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On-Street Parking Utilization and Management Efficiency: A Case Study of Mahendranagar, Nepal

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Abstract

This study investigates the escalating issue of on-street parking in Mahendranagar, Nepal, concentrating on five principal streets that encounter elevated traffic volumes and significant parking demand. Accelerated urban growth and a persistent increase in car ownership have exerted significant pressure on constrained roadside areas, leading to congestion, road encroachment, and operational traffic disputes. Efficient parking management is important for urban area such as Mahendranagar, as it facilitates effective and smooth public transportation operations and promotes the utilization of sustainable mobility alternatives. A three-day field observation survey was conducted to analyze parking behavior, peak demand hours, and space use along the designated routes. The data gathering encompassed methodical vehicle counts, computation of parking indices, and evaluation of adherence to current parking restrictions. The findings illustrate the significant overuse of on-street parking facilities. Parking indices attained 182.50% on Street 1 and 191.25% on Street 5, unequivocally indicating demand significantly beyond available capacity. Maximum parking activity occurred in the morning from 9:30 to 11:30 AM and in the afternoon from 3:00 to 3:30 PM. During these peak periods, most of the street accommodated over 300 parked vehicles, despite an effective capacity of only 160 vehicles. These conditions show the increase traffic occupancy and cause traffic

congestion and safety hazards. Additionally, the problem has become even worse because there has been a substantial increase in vehicle registrations, especially two-wheelers, which have gone up by more than 15,000 units in the last five years. To deal with the immediate effects, we need things like clearly marked parking areas, stricter enforcement, and specific changes to the design of the streets. Long-term growth of sustainable urban transportation will depend on changes to infrastructure, such as widening roads, building multi-level parking lots, and using vertical parking systems. Public participation and technology-assisted parking management will also be important.

Keywords : Traffic occupancy, Parking demand, Safety, Parking management, Streets

Introduction

Urban on-street parking is a fundamental operational component of city transport systems. (Biswas et al., 2017). It facilitates access to commercial activities, structures Kerbspace use, and exerts a direct influence on traffic flow, road safety, and the quality of the pedestrian environment. As small and intermediate cities in developing countries undergo rapid motorization, the pressure on on-street Kerbspace increases sharply, producing conflict between the needs of parked vehicles, through traffic, roadside commerce, and pedestrians. Unmanaged Kerbspace parking can thus reduce roadway capacity, follow illegal parking blocking pedestrian routes, which collectively degrade mobility, safety, and the commercial vitality of market areas (Sha et al., 2024).A study of on-street parking must be based on related technical themes that deal with figuring out how to measure and understand parking supply and demand, finding quantitative thresholds and performance criteria that set apart functional from ineffective use of sidewalk space, and figuring out how decisions about sidewalk parking affect road capacity, vehicle operations, and pedestrian safety (Cats et al., 2016),(Aljoufie, 2016),(Salini et al., 2016) .

The design and analysis of the parking accumulation survey utilized in this study were directly influenced by each of these elements. The survey comprised counting every half hour on five streets over three days, as well as classifying vehicles by type and observing the weather at the same time. The survey design and the interpretation of the observed parking indices in Mahendranagar are both based on known methodological standards and empirical thresholds from the literature (Gogola & Hocova, 2016), (Sivakani et al., 2024). When feasible, direct measurement of on-street parking typically employs occupancy accumulation surveys, duration occupancy studies, or automated transaction or sensor data (Chouhan et al., 2023).There are different guidelines for different surveys, but the literature strongly recommends multiple time-point counting, usually every 15 minutes to an hour, over several representative days. This will help to see patterns in the data over time, the most important events, and how sensitive the data tom show the existing trend. This method counts every half hour for three consecutive days and follows all best practices. It provides a sufficient time window to make daily demand curves and find the peak occupancy times. Researchers and real-world practice recommendations demonstrate that the system stops working when parking lots are more than 85% occupied of their full capacity. At this level, drivers spend more time searching for parking spots, which leads them to cruise, park illegally, and spill over into other areas. These things make traffic less efficient and make it less safe and comfortable for individuals to walk (Aljoufie, 2016).By comparing this level to the Mahendranagar parking index, we can easily see how challenged the Kerb is and what management needs to do. On-street parking influences road capacity by introducing side-friction effects. Parked vehicles occupy part of the usable roadway width, which can result in reduced lane width, lateral lane shifts, or brief interruptions to traffic flow during parking and unparking activities (Prakash et al., 2020).The research shows that these side frictions slow down traffic and reduce throughput on major roads. When the parking is well-organized and follows a regular pattern, parked cars on smaller business routes can help slow down traffic or shield pedestrians from moving cars(Chauhan et al., 2025). The layout and management of on-street parking play a critical role in pedestrian safety. Correctly arranged parked vehicles can enhance protection, but improper parking can obstruct sight distances at crosswalks or encroach on pedestrian space, heightening the likelihood of accidents. According to statistics, every day a lot of pedestrian accidents happen when individuals get out of parked cars in a single day. Researchers frequently identify that the poor visibility at crossings is a major contributing factor (Mikulić et al., 2024). To limit the parking near crosswalks and crossings, buffers in the market areas are required to ensure that pedestrian walkways are clear and continuous, and keeping parking lots safe can all help. The method used to look into parking trends in Mahendranagar city takes these safety issues into account. Kerbside is used for both as a walkway for pedestrians and an entryway.

The literature suggests a range of interventions that enhance Kerbspace efficiency and safety, encompassing enforcement and regulation, supply increase, demand management, and information systems (Cai et al., 2025),(Weidmann, 2011),(Gomari et al., 2023). Each intervention carries integral trade-offs in terms of financial burden and social equity. The policies for the pricing effectively prevent and minimize parking search duration; however, they frequently face political resistance, especially in smaller metropolitan centres. Developing off-street parking facilities necessitates extensive economic investment; yet, it reduces roadway congestion and enhances the aesthetic quality of the built environment by eliminating visual distractions. Similarly, smart parking technologies can deliver substantial operational benefits, though their success depends on sufficient spatial coverage, technical expertise, and budgetary support (Fahim et al., 2021). Evidence from critical reviews and empirical modelling of on-street parking in diverse urban settings provides practical threshold indicators and behavioural insights that help contextualise the present results. In particular, peak parking indices above full capacity are widely recognised as markers of illegal or spill over parking, a pattern consistent with observations from dense market corridors in comparable cities (Nur Iman et al., 2025).

Despite the substantial body of work on on-street parking in large cities, smaller municipalities such as Mahendranagar have received little scholarly attention. This study helps bridge this gap by quantifying kerbside parking demand in two-wheeler-oriented urban streets using structured parking accumulation survey methods (Biswas et al., 2017). This approach generates context-specific evidence and illustrates a methodological framework that can be replicated in comparable small and mid-sized cities. An increase in the number of vehicle owners, limited road capacity, and a lack of focused research on parking in Mahendranagar city. This study systematically measures parking supply, demand, and index on five major corridors and analyzes the resulting impacts and risks to develop context-appropriate parking strategies.

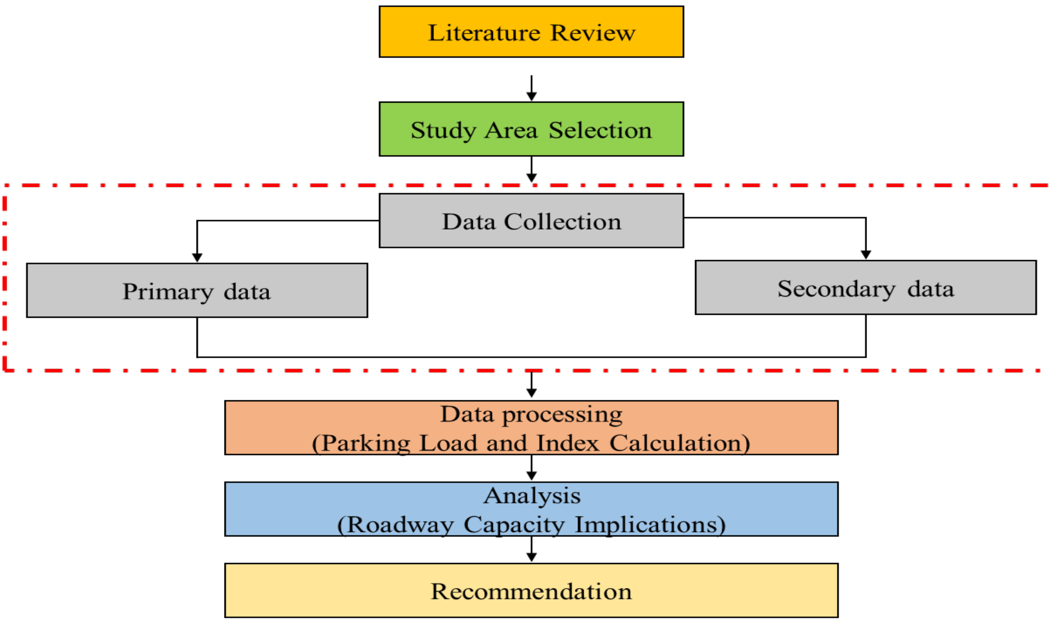
Methods

Research Framework

This study employed a mixed-method approach to look at how well on-street parking was managed using a mix of qualitative and quantitative methods. This study begins with a thorough look at the state of on-street parking around the world to make the survey methods used clearer. This study found major problems, such as the lack of a thorough occupancy analysis for local streets in places like Kanchanpur and the lack of proper consideration of pedestrian safety and business impact evaluations. This helped to define the study's goals. Field data collection forms the core of the methodology. Parking accumulation surveys are conducted on selected major streets to document parking supply, occupancy levels, vehicle types, and time-dependent variations in parking use. The collected data are evaluated to assess parking demand, compute parking indices, and separate spatial and temporal consumption trends. Afterwards identified the current parking-related issue, then recommended actionable activities for suitable parking management techniques.

Figure 1

Methodology framework

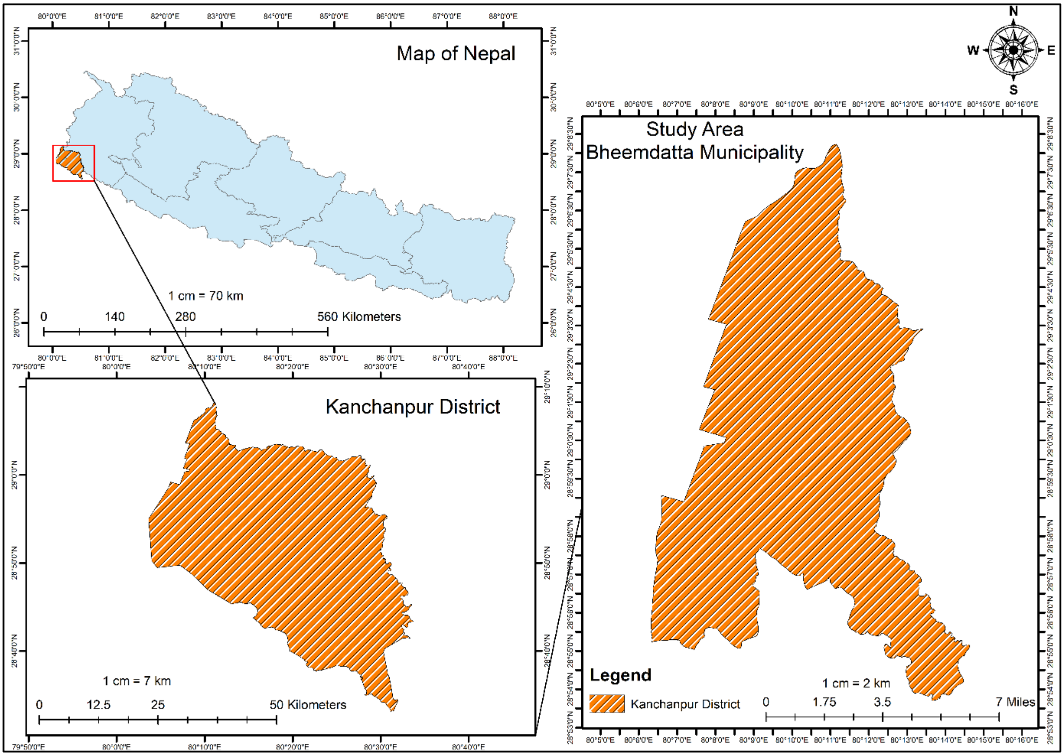


Study Area

The study focuses on Mahendranagar City, the primary commercial centre of Kanchanpur district, Nepal, consisting of a dense and highly developed zone of approximately with an area of 0.42 km² and perimeter of 3,474 with five key street were studied in depth (Khadka, Negi, Pali, et al., 2025). Main market road is busy with stores, banks, and a lot of people walking around. The hospital access corridor has clinics, pharmacies, and mostly short-term parking needs. The mixed residential-commercial street has homes above stores that constantly block the sidewalk. More than 80% of the city's official business takes place in these corridors (Khadka, Negi, Khatri, et al., 2025). They don't have enough authorized parking spaces and their roads are too narrow. The research area is important because it is the economic centre of Kanchanpur, and parking problems have a direct impact on business, pedestrian safety, and traffic flow. The chosen zone is a good place to try out parking management plans that could work in other places because it is small and has a high perimeter-to-area ratio (8.27 km/km²). The pricing system and smart parking interventions are two of these strategies. They are meant to make cities more accessible, safer, and fairer.

Figure 2

Study area



Data Collection

Five important streets in Kanchanpur were chosen because they have distinct types of business, pedestrian traffic, and road function (arterial and collector). A fixed-interval accumulation survey was used to capture parking conditions. Observations were made every 30 minutes from 9:30 AM to 4:30 PM on three weekdays. The 30-minute interval was chosen because it represents an appropriate equilibrium between data resolution and survey effort. Shorter and longer observation intervals have their own problems. During each period, all parked cars were counted and sorted by kind.

Parking Index Calculation

The parking index for the existing traffic and the capacity is calculated as:

$$Parking\ Index = \frac{Parking\ Load}{Parking\ Capacity} * 100 \quad \text{(Equation I)}$$

Analyzed the parking circumstances using index levels of less than 85% to indicate satisfactory operation, 85–100% to indicate emerging stress, and values exceeding 100%

to indicate congestion. Hourly occupancy curves constructed to illustrate the fluctuations in demand over time and identify peak periods. Exanimated these indicators to assess their impact on roadway efficiency, including lane encroachment and reduced traffic flow, as well as pedestrian safety due to obstructed walkways. The outcomes resulted in a sequence of management strategies implemented in phases, ranging from immediate indicators and enforcement to intermediate price or time limit trials and long-term smart parking integration. During all phases, pedestrian safety, equitable access for users, and the seamless functioning of commercial corridors were the primary goals.

Parking Supply Analysis

The on-street parking supply was carried out through an inventory survey, geometric parameters of selected streets were measured to determine suitable parking methods. Streets wider than 9 meters can accommodate 90-degree parking however, most of the streets are only around 7.5 meters wide, except one street. Therefore, 30-degree parking was adopted to avoid obstructing traffic flow. Since two-wheelers dominate parking demand, calculations were based on existing traffic. For practical estimation, space for motorcycles was assumed sufficient for both. The effective parking length was reduced to 275m per 405 m street considering the requirement for the shop and pedestrian movements.

Space Requirement: As Per (SP-12:2015), the required space for Motorcycles = 2m × 1m, Cycles: 2m × 0.5m.

Parking Supply Capacity $= \frac{275 - 0.232}{2} = 140\ (approx.)$ 0.232 is the adjustment factor for gaps required between vehicles. This means that the parking space can accommodate about 140 two-wheelers, or 160 cars per street in terms of Equivalent Car Space (ECS). This number is the baseline for the section on comparing demand and congestion.

Result and Discussion

Parking Observations and Land Use Characteristics

The service area functions as a major generator and attractor of traffic due to the concentration of commercial, institutional, and transport-related activities. To capture this spatial pattern, an observational survey was conducted along the principal corridors, including Mahendranagar Highway (NH-01), the bus station area, and connecting streets such as Hospital Road and Campus Road. The distribution of service facilities identified through this survey is summarized in Table 1. These corridors accommodate a diverse mix of land uses, ranging from banks, hotels, restaurants, and petrol pumps to small retail establishments such as general stores, grocery shops, and stationery outlets. Table 1 illustrates that the composition and intensity of land use differ significantly across the study streets, which distinctly affects parking demand and vehicular movement. Streets containing abundant general merchants and grocery stores typically display a high demand for short-term parking with rapid occupancy rates. Street 5, characterized by the highest number of general businesses (33) and grocery stores (17), experiences significant stopping and parking activity throughout the day. Corridors featuring a higher concentration of hotels, lodges, and restaurants produce medium to long-term parking demand, leading to increased kerbside occupancy over time. Whereas, banks and petrol stations contribute to congestion during peak hours by increasing vehicle movement in constrained road space. The area between the bus stop and Madan Chowk is a significant location, serving as a hub for transportation that facilitates ongoing passenger traffic and vehicle flow. The patterns illustrated in Table 1 indicate that both the concentration and type of land use significantly influence parking behavior and spatial parking pressure. Thus, understanding service-area distribution is crucial for interpreting observed parking conditions and for formulating effective, context-sensitive parking management strategies for Mahendranagar.

Table 1

Service area possessing mass traffic volume

Location	Banks	Hotels	Restaurants	Stationaries	General stores	Groceries	Petrol pump
NH-01 to the Bus stop	0	4	3	0	11	7	2
Bus stop to Madan Chowk	2	6	7	3	23	9	0
Street 5	5	8	3	12	33	17	0
Street 4	3	8	5	4	23	15	0
Street 3	5	6	13	6	19	13	0
Street 2	4	2	6	5	22	12	0
Street 1	3	2	9	7	17	22	0
Hospital road	1	8	10	3	7	5	0
Campus road	0	0	6	8	14	16	0

Figure 3

Unorganized on-street two-wheelers parking in Mahendranagar

Systematic field surveys were conducted on three typical weekdays to quantify on-street parking characteristics, covering the period from morning to late afternoon at 30-minute intervals. The observations concentrated on two-wheelers, the primary mode of urban transportation, typically linked to short-duration parking, as well as other vehicle categories that generally occupy spaces for extended periods. Both the temporal and vehicle-specific approaches facilitated the identification of variations in parking occupancy and demand at different times of day and across various street segments. It offers insights into traffic circulation, peak parking periods, and spatial demand patterns. Continuous visual survey along the kerbside space utilization, enabling clear differentiation between consistently congested commercial corridors and relatively under-utilized streets. The survey covered three weekdays to minimize atypical influences and represent normal parking conditions. Two-wheelers significantly contribute to total parking demand, while also clarifying the spatial needs of other vehicle categories. Tables 2, 3, and 4 form the basis for evaluating existing parking adequacy and developing context-specific parking management strategies for Mahendranagar.

Table 3

On-street parking data, day- I

Vehicle Type	Time / Street	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30
Two Wheeler	1	206	266	280	270	258	244	255	235	222	239	247	262	255	253	230
	2	154	145	155	152	140	142	152	132	122	135	132	149	155	138	128
	3	135	209	252	252	260	237	258	235	224	253	266	256	240	220	218
	4	85	117	120	123	129	139	129	129	112	132	135	132	136	139	128
	5	220	245	275	265	280	255	270	250	225	278	282	272	266	265	223

Others	1	13	9	11	12	11	16	12	1	3	8	11	6	3	19	2
	2	9	8	7	9	9	9	9	8	8	9	6	9	2	13	6
	3	6	7	11	6	10	8	6	9	5	9	11	7	11	10	8
	4	7	10	12	8	4	7	7	11	8	9	5	7	8	8	3
	5	3	11	9	12	6	10	9	7	7	7	8	9	5	18	8

Table 4

On-street parking data, day-II

Vehicle Type	Time / Street	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30
Two Wheeler	1	226	276	292	272	269	253	262	247	231	249	262	282	269	264	237
	2	174	155	167	158	146	153	163	142	136	148	146	166	164	168	143
	3	165	235	266	269	282	265	256	251	243	273	276	256	249	238	221
	4	119	126	135	132	142	149	138	127	122	143	146	145	132	152	129
	5	254	261	295	287	302	287	299	283	246	296	306	292	289	279	259
Others	1	8	5	11	12	13	9	11	9	7	5	3	9	11	7	9
	2	7	9	11	8	6	8	6	4	9	8	15	9	8	11	6
	3	12	9	3	9	6	7	4	7	9	11	7	12	8	9	10
	4	9	12	1	9	7	8	6	13	12	6	8	12	12	7	5
	5	11	9	5	13	7	8	10	10	10	7	3	14	8	12	7

Table 5

On-street parking data, day-III

Vehicle Type	Time / Street	9:30	10:00	10:30	11:00	11:30	12:00	12:30	13:00	13:30	14:00	14:30	15:00	15:30	16:00	16:30
Two Wheeler	1	134	173	182	243	232	220	230	212	200	215	222	236	230	228	207
	2	100	94	101	137	126	128	137	119	110	122	125	137	134	140	124
	3	88	136	164	227	243	231	232	212	202	228	239	230	216	198	196
	4	55	76	78	118	116	125	116	101	100	119	122	119	122	125	115
	5	143	159	179	239	252	230	243	225	203	248	254	245	239	239	201
Others	1	8	6	7	8	7	10	8	1	2	5	7	4	2	12	1
	2	6	5	5	6	6	6	6	5	6	5	6	1	8	4	4
	3	4	5	7	4	7	5	4	6	3	3	6	7	5	7	6
	4	5	7	8	5	3	5	3	7	3	5	4	3	5	5	5
	5	2	7	6	8	7	4	6	5	5	5	7	6	3	12	5

Parking Supply Analysis

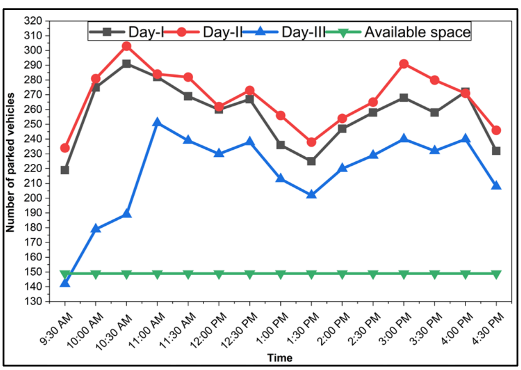
Field measurements showed that the majority of the streets are less than 9 meters wide, limiting the possibilities of perpendicular parking. Only one corridor (Street 1) can partially handle 90° parking, while the others require 30° arrangements. The effective on-street capacity ranged from 140 to 160 two-wheelers per street, with small variations depending on local access points and barriers. This restricted capacity contrasts significantly with the recorded peak demand of over 300 vehicles on high-activity routes like Street 5. The obtained discrepancy illustrates the lack of traffic capacity required for available parking spaces, which explains the frequent spillover and illegal parking witnessed during peak hours. The findings give an empirical foundation for constructing optimal layouts or off-street facilities.

Parking Demand Analysis

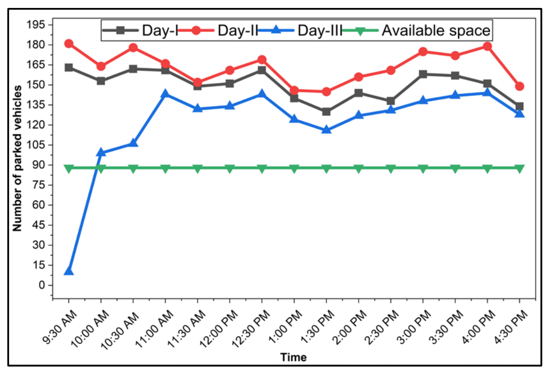
The parking demand was analyzed across three consecutive working days from 9:30 AM to 4:30 PM with fixed-interval sampling at 30-minute intervals. Vehicles were categorized into two-wheelers and other categories, with a specific focus on two-wheelers because of their dominance. The study recorded crucial statistics such as vehicle counts, parking time, parking load, accumulation, and turnover rates.

Figure 4

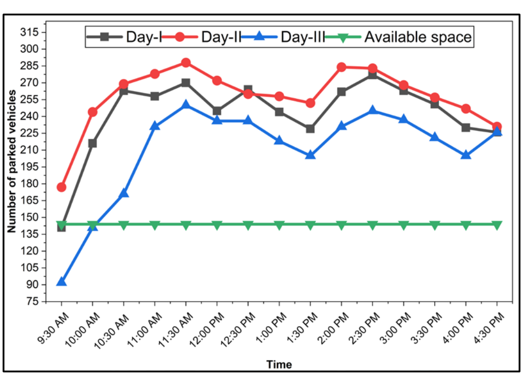
Two-wheeler parking demands for different streets



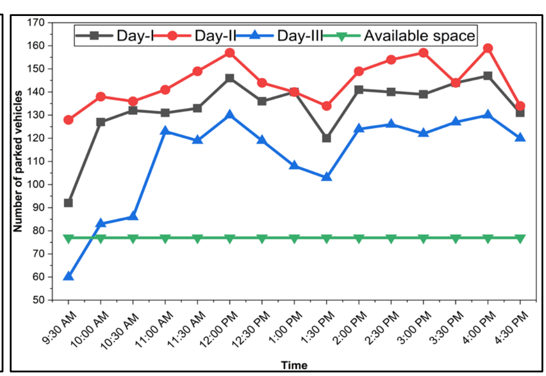
a) Street-1



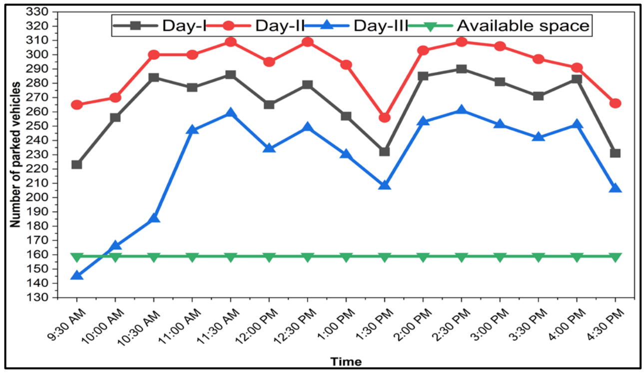
b) Street-2



c) Street-3



d) Street-4



e) Street-5

Figure 4 compares the two-wheeler parking demand across five streets over the consecutive working days. Street 5 shows the highest peak demand, while variations occur during morning and afternoon hours on other streets

Average Parking Index

Table 6 shows the average parking index for five streets over three consecutive working days, highlighting considerable temporal and spatial variations in parking demand. At peak times, parking numbers may surpass 100%, signifying oversaturation and inadequate kerbside capacity. Street 5 exhibits the highest demand, often over 150% from late morning to afternoon, underscoring the urgent need for improved parking infrastructure and management. Whereas, Streets 1 and 3 demonstrate considerable variety, with indices rising to 120–170% in the late morning and early afternoon. In contrast, Streets 2 and 4 generally demonstrate low demand, although occasional exceedances exceeding 100% suggest intermittent capacity constraints.

The results indicate a pronounced mid-day peak in parking congestion and notable spatial disparities across the study area. A restricted number of streets account for around 65–70% of total demand, while others remain comparatively unused, highlighting inefficiencies in distribution and management. The situation is exacerbated by inadequate enforcement and inefficient parking restrictions. To address these concerns, recommended actions include the creation of multi-tiered and off-street parking, the imposition of time restrictions and dynamic pricing, improved enforcement of on-street regulations, promotion of shared mobility, and the installation of parking guidance systems. Without such measures, the continual rise in automobile ownership is anticipated to intensify congestion and reduce urban accessibility.

Table 6

Average parking index in % during each interval for 3 days

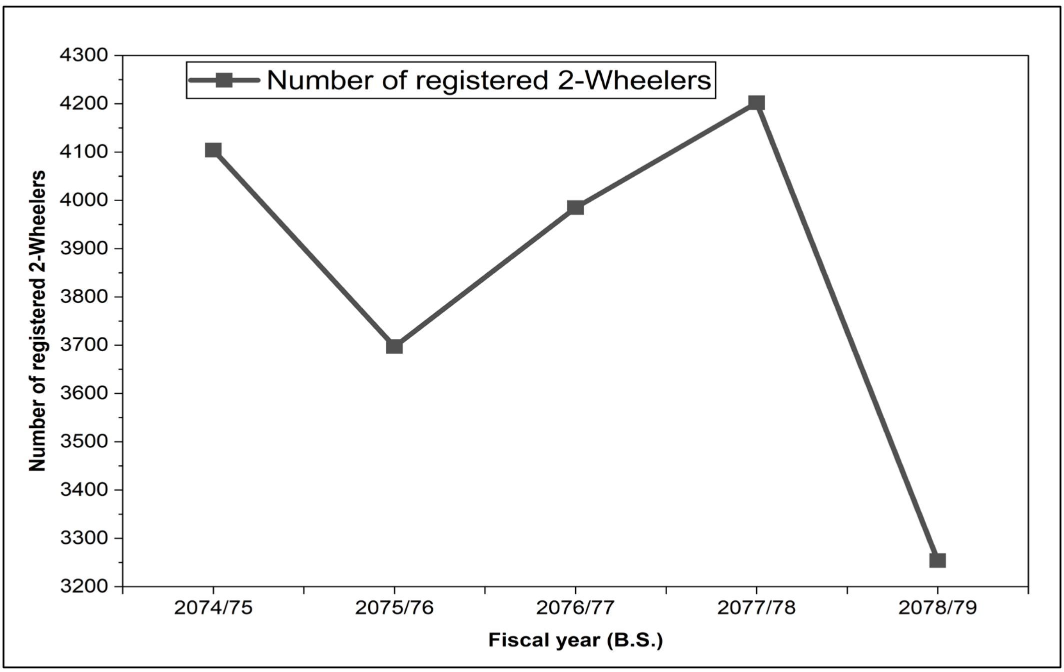
Street	1			2			3			4			5		
Days / Time	1	2	3	1	2	3	1	2	3		2	3	1	2	3
9:30 AM	128.75	141.25	83.69	96.25	108.75	62.56	84.38	133.13	54.84	53.13	74.38	34.53	137.5	158.75	89.38
10:00 AM	166.25	172.5	108.06	90.63	96.88	58.91	130.63	146.88	84.91	73.13	78.75	47.53	153.13	163.13	99.53
10:30 AM	175.0	182.5	115.75	96.88	104.38	62.97	157.5	165.63	102.38	75.0	84.38	48.75	171.88	184.38	111.72
11:00 AM	168.75	170.0	115.0	95.0	98.75	85.5	157.5	168.75	141.75	76.88	82.5	69.19	165.63	179.38	149.06
11:30 AM	161.25	168.13	148.63	87.5	91.25	78.75	160.63	173.13	146.25	80.0	88.75	72.56	173.0	188.75	157.5
12:00 PM	152.5	158.13	137.25	88.75	95.63	79.88	148.13	165.63	133.81	68.88	93.13	79.38	159.38	179.38	143.44
12:30 PM	159.38	163.75	143.44	95.0	101.88	85.5	160.0	160.0	145.13	80.63	86.25	88.75	168.75	186.88	151.88
1:00 PM	146.88	154.38	132.19	82.5	88.75	74.25	146.88	151.88	132.19	70.0	79.38	63.0	156.25	176.88	140.63
1:30 PM	138.75	144.38	124.88	76.25	85.0	68.63	140.0	151.88	126.0	69.38	76.25	62.44	140.63	153.75	126.56
2:00 PM	149.38	155.63	134.44	84.38	92.5	75.94	158.13	170.63	142.31	82.5	89.38	74.25	171.88	185.0	154.69
2:30 PM	154.38	163.75	138.94	86.88	91.25	78.19	166.25	172.5	149.63	84.38	91.25	75.94	176.25	191.25	158.63
3:00 PM	163.75	176.25	147.38	95.0	103.75	85.5	160.0	165.0	144.0	82.5	90.63	74.25	170.0	182.5	153.0
3:30 PM	159.38	168.13	143.44	93.13	102.5	83.81	150.0	153.13	135.0	85.0	92.5	76.5	166.25	180.63	149.63
4:00 PM	158.13	165.0	142.31	96.88	105.0	87.19	137.5	148.75	123.75	86.88	95.0	78.19	165.63	174.38	149.06
4:30 PM	143.75	148.13	129.38	86.25	89.38	77.63	136.25	138.13	122.5	80.0	80.63	72.0	139.38	161.88	125.44

Increment in Vehicles

The pattern of motor vehicle registration over the last five fiscal years (2074/75–2078/79 B.S.) shows a sustained rise in new vehicle additions, with annual registrations generally ranging from about 4,000 to 6,000 units. Although a slight reduction is evident in 2078/79, the overall trajectory reflects substantial cumulative growth, largely attributable to the increasing ownership of two-wheelers. This steady expansion has placed growing pressure on on-street parking, as parking supply and supporting infrastructure have not increased at a comparable rate. Parking index values observed along the five study streets clearly reflect this imbalance between demand and available capacity, with frequent indications of congestion and overuse of kerbside space. From a traffic engineering viewpoint, such conditions lead to increased circulation by vehicles searching for parking, higher vehicle-hours travelled, reduced effective roadway capacity, and recurring delays. Moreover, insufficient parking demand results in illegal and illegal parking, which narrows roadways, hampers traffic flow, and increases safety hazards. Economically, ongoing parking congestion restricts access to commercial zones, negatively impacting customer foot traffic and local business operations. Thus, the increase in vehicle registrations is a primary factor contributing to rising parking congestion. Addressing this issue necessitates a comprehensive strategy that integrates the establishment of organized and off-street parking facilities with demand-management tactics, such as time-restricted parking, variable pricing models, and enhanced enforcement of parking restrictions.

Figure 5

Increment in motor vehicles per year



Conclusion

This analysis shows substantial congestion and operational inefficiencies, primarily due to insufficient parking facilities and a continuous rise in vehicle ownership. The findings indicate that the current on-street parking availability is inadequate to satisfy present demand, especially during peak times. Parking indices sometimes over 100% indicate a systematic excessive use of available spaces, particularly on high-demand streets. These conditions promote unlawful parking, reduce effective roadway width, worsen traffic congestion, and increase safety hazards for both drivers and pedestrians. The rapid increase in vehicle registrations, particularly of two-wheelers, has exacerbated the strain on constrained parking facilities. The weekday temporal analysis indicates distinct fluctuations in demand, with congestion reaching its zenith between 9:30–11:30 AM and again from 3:00–3:30 PM. These intervals align with increased commercial activity and transportation movements, highlighting the strong connection between parking demand and urban economic functions.

The findings indicate a necessity for interventions across various time horizons from an engineering and managerial standpoint. Immediate actions should prioritise enhanced enforcement of parking laws, clearer signage, and improved traffic oversight to mitigate disorderly parking. In the intermediate term, demand-management strategies like time-restricted parking and user-based charging systems can effectively govern space turnover and deter prolonged occupancy. These initiatives, however, must be supplemented with enduring infrastructural solutions, including the establishment of multi-level and off-street parking facilities, selective road expansion where practicable, and the implementation of intelligent parking systems to enhance space use and information dissemination.

The research underscores the need of a cohesive and collaborative methodology. Collaboration among urban planners, municipal authorities, and local stakeholders, including business owners and citizens, is crucial for achieving viable and socially acceptable solutions. Prioritizing pedestrian safety through clearly delineated parking configurations, sufficient distances from crossings, and unobstructed walkways is essential. By establishing a comprehensive and equitable parking management system, Mahendranagar can mitigate current congestion issues while progressing towards a more efficient, secure, and sustainable urban transportation landscape.

Actionable Recommendations

Based on the findings of this study, it is evident that growing traffic and market activities, as well as the rising parking indices, demand immediate interventions to ensure sustainable urban mobility. The results underscore the importance of implementing comprehensive parking management policies that can effectively balance supply and demand. To address congestion, improve traffic flow, and support local businesses, the following actionable policy recommendations are proposed for implementation in urban streets and commercial zones:

- Ensure off-street parking provision for banks, hotels, restaurants, and hospitals, monitored by the Building and Architect Department.
- Local government must enforce strict parking rules, designate areas, and impose tariffs for organized on-street and off-street parking.

- Increase the number of traffic police to manage and monitor parking practices effectively.
- Shopkeepers should maintain a minimum setback for customer parking after adequately widening the streets.
- Relocate street vendors to designated zones to prevent congestion and maintain smooth traffic flow.
- Strengthen collaboration between the municipality, traffic police, and infrastructure departments to address haphazard parking.
- Propose flyovers, multi-storied, underground, and vertical parking structures to address future parking demands sustainably.

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Conflicts of Interest

The authors declare that they have no conflict of interest.

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