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IMPACT OF VARIOUS ASPECTS OF NEIGHBOURHOOD-LEVEL URBAN FORM ON TRAVEL BEHAVIOUR

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ABSTRACT

This paper investigates how different aspects of neighborhood-level urban form influence travel behavior in Jaipur. It examines the evolution of urban forms from 1991 to the present and their impact on residents' travel behaviors. The study explores the relationship between urban planning and travel patterns, emphasizing sustainable and efficient mobility solutions. A comparative analysis between Vidhyadhar Nagar and Sanganer in Jaipur will highlight disparities in local urban forms and their effects on travel behaviors. Ultimately, the findings aim to provide insights that can guide urban planning strategies for fostering sustainable urban mobility.

KEY WORDS

Urban mobility, Transport, travel behaviour, urban form

INTRODUCTION

Travel had become a significant component of day-to-day life. It helps meet people's needs such as locations, services and facilities. Travel behaviour refers to how people use transportation. Cerver says that the sprawling growth of urban territories and a rise in income are two significant factors influencing the decline of sustainable travel behaviour. Sustainable transportation is an integral part of the growth of a city. The way people travel changed over the last century, like how people travelled in the 19th century is not the same as today. And in the future, this will constantly change. One of the things responsible for this is technology after the invention of motor vehicles. People usually use the cheapest, most convenient and fastest means of transportation to get around. So how they like to get from one place to another depends on many things. How likely people are to travel is vital in planning. According to Crane (1996), there is a pattern of how the built environment of an urban area affects the commuting behaviour of its inhabitants. It also depends on people's personal choices and decisions. People are using more cars and buses to get from place to place. It's more convenient and faster. But there are other things that have come with the advancement of technology. Because so many people use motor vehicles, it becomes a pollution problem, a traffic problem, and it is not sustainable Successful implementation of such a plan in suburban areas requires a better understanding of neighbourhood developments and their relationship with travel behaviour. The objective of the study is to understand the relationship between urban development and travel behaviour. The study also identifies the parameters and indicators to measure various terms associated with neighbourhoodscale urban Form and travel behaviour of that neighbourhood.

Understanding travel behavior is crucial for effective traffic management and achieving sustainable transportation. One significant factor influencing travel behavior is the neighborhood form. Current comprehensive mobility plans often overlook the impact of urban form on how people travel. Urban transportation planning encounters numerous challenges that could undermine its sustainability over time. Recent studies highlight that modern transport planning prioritizes addressing urban sprawl, pollution, and travel times, emphasizing the analysis of urbanization and transportation infrastructure impacts. This approach is instrumental in examining neighborhood characteristics and understanding how they influence changes in travel behavior.

By integrating insights into neighborhood urban forms and their effects on travel behavior, planners can develop strategies that promote sustainable transportation solutions. This holistic approach not only addresses current transportation challenges but also prepares cities for future mobility needs while mitigating environmental impacts and enhancing quality of life.

CITY PROFILE-

Jaipur, known as the Pink City, has experienced significant urban development characterized by a blend of historical charm and modern infrastructure. The city's urbanization has been marked by planned expansions and initiatives to accommodate its growing population and economic activities.

In recent years, Jaipur has seen the development of new residential and commercial areas, supported by improved transportation networks such as metro rail and road infrastructure. The Jaipur Metro, inaugurated in 2015, has enhanced intra-city connectivity and reduced traffic congestion.

The city's urban planning efforts have focused on sustainable development practices, including the preservation of its cultural heritage while embracing modern amenities and services. Initiatives like the Smart City Mission aim to leverage technology for efficient governance and infrastructure management.

However, challenges remain, including managing rapid urban growth, ensuring equitable development across all sectors, and preserving the city's unique architectural heritage amidst modernization efforts. Jaipur continues to evolve as a vibrant urban center with a balance between tradition and progress.

Jaipur's Comprehensive Mobility Plan (CMP)(2010) is a strategic framework designed to address the city's transportation needs comprehensively. It focuses on expanding and upgrading transportation infrastructure, including road networks, public transit systems like buses and the metro, and facilities for cycling and walking. The CMP also prioritizes traffic management strategies such as intelligent transportation systems (ITS) and synchronized traffic signals to optimize traffic flow and reduce congestion.

A key aspect of the CMP is enhancing last mile connectivity to improve accessibility and reduce dependency on private vehicles. Sustainable transport options, including promoting electric vehicles and integrating transport planning with urban development, are integral to the plan. Public participation and stakeholder engagement play crucial roles in ensuring that the CMP aligns with the community's needs and aspirations.

Jaipur enjoys excellent connectivity through road, rail, and air networks. The city is traversed by three major national highways: NH21, NH52, and NH48.The main railway lines passing through Jaipur include the Delhi–Jodhpur line via Ajmer, the Delhi–Ahmedabad line via Ajmer, and the Sawai Madhopur–Jaipur line, which terminates in Jaipur and operates on a single broad gauge diesel line.

Jaipur's transportation infrastructure is primarily composed of road and rail networks. Historically, the city's street layout evolved into a hierarchical grid pattern nearly three centuries ago. The 1998 Master Plan for Urban Development proposed a structured road system featuring nine levels, including national roads, regional thoroughfares, and cycle lanes. The road network spans 2,500 km, with 8 radial and 3 circular lanes centered around the old city. Ten main traffic arteries traverse Jaipur, with plans for a 144 km ring road to enhance regional connectivity.

The Jaipur Metro Rail Corporation (JMRC) operates Line 1, spanning 12 km in the east-west corridor, with Line 2's construction anticipated to cover 23 km along the north-south corridor. As of 2017, Jaipur boasted over 27,000 registered vehicles, constituting 19% of Rajasthan's total vehicle registrations

The types of neighbourhood level urban form that has been addressed is planned area and organic areas i.e. vidhyadhar nagar and Sanganer in jaipur respectively.

Vidyadhar Nagar, planned by BV Doshi in 1984 north of Jaipur City, aimed to alleviate overcrowding by implementing a structured layout based on architectural ideals of Vidyadhar Bhattacharya. It adopted a nine-square grid plan influenced by Jaipur's historical mandala concept, integrating large central roads and ample parking near commercial areas. Doshi combined Le Corbusier's urbanism principles with traditional Indian urban design, emphasizing community, nature, and cosmic harmony. The layout prioritized open spaces and sun orientation to enhance livability, marking a significant urban planning effort to balance modern amenities with historical context in Jaipur.

Sanganer used to be a small town near Jaipur city, but over the years, Jaipur expanded, and Sanganer became a part of Jaipur. It grows organically. Sanganer is a small township Known for its famous handmade paper industry and the textile printing industry. Jain temple is there in this area which is built of red stones.

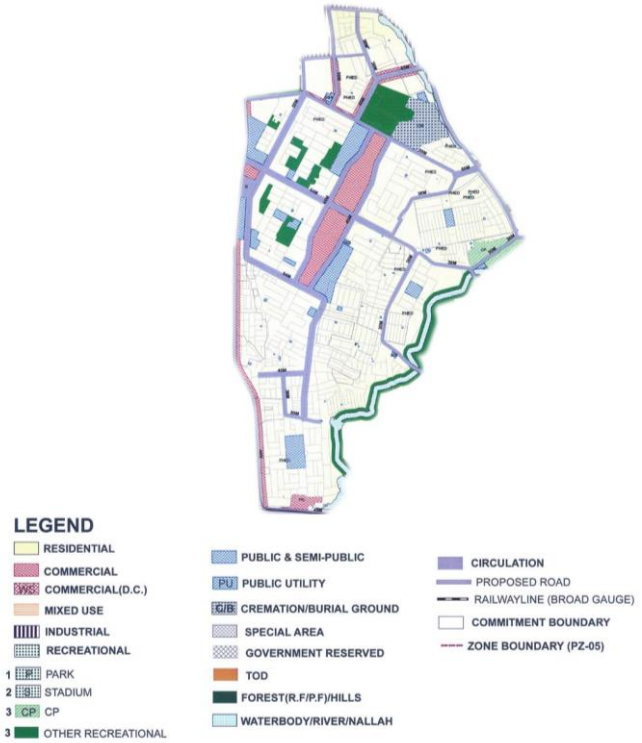


figure 1 land use of vidhyadhar nagar

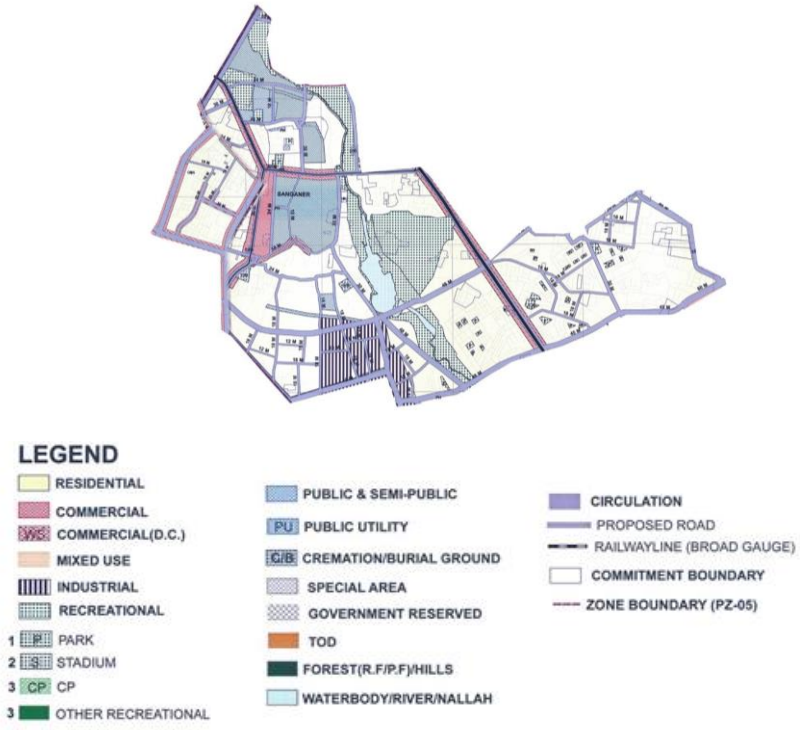


figure 2 land use of sanganer

LITERATURE REVIEW

There is now a significant amount of study on the effects of urban Form on travel behaviour. (Crane, 1996) proposes that developing a typology of the built environment's impact on travel could help incomprehension. According to Crane, research into `in a meaningful way by:

- Residential and employment developments that are compact and dense.
- Reason for travel (journey-to-work, shopping, trip chaining, etc.)
- The analytical technique (simulations, regressions, etc.)
- Explanatory variables (travel prices, travel opportunities, etc.)

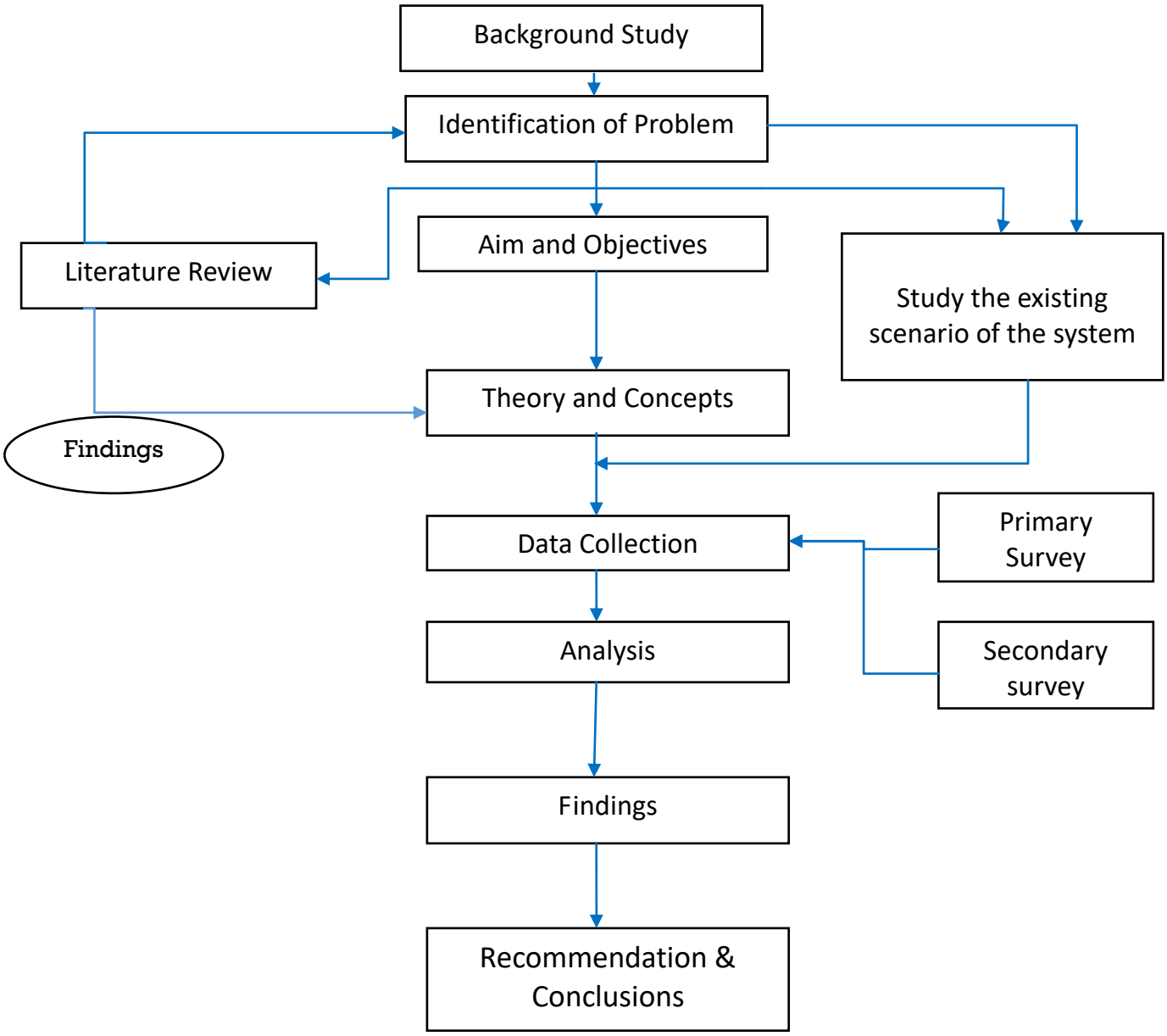
  Socioeconomic factors, for example.)
- The data's nature and amount of detail

The following typology is based on Crane's late suggestion. This Form of classification is ideal for the empirical method used in this study because it provides a straightforward framework for finding and understanding the relationship between the many components of a study (meta-analysis), Travel behaviour and the built environment (independent variables).

Many communities and different cities use and employed this method and get a good result is an attempt to reduce the negative social, economic, and environmental impacts of urban sprawl over the last two decades. These planning approaches might be summarised as an effort to refocus peripheral development toward patterns reminiscent of pre-World War II American towns. The Neo-Traditional, New Urbanism, and Transit-Oriented Development (TOD) approach uses the following core design strategies:

- A wide range of activities and lodging alternatives
- A concentration of homes and jobs around transit terminals and business areas.
- At the neighbourhood scale, smaller buildings, blocks, and roadways are designed.
- Highly connected roadways (grid plan), sidewalks, and paths allow motorized and non-motorized modes of transportation to travel relatively directly.
- A well-defined centre contained open space, public buildings, and retail establishments.

DATABASE AND METHODOLOGY



Original data was collected directly from individuals via a questionnaire for research purposes. This approach provided direct oversight of data collection methods, ensuring that relevant information aligned with study objectives was gathered systematically. The survey was conducted in two neighborhoods: Vidyadhar Nagar, with 71 respondents, and Sanganer, with 76 respondents. This primary survey methodology facilitated the acquisition of specific insights into the demographics, behaviors, and preferences of residents in each area, crucial for conducting detailed analysis and drawing informed conclusions related to the study's focus on urban form and travel behavior.

We conducted correlation and regression analyses on the data gathered from our primary survey to explore relationships between urban form variables and travel behavior. Initially, correlation analysis was performed to assess the strength and direction of relationships between variables. This step helped identify any significant correlations that could indicate potential dependencies or influences between aspects of urban form and travel behavior.

Following correlation analysis, regression analysis was employed to determine the statistical significance and predictive power of these relationships. Regression models were used to establish whether the observed correlations could be validated and to quantify the extent to which urban form variables predict variations in travel behavior outcomes.

By integrating these analytical methods, we aimed to provide a robust understanding of how specific elements of urban design impact travel patterns. These findings contribute valuable insights for urban planners and policymakers seeking to develop strategies that promote sustainable and efficient transportation systems within cities like Jaipur.

Following variable were taken as travel behavious aspects-

- **Safety**: Safety concerns affect travel decisions significantly. Safe neighborhoods and well-lit streets encourage walking and cycling, while high crime areas may deter pedestrians and cyclists, leading to increased reliance on motorized transport.
- **Travel Cost**: The cost of travel, including fuel, public transport fares, and parking fees, influences mode choice. Higher costs for car use may encourage people to opt for public transport or non-motorized modes, especially in cities with good transport infrastructure.
- **Reliability**: Reliable transportation services, such as punctual buses or trains, reduce uncertainty and encourage their use. Unreliable services can lead to increased car use due to the perceived reliability of personal vehicles.
- **Walkability**: Cities designed with pedestrian-friendly infrastructure, such as sidewalks, crosswalks, and pedestrian signals, promote walking as a primary mode of transport for short trips.
- **Bicycle Friendliness**: Infrastructure like dedicated bike lanes, bike-sharing systems, and secure bike parking facilities encourage cycling as a mode of transportation, particularly for short to medium distances.
- **Road Infrastructure**: Well-maintained roads and efficient traffic management systems reduce congestion and travel times, impacting both private and public transport usage.
- **Recreational/Open Spaces**: Access to parks and recreational areas encourages active travel behaviors like walking or cycling for leisure, contributing to overall physical and mental well-being.
- **Commercial Areas**: Proximity to commercial centers influences travel patterns, with people often choosing to walk or use public transport for shopping and leisure activities within these areas.
- **Traffic**: Congested road networks can discourage car use and promote alternative modes like public transport or cycling, depending on the availability and reliability of these options.

Correlation

Vidyadhar Nagar

	Safety	Travel Cost	Reliability	Walkability	Bicycle Friendly	Road Infrastructure	Recreational/ Open Spaces	Commercial	Traffic
Safety	1.000								
Travel Cost	-0.046	1.000							
Reliability	0.032	-0.053	1.000						
Walkability	0.170	0.176	0.107	1.000					
Bicycle Friendly	-0.233	-0.061	-0.093	-0.124	1.000				
Road Infrastructure	0.114	-0.155	0.025	0.478	0.129	1.000			
Recreational/Open Spaces	0.120	0.366	-0.367	0.452	-0.068	0.166	1.000		
Commercial	0.165	-0.172	0.203	-0.088	-0.056	-0.056	0.043	1.000	
Traffic	-0.091	-0.206	0.625	-0.197	0.109	-0.475	-0.397	0.102	1.000

Table 1 Correlation between the different variables of urban form and travel behaviour in Vidyadhar Nagar

Sanganer

	Safety	Travel Cost	Reliability	Walkability	Bicycle Friendly	Road Infrastructure	Recreational/ Open Spaces	Commercial	Traffic
Safety	1.000								
Travel Cost	0.017	1.000							
Reliability	-0.478	0.199	1.000						
Walkability	0.030	-0.100	0.379	1.000					
Bicycle Friendly	-0.057	-0.541	0.039	-0.087	1.000				
Road Infrastructure	-0.092	-0.316	0.083	-0.054	0.602	1.000			
Recreational/Open Spaces	-0.353	-0.034	0.403	0.650	0.133	0.093	1.000		
Commercial	0.039	0.332	-0.055	0.275	-0.281	-0.031	0.049	1.000	
Traffic	0.359	0.025	-0.243	0.266	0.004	0.064	0.199	0.412	1.000

Table 2 Correlation between the different variables of urban form and travel behaviour in Sanganer

A positive correlation is **a relationship between two variables that tend to move in the same direction**. A positive correlation exists when one variable tends to decrease as the other variable decreases.

There is a strong correlation between the highlighted variables. So regression is done on the highlighted variables.

Regression

5.2.1 Regression between Road infra and Walkability, Vidyadhar Nagar

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.289
R Square	0.084
Adjusted R Square	0.038
Standard Error	1.432
Observations	22.000

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1.000	3.739	3.739	1.822	0.192
Residual	20.000	41.034	2.052		
Total	21.000	44.773			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	4.516	1.633	2.764	0.012	1.108	7.923	1.108	7.923
Road Infrastructure	0.326	0.242	1.350	**0.192**	-0.178	0.831	-0.178	0.831

Table 0-1 Regression between the Road infra and walkability in Vidyadhar Nagar

***p*-value - .192**

p-value of this regression is greater than 0.05. Therefore, it is not statistically significant.

Regression between Road infra and Open/Recreation spaces Vidyadhar Nagar

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.166
R Square	0.027
Adjusted R Square	-0.021
Standard Error	1.306
Observations	22.000

ANOVA

	df	***SS***	***MS***	***F***	***Significance F***
Regression	1.000	0.961	0.961	0.563	0.462
Residual	20.000	34.130	1.706		
Total	21.000	35.091			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	5.688	1.294	4.396	0.000	2.989	8.387	2.989	8.387
Recreational/ Open Spaces	0.141	0.188	0.751	0.462	-0.251	0.533	-0.251	0.533

Table 0-2 Regression between the Road infra and open/recreational spaces in Vidyadhar Nagar

***p*-value - .462**

The *p*-value of this regression is greater than 0.05, so these variables do not have a statistically significant correlation.

Regression between Reliability and Traffic, Vidyadhar Nagar

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.625
R Square	0.390
Adjusted R Square	0.360
Standard Error	0.852
Observations	22.000

ANOVA

	df	***SS***	***MS***	***F***	***Significance***

					F
Regression	1.000	9.296	9.296	12.803	0.002
Residual	20.000	14.522	0.726		
Total	21.000	23.818			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.609	1.266	2.061	0.053	-0.032	5.249	-0.032	5.249
Traffic	0.609	0.170	3.578	0.002	0.254	0.964	0.254	0.964

Table 0-3 Regression between the reliability and traffic in Vidyadhar Nagar

***p*-value - .002**

The *p*-value of this regression is much less than 0.05, so these variables have a statistically significant correlation.

Regression between Walkability and Open/Recreation spaces, Sanganer

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.650
R Square	0.423
Adjusted R Square	0.394
Standard Error	0.664
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	6.459	6.459	14.658	0.001
Residual	20	8.813	0.441		
Total	21	15.273			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.660	0.674	3.948	0.001	1.255	4.065	1.255	4.065
Recreational/ Open Spaces	0.487	0.127	3.829	0.001	0.222	0.752	0.222	0.752

Table 0-4 Regression between the walkability and open/ recreational spaces, Sanganer

***p*-value - .001**

The *p*-value of this regression is much less than 0.05, so these variables have a statistically significant correlation.

Regression between Traffic and Commercial Spaces, Sanganer

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.412
R Square	0.170
Adjusted R Square	0.129
Standard	1.241

Error	
Observations	22

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	6.311	6.311	4.101	0.056
Residual	20	30.780	1.539		
Total	21	37.091			

	Coefficients	***Standard Error***	***t Stat***	***P-value***	***Lower 95%***	***Upper 95%***	***Lower 95.0%***	***Upper 95.0%***
Intercept	4.898	1.246	3.932	0.001	2.300	7.497	2.300	7.497
Traffic	0.542	0.268	2.025	0.056	-0.016	1.101	-0.016	1.101

Table 0-5 Regression between the Traffic and Commercial Spaces, Sanganer

***p*-value - .056**

The *p*-value of this regression is greater than 0.05, so these variables do not have a statistically significant correlation.

RESULTS AND DISCUSSION

The survey conducted in Vidyadhar Nagar reveals that a majority, 57.4%, of residents commute to work using cars, traveling an average distance of 6.42 km. Additionally, 28.8% of respondents use bicycles for recreational activities, covering an average distance of 0.62 km. Walking is a common mode of transport, averaging 18.9 minutes per trip. Car commuters in Vidyadhar Nagar spend an average of Rs. 33.6 on fuel for work commutes, while two-wheeler users spend Rs. 10.2.

In contrast, Sanganer shows different travel patterns, with 36% using two-wheelers for work commutes, covering an average distance of 4.05 km. For recreational activities, 16% use bicycles, averaging 0.80 km per trip. Walking averages 12.5 minutes. Fuel costs for car commuters in Sanganer amount to Rs. 26.8, while two-wheeler users spend Rs. 17.5. These findings highlight distinct transportation preferences and behaviours between the planned development of Vidyadhar Nagar and the organic growth of Sanganer in Jaipur.

Also, correlation and regression analysis were done among various variables in order find the relation between those variables.travel behaviour aspects such as Safety, wlakbility, road infrastructure, traffic, open spaces, bicycle use etc were used for the data analysis. The analysis was done for both selected study areas respectively.

CONCLUSION

From primary survey findings, neighborhoods with organic growth like Sanganer face higher traffic and less efficient circulation compared to planned developments like Vidyadhar Nagar, where traffic is lower. Residents in planned areas express higher satisfaction with road infrastructure. Traffic conditions can increase walkability, promoting less car use on narrower roads under certain circumstances.

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