles in this area. The accumulation, which is the number of vehicles using the parking facility at a specific time (usually the peak period), is recorded at 245.25 ECS. This accumulation contributes to the parking load,

calculated at 61.3 ECS per hour, showing the total amount of time vehicles occupy parking spaces within a specific timeframe.

The average parking duration, reflecting the typical length of time a vehicle stays parked, is calculated at 1.1 hours. The parking capacity, which signifies the maximum number of vehicles the facility can accommodate at once, is determined to be 90 ECS. The parking index, a ratio expressed as a percentage, is calculated at 68%, indicating a relatively high utilization rate of parking spaces in this area.

The parking turnover, which represents the rate at which parking spaces are being used and vacated, is calculated at 0.6 ECS per hour per bay, suggesting a moderate turnover rate. Overall, the analysis of these parameters indicates that while the parking facility in Dwarka Sector 6 is being utilized, there is still capacity available for additional vehicles. This information can be valuable for urban planners and policymakers in assessing parking demand and capacity in commercial areas to optimize parking management strategies.

4.9 Primary Survey Analysis – Summary

The analysis categorizes parking areas in Delhi based on their accumulation levels, highlighting the need for different management strategies. High accumulation areas like Nehru Place, Bhikaji Cama Place, and Karol Bagh are experiencing significant congestion due to high parking demand. Immediate parking management strategies, such as implementing dynamic pricing, improving enforcement, and enhancing public transportation access, are necessary to alleviate congestion and improve traffic flow in these areas.

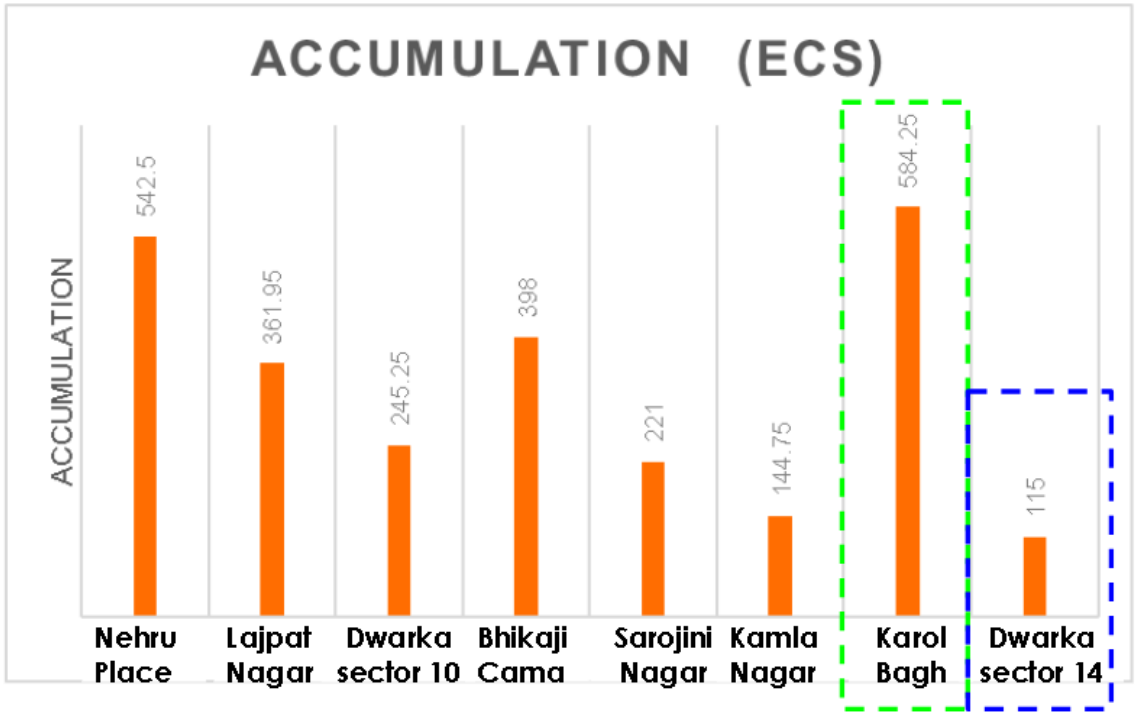


Figure 23 Accumulation Comparison
Source: AuthorModerate accumulation areas like Lajpat Nagar, Sarojini Nagar, and Dwarka Sector 6 have a moderate level of parking demand. While they may not be experiencing severe congestion currently, it is crucial to closely monitor parking demand trends to anticipate future needs. Implementing parking guidance systems, promoting alternative transportation modes, and optimizing parking facilities can help manage parking effectively in these areas.

On the other hand, low accumulation areas like Kamla Nagar and Dwarka Sector 14 have relatively low parking demand. These areas may not require immediate interventions but should still be monitored to ensure that parking remains adequate as urban development progresses. Strategies such as promoting walking and cycling infrastructure, implementing carpooling programs, and integrating smart parking technologies can help maintain a balanced parking supply in these areas. Overall, adopting tailored parking management strategies based on accumulation levels is essential for ensuring efficient urban mobility and addressing parking challenges in Delhi.

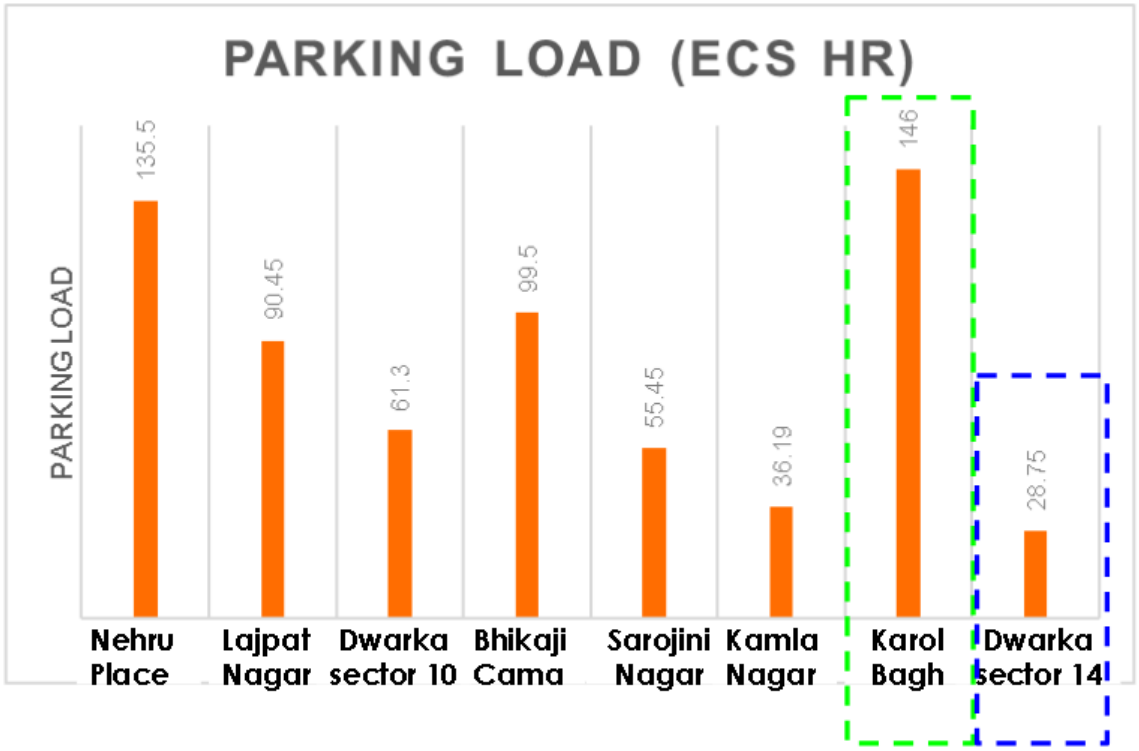


Figure 24 Parking Load Comparison

Source: Author

The analysis of parking load across different areas highlights varying levels of demand and capacity utilization. Nehru Place, Karol Bagh, and Dwarka Sector 14 are identified as experiencing high parking load, indicating that these areas either require additional parking capacity or more effective management strategies to address congestion and meet the high demand for parking.

On the other hand, Lajpat Nagar, Sarojini Nagar, Kamla Nagar, and Dwarka Sector 6 exhibit moderate to low parking loads, suggesting that these areas currently have sufficient parking capacity to meet the demand. However, monitoring and periodic assessment are still recommended to ensure that these areas do not face congestion issues in the future. Bhikaji Cama Place is noted to have a moderate parking load, indicating that while the current capacity is sufficient, it requires careful monitoring to prevent congestion. This suggests that Bhikaji Cama Place could benefit from regular assessments and potential adjustments to parking management strategies to maintain an optimal balance between demand and capacity.

Overall, this analysis underscores the importance of dynamic parking management strategies that can adapt to changing demand patterns. By addressing the specific needs of each area, such as increasing capacity where necessary and implementing effective monitoring and management practices, cities can improve parking efficiency, reduce congestion, and enhance the overall urban mobility experience for residents and visitors alike.

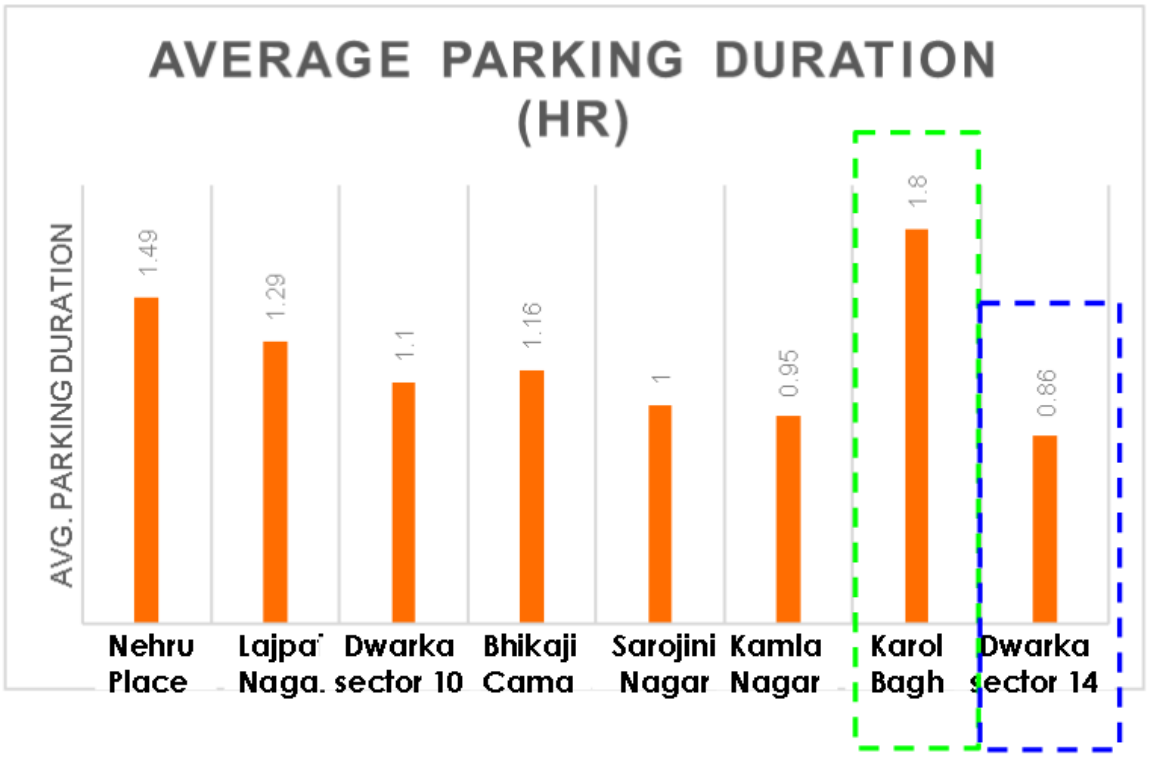


Figure 25 Average Parking Duration Comparison
Source: Author

The analysis suggests that Nehru Place and Karol Bagh may benefit from implementing time-limited parking or pricing strategies to encourage turnover. These areas likely have longer parking durations, which could lead to reduced availability of parking spaces for other users. By implementing measures that encourage turnover, such as time limits or pricing structures that incentivize shorter stays, these areas can improve the availability of parking spaces and reduce congestion.

On the other hand, Dwarka Sector 6, Sarojini Nagar, and Kamla Nagar show efficient turnover, indicating that parking spaces are being used effectively. In these areas, the average parking duration is likely shorter, allowing more vehicles to use the available parking spaces throughout the day. This efficient

turnover is beneficial for reducing congestion and ensuring that parking spaces are utilized optimally.

By implementing strategies that encourage turnover in areas with longer durations and maintaining efficient turnover in areas with shorter durations, cities can improve the overall availability and utilization of parking spaces. This balanced approach can contribute to a more sustainable and efficient urban transportation system.

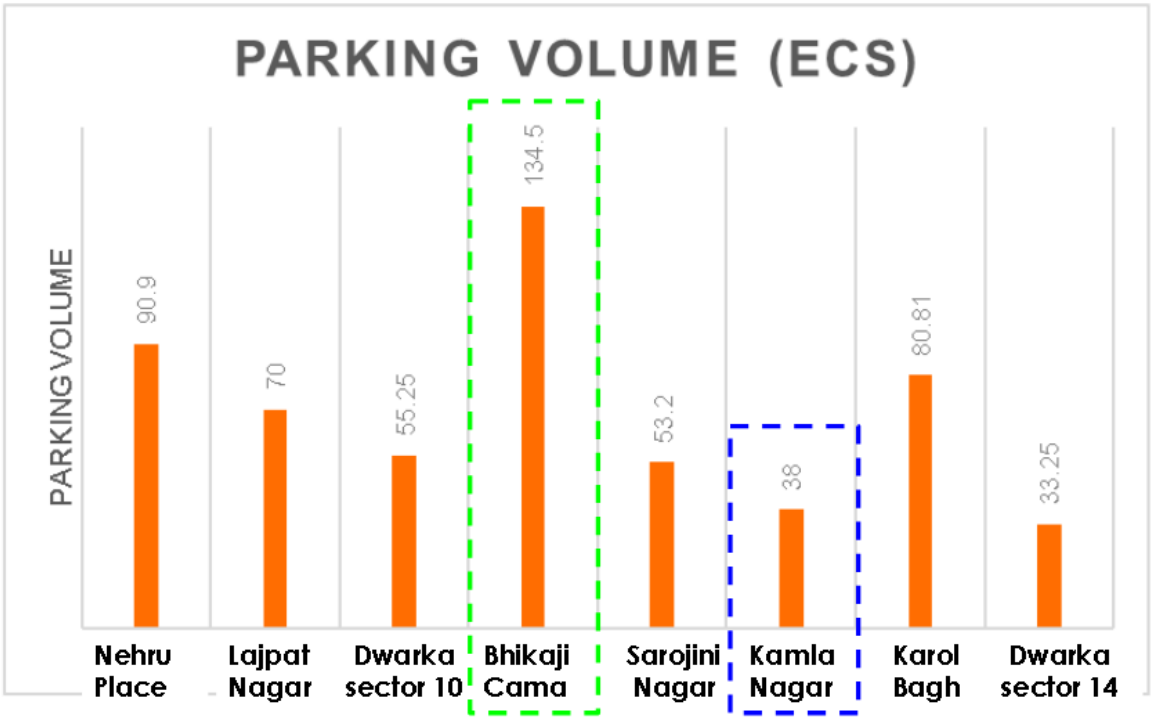


Figure 26 Parking Volume Comparison
Source: Author

The analysis of parking demand across different areas reveals distinct patterns in Delhi. High demand areas such as Nehru Place, Bhikaji Cama Place, and Karol Bagh exhibit significant parking volumes, indicating a substantial demand for parking facilities. These areas are likely commercial hubs or popular destinations, attracting a large number of vehicles requiring parking.

On the other hand, moderate demand areas like Lajpat Nagar and Dwarka Sector 6 show moderate parking volumes, suggesting a moderate level of parking demand. These areas may have a mix of commercial and residential properties, leading to a relatively balanced parking demand. In contrast, low demand areas such as Sarojini Nagar, Kamla Nagar, and Dwarka Sector 14 have relatively low parking volumes, indicating lower parking demand. These areas

may have better access to public transportation or fewer commercial activities, resulting in lower vehicle parking requirements.

Overall, the analysis of parking volumes in these areas provides valuable insights for urban planners and policymakers to understand the parking demand patterns in different parts of Delhi. This information can be used to develop targeted parking management strategies, such as implementing parking pricing mechanisms or improving public transportation options, to better address the varying parking needs across the city.

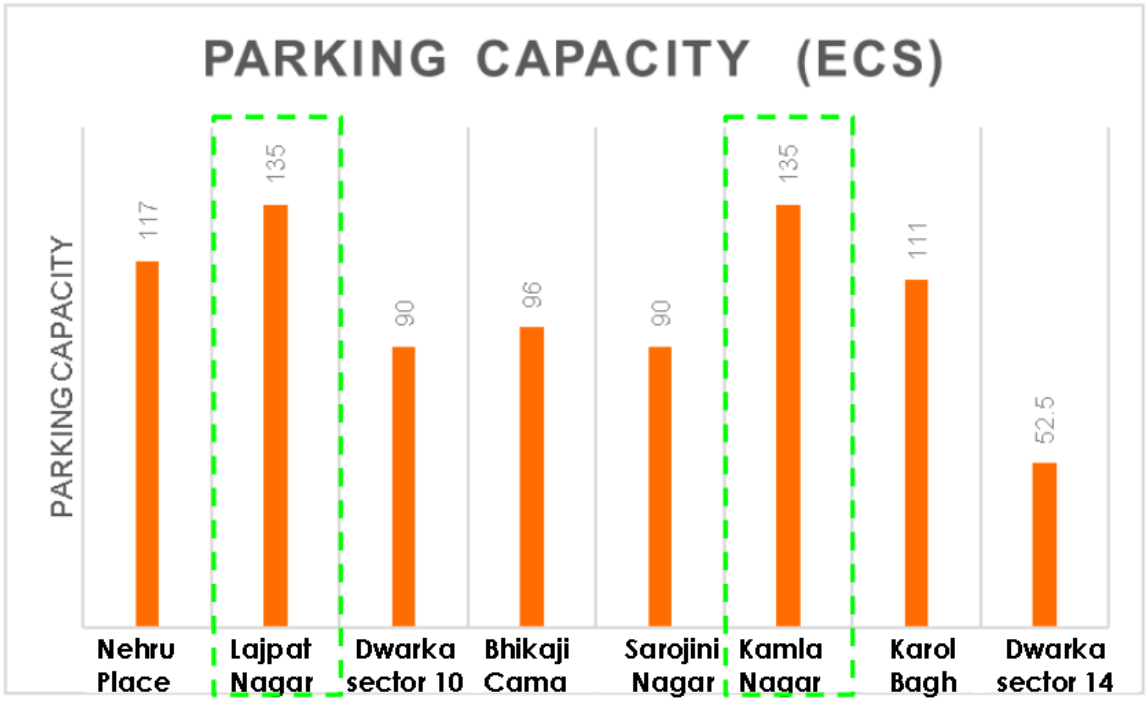


Figure 27 Parking Capacity Comparison
Source: Author

The analysis of parking capacity in various areas reveals a mixed picture in terms of meeting current demand. Lajpat Nagar, Dwarka Sector 6, Sarojini Nagar, and Kamla Nagar are identified as having adequate parking spaces to meet the current demand. These areas likely have sufficient parking infrastructure or management strategies in place to accommodate the number of vehicles seeking parking.

On the other hand, Nehru Place, Bhikaji Cama Place, Karol Bagh, and Dwarka Sector 14 are identified as potentially facing parking shortages. These areas may experience challenges in meeting the demand for parking, indicating a need for additional parking facilities or the implementation of effective parking management strategies. Addressing these potential shortages will be crucial to

ensure smooth traffic flow and enhance the overall parking experience for commuters and visitors in these areas.

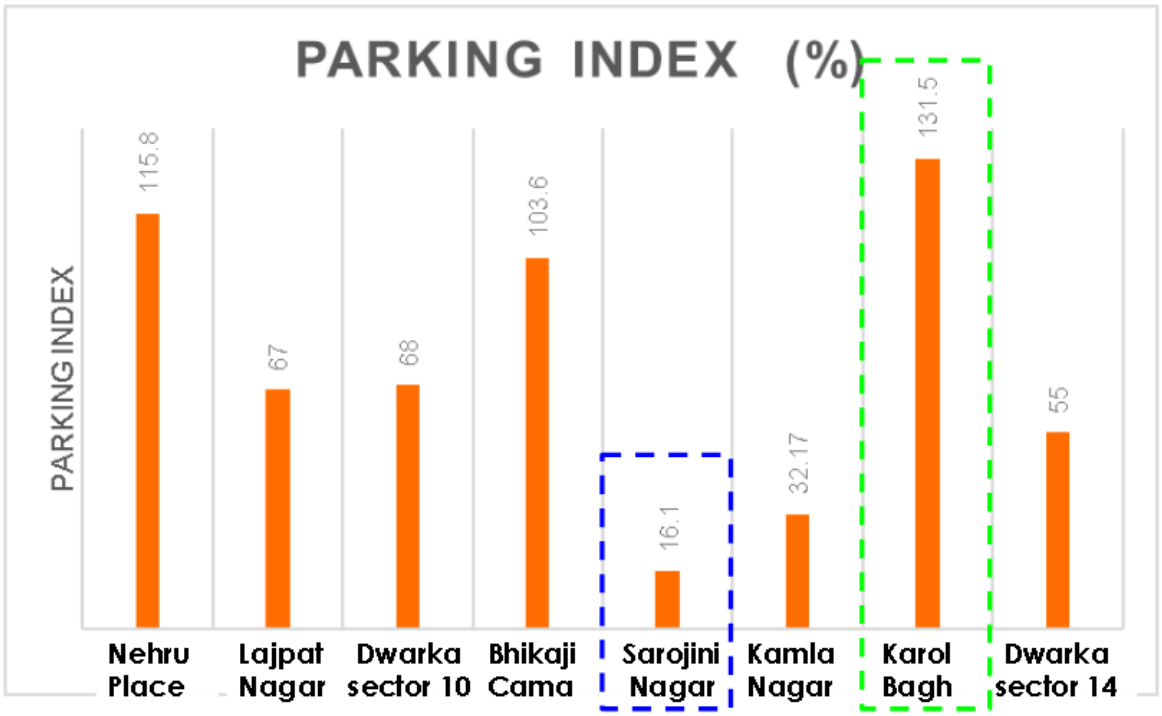


Figure 28 Parking Index Comparison

Source: Author

The analysis of parking indices for various locations in Delhi provides valuable insights into the parking situation in these areas. Nehru Place, Bhikaji Cama Place, and Karol Bagh exhibit high parking indices, indicating a high utilization rate of parking spaces. This suggests a need for additional parking capacity or improved management strategies to prevent congestion and ensure sufficient parking availability for vehicles in these areas.

On the other hand, Sarojini Nagar and Kamla Nagar show low parking indices, which implies that there is sufficient parking capacity available in these locations. This suggests that these areas may not require immediate interventions to address parking issues. Lajpat Nagar, Dwarka Sector 6, and Dwarka Sector 14 have moderate parking indices, indicating a relatively balanced parking situation. While these areas do not currently face severe congestion issues, there is still room for improvement in parking management to maintain this balance as urban development and population growth continue.

Overall, the analysis highlights the importance of monitoring parking indices to understand the parking demand and capacity in different areas of the

city. This information can help urban planners and policymakers make informed decisions regarding parking infrastructure development and management strategies to ensure efficient use of parking spaces and alleviate congestion in urban areas.

4.10 Proposals Zone 1- Lajpat Nagar

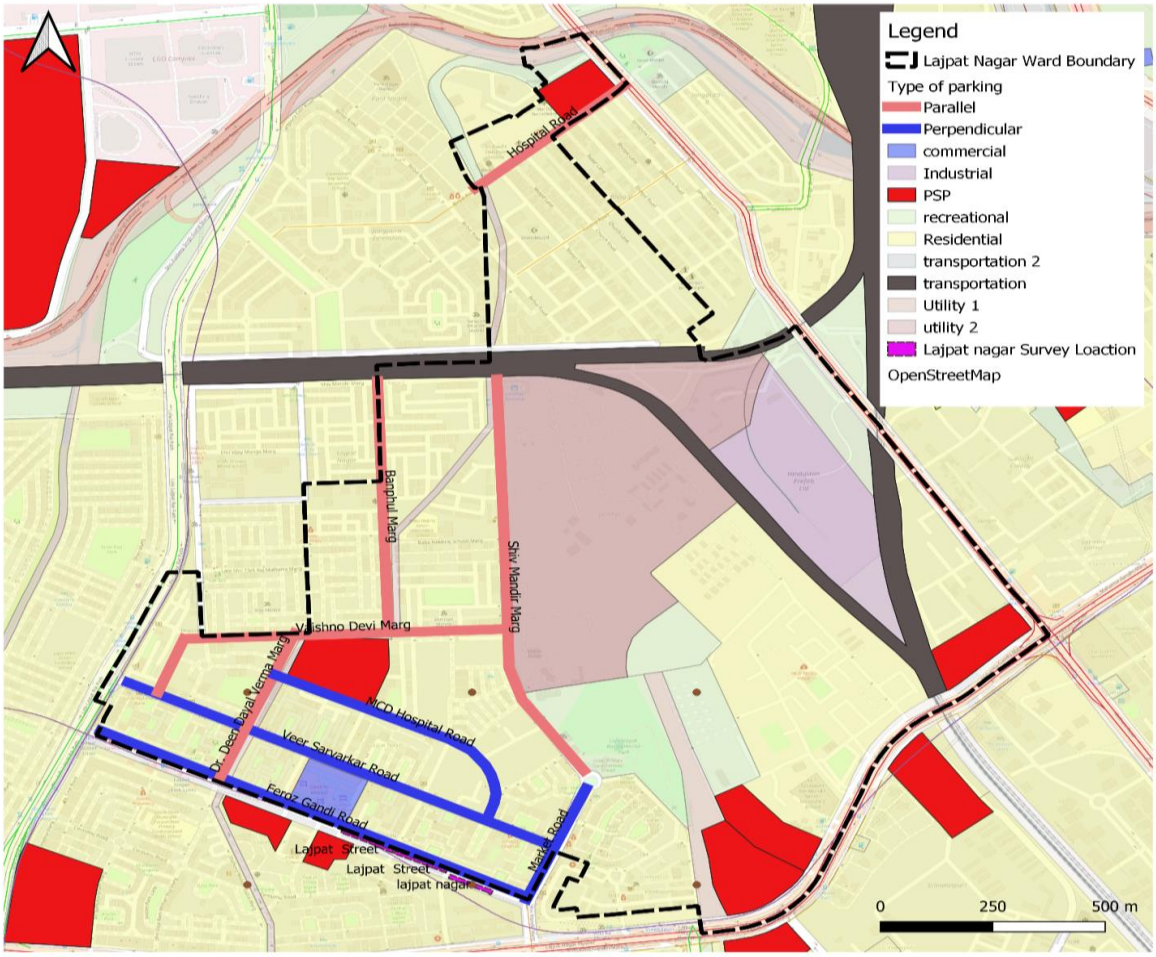


Figure 29 Lajpat Nagar on Street Parking
Source: Author

To calculate the on-street parking revenue for Lajpat Nagar, we first need to determine the number of parking bays available on the street. This can be calculated using the Effective Available Road Length (ARL) and the Parking Bay Length (PBL).

1. **Effective Available Road Length (ARL):** ARL = Total Right of Way (ROW) - Setbacks / Road Margins
2. **Parking Bay Length (PBL):** PBL = Average vehicle length + Gap between vehicles

3. **Number of bays:** Number of bays = ARL / PBL

Once the number of bays is determined, we can calculate the parking charges per hour using a thumb rule. The parking charge per hour can be calculated as follows:

Parking charge per hour = Rate per square meter X (2/100 X 1/12 X 1/200) X 2

Additionally, we can estimate the monthly revenue generated from parking by considering the average trip length in Delhi and the land value in the area. Assuming 2% of the land value as the cost of parking space, we can calculate the cost per month and then determine the charges per hour at 50% utilization.

For the MCD parking facility in Sarojini Nagar, the revenue can be calculated using the monthly revenue calculator formula provided by the MCD, which is based on the number of Equivalent Car Spaces (ECS) and a fixed rate per ECS.

Overall, these calculations provide a framework for estimating parking revenue and setting appropriate parking charges based on the available infrastructure and land use in the area.

Table 4 Lajpat Nagar on Street Parking Revenue Calculation

Lajpat Nagar - Street Parking																
S.No	Name	Width (M)	Type of Parking	Length of the road (M) (Left)	Bays Available (Left)	Length of the road (M) (Right)	Bays Available (Right)	Total Bays	if considering 85% occupancy (ECS)	Taking 2% of the cost of the parking space as the rental value per year, the cost per annum	Min. Charge to cover 11.3 km by Metro	accoding to willingnes s survey (Double the existing Price)	Revenue Case 1	Revenue Case 2	Revenue Case 3	Existing Case
5	Hospital Road	15	Parallel	397	66	359	59	125	106	33.2	36	40	281536	305280	339200	212000
9	Shiv Mandir Marg	12	Parallel	1014	169	1061	176	345	293	33.2	36	40	778208	843840	937600	586000
10	Dr.Deen Dayal Varma Marg	10	Parallel	363	60	360	60	120	102	33.2	36	40	270912	293760	326400	204000
11	Banphul Marg	10	Parallel	616	102	616	102	204	173	33.2	36	40	459488	498240	553600	346000
6	Ary Samaj Marg	12	Parallel	136	22	127	21	43	36	33.2	36	40	95616	103680	115200	72000
7	Vaishno Devi Marg	12	Parallel	570	95	660	110	205	174	33.2	36	40	462144	501120	556800	348000
1	Feroz Gandhi Road	22	Perpendicular	499	166	954	318	484	411	33.2	36	40	1091616	1183680	1315200	822000
2	Veersarvarkar Road	22	Perpendicular	954	318	773	257	575	488	33.2	36	40	1296128	1405440	1561600	976000
3	Market Road	24	Perpendicular	278	92	363	121	213	181	33.2	36	40	480736	521280	579200	362000
4	MCD Hospital	15	Perpendicular	663	210	630	210	420	357	33.2	36	40	948192	1028160	1142400	714000
8	Market Road 2	12	Perpendicular	322	107	330	110	217	184	33.2	36	40	488704	529920	588800	368000
									2505				6653280	7214400	8016000	5010000

Source: Author

Lajpat Nagar's Multi-Level Car Parking (MLCP) has a total capacity of 248 Equivalent Car Spaces (ECS) spread across 6 floors. The parking rates for cars are structured as follows:

- Rs 20 per hour
- Rs 100 for a 24-hour period
- Rs 1200 for a Day Pass (valid for one month)
- Rs 2000 for a Day & Night pass (valid for one month)
- A fine of Rs 50 for violations

The MLCP generates revenue by charging these rates for parking services. The revenue collected is then deposited into the MCD Commissioner's account. The total amount deposited in the MCD Commissioner's account from the MLCP in Lajpat Nagar is Rs 2,72,880.00 per month. This revenue helps support the maintenance and operation of the parking facility, contributing to the overall infrastructure and services provided by the Municipal Corporation of Delhi.

Table 5 Revenue Sharing – Lajpat Nagar
Source: Author

For Maximum Revenue Scenario			
Govt. Share (%)	Private Op. share (%)	Revenue Earned by Govt. (Rs)	Revenue Earned by Operator (Rs)
30	70	2404800	5611200
40	60	3206400	4809600
50	50	4008000	4008000
39 **(Avg. Share)**	61	3126240	4889760

The revenue sharing model for parking facilities, such as in the case of the total 2505 Equivalent Car Spaces (ECS), involves a partnership between the government and private operators. The model typically outlines the percentage of revenue each party receives based on the total earnings.

In the scenario presented, various revenue sharing ratios are considered, ranging from 30% government share and 70% private operator share to a

balanced 50-50 split. Each scenario results in different revenue distributions, with the government earning between Rs 2,406,400 and Rs 4,008,000, and the private operator earning between Rs 4,808,000 and Rs 5,611,200, depending on the revenue share percentage.

The average share scenario, with 39% for the government and 61% for the private operator, results in the government earning Rs 3,126,240 and the operator earning Rs 4,889,760. This model aims to balance the interests of both parties, ensuring fair compensation for their respective roles in managing and maintaining the parking facility. Such revenue sharing mechanisms help optimize the utilization of parking resources while ensuring the sustainability of parking operations.

4.11 Proposals Zone 2 – Karol Bagh

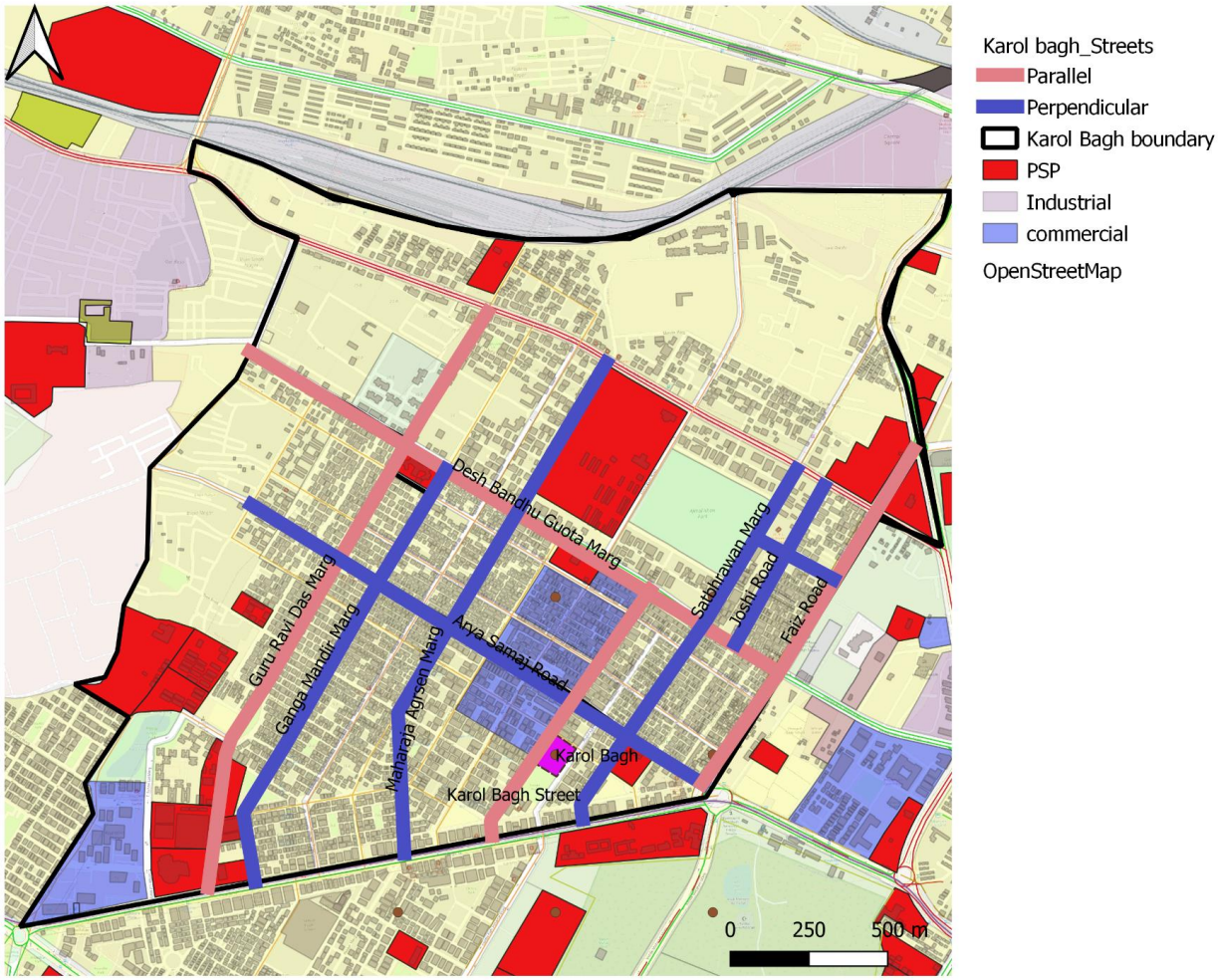


Figure 30 Karol Bagh on street parking
Source: Author

To calculate the revenue from on-street parking in Karol Bagh, we first need to determine the number of parking bays available on the street. This is done by calculating the Effective Available Road Length (ARL), which is the total Right of Way (ROW) minus setbacks divided by the road margins. The Parking Bay Length (PBL) is then calculated as the average vehicle length plus the gap between vehicles. The number of bays is the ARL divided by the PBL. Once we have the number of bays, we can use a thumb rule to calculate the parking charge per hour. This rule involves multiplying the rate per square meter of parking space by a factor that accounts for the average trip length in Delhi and the land value in the area. For example, for a 12.5 sqm parking space, the cost would be Rs 32000.

To determine the revenue, we need to calculate the cost per month and then divide it by the number of working days in a month and the hours of utilization per day to get the cost per hour at 50% utilization. This gives us an estimate of the revenue generated from on-street parking in Karol Bagh.

Additionally, considering the land use as Market/Commercial, we can use the monthly revenue calculator provided by the Municipal Corporation of Delhi (MCD) to estimate the revenue generated from different types of vehicles, such as 4-wheelers, based on the number of Equivalent Car Spaces (ECS) and the applicable rate.

Table 6 Karol Bagh on Street Revenue Calculation

Karol Bagh Street Parking																
S.No	Name	Width (M)	Type of Parking	Length of the road (M) (Left)	Bays Available (Left)	Length of the road (M) (Right)	Bays Available (Right)	Total Bays	if consideri ng 85% occupanc y (ECS)	Taking 2% of the cost of the parking space as the rental value per year, the cost per annum	Min. Charge to cover 11.3 km by Metro	accoding to willingnes s survey (Double the existing Price)	Revenue Case 1	Revenue Case 2	Revenue Case 3	Existing Case
1	Desh Bamdhu Gupta Marg	22	Parallel	2345	469	2372	474	943	800	26.6	36	40	1702400	2304000	2560000	1600000
2	Guru Ravi Das Marg	15	Parallel	1734	346	1581	316	662	562	26.6	36	40	1195936	1618560	1798400	1124000
4	Faiz Road	20	Parallel	455	91	530	106	197	167	26.6	36	40	355376	480960	534400	334000
5	Gurudwara Road	20	Parallel	800	160	800	160	320	272	26.6	36	40	578816	783360	870400	544000
3	Arya Samaj Road	24	Perpendicular	1500	500	1522	507	1007	855	26.6	36	40	1819440	2462400	2736000	1710000
6	Satbhrawan Marg	15	Perpendicular	1057	352	1070	356	708	600	26.6	36	40	1276800	1728000	1920000	1200000
7	Ganga Mandir Marg	15	Perpendicular	1285	428	1285	428	856	727	26.6	36	40	1547056	2093760	2326400	1454000
8	Saraswati Marg	18	Perpendicular	385	128	370	123	250	213	26.6	36	40	453264	613440	681600	426000
9	Khjur Marg	18	Perpendicular	250	83	250	83	166	141	26.6	36	40	300048	406080	451200	282000
10	Joshi Road	10	Perpendicular	540	180	540	180	360	306	26.6	36	40	651168	881280	979200	612000
									4643				9880304	13371840	14857600	9286000

Source: Author

Table 7 Revenue Sharing - Karol Bagh
Source: Author

For Maximum Revenue Scenario			
Govt. Share (%)	Private Op. share (%)	Revenue Earned by Govt. (Rs)	Revenue Earned by Operator (Rs)
30	70	2404800	5611200
40	60	3206400	4809600
50	50	4008000	4008000
39 **(Avg. Share)**	61	3126240	4889760

The revenue sharing model outlined here presents different scenarios for the distribution of revenue generated from parking facilities between the government and private operators. The total revenue is based on the total number of Equivalent Car Spaces (ECS) utilized for parking.

In the Maximum Revenue Scenario, the revenue is divided into two parts: the government's share and the private operator's share. The percentages for each party vary across scenarios, with the government's share ranging from 30% to 50% and the private operator's share ranging from 50% to 70%.

For example, in the scenario where the government's share is 30% and the private operator's share is 70%, the total revenue earned is Rs. 14,700,000. Of this, the government would earn Rs. 4,457,280, while the private operator would earn Rs. 10,400,320.

Similarly, in the scenario where the government's share is 39% (the average share across scenarios) and the private operator's share is 61%, the total revenue earned is Rs. 14,856,800. In this scenario, the government would earn Rs. 5,794,464, while the private operator would earn Rs. 9,063,136.

This revenue sharing model provides a framework for understanding how revenue from parking facilities can be distributed between the government and private operators, depending on the agreed-upon share percentages.

4.12 Proposals Zone 3 – Kamla Nagar

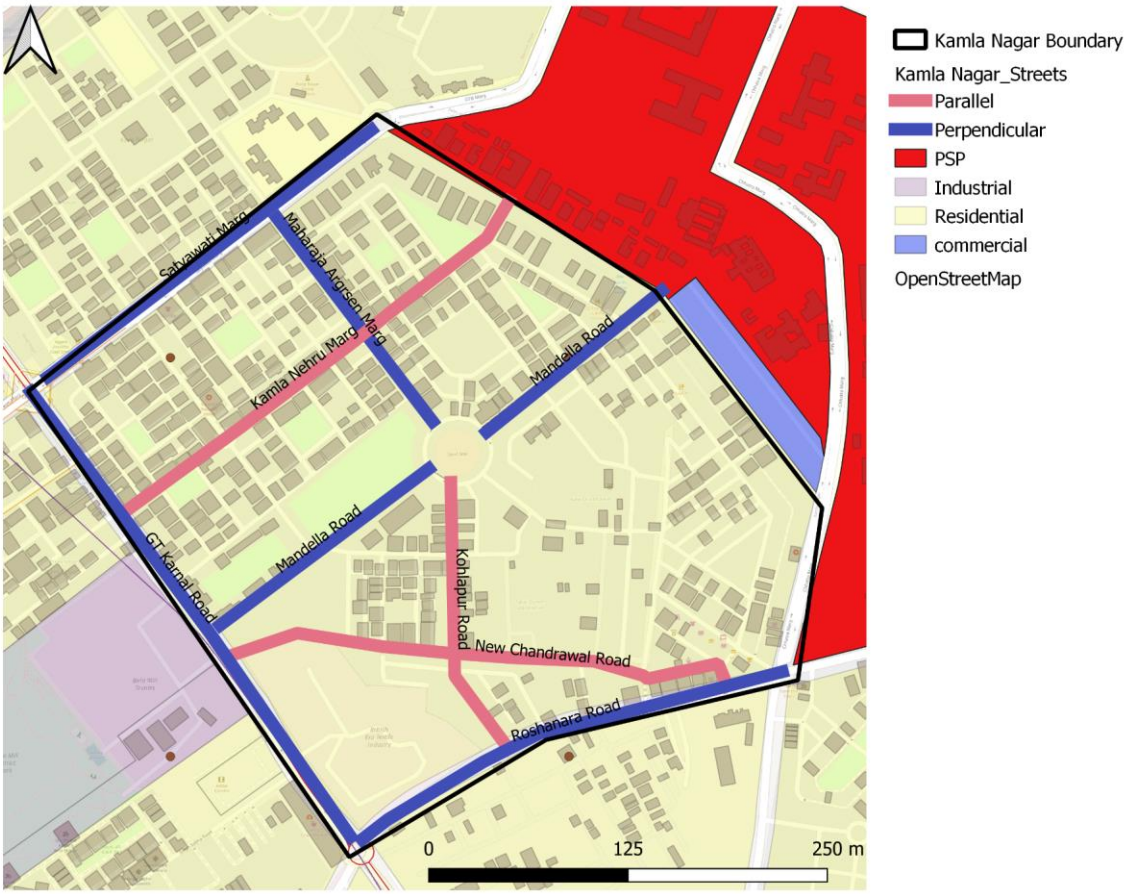


Figure 31 Kalma Nagar on street parking
Source: Author

The calculation for on-street parking revenue in Kamla Nagar involves several steps. First, the effective available road length (ARL) is calculated by subtracting setbacks or road margins from the total right-of-way (ROW) of the street. Next, the parking bay length (PBL) is determined based on the average vehicle length and the gap between vehicles when parked. The number of parking bays is then calculated by dividing the ARL by the PBL.

To determine the parking charge per hour, a thumb rule is used, which involves multiplying the rate per square meter by a factor calculated from the average trip length in Delhi. This factor accounts for the percentage of land value (circle rate) in the area, resulting in the cost of a parking space.

For example, for a 12.5 sqm parking space, the cost would be Rs 32000. The cost per month is then calculated based on the utilization rate (e.g., 50% utilization for 200 hours per month), resulting in an hourly parking charge.

Additionally, for residential or public service provider (PSP) land use, the monthly revenue can be calculated using a formula based on the number of equivalent car spaces (ECS) and a multiplier.

Overall, these calculations help estimate the potential revenue from on-street parking in Kamla Nagar and provide insights into setting parking rates and managing parking spaces efficiently.

Table 8 Kamla Nagar on street parking revenue calculation

S.No	Name	Width (M)	Type of Parking	Length of the road (M) (Left)	Bays Available (Left)	Length of the road (M) (Right)	Bays Available (Right)	Total Bays	if considering 85% occupancy (ECS)	Taking 2% of the cost of the parking space as the rental value per year, the cost per annum	Min. Charge to cover 11.3 km by Metro	accoding to willingness survey (Double the existing Price)	Revenue Case 1	Revenue Case 2	Revenue Case 3	Existing Case
5	New Chandrawal Road	10	Parallel	448	90	452	90	180	153	26.6	36	40	325584	440640	489600	153000
9	Satayawati Marg	25	Parallel	304	100	452	150	250	212	26.6	36	40	451136	610560	678400	212000
6	Kamla Nehru Marg	10	Parallel	420	84	416	84	166	141	26.6	36	40	300048	406080	451200	141000
1	Mandella Road	15	Perpendicular	188	62	235	78	140	119	26.6	36	40	253232	342720	380800	119000
2	Maharaja Agrsen Marg	15	Perpendicular	261	87	273	91	178	151	26.6	36	40	321328	434880	483200	151000
3	Mandella Road	16	Perpendicular	313	104	294	99	203	172	26.6	36	40	366016	495360	550400	172000
4	Kohlapur Road	10	Perpendicular	176	58	180	60	118	100	26.6	36	40	212800	288000	320000	100000
7	GT Karnal Road	24	Perpendicular	588	196	576	192	388	329	26.6	36	40	700112	947520	1052800	329000
8	Roshanara Road	15	Perpendicular	504	168	795	165	333	283	26.6	36	40	602224	815040	905600	283000
													2455712	3323520	3692800	1660000

Source: Author

Table 9 Revenue Sharing - Kamla Nagar

For Maximum Revenue Scenario			
Govt. Share (%)	Private Op. share (%)	Revenue Earned by Govt. (Rs)	Revenue Earned by Operator (Rs)
30	70	1107840	2584960
40	60	1477120	2215680
50	50	1846400	1846400
39 (Avg. Share)	61	1440192	2252608

Source: Author

Revenue sharing between the city and private operator(s) is crucial for managing parking facilities efficiently. In the case of Kamla Nagar, where there are 1660 equivalent car spaces (ECS), different revenue sharing scenarios were considered to determine the earnings for both parties.

For the maximum revenue scenario, where the total revenue is maximized, various revenue-sharing models were analysed. If the government takes a 30% share, it would earn Rs. 1,107,840, while the operator would earn Rs. 2,584,960. With a 40% government share, the government's earnings would be Rs. 1,477,120, and the operator's earnings would be Rs. 2,215,680. Similarly, with a 50-50 split, both parties would earn Rs. 1,846,400 each.

The average share scenario, where the government takes a 39% share, would result in the government earning Rs. 1,440,192, and the operator earning Rs. 2,252,608. This analysis highlights the importance of carefully considering revenue-sharing agreements to ensure that both the city and the private operators benefit equitably from parking operations. Proper revenue sharing can incentivize private operators to provide better services while ensuring the city receives a fair share of the revenue generated.s

4.13 Proposals Zone 3 – Sarojini Nagar

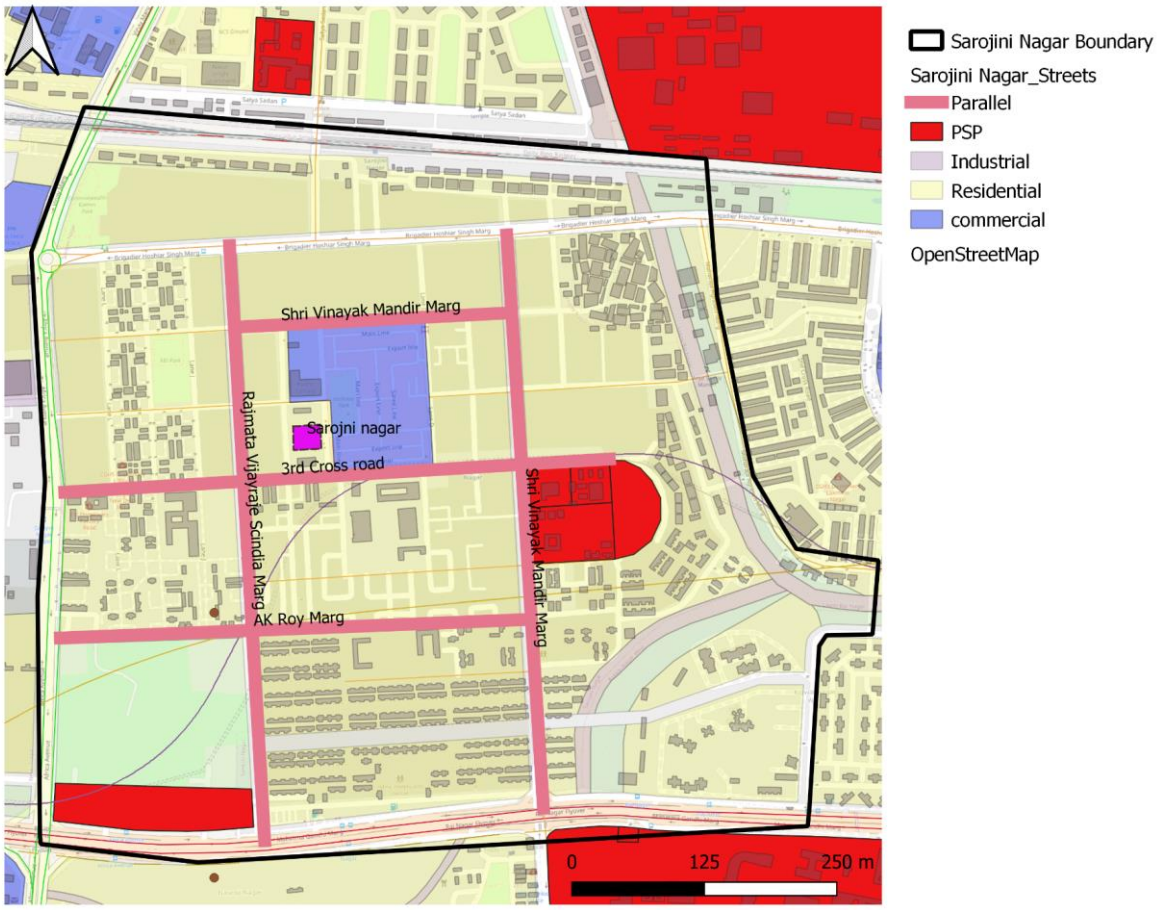


Figure 32 Sarojini Nagar on street parking

Source: Author

The calculation for on-street parking revenue in Sarojini Nagar involves several steps. First, the available road length (ARL) is determined by subtracting setbacks or road margins from the total right of way (ROW). Then, the parking bay length (PBL) is calculated based on the average vehicle length and the gap between vehicles. The number of bays is then calculated by dividing the ARL by the PBL.

Next, a thumb rule is used to calculate the parking charge per hour based on the rate per square meter and other factors. For example, if the rate per square meter is Rs. 4920 and the area for parking is 12.5 sqm, the cost of the parking space would be Rs. 61500.

To calculate the cost per month, it's assumed that the parking space is utilized for 8 hours a day, 25 days a month. This results in 200 hours of utilization per month. The cost of the parking space at 100% utilization is then divided by 200 to get the charges per hour at 50% utilization, which is Rs. 51.25.

Finally, considering the land use as market/commercial, the monthly revenue can be calculated using a formula like { 4W = (no. of ECS X 80 X 25) } where 4W represents four-wheelers, ECS is equivalent car spaces, 80 is the average parking charges, and 25 is the number of working days in a month. This calculation helps estimate the revenue generated from parking for commercial areas like Sarojini Nagar.

Table 10 Sarojini Nagar on street parking revenue calculation

Sarojini Nagar Street Parking																
S.No	Name	Width (M)	Type of Parking	Length of the road (M) (Left)	Bays Available (Left)	Length of the road (M) (Right)	Bays Available (Right)	Total Bays	if considering 85% occupancy (ECS)	Taking 2% of the cost of the parking space as the rental value per year, the cost per annum	Min. Charge to cover 11.3 km by Metro	accoding to willingness survey (Double the existing Price)	Revenue Case 1	Revenue Case 2	Revenue Case 3	Existing Case
1	Rajmata Vijayraje Scindia Marg	12	Parallel	1070	214	1050	210	424	360	51	36	40	1476000	1036800	1152000	720000
3	Shri Vinayak Mandir Marg	20	Parallel	924	184	940	188	372	316	51	36	40	1295600	910080	1011200	632000
4	3rd Cross Road	10	Parallel	958	191	950	190	380	323	51	36	40	1324300	930240	1033600	646000
5	AK Roy Marg	10	Parallel	1000	200	1000	200	400	340	51	36	40	1394000	979200	1088000	680000
2	Shri Vinayak Mandir Marg	15	Perpendicular	474	158	470	156	314	267	51	36	40	1094700	768960	854400	534000
									1606				5489900	3856320	4284800	3212000

Source: Author

The revenue sharing scenario presented involves a partnership between the city government and private operator(s) for managing parking facilities, with a total of 1606 equivalent car spaces (ECS). The revenue sharing is based on different scenarios, with varying percentages of revenue allocated to the government and the private operator(s).

- For the Maximum Revenue Scenario, the revenue sharing options are as follows:
    - Government Share: 30%, Private Operator Share: 70%
    - Government Share: 40%, Private Operator Share: 60%
    - Government Share: 50%, Private Operator Share: 50%
    - Average Share: Government Share: 39%, Private Operator Share: 61%

The table provides the revenue earned by the government and the private operator(s) under each scenario. For example, in the scenario where the government receives 30% and the private operator(s) receive 70% of the revenue, the government's revenue is Rs. 1,646,970 and the operator(s) earn Rs. 3,842,930.

Table 11 Revenue Sharing - Sarojini Nagar
Source: Author

For Maximum Revenue Scenario			
Govt. Share (%)	Private Op. share (%)	Revenue Earned by Govt. (Rs)	Revenue Earned by Operator (Rs)
30	70	1646970	3842930
40	60	2195960	3293940
50	50	2744950	2744950
39 **(Avg. Share)**	61	2141061	3348839

This revenue sharing analysis helps in understanding the potential financial implications and benefits of different revenue sharing models for the management of parking facilities between the city and private operators. It provides insights into how the revenue can be distributed based on different sharing percentages, allowing decision-makers to choose the most suitable option based on their objectives and priorities.

Sarojini Nagar MLCP - The parking facility has a total capacity of 824 equivalent car spaces (ECS) spread over 8 floors. The parking rates for cars are Rs 17 per hour for every hour of parking. Additionally, there is a charge of Rs 17 for every additional hour or part thereof beyond the first hour.

Customers can also opt for a parking smart card, which has a charge of Rs 100. The smart card likely provides convenience and possibly discounts or other benefits for regular customers.

The drive-out time is 300 seconds, which is the time allowed for a vehicle to exit the parking facility after payment or validation.

There is also a penalty of Rs 100, presumably for overstaying the allotted parking duration or for other violations of the parking rules.

Overall, these pricing and penalty structures are designed to manage parking demand, encourage turnover, and ensure fair use of the parking facility. The smart card option provides convenience and potential cost savings for frequent users. The penalty serves as a deterrent against parking violations.

CHAPTER 5 RECOMMENDATIONS

5.1 Recommendations for Parking Pricing and Standards:

To enhance parking management strategies, it is recommended to implement dynamic pricing based on demand and time of day. Dynamic pricing can help manage congestion by incentivizing shorter stays during peak hours and encouraging turnover, thereby ensuring that parking spaces are utilized more efficiently. Additionally, establishing parking standards based on land use and demand is crucial to avoid over-provision of parking facilities, which can lead to urban sprawl and increased traffic congestion. By aligning parking provision with actual demand, cities can optimize the use of available parking spaces and promote more sustainable urban development.

Another important recommendation is to delineate parking sites based on Public Transport Accessibility Levels (PTAL). This approach ensures that parking facilities are located in areas where public transportation is easily accessible, thereby encouraging the use of public transport over private vehicles. By aligning parking provision with PTAL, cities can improve the overall accessibility of public transportation and reduce car dependency, leading to a more sustainable urban mobility system.

Implementing these recommendations requires a collaborative effort between city authorities, urban planners, and transportation experts. It is essential to conduct detailed assessments of parking demand, land use patterns, and public transport accessibility to develop effective parking pricing and standards. Additionally, public awareness campaigns and stakeholder engagement are crucial to ensure the successful implementation of these strategies. Overall, these recommendations aim to improve parking management, reduce traffic congestion, and promote sustainable urban mobility in cities.

Comprehensive approach to parking management in urban areas, with a focus on reducing parking demand, increasing the efficiency of existing infrastructure, and addressing legal and enforcement issues. Here's an elaboration on the key recommendations:

Reduce Parking Demand: Implementing high parking charges and promoting public transit can help reduce the demand for parking spaces. High parking charges, especially in high-demand areas, can discourage car use and encourage people to use alternative modes of transportation, such as public transit, walking, or cycling. Promoting public transit through improved services, infrastructure, and incentives can further reduce the reliance on private vehicles.

Increase Efficiency of Existing Infrastructure: Prioritizing short-term parking over long-term parking and eliminating free parking can improve the efficiency of existing parking infrastructure. Short-term parking prioritization ensures that spaces are available for short-term visitors and customers, rather than being occupied by long-term parkers, such as commuters. Eliminating free parking removes the incentive for car owners to park for extended periods, encouraging turnover and making parking spaces more accessible.

Address Legal and Enforcement Issues: Addressing legal and enforcement issues related to parking is essential for effective parking management. This includes ensuring that parking regulations are clear and enforced consistently, addressing issues such as illegal parking and parking in restricted areas. Improving enforcement can help deter violations and ensure fair use of parking spaces.

Moving forward, several specific recommendations to implement these strategies, such as setting fixed parking charges based on land prices, eliminating subsidized parking, and prioritizing short-term parking. These recommendations are aimed at creating a more sustainable and efficient transportation system in Delhi, benefiting residents, businesses, and the environment.

5.2 Revenue Sharing

Revenue Sharing Between the City and Private Operator(s): Revenue sharing between the city and private operators involves the distribution of revenue generated from parking facilities. Typically, this revenue is shared based on a predetermined agreement between the city government and the private operator. The agreement may specify the percentage of revenue that each party is entitled to, taking into account factors such as initial investment, operational

costs, and profit-sharing arrangements. Revenue sharing can incentivize private operators to invest in parking infrastructure and services, while also ensuring that the city receives a fair share of the revenue generated from public assets.

Among Parking Districts: Revenue sharing among parking districts refers to the distribution of revenue generated from parking facilities across different districts within a city. In some cities, parking districts are designated areas that have specific parking regulations and pricing schemes. Revenue generated from parking fees in each district can be used to fund local transportation projects, improve parking infrastructure, or enhance public spaces within the district. Revenue sharing among parking districts can help ensure that revenue is distributed equitably and that each district receives funding based on its parking needs and usage patterns.

Across Municipal Agencies: Revenue sharing across municipal agencies involves the distribution of revenue generated from parking facilities among different agencies within a city government. This can include revenue sharing between transportation departments, parking authorities, and other relevant agencies. Revenue generated from parking fees can be used to fund various transportation projects, such as public transit improvements, road maintenance, or pedestrian and cycling infrastructure. Revenue sharing across municipal agencies helps coordinate efforts to address transportation challenges and ensure that revenue is used efficiently to benefit the entire city.

5.3 Revenue Sharing

On-Street Parking Revenue Streams: On-street parking revenue includes fees paid by motorists for parking, fines for violations, and any surplus revenue generated from these sources. This revenue is a significant source of income for cities and is often used to fund various initiatives aimed at improving urban mobility, sustainability, and quality of life.

Surplus Revenue Allocation: The surplus revenue generated from on-street parking, after covering operational costs and maintenance, can be directed

towards specific purposes based on the city's priorities. In this case, the surplus revenue is allocated as follows:

1. **Parking Places Reserve Account (PPRA):** A portion of the surplus revenue is directed to the Parking Places Reserve Account (PPRA). This account serves as a reserve fund for future parking-related projects and infrastructure improvements, ensuring a sustainable source of funding for parking initiatives.
2. **Environment and City Management:** A portion of the surplus revenue is allocated to environment and city management initiatives. These may include projects aimed at improving air quality, managing waste, enhancing green spaces, and promoting sustainable urban development.
3. **Placemaking, Public Health, and Family Services:** Another portion of the surplus revenue is directed towards placemaking, public health, and family services. This allocation can fund projects that enhance the overall livability and wellbeing of residents, such as improving public spaces, promoting active transportation, and supporting community health programs.
4. **City's Bikeshare Program and Bicycle Infrastructure:** A portion of the surplus revenue is allocated to the city's bikeshare program and the maintenance and expansion of bicycle lanes. This allocation supports sustainable transportation options and encourages cycling as a mode of transport, contributing to reduced congestion and emissions.
5. **Mobility and Urban Infrastructure Projects in Parking Districts:** The remaining portion of the surplus revenue is directed towards mobility and urban infrastructure projects in parking districts. These projects may include improving public transportation, enhancing pedestrian infrastructure, and implementing smart mobility solutions to improve overall mobility in the city.

Overall, the allocation of surplus revenue from on-street parking reflects a balanced approach to addressing various urban challenges, including

transportation, sustainability, and quality of life, while ensuring a sustainable funding mechanism for future parking-related initiatives.

5.4 Refinancing Parking Earnings

The concept of a circular economy in the context of parking pricing and refinancing involves creating a system where parking revenues are reinvested back into sustainable transport projects, thereby creating a self-sustaining cycle of funding and development. Public-Private Partnerships (PPPs) can play a crucial role in this by allowing private operators to finance and operate parking facilities, with a portion of the revenue directed towards sustainable transport projects. This not only helps in funding public transport infrastructure but also encourages the private sector to invest in sustainable mobility solutions.

Land Value Capture (LVC) is another important strategy where parking revenues contribute to funding public transport infrastructure. By capturing the increased land values resulting from improved public transport accessibility, cities can generate additional revenue that can be reinvested in sustainable transport projects. This helps in creating a more integrated and efficient transport system that reduces reliance on private vehicles.

Parking Benefit Districts (PBDs) are another innovative approach where parking revenues are reinvested in the same district to enhance public transport and non-motorized transport options. This can include improving walking and cycling infrastructure, enhancing public transport services, and implementing innovative mobility solutions. By reinvesting parking revenues locally, cities can create a more sustainable and integrated transport system that benefits the entire community.

Establishing a dedicated fund for parking revenue is another effective way to ensure that parking revenues are allocated towards improving public transport, cycling infrastructure, and pedestrian facilities. This can help in financing sustainable transport projects and promoting modal shift towards more sustainable modes of transport.

Congestion pricing is another effective strategy to manage parking demand and reduce traffic congestion in high-demand areas. By implementing

congestion pricing, cities can generate revenue that can be directed towards improving public transport services, thereby creating a more sustainable and efficient transport system.

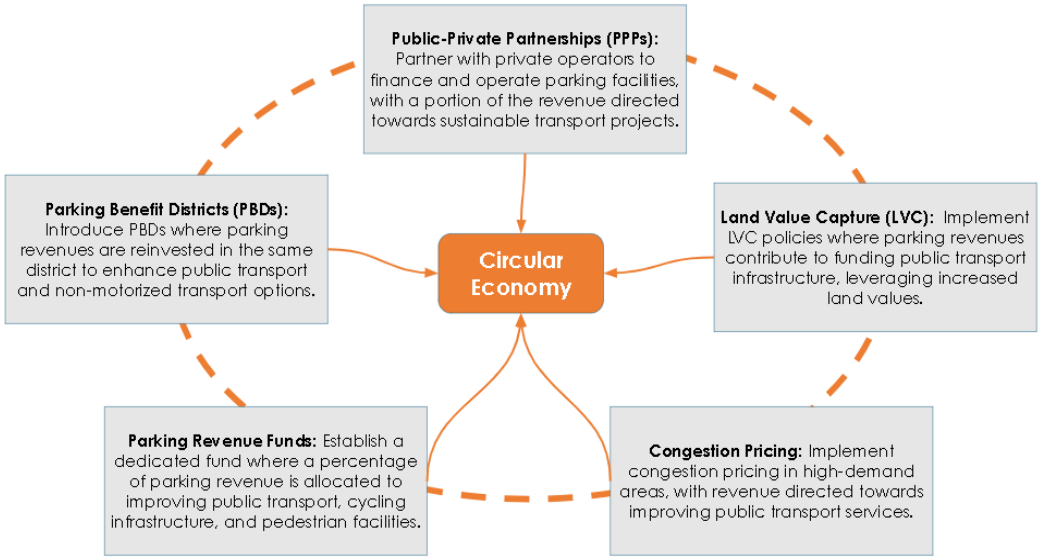


Figure 33 Parking Pricing Role in Circular Economy
Source: Author

5.5 Optimizing Parking Revenue: Six Steps for Success

Optimizing parking revenue can be a key strategy for cities looking to generate additional revenue while also creating more inclusive and sustainable streets. The first step is to set citywide goals for parking management, such as increasing revenue, improving access to parking for all users, and reducing congestion and emissions.

Next, effective management strategies should be implemented. This includes setting appropriate pricing policies, ensuring efficient use of parking spaces, and providing alternative transportation options. Engaging with stakeholders, including businesses, residents, and transportation experts, is crucial to developing and implementing successful parking management strategies.

Financial considerations are also important. Cities should explore innovative financing mechanisms, such as public-private partnerships or land value capture, to fund parking infrastructure and other sustainable transport projects.

Enforcement of parking regulations is another key aspect. Proper enforcement ensures that parking rules are followed, maximizing revenue and improving traffic flow.

Engagement with the community is essential throughout the process. This includes educating the public about parking policies and gathering feedback to continuously improve parking management strategies.

Finally, regular evaluation of parking policies and practices is essential to ensure they are meeting citywide goals and making progress towards creating more inclusive and sustainable streets. By following these six steps, cities can effectively manage parking, maximize revenue, and create more inclusive and sustainable urban environments.

5.6 Conclusion

In the context of Delhi, parking has the potential to play a crucial role in the financial sustainability of urban transport. The city faces significant challenges related to congestion, air pollution, and inadequate public transportation infrastructure. Addressing these challenges requires a multifaceted approach that includes efficient management of parking facilities.

The survey findings on parking behaviours and preferences in urban areas, with a focus on Delhi, reveal a nuanced landscape that policymakers and urban planners must consider. One of the key takeaways is the diverse usage patterns of parking facilities, with the majority of respondents using parking daily or occasionally, often preferring street parking or a combination of street parking and parking lots. This indicates a need for a flexible approach to parking management that caters to different user groups and preferences. Another significant insight is the importance of factors such as the availability of free parking alternatives and security in influencing parking choices. Respondents expressed a willingness to pay slightly higher parking charges if it leads to better urban infrastructure or services, highlighting the potential for revenue generation through parking.

The willingness of respondents to pay slightly higher parking charges if it contributes to better urban infrastructure or services highlights a key opportunity for cities to implement dynamic pricing strategies. Dynamic pricing involves adjusting parking charges based on factors such as location, time of day, and vehicle type to reflect the demand for parking spaces. By implementing dynamic pricing, cities can achieve several goals. Firstly, it can help increase revenue from parking, as charges can be higher during peak times or in high-demand areas. This additional revenue can then be reinvested into improving urban infrastructure, public transport, or other services, fulfilling the expectations of the respondents. Secondly, dynamic pricing can incentivize the use of alternative modes of transportation. Higher parking charges during peak times or in busy areas can encourage people to consider other options such as public transport, cycling, or walking. This can help reduce congestion on roads, improve air quality, and promote a more sustainable urban transport system. The willingness of respondents to accept dynamic pricing as a means to improve urban infrastructure and services suggests that this strategy could be effective in not only increasing parking revenue but also in encouraging a modal shift towards more sustainable modes of transportation.

Improving the quality of parking facilities and services is crucial for enhancing customer satisfaction and increasing revenue. Security and cleanliness are key factors that influence people's decisions to use parking facilities. By addressing these concerns, parking operators can attract more users, leading to higher revenue. The analysis of parking capacity and utilization in different areas of Delhi provides valuable insights for policymakers and urban planners. Areas with high parking index values, indicating high demand relative to supply, may require additional parking capacity or better management strategies to prevent congestion and meet the needs of users. This could include building new parking facilities, implementing dynamic pricing to manage demand, or improving public transportation options to reduce the need for private vehicle parking.

On the other hand, areas with low parking index values, indicating underutilized capacity, present an opportunity to optimize existing parking resources. This could involve repurposing underutilized parking spaces for other

uses, such as green spaces or commercial development, or implementing pricing strategies to encourage more efficient use of existing parking facilities. The survey highlights areas for improvement in parking facilities, including the need for better maintenance, cleanliness, and security. Many respondents also expressed dissatisfaction with unclear parking regulations and traffic congestion, indicating a need for clearer guidelines and improved traffic management strategies.

Addressing legal and enforcement issues related to parking is another key aspect. In Delhi, there is often a lack of clarity regarding parking regulations, leading to confusion and non-compliance. By streamlining regulations and improving enforcement mechanisms, the city can ensure that parking rules are followed, enhancing revenue collection and improving traffic management. Overall, by implementing these measures, Delhi can harness the potential of parking as a revenue generator and a tool for promoting sustainable urban mobility. This not only benefits the city financially but also creates a more inclusive and liveable urban environment for all residents.

References

1. Anirudh, B., Mazumder, T. N., & Das, A. (2021). A contemporary review of residential parking: Lessons for Indian cities.
2. Parmar, J., Das, P., & Dave, S. M. (2019). Study on demand and characteristics of parking system in urban areas: A review.
3. Shoup, D. C. (2005). The high cost of free parking.
4. Parmara, J., Dasb, P., Azadb, F., Davea, S., & Kumarb, R. (2020). Evaluation of parking characteristics: A case study of Delhi.
5. Kolhar, P. (2012). On-street parking management plan and cost-benefit analysis for Dharwad City, Karnataka, India.
6. Nourinejad, M., & Roorda, M. J. (2017). Impact of hourly parking pricing on travel demand.
7. Yan, X., Levine, J., & Marans, R. (2019). The effectiveness of parking policies to reduce parking demand pressure and car use.
8. Albert, G., Mahalel, D., et al. (2006). Congestion tolls and parking fees: A comparison of the potential effect on travel behavior.
9. Ellk, D. S., Mohsin, A. H., & Hasan, S. A. (2020). Feasibility study for the establishment of a multi-story car park, a case study.
10. Christiansen, P., Engebretsen, Q., Fearnley, N., & Hanssen, J. U. (2017). Parking facilities and the built environment: Impacts on travel behavior.
11. Khandelwal, T. (2014). Subsidy in parking
12. Das, P., Parmar, J., & Azad, F. (2019). A methodology of evaluating urban parking system: Case study of Delhi.
13. Pitsiava-Latinopoulou, M., Basbas, S., Papoutsis, K., & Sdoukopoulos, E. (2012). Parking policies for supporting sustainable mobility.
14. Reddy, A., & Tilak, C. (2017). A case study on parking and its management in high-density urban corridors.
15. Wattimena, M. A., & Puturuhu, D. (2022). Implementation of parking retribution and illegal parking management and their effect on original local government revenue.
16. Ornelas, D. A., Nourinejad, M., Park, P. Y., & Roorda, M. J. (2022). Managing parking with progressive pricing.

17. Shoup, D. (2021). Pricing curb parking.
18. Mo, B., Kong, H., Wang, H., Wang, X. (2021). Impact of pricing policy change on on-street parking demand and user satisfaction: A case study in Nanning, China.
19. Saharan, S., Kumar, N., & Bawa, S. (2020). An efficient smart parking pricing system for a smart city environment: A machine-learning based approach
20. Zhang, R., & Zhu, L. (2016). Curbside parking pricing in a city centre using a threshold.
21. Pierce, G., Willson, H., & Shoup, D. (2015). Optimizing the use of public garages: Pricing parking by demand

ANNEXURES

1.0 Willingness Survey Responses

Age	Gender	Occupation	What type of parking do you generally use ?	How frequently do you use parking facilities in urban areas?	On average, how much do you spend on parking per month?	Do you typically use street parking, parking lots, or multi-level garages?	What is your opinion on the current parking charges in urban areas?	Do you believe that parking charges contribute significantly to revenue generation for municipalities or private operators?	How do you perceive the quality of parking facilities and services in relation to the charges levied?	Would you be willing to pay slightly higher parking charges if it contributes to better urban infrastructure or services?	What factors would influence your willingness to accept increased parking charges?	Would a significant increase in parking charges influence your mode choice for commuting or running errands?	Would you be more willing to pay increased parking charges if you knew the funds would be used for specific projects like public transportation improvements or green initiatives?	What factors do you consider when deciding whether to use paid parking facilities?	Do you think the current parking charges in urban areas adequately reflect the demand for parking spaces?	How do you think increased parking charges would affect parking behavior in urban areas?	How important is the availability of affordable parking in your decision to visit a shopping mall or commercial area?	Do you believe that parking charges should be adjusted based on factors such as location, time of day, or vehicle	Thank you for taking the time to complete this survey! Your feedback is greatly appreciated.
18-25	Female	Student		Daily	1500	Parking Lots	Moderate	no	Fair	Yes, definitely	Better security	Yes	Yes	Proximity to destination	Yes	Encourage use of alternative transportation	Somewhat important	Yes	
Under 18	Female	Student		Once a week	500	Combination of the above	Low	yes	Poor	Yes, but with conditions	Improved facilities, Additional	Yes	No	Proximity to destination	No	Lead to increased use of illegal parking	Somewhat important	Yes	
36-50	Female	Self-employed		Daily	2000	Combination of the above	High	yes	Good	Yes, but with conditions	Improved facilities,	Yes	Yes	Proximity to destination	Unsure	Lead to increased use of illegal	Very important	Yes	
26-35	Female	Student		Rarely	NA	Street parking	Moderate	yes	Poor	Yes, but with conditions	Better security	Yes	Yes	Availability of free parking	No	Lead to increased use of illegal	Somewhat important	Yes	
18-25	Female	Employed		Once a week	500	Combination of the above	Moderate	yes	Good	No, I prefer not to	Better security, Affordability	Yes	No	Security and safety of the	Unsure	Lead to increased use of illegal	Very important	Yes	
18-25	Female	Student		Occasionally	500	Combination of the above	High	yes	Fair	Yes, but with conditions	Better security, Affordability	Yes	Yes	Availability of free parking	Yes	Lead to increased use of illegal	Somewhat important	Yes	
18-25	Male	Student		2-3 times a week	500	Street parking	Moderate	yes	Good	Yes, but with conditions	Improved facilities, Better security,	Yes	Unsure	Cost of parking charges	Yes	Encourage use of alternative transportation	Very important	Yes	..
26-35	Female	Self-employed		Daily	1500	Street parking	Moderate	no	Fair	No, I prefer not to	Additional amenities	Yes	No	Availability of free parking alternatives	No	Encourage use of alternative transportation	Somewhat important	No	
Under 18	Male	Student		Daily	500	Street parking	Low	yes	Good	Yes, definitely	Improved facilities	Yes	Yes	Proximity to destination	Yes	Encourage use of alternative transportation	Somewhat important	Yes	
26-35	Female	Employed		Occasionally	NA	Street parking	Moderate	yes	Fair	Yes, definitely	Improved facilities, Additional	Yes	Unsure	Proximity to destination	No	Encourage use of alternative transportation	Very important	Yes	
18-25	Female	Student		Rarely	500	Parking Lots	Moderate	yes	Good	No, I prefer not to	Affordability	No	No	Cost of parking charges	No	Lead to increased use of illegal	Very important	Yes	
18-25	Female	Employed		Once a week	500	Combination of the above	Low	yes	Poor	Yes, but with conditions	Improved facilities, Better security,	Yes	No	Proximity to destination	No	Encourage use of alternative transportation	Somewhat important	Yes	
18-25	Female	Student		Once a week	1500	Combination of the above	Moderate	no	Poor	No, I prefer not to	Improved facilities, Better security,	Yes	Yes	Security and safety of the parking facility	Yes	Lead to increased use of illegal parking	Very important	Yes	
26-35	Male	Student		Rarely	NA	Street parking	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Affordability	No	Yes	Security and safety of the parking facility	Yes	Encourage use of alternative transportation	Somewhat important	Yes	
18-25	Female	Student		Rarely	NA	Street parking	High	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	No	Security and safety of the parking facility	Yes	Encourage use of alternative transportation modes	Very important	Yes	
26-35	Female	Student		Once a week	500	Parking Lots	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	Yes	Security and safety of the parking facility	Yes	Encourage use of alternative transportation modes	Very important	Yes	

Age	Gender	Occupation	What type of parking do you generally use ?	How frequently do you use parking facilities in urban areas?	On average, how much do you spend on parking per month?	Do you typically use street parking, parking lots, or multi-level garages?	What is your opinion on the current parking charges in urban areas?	Do you believe that parking charges contribute significantly to revenue generation for municipalities or private operators?	How do you perceive the quality of parking facilities and services in relation to the charges levied?	Would you be willing to pay slightly higher parking charges if it contributes to better urban infrastructure or services?	What factors would influence your willingness to accept increased parking charges?	Would a significant increase in parking charges influence your mode choice for commuting or running errands?	Would you be more willing to pay increased parking charges if you knew the funds would be used for specific projects like public transportation improvements or green initiatives?	What factors do you consider when deciding whether to use paid parking facilities?	Do you think the current parking charges in urban areas adequately reflect the demand for parking spaces?	How do you think increased parking charges would affect parking behavior in urban areas?	How important is the availability of affordable parking in your decision to visit a shopping mall or commercial area?	Do you believe that parking charges should be adjusted based on factors such as location, time of day, or vehicle	Thank you for taking the time to complete this survey! Your feedback is greatly appreciated.
18-25	Male	Student		Daily	NA	Parking Lots	Moderate	yes	Fair	Yes, definitely	Improved facilities, Better security, Additional amenities	No	Yes	Security and safety of the parking facility	Unsure	Lead to increased use of illegal parking	Very important	Yes	Spaces play an important role in traffic management and safety and security of
18-25	Female	Student		Occasionally	NA	Parking Lots	Moderate	yes	Fair	Yes, definitely	Improved facilities, Better security,	Yes	Yes	Security and safety of the parking facility	Unsure	Lead to increased use of illegal parking	Very important	Yes	
18-25	Female	Student		Occasionally	500	Combination of the above	Low	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	Yes	Proximity to destination	Yes	Lead to increased use of illegal parking	Somewhat important	Yes	
18-25	Female	Student		2-3 times a week	NA	MLCP	Low	yes	Fair	Yes, definitely	Improved facilities	Yes	Yes	Proximity to destination	Yes	Have no significant impact	Very important	Yes	
26-35	Male	Student		Once a week	500	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better security,	Yes	Yes	Security and safety of the parking facility	Yes	Lead to increased use of illegal parking	Very important	Yes	
18-25	Male	Student		Occasionally	NA	Street parking	Moderate	no	Good	Yes, but with conditions	Improved facilities, Better security, Additional amenities, Affordability	Yes	Unsure	Proximity to destination	No	Have no significant impact	Very important	Yes	scenario in respect of security and availability is much different for 2 and 4 wheelers, its
18-25	Male	Other		Occasionally	500	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	No	Unsure	Security and safety of the parking facility	Yes	Encourage use of alternative transportation modes	Somewhat important	No	
26-35	Female	Employed		Occasionally	500	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	No	Unsure	Security and safety of the parking facility	Yes	Have no significant impact	Very important	Yes	N/A
18-25	Male	Student		Rarely	500	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Better security	Yes	Yes	Cost of parking charges	Yes	Lead to increased use of illegal	Somewhat important	Yes	
26-35	Female	Self-employed		Daily	500	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better	Yes	Yes	Cost of parking charges	Yes	Lead to increased use of illegal	Very important	Yes	
18-25	Female	Employed	Other	Rarely	NA	Parking Lots	Moderate	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	Unsure	Others	Unsure	Lead to increased use of illegal parking	Very important	Yes	
18-25	Male	Student	4 wheeler	Daily	1000	Combination of the above	High	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	No	Yes	Security and safety of the parking facility	Yes	Have no significant impact	Very important	Yes	
18-25	Female	Employed	2 wheeler	Daily	1000	Combination of the above	High	yes	Fair	Yes, but with conditions	Improved facilities, Better	Yes	Unsure	Proximity to destination	Yes	Lead to increased use of illegal	Very important	Yes	

Age	Gender	Occupation	What type of parking do you generally use ?	How frequently do you use parking facilities in urban areas?	On average, how much do you spend on parking per month?	Do you typically use street parking, parking lots, or multi-level garages?	What is your opinion on the current parking charges in urban areas?	Do you believe that parking charges contribute significantly to revenue generation for municipalities or private operators?	How do you perceive the quality of parking facilities and services in relation to the charges levied?	Would you be willing to pay slightly higher parking charges if it contributes to better urban infrastructure or services?	What factors would influence your willingness to accept increased parking charges?	Would a significant increase in parking charges influence your mode choice for commuting or running errands?	Would you be more willing to pay increased parking charges if you knew the funds would be used for specific projects like public transportation improvements or green initiatives?	What factors do you consider when deciding whether to use paid parking facilities?	Do you think the current parking charges in urban areas adequately reflect the demand for parking spaces?	How do you think increased parking charges would affect parking behavior in urban areas?	How important is the availability of affordable parking in your decision to visit a shopping mall or commercial area?	Do you believe that parking charges should be adjusted based on factors such as location, time of day, or vehicle	Thank you for taking the time to complete this survey! Your feedback is greatly appreciated.
26-35	Female	Student	2 wheeler	2-3 times a week	500	Street parking	Moderate	no	Good	Yes, but with conditions	Better security	Yes	No	Availability of free parking alternatives	No	Have no significant impact	Somewhat important	No	Thankyou for considering my opinion
26-35	Female	Student	2 wheeler	Daily	NA	Street parking	Moderate	no	Good	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	Unsure	Proximity to destination	Yes	Lead to increased use of illegal parking	Very important	Yes	
18-25	Male	Student	2 wheeler	Occasionally	NA	Street parking	Moderate	yes	Good	Yes, but with conditions	Better security	No	Yes	Security and safety of the parking facility	Yes	Encourage use of alternative transportation modes	Very important	Yes	What is my nearest parking space is full and I
26-35	Male	Student	2 wheeler	Once a week	500	Street parking	Moderate	yes	Good	Yes, but with conditions	Improved facilities, Better security, Additional	Yes	Yes	Availability of free parking alternatives	Unsure	Lead to increased use of illegal parking	Somewhat important	Yes	
18-25	Male	Student	2 wheeler	Rarely	NA	Street parking	Moderate	no	Good	Yes, but with conditions	Improved facilities, Better	Yes	Yes	Cost of parking charges	Yes	Lead to increased use of illegal	Somewhat important	Yes	
26-35	Male	Employed	4 wheeler	2-3 times a week	1000	Parking Lots	Moderate	yes	Poor	Yes, but with conditions	Improved facilities, Better security,	Yes	Yes	Security and safety of the parking facility	Yes	Encourage use of alternative transportation	Very important	Yes	
Under 18	Male	Student	2 wheeler	Daily	500	Street parking	Low	yes	Poor	Yes, but with conditions	Better security, Additional amenities	Yes	Yes	Proximity to destination, Security and safety of the	Unsure	Encourage use of alternative transportation modes	Very important	Yes	
26-35	Male	Employed	4 wheeler	Daily	1500	MLCP	Moderate	yes	Fair	Yes, but with conditions	Better security, Additional amenities	Yes	Yes	destination, Cost of parking charges, Security and safety of the	Yes	Have no significant impact	Very important	Yes	
26-35	Male	Student	2 wheeler	Daily	1000	Street parking	Moderate	no	Fair	Yes, but with conditions	Better security, Additional amenities	Yes	Yes	Proximity to destination, Cost of parking	Yes	Encourage use of alternative transportation	Somewhat important	Yes	
36-50	Male	Self-employed	4 wheeler	Daily	2000	MLCP	Moderate	yes	Fair	Yes, definitely	Better security, Additional amenities	Yes	Yes	destination, Availability of free parking alternatives, Security and safety of the	Yes	Encourage use of alternative transportation modes	Very important	No	
51 and above	Female	Retired	4 wheeler	2-3 times a week	1500	Parking Lots	Moderate	yes	Good	Yes, definitely	Additional amenities, Affordability	Yes	Yes	destination, Cost of parking charges, Security and safety of the	Yes	Have no significant impact	Very important	Yes	
36-50	Female	Employed	4 wheeler	2-3 times a week	1500	Parking Lots	Moderate	yes	Fair	Yes, definitely	Better security	Yes	Yes	Cost of parking charges, Security and safety of the	Yes	Encourage use of alternative transportation modes	Very important	Yes	

Age	Gender	Occupation	What type of parking do you generally use ?	How frequently do you use parking facilities in urban areas?	On average, how much do you spend on parking per month?	Do you typically use street parking, parking lots, or multi-level garages?	What is your opinion on the current parking charges in urban areas?	Do you believe that parking charges contribute significantly to revenue generation for municipalities or private operators?	How do you perceive the quality of parking facilities and services in relation to the charges levied?	Would you be willing to pay slightly higher parking charges if it contributes to better urban infrastructure or services?	What factors would influence your willingness to accept increased parking charges?	Would a significant increase in parking charges influence your mode choice for commuting or running errands?	Would you be more willing to pay increased parking charges if you knew the funds would be used for specific projects like public transportation improvements or green initiatives?	What factors do you consider when deciding whether to use paid parking facilities?	Do you think the current parking charges in urban areas adequately reflect the demand for parking spaces?	How do you think increased parking charges would affect parking behavior in urban areas?	How important is the availability of affordable parking in your decision to visit a shopping mall or commercial area?	Do you believe that parking charges should be adjusted based on factors such as location, time of day, or vehicle	Thank you for taking the time to complete this survey! Your feedback is greatly appreciated.
36-50	Male	Employed	4 wheeler	2-3 times a week	1500	Parking Lots	Moderate	yes	Fair	Yes, but with conditions	Improved facilities	Yes	Yes	Security and safety of the	Unsure	Lead to increased use of illegal	Somewhat important	Yes	
26-35	Female	Employed	4 wheeler	2-3 times a week	500	Parking Lots	Low	yes	Poor	Yes, but with conditions	Better security, Additional	Yes	Unsure	Security and safety of the	Yes	Lead to increased use of illegal	Somewhat important	Yes	
51 and above	Male	Self-employed	4 wheeler	Occasionally	1000	Parking Lots	Low	yes	Good	Yes, definitely	Improved facilities, Better security	No	Unsure	Proximity to destination, Cost of parking	Unsure	Others	Somewhat important	Yes	
Under 18	Male	Student	2 wheeler	Daily	500	Street parking	Low	yes	Good	Yes, definitely	Improved facilities, Better security	Yes	Yes	charges, Security and safety of the parking facility, Others	Yes	Lead to increased use of illegal parking	Not important	Yes	
18-25	Female	Student	2 wheeler	2-3 times a week	500	Street parking	Low	yes	Good	Yes, definitely	Better security	No	Unsure	Cost of parking charges, Security and safety of the	Yes	Have no significant impact	Somewhat important	Yes	
26-35	Male	Self-employed	4 wheeler	2-3 times a week	500	Parking Lots	Moderate	yes	Fair	Yes, definitely	Improved facilities, Better security, Additional	Yes	Unsure	Proximity to destination, Cost of parking charges	Yes	Encourage use of alternative transportation modes	Very important	Yes	
36-50	Male	Self-employed	4 wheeler	Daily	1500	MLCP	Moderate	yes	Fair	Yes, but with conditions	Improved facilities,	Yes	Yes	Cost of parking charges	Yes	Have no significant impact	Somewhat important	Yes	
51 and above	Female	Retired	4 wheeler	Occasionally	500	MLCP	Low	yes	Good	Yes, definitely	Better security, Additional amenities, Affordability	Yes	Yes	destination, Availability of free parking alternatives, Cost of parking charges, Security and safety of the	Yes	Encourage use of alternative transportation modes	Very important	Yes	
51 and above	Female	Retired	4 wheeler	Once a week	500	Combination of the above	Low	yes	Fair	Yes, but with conditions	Improved facilities, Better security, Additional	No	Unsure	Availability of free parking alternatives, Security and	Unsure	Lead to increased use of illegal parking	Very important	Yes	
51 and above	Male	Retired	4 wheeler	2-3 times a week	500	Street parking	Low	yes	Fair	Yes, definitely	Better security	Yes	Yes	free parking alternatives, Cost of parking charges, Security and safety of the	Yes	Encourage use of alternative transportation modes	Very important	Yes	
51 and above	Female	Retired	4 wheeler	Rarely	NA	Combination of the above	Moderate	yes	Fair	Yes, but with conditions	Better security, Affordability	Yes	No	Availability of free parking alternatives, Cost of parking	Yes	Have no significant impact	Somewhat important	Yes	
		Self-				Combination of the					Improved facilities, Better security,			Proximity to destination, Security and		Encourage use of alternative transportation			

2.0 Inventory Survey. Responses

Parking Facility Name	Type of Facility	Spaces for Pers	Hourly/ Daily Rate	Monthly 24hr rate	Accepted Payment Methods	Standard Operating Hours	Any Restrictions or Timed Parking?	Availability Tracking System	Payment Automation	Security Personnel	Surveillance Cameras	Proximity to Public Transport	Facilities for Bicycles	Restrooms	Compliance with Local Regulations	Any Regulatory Violations	User Satisfaction Ratings	Common User Complaints
Dwarka Sector 14	Parking lot	No	20 rs /hr	1800	mobile app	12hr	yes	NA	NA	yes	no	within 1km	Bicycle Parking Spaces	no	no	No	2	Security
MCD Parking Dwarka Sector 14	Parking lot	No	20	1200	cash, mobile app	24hr	no	NA	NA	no	no	below 500m	No	no	no	No	1	Poor Maintenance and Cleanliness, Inadequate Security Measures, Lack of Accessibility and Amenities
MCD Parking Dwarka Sector 6	Street Parking	No	20	NA	cash, mobile app	8hr	no	NA	NA	no	no	more than 1km	No	no	no	No	3	Cleanliness, Inadequate Security Measures, Unclear Parking Regulations, Traffic Congestion and Management
MCD Parking Karol Bagh (lot)	Parking lot	No	20	2000	cash, mobile app, credit card	24hr	no	NA	Contactless Payment	yes	no	below 800m	No	no	no	No	3	Difficulty in Finding Parking Space, Poor Maintenance and Cleanliness, Inadequate Security Measures, Unclear Parking Regulations, Lack of Accessibility and Amenities
MCD Parking Karol Bagh (Street)	Street Parking	No	20	NA	cash, mobile app	12hr	no	NA	NA	no	no	below 800m	No	no	no	No	3	Difficulty in Finding Parking Space, Inadequate Security Measures, Traffic Congestion and Management, Lack of Accessibility and Amenities, Overall Customer Service Experience
Kamla Nagar	Street Parking	No	20	NA	cash, mobile app, credit card	8hr	no	NA	NA	no	no	more than 1km	No	no	no	No	2	Difficulty in Finding Parking Space, Unclear Parking Regulations, Traffic Congestion and Management, Lack of Accessibility and Amenities
Nehru Place	Parking lot	No	20	2000	cash, mobile app, credit card	24hr	no	NA	NA	yes	yes	more than 1km	No	no	no	No	2	Poor Maintenance and Cleanliness, Inadequate Security Measures, Lack of Accessibility and Amenities
Sarojni Nagar	MLCP	No	20	2000	cash, mobile app, credit card	24hr	no	NA	NA	yes	yes	below 800m	No	yes	no	No	3	Difficulty in Finding Parking Space, Lack of Accessibility and Amenities, Overall Customer Service Experience
MCD Lajpat MLCP	MLCP	No	20	2000	cash, mobile app, credit card	24hr	no	NA	Contactless Payment	yes	yes	within 1km	No	no	yes	No	3	Difficulty in Finding Parking Space, Traffic Congestion and Management, Lack of Accessibility and Amenities
MCD Lajpat Street	Street Parking	Yes	20	NA	cash, mobile app	8hr	no	NA	NA	no	no	within 1km	No	yes	no	No	3	Cleanliness, Inadequate Security Measures, Unclear Parking Regulations, Traffic Congestion and Management
MCD Bhikaji	Parking lot	No	20	more than 2000	cash, mobile app, credit card	8hr	no	NA	NA	yes	no	below 500m	No	no	no	No	2	Difficulty in Finding Parking Space, Poor Maintenance and Cleanliness, Unclear Parking Regulations, Lack of Accessibility and Amenities

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