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Land Use Forecasting based upon Travel Behaviour Pattern - A Case Study of Nasik

Mr. Rahul Choudhari¹, Prof. Shishir Dadhich²

^{1, 2}Sandip university Nasik, India

Abstract: *The city as a whole is considered a composite system, as it consists of frequent interactive sub systems. Land use and transportation are considered to be the most important subsystems among all. Travel is a derived demand of land use design, while Transportation also affects land use. Land use based urban growth is also one of the main aspect in the urban development studies and it is driven by population explosion and transportation development. To derive the relation between different land use and travel performance is very difficult as well as dynamic. The main objective of this research is to decide future land use by accessing impact of land use change on trip attraction for the study area Nasik City. Nasik City is located in the state of Maharashtra on the Western part of India. It is one of the fastest growing cities with rapid growth rate of migration from all over the country. At present the city is spread over an area of 2681 sq. km. As a result of rapid urbanization and population detonation in the past decade, land use of the Nasik city has knowledgeable the dynamic change. To decide future land use by accessing force of land use change on trip attraction, the present study has been taken up.*

Keywords: *Land use, Transportation, Nasik City, trip.*

I. INTRODUCTION

Nasik is the third largest urban area in the state of Maharashtra covering an area of about 267.48 square kilometers (i.e. 26747.75 hectares) with a population of 1.48 million as per 2011 census. Nasik Municipal Corporation includes 25 villages out of which Vihitgaon, Vadner and PimpalgaonKhamb are partly included. With increasing migration to urban areas, increasing population brings with it rapid motorization leading to congestion and pollution. To alleviate the existing and future transport problems of Nasik, it is essential to develop a Comprehensive Traffic and Transport Plan that provides a long phrase vision and mobility solutions for the citizens of Nasik.

In most of the little sized Indian cities, there will be a significant increase in the modal shares of private transport modes such as cars and motorized two-wheelers. Also, the share of the public transport modes (5%) and non-motorized modes (38%) is falling in many of these cities. According to a report available with the Ministry of Urban Development, Govt. of India (2008), the percentage mode share of public transfer for small cities with population less than five hundred thousand was very low and also predicted it to be much lower in future (2% in 2031). In the year 2031, the share of non-motorized modes would be 26% in these cities. In India, many towns of medium size are rapidly growing and travel patterns observed in these cities are significantly changing. These changes may be attributed to the change in the socio-economic, and land use characteristics. Land use planning has significant impacts on many travel related parameters. Appropriate land use planning results in in general reduction of travel (expressed in vehicles or persons kilometre travelled) and a significant modal shift from personalized modes to public or no motorized transport modes. In the past, various researchers have analyzed the land use effects on travel behaviour.

Travel demand models, which are used for this purpose, should therefore incorporate realistic representations of individual and household activity and travel conclusion making. As we move into the next millennium, this need for realistic representation of decision making behavior is particularly acute for at least two reasons. First, rising traffic congestion and associated air quality problems, combined with the incomplete efficiency and increasing lack of financial and environmental viability of investment-based capital improvement strategies, has led to a shift toward shorter-term demand management policy. That is including alternate work schedules, telecommuting, and congestion pricing. The complex nature of responses to such demand organization strategies can only be anticipated through incorporating realistic behavioral decisions in demand modeling. Second, as there are substantial shift in household structures and individual and family circle socio demographics, (for example, more single-parent households, more single-individual households, aging of the population, etc.), the activity and travel needs of the outlook will be very much diverse. Forecasting these activity-travel needs for transportation planning purposes can be achieved only through incorporating realistic representations of behavior. Behavioral representation also provides a clear picture of the functioning of urban areas (for example, the spatial characteristics of intra-urban labor markets) and has the potential to identify or resolve the differential quality of transportation services associated with different segments of the population.

A. Travel Demand Modelling And Forecasting

The main focus of the study is to build up a long-term transportation strategy for Nasik with the help of an urban transport planning model. The process of replicating the “real world” transportation classification and forecasting the state of the system for the possibility year is generally referred to as Transport Demand Modeling. Often this is done by the use of highly developed position of the art computer packages such as CUBE, EMME2, TRANSCAD, TRANPLAN etc. built overtly for such purposes.

The data that would affect the travel patterns are changes in the transportation system (e.g., new roads, wider roads, Metro etc); changes in the earth use (e.g., more residential development, more employment, SEZ etc.); and changing demographics (satellite towns, increasing per capita income, right to use to confident motor vehicle modes, etc.). The base network is developed in GIS using current roadway inventory data. Socio-economic data such as family circle size, sports car availability, employment data and other census data are also utilize.

B. Urban Mobility Strategies

The mobility goals for Nasik need to be addressed from side to side a multipronged approach. Solutions for complex transport improvements cannot be achieved by a single strategy. The next strategy need to be adopted in tandem to meet the various goals set for Nasik.

- 1) Land Use and Transport Strategy
- 2) Development of Mobility Corridors
- 3) Public Transit Improvement Strategy
- 4) Non-Motorized Transport Strategy
- 5) Freight Management Strategy
- 6) Traffic Engineering Measures
- 7) Travel Demand Management Strategy
- 8) Technological Strategy

It is important to note that each of the above strategies is equally important and the order of listing does not imply precedence. Each of the broad strategy includes sub strategies of immense importance. The strategies when implemented through specific projects shall fulfill the goals and objectives of this CTPP. The sections below discuss these strategies.

II. LITERATURE REVIEW

- 1) *Todor Stojanovski*: The lack of mobility choices in many Swedish neighborhoods and cities designed for automobiles hinders the possibilities to shift towards more sustainable travel alternatives. Urban designers and planners can help with redesigning these neighborhoods and creating built-up forms that encourage walking, cycling and increased use of public carrying if they are informed about the environmental routine and carbon implications of moving systems in existing and newly planned neighborhood. This paper proposes a mobility choices model based on urban form and accessibility factors commonly used in urban planning and design practices. The mobility choices model produces heat maps and visually informs about the integration with walking, cycling, public transportation and private car, modal shares, carbon emissions and transportation energy use. This in sequence can (potentially) trigger urban transformation or redesign to better integrate sustainable travel alternatives in these neighborhoods and contribute to more sustainable cities. Many houses can have an excellent environmental performance as buildings but they can be located at a distance where it is impossible to walk, cycle or use public transportation. The benefits of energy efficient and carbon neutral home then disappear with extensive travel and commuting by automobile.
- 2) *Johannes Schieleina and Jan Börnera*: After forest governance reforms by the Brazilian government, Amazon deforestation rates dropped by almost 80% between 2004 and 2012. Since then, however, deforestation has slowly increased again, casting doubts on the long-term sustainability of past conservation policy achievements. Clearly, deforestation rates and the associated local drivers of land-use and land-cover change differ considerably across the region, and adapting public policies to dynamic local context and actor constellations remains a major challenge for decision-makers. This paper seek to contribute to the related science-policy debate by applying frontier theory insights to map, quantify, and compare land-cover dynamics in the Brazilian Amazon between 2004 and 2015. Our theoretical framework performs well in explaining broad variations in scope, nature, and agents of land-use and land-cover change across different frontier regions. We observe two types of transformative processes at deforestation frontiers in the Amazonian context. First, recent frontier expansion is characterize by an intensification of cattle ranching, and an increasing share of agricultural activities in the production portfolio, which could be the result of better access to modern technologies and markets, combined with forest governance induced scarcity of land for expansion of historically dominant extensive paddock systems. Second, the share of medium and large-scale deforestation

declines at first, but rebounds through the surveillance period in all frontier types after 2012. Further research is needed to better comprehend the role of the altering political environment in driving these medium as well as short-term transformations in land-use and land-cover change. Furthermore, policy-makers, worldwide cooperation, and civil society must seek strong integration between value chain based governance measures and effective environmental law enforcement.

- 3) *S Niranjana, Mahesh Kumar Chenna, Amit Bhandari & Supraja K:* This document has been prepared for the "Comprehensive Traffic and Transportation Plan for Nasik" and should not be relied upon or used for any other project without an independent check being carried out as to its suitability and prior written authority of UMTC being obtained. UMTC accepts no responsibility or liability for the consequence of this document being used for a purpose other than the purposes for which it was commissioned. Any person using or relying on the document for such other purpose agrees, and will by such use or reliance be taken to confirm his agreement to indemnify UMTC for all loss or damage resulting there from. UMTC accepts no responsibility or liability for this document to any party other than the person by whom it was commissioned.
- 4) *Syed Fazal Abbas Baqueri, Won Do Leeb, Luk Knapena, Tom Bellemansa, Davy Janssens, Ansar-Ul-Haque Yasara, Geert Wetsa:* A multitude of studies have been motivated on the organization between land use, urban settings and transport infrastructure to assist policy makers in sustainable planning. Alike, incorporation of cross-border trips have been an integral part of transportation demand models through external surveys. The present study seeks to explore the Incoming Cross Border Traffic (ICBT) into a study area based on the characteristics of a study area that attracts cross-border trips from outer surface region. This paper presents an examination of cross-border trips in Karachi Metropolis, largest city of Pakistan, through Household Individual Survey (HIS-2010) and land use data from open resources. Results reveal that land use particulars, socioeconomic characteristics and travel attribute of individuals significantly influence cross-border trips and this effect varies spatially. Work, shopping and Education trips are discussed through separate models in this paper with a number of practical insights to policy makers for sustainable development of city. This study contributes in elucidating travel behaviour through land use parameters and also persuades professionals to integrate estimation of cross-border trips by socioeconomic parameter, in bring forecasting models.
- 5) *Konstadinos G. Goulias:* Planning for transportation requires analysis, modeling, and simulation of the use and performance of transportation systems. The ultimate objective is to design efficient infrastructure and services to meet our needs for accessibility and mobility, but also to implement policies improving sustainability. At the center of this design are analytical methods requiring understanding of human actions. Understanding human behavior requires us to collect data, and analyze and develop synthetic models of human agency in its most important dimensions and most simple constituent parts. This includes but is not limited to understanding individual development along life-cycle paths and the complex interface between an individual and the anthropogenic, accepted, indocile environments. Travel behavior analysis aims to understand how traveler values, norms, attitudes, and constraints lead to observed behavior. Traveler values and attitudes refer to motivational, cognitive, situational, and dispositional factors that determine human behavior.

III. STUDY AREA PROFILE

Vehicle is the main component of the transport system. Vehicle is used for ease and for time reduction purpose. Therefore vehicle are increasing day by day in number become use of communication social purpose also. Our Nasik city in Maharashtra is fastly growing city among the country as well as planet and it is declared as metrocity earlier than some years. The present situations ban the BS-3 engines greater than before sudden traffic. And like kumbhmela sudden increase in traffic in kumbhmela period. So need the supervision of traffic and underneath the safe driving and to solve the problem of traffic.

In the Nasik in Maharashtra state different types of vehicle's like four wheeler's, three wheeler's, two wheeler's, cycle's, etc. Nasik has grown city from a population of 1077236 in 2001 to 15 lakh's in 2011. The current population is approximately 1.48 million Nasik city enlarge rate are most as measure up to to other so that population effect are traffic so daily transfer are increases.

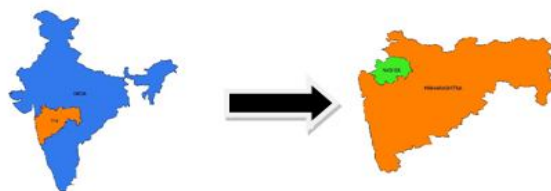


Figure 1. Study Area

A. Demographic Characteristics

As per the 2011 census, the total population of the entire area of Nashik Municipal Corporation, was 14,86,053 souls as against the 2001 census population of 10,77,236 souls, indicating the growth rate of 37.95% during 2001-2011 decade. Similarly, population for 1991 was 7,33,000 souls indicating decadal growth of 46.96%. Following Table shows decadal population growth.

Table 3.1: Population Growth of Nashik City from 1921.

YEAR	TOTAL POPULATION	ABSOLUTE GROWTH	GROWTH IN PERCENTAGE
1921	38230	8132	27.02
1931	45744	7514	19.65
1941	52386	16642	14.52
1951	97042	44656	85.24
1961	131103	34061	35.10
1971	176091	44988	34.32
1981	262428	86337	49.03
1991	733000	394497	50.33
2001	1077236	420311	63.98
2011	1486053	689233	69.74

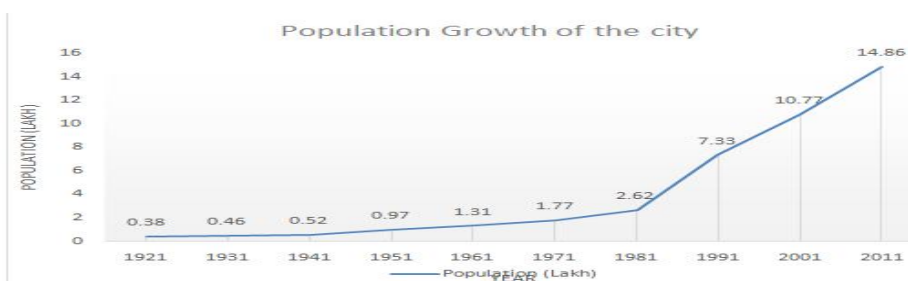


Figure 2. Population Growth

Table 3.2: Growth of Area Boundary of Nashik City over the Years.

YEAR	AREA (SQ.KM)	TOTAL POPULATION
1881	13	8132
1931	20	45744
1951	47	97042
1981	147	262428
2011	259	1486053
2001	250	1077236

IV. DATA COLLECTION

In travel behavior research, we find at least five different data collection approaches. The first and most popular is a natural evolution of the household-based questionnaire and diary of activities and trips in a day. Data from this source have been used to estimate many revealed preference discrete-choice models and the majority of activity-based models. This scheme with its meeting point on travel became the national average for keep an eye on changes of actions with a repeated cross-sectional approach up to date travel-behavior surveys are also being designed to be additional interactive with respondents, by request scheduling details via the internet and applying geospatial technologies in order to build complex dynamic interview. A very imperative expansion is the coming out of smart phones to record richer data. The second is the panel survey, designed to improve our thoughtful of changes in behavior. The third asks hypothetical questions of respondents by varying attributes of choices to study options that we cannot execute in real life. The fourth is real-life interactive experimentation. In an interactive experiment, the aim is to modify behavior by as long as comment to participants about their past behavior. A fifth data collection approach is based on qualitative research methods and can be used for any behavioral issue. Online sources such as social media are also used to obtain data on travel satisfaction, tabloid activities, traditional origin-destination patterns, and place specific sentiments

A. Inventory Data

Table 4.1: Population Growth from 2001 to 2011 at Zonal level

SR NO.	ZONE	AREA(SQ.KM)	POPULATION		DENSITY POP.P.SQ.KM
			2001	2011	
1	NASIK WEST	9.3	1,23,481	1,83,813	19765
2	SATPUR	37	1,68,800	2,32,619	6287
3	NASIK EAST	14.6	1,65,423	2,37,660	16278
4	PANCHAVATI	108.7	2,14,256	2,87,432	2644
5	NASIK ROAD	32.7	1,90,326	2,42,922	7429
6	CIDCO	56.8	2,14,950	3,01,607	5310

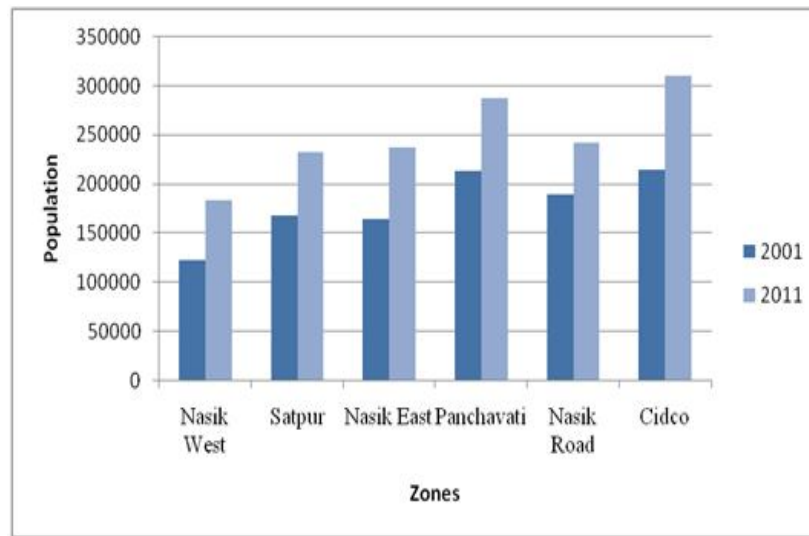


Figure 3. Population Growth from 2001 to 2011 at Zonal level

V. DATA ANALYSIS

Since then, due to population detonation and rapid urbanization growth rate, land use of Nasik city has undergone drastic change. While the change is land use has affected overall people movement throughout the city. To decide future land use by access impact of land use change on trip attraction for the study area, existing land use and trip hold behaviour is to be analyzed in detail.

A. Household Characteristics

The household structure such as number of working members, number of school /college going members plays a very important role in the trip making behaviour of the individual household. In the study area it is observed that the average family size is between 4 to7. Table 5.1 shows the range of family size, average working members and average school going members per household.

Table 5.1: Zone wise Household Structure

ZONE	AVG HH SIZE	AVG WORKING MEMBERS/HH	AVG SCHOOL/COLLEGE GOING MEMBERS/HH
NASIK WEST	4.30	2.64	0.52
SATPUR	4.45	1.91	1.58
NASIK EAST	5.70	2.27	2.48
PANCHAVATI	5.39	3.06	1.30
NASIK ROAD	5.58	1.94	3.09
CIDCO	4.88	2.12	1.55

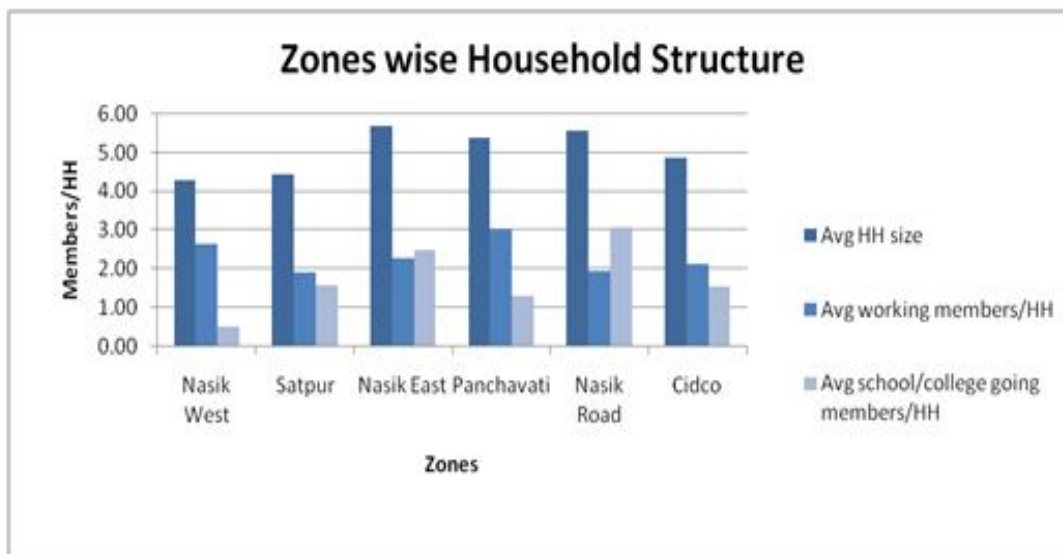


Figure 4. Zone wise Household Structure

VI. VEHICLE OWNERSHIP PATTERN

The data collected for vehicular ownership/HH at zonal level is analyzed and presented in Table no.- 5.2. It is observed that the range of 2 wheeler ownership lies between 1.58 in North zone to 2.35 in West zone. While 4 wheeler ownership is also high in West zone i.e 0.77. The city level scenario depicts.

Table 5.2: Zone wise vehicular ownership/HH

ZONE	CAR/HH	WHEELER/HH	BICYCLE/HH
NASIK WEST		2.36	0.96
SATPUR		2.18	0.64
NASIK EAST		2.39	0.82
PANCHAVATI		2.55	0.67
NASIK ROAD		2.33	0.52
CIDCO		2.48	0.88

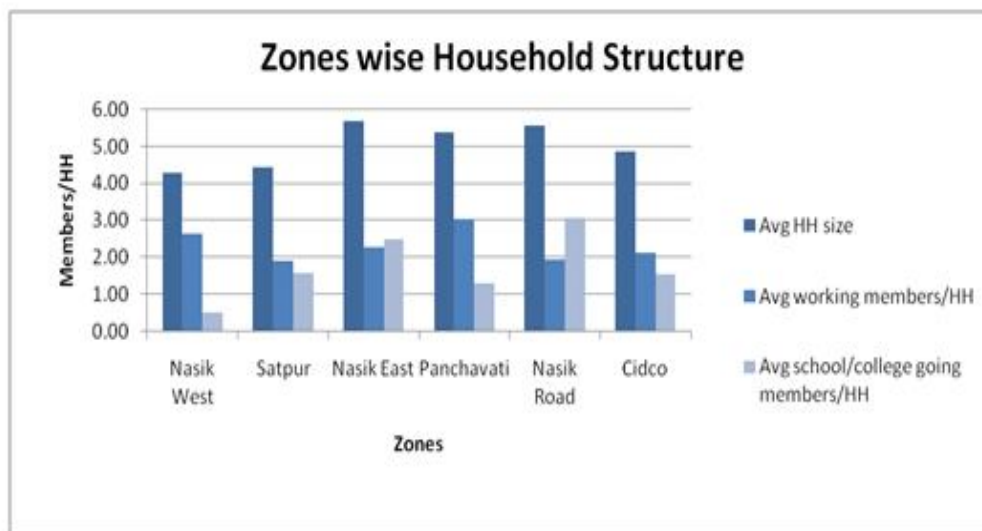


Figure 5. Zone wise Household Structure

VII. PURPOSE WISE TRIP GENERATION

In the study area it is observed that trip generation generally takes place for the purpose like work, study, shopping, recreation and social. From the examination it is observed that most daily trips takes place for the work and study purpose. The Table No 5.3 below shows the purpose wise trip/ capita at zonal level.

Table 5.3: Purpose wise trip/capita/day at zonal level

ZONE CAR/HH	WORK TRIP	SCHOOL/COLLEGE TRIP	SHOPPING TRIP	RECREATION TRIP	SOCIAL TRIP	TOTAL NO OF TRIP
NASIK WEST	2.52	1.91	2.79	1.06	1.33	9.61
SATPUR	2.70	2.12	2.76	1.21	1.42	10.21
NASIK EAST	2.27	2.30	2.36	2.03	1.70	10.67
PANCHAVATI	2.70	1.94	2.73	1.36	1.88	10.61
NASIK ROAD	2.36	2.12	2.42	1.64	1.58	10.12
CIDCO	2.64	2.36	2.15	1.55	2.15	10.85

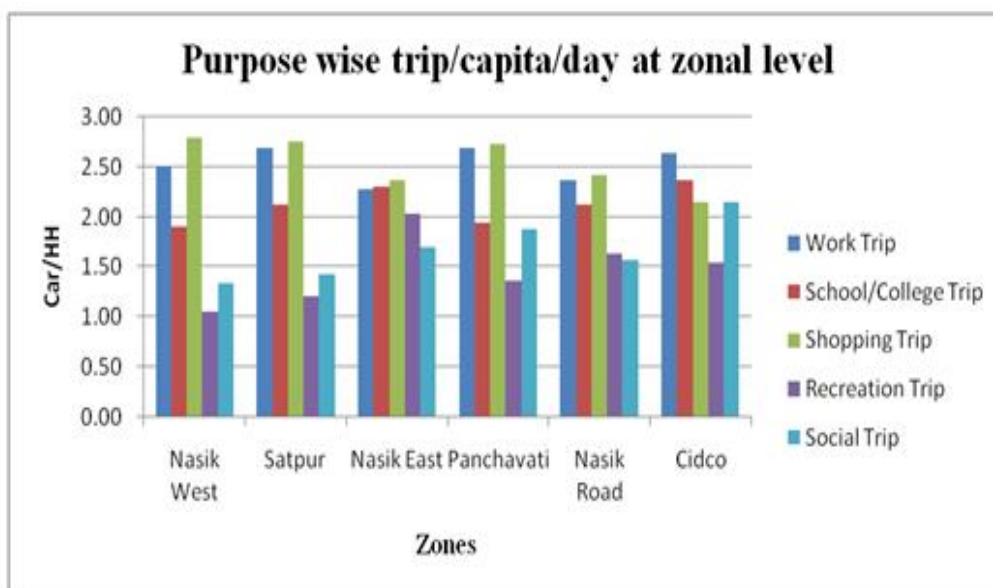


Figure 6. Purpose wise trip/capita/day at zonal level

VIII. TOTAL TRIPS/HH/DAY AT ZONAL LEVEL

The Table No 5.3 shows the total number of trips occurring per household at zonal level. It is found that maximum number of trips/HH counting all purpose is very high in Cidco zone i.e. 10.85 trip/HH and low in Nasik West i.e. 9.61 trips/HH. The graph 5-5 represents the range of trips/HH; it lies between 5.6 to 8.6.

Table 5.4: Total Trips/HH/Day at Zonal level

ZONES	TOTAL NO OF TRIP	AVG HH SIZE
NASIK WEST	9.61	4.30
SATPUR	10.21	4.45
NASIK EAST	10.67	5.70
PANCHAVATI	10.61	5.39
NASIK ROAD	10.12	5.58
CIDCO	10.85	4.88

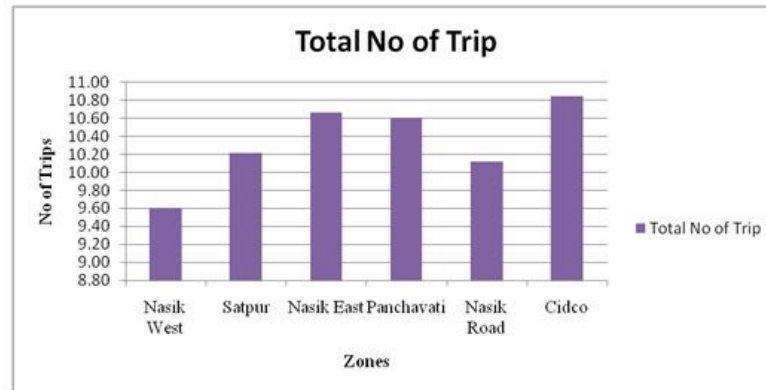


Figure 7. Total Trips/HH/Day at Zonal level

IX. CONCLUSIONS

The present study is passed out to estimate land use for partly developed or undeveloped area based on trip attraction examination for the learning area of Nasik City. The study comprise two major analysis, i) Land use analysis and ii) Trip attraction analysis. Based on this two analysis various trip hold models are residential. The whole study is summarized in the following major heads, a) Household Characteristics, b) Vehicular Ownership Pattern, c) Purpose of Trip generation and Total Trip at Zonal level concluded here after

- A. The household structure such as number of working members, number of school /college going members plays a very important role in the trip production behaviour of the human being household. In the study area it is observed that the average family size is between 4 to7. Table 5.1 shows the range of family size, average working members and average school going members per household.
- B. The data together for vehicular ownership/HH at zonal level is analyzed and presented in Table no.- 5.2. It is observed that the series of 2 wheeler ownership lies between 1.58 in North zone to 2.35 in West zone. While 4 wheeler ownership is also high in West zone i.e 0.77. The city level scenario depicts.
- C. In the study area it is observed that trip generation generally takes place for the purpose like work, study, shopping, recreation and social. From the analysis it is experimental that maximum daily trips takes place for the work and study purpose. The Table No 5.3 below shows the purpose wise trip/ capita at zonal level.
- D. The Table No 5.3 shows the total number of trips occurring per household at zonal level. It is found that maximum number of trips/HH including all purpose is very high in Cidco zone i.e. 10.85 trip/HH and low in Nasik West i.e. 9.61 trips/HH. The graph 5-5 represents the range of trips/HH; it lies between 5.6 to 8.6.

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