EFFECT OF LAND USE ON TRAVEL BEHAVIOR – CASE OF SOUTHWEST ZONE OF SURAT CITY

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Abstract*: The transportation planning and management is an important factor in town planning scheme and in development plan. To relate the various socio-economic variables with travel demand using linear regression modelling technique is the main objective of study. Second objective is to develop Trip distribution gravity model to understand the importance of attraction of different area. Technique will help to forecast future travel demand for different purpose trip and will guide for proposal of Mass Transit System and also in management of existing Mass Transit System by route identification. The study shows the shift of attraction as time elapsed from area at a far distance to CBD to area with high population near CBD.*

Keywords: Effect of landuse, Travel behavior, Trip generation, Trip distribution.

I. INTRODUCTION

The interaction between landuse and travel behavior is important for transportation planning point of view, as change in landuse also change in travel behavior and travel demand. Travel demand is a need of participants of different activities to reach at desired locations.

Higher economy increased the growth of vehicles and particularly ownership of personalized vehicles. The change in travel behavior leads to change in total number of trips, trip length, expenditure behind trips etc. It is very important as transportation planning point of view to envisage the future travel demand and related statics. The travel pattern of any study area depends upon the family size, family income, ownership of vehicles, and kind of landuse.

Landuse mix is a factor which affect intra urban travel and also considered as contradictory parameter to traditional physical transportation planning. As population growth increase the related socio – economic activities also increase and result in high travel demand. The travel demand of an urban area is influence by the various attributes of the area grouped under main two heads (1) Urban area characteristics (2) Urban population characteristics. Urban area characteristics include land area urban form, floor area ratio, edge of area, transportation network, land use pattern, employment density and economic based of the city. Urban population characteristics includes socio-economic attributes like total population, family size, Age structure of family, family income, vehicular ownership, and population density.

It can be challenging task for any urban planner to have transportation planning in absence of household characteristics. It is not possible to cover whole population within time limit, so suitable sampling technique is required to select. This study is carried out to understand travel behavior analysis of southwest zone of Surat city.

Surat is fastest growing and second largest city of state of Gujarat has been selected as the study area for carrying out metropolitan travel behavior analysis so as to reflect travel behavior in Indian metropolitan context. For easiness of work Southwest zone is divided into 22 wards. Each ward is separated on the population base. Travel behavior analysis is done by collecting two types of data i.e. inventory survey and home interview survey. A mathematical model is generated to analysis current travel behavior Southwest zone of Surat city using TransCad 4.5 software.

Trip generation model and trip intensity model is developed with considering the family size, family income, school going member, working member, and no. of vehicle which are having the major influence on trip generation.

This study reflects that the sample survey technique with statistics base will help the urban planner to represent the sample data as overall zone characteristics. The trip is highly depends on family size, family income, no. of working member, no. of school going member, and no. of vehicle per house hold factors. The landuse only play vital role in generation trip and trip length. The town planning scheme with all infrastructure facility will act as self-independent area which recreation trip, education trip and other purpose trip. This Aim of study will help in planning the sustainable landuse and transportation planning.

II. Methodology

The study for the travel demand analysis and forecasting for Southwest zone Surat city is carried out on the basis of the present aggregate behavior of the zonal parameters. The field surveys are carried out on the ward basis to capture the travel pattern attributes in the background of the inventory of the ward physical and demographic characteristic. The mapping of relationship between travel stimulants and trip rates has been tried through appropriate regression analysis. The concept of relative attraction potential in the form of gravity model is applied to model the ward level trip interchange demand.

III. Study area profile

South west zone is situated along south end of river Tapi on western bank. Southwest zone has shore line on west side, and connected with CBD area i.e. central zone on eastern site. There is a one another zone on southeast side of zone known as Udhna zone. The zone comprises of mix landuse in which majority of area comprises to residential, commercial and educational. The remaining area comprises to administrative blocks, transportation links, open spaces etc. The educational land share in this zone is higher than the other zone, as zone comprises to famous Veer Narmad South Gujarat University (VNSGU), Sardar Vallabhbhai National Institute (SVNIT), Sarvajanik college of engineering and technology, Civil Hospital and medical college and many more other colleges.
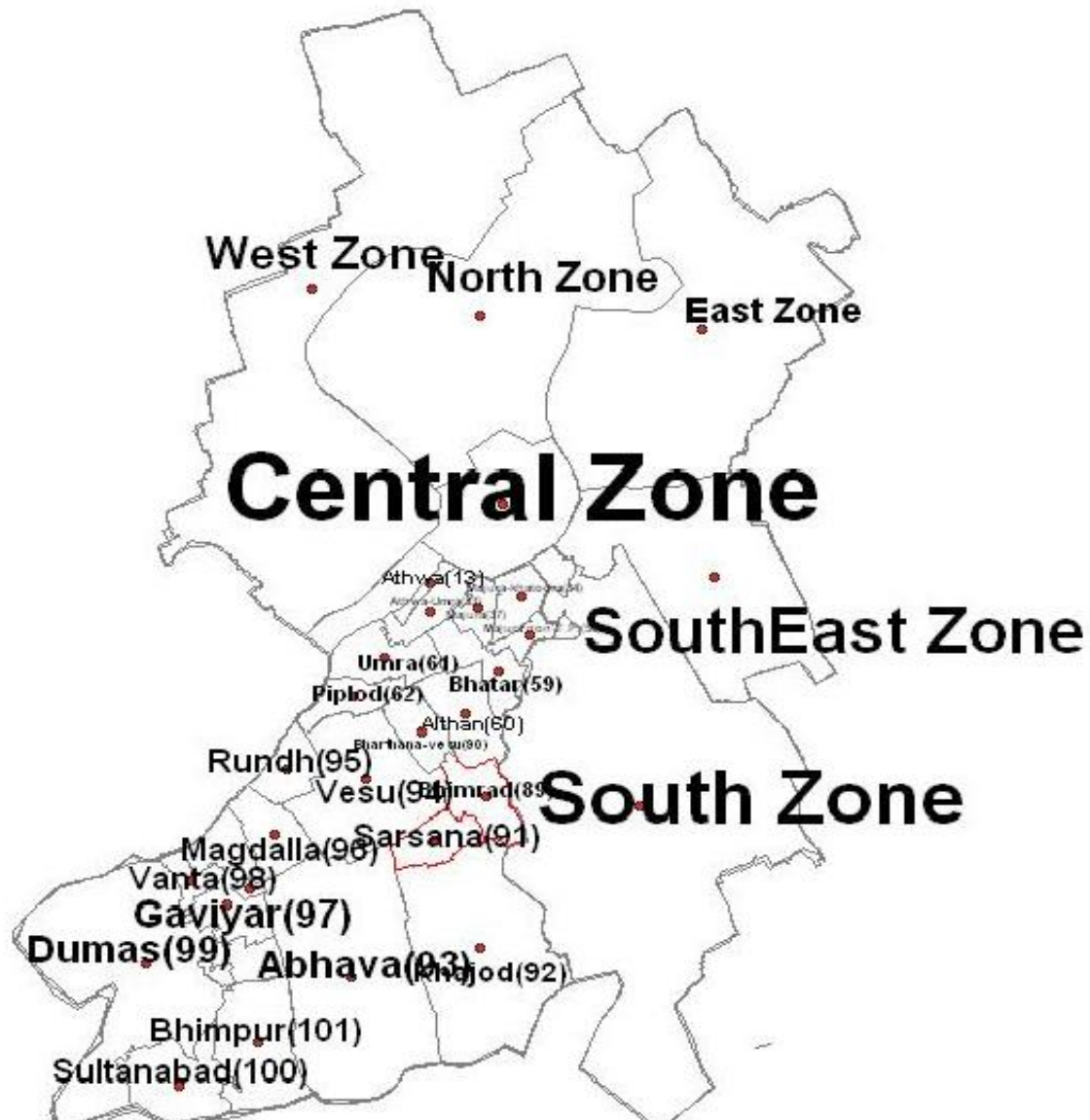
IV.DATA COLLECTION

Home Interview Survey (HIS) method survey is one of the most reliable types of surveys for collection of socio-economic and travel data. The information on a travel pattern like number of trips made, purpose of trip, travel mode, and information on house hold characteristics like type of dwelling units, number of residents, age, sex, vehicle ownership, number of drivers, family income is collected in the HIS. These data is useful to relate the amount of travel to various socio-economic attributes of household and zonal characteristics and develop trip rate equations and classified matrices for the trip generation rates.

PART A: Household Characteristics:-

In this part, address of household, form of dwelling unit, number of residents, occupation of working members, numbers of school and college going members, number of vehicles owned by the family, activities of family members are collected.

PART B: Travel Particulars

Travel related data like Purpose wise and Mode wise trips data. Purpose wise trips like work, school, shopping, social, recreation and other purposes is collected as because this study is collected as limited to first stage of sequential travel demand modelling. Mode wise trips like 2W, 3W, 4W, bus, cycle and pedestrian.

V. SAMPLE SIZE CALCULATION

$$n = \frac{z^2.N.\sigma^2}{(N-1)e^2 + z^2.\sigma^2}$$

Where, n = Number of samples,

Z= 1.96

N = size of population = 95259 (for year 2015)

e = acceptable error = 10% of mean value = 374.62

σ = Standard deviation = 4201.17

By putting the above value in equation,

n = 480.

Again the number of samples distributed among the wards as per their contribution in total household numbers.

VI. REGRESSION BASED TRIP GENERATION MODEL

Trip generation model developed using regression method. The input variable of family size, family income, vehicle ownership, working member, school going member, were consider to predict output of trip generation. Total 480 dataset is used to developed model.

TGm = 0.564883 + 0.130446Fs - 2.17732e-006Fi + 1.31749Wm + 1.59347Sm - 0.242210Tve…. **(R Squared = 0.7701)**
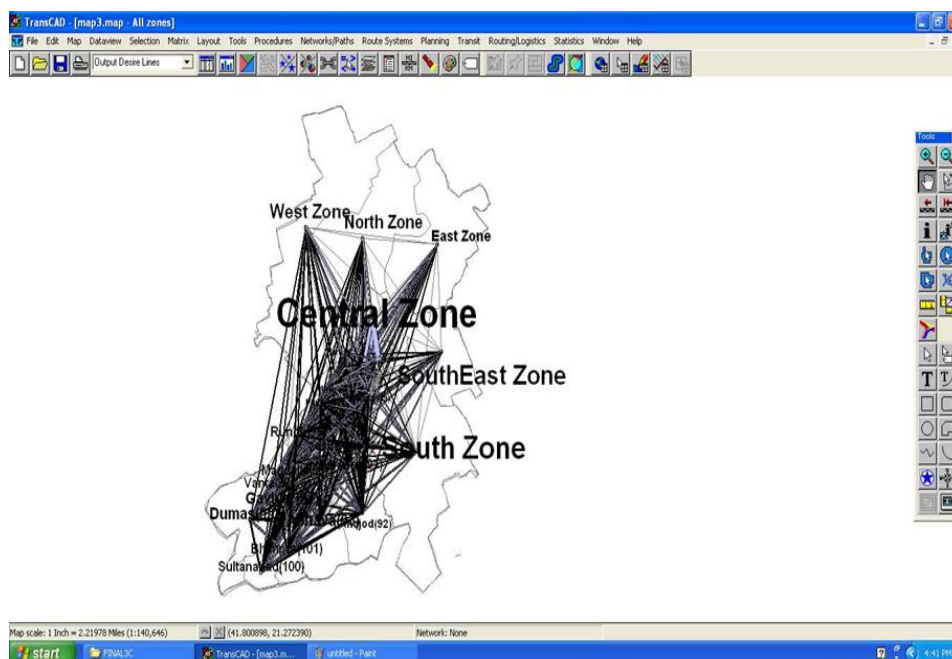
Where

Fs = Family size

Fi = Family income

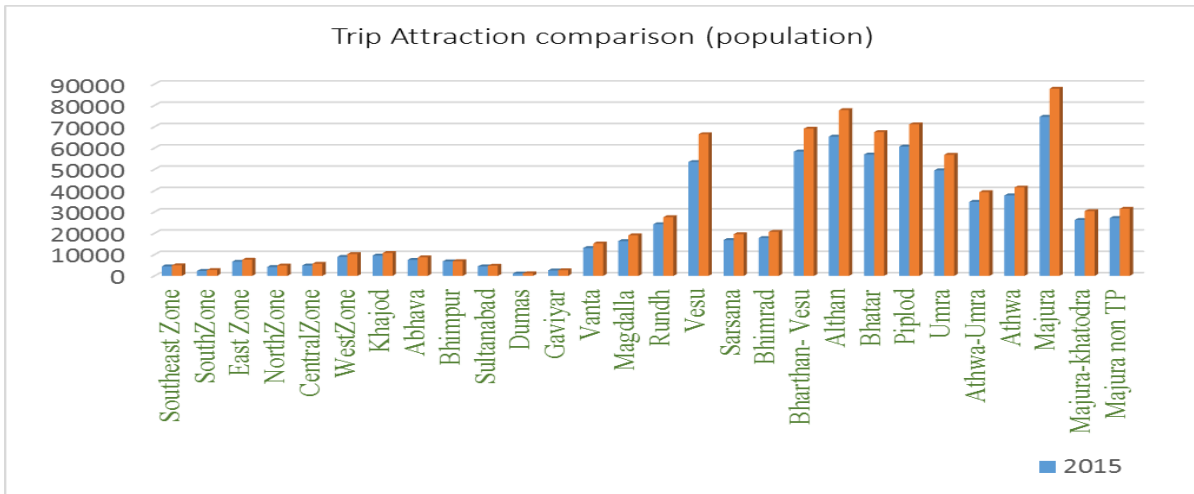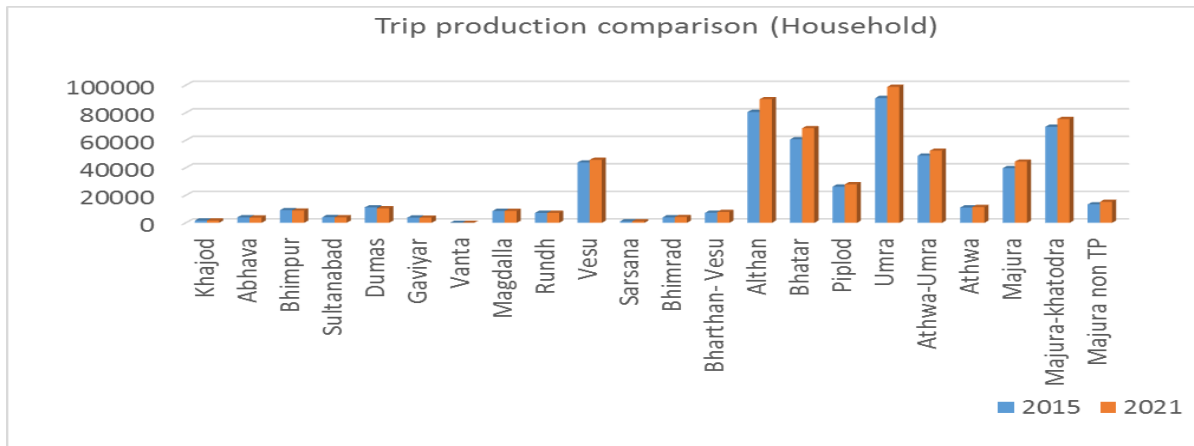Wm = Working member

Sm =School going member

Tve = Total no. of vehicle

VII. TRIP DISTRIBUTION GRAVITY MODEL

Trip production comparison (Household)

Trip Attraction comparison (population)

To calculate total trip production from the zone can be worked out on two basis. In the first base the average Total Trip/HH/day of ward is multiplied with total number of household of the ward. Which will provide Total Trip/day from the ward. The summation from the result of all the ward provide the Total Trip/day of whole Zone. In second approach average Total Trip/capita/day of ward is multiplied with total number of population of the ward. Which will provide Total Trip/day from the ward. The summation from the result of all the ward provide the Total Trip/day of whole Zone.

Trip Attraction comparison (population)

Trip Attraction comparison(Household)
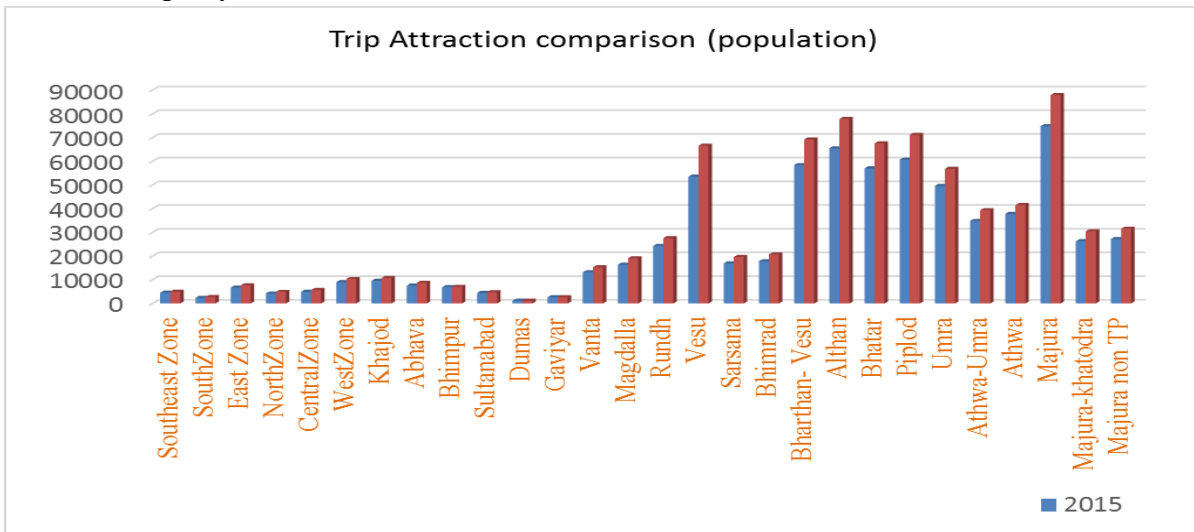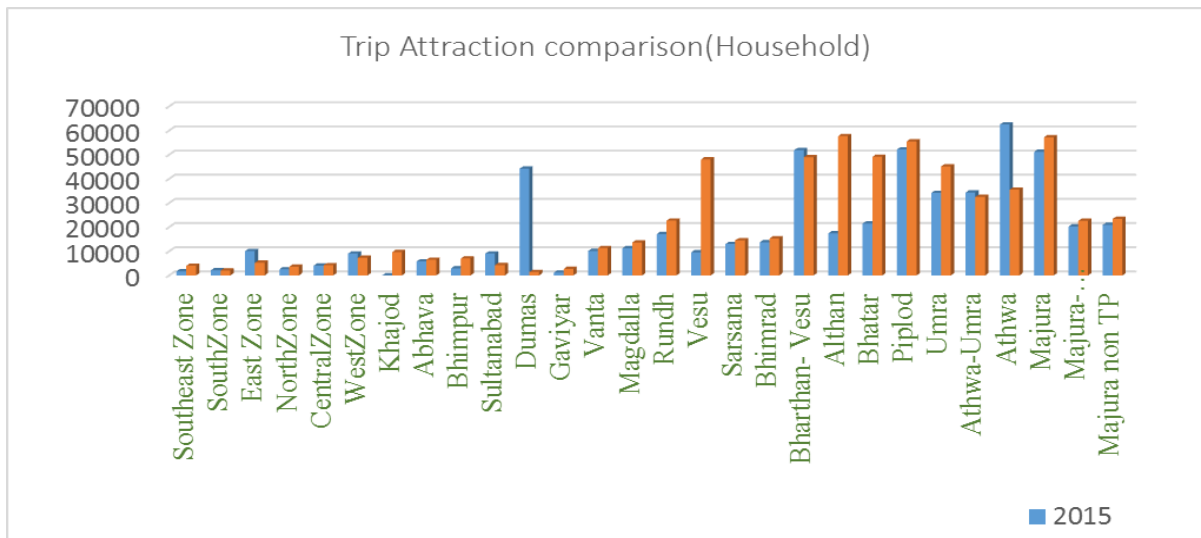
CONCLUDING RAMARKS

- Maximum population concentration observed in Majura – Katodara, Athwa- Umra, Umra, Althan and Bhatar wards.

- Majura Khatodara and Bhatar has highest density while khajod and Abhava has lowest density.

- The purpose of trip generation is highest for work and study while less for all other purpose.

- Maximum use of two wheeler observed for any kind of trip, which shows the lack of public transport facilities in terms of number, timings and routes.

- In linear regression model of trip generation, number of school going member and number of working member shows the significant impact in the model , while the constant for family income appear with less impact at all other variables are in the range of 1 to 10 and value of incomes are in thousand and lacks.

- The value of R^2 (0.7701) shows the strong association between parameters responsible for trip generation.

- The trip attraction towards central zone is observed as highest and almost measure kind of economic activities carried out in central zone. As the distance from central zone increase the attraction towards central zone decrease.

- The highest value of total trip/day from ward level by both the approach i.e. by considering household and by considering population of ward, is observed in Umra zone.

- In current situation contract city bus services operated from two terminus from station and chowk , both are located in central zone.

- If the city development is in radial pattern then it would be suggestive to have at least one bus terminus from each zone, and which is located in the ward from where highest trip is generated.

- From Umra and Majura – Katodara no suitable site found for bus terminus as both the wards having highest value of trip production for the year 2021.

- In Althan ward having third highest trip production for year 2021 provide suitable sit for bus terminus with accessibility of 90m wide road as well connectivity with all other wards and zones also.
- Total trip attraction/day shows the shifting of attraction towards the wards of higher population concentration and near to central zone.

FUTURE SCOPE OF WORK

- The same approach can be adopted to understand the travel behavior of different zones of city.
- The mass transportation proposal can be work out at city level by considering behavioral analysis of travel of different zones of city.
- In this thesis the friction factor matrix worked out by using trip length of sample survey from ward to ward and ward to other zone. The same can be work out by considering travel cost or travel time as impedance matrix

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