A Review on Developing Shopping Trip Generation Model In Residential Area of Ahmedabad City - A Case Study of Gurukul Area

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Abstract **- Safe, economic and timely transportation of passengers and goods/freight is necessary for the development of any nation. Efficient shopping activities are important for the transportation. Due to increased population and shopping malls and retails/wholesale hub, satisfying the need for the fast supply of consumers' products at regional and urban level becomes essential. Special shopping activities are inevitable to develop for the uninterrupted movement of public at regional level. At urban area level it is interesting to know about the movement of people. In the highly dense populated urban area, trips of shopping may be considerable to affect the passenger vehicle trips. How these trips increase with respect to increase in population? Which commodities generate more trips of supply? What is the influence of shop area on these trips? Which are the other factors significant to generate these trips? These are the questions to be answered in the context of today's rapid urbanization, which may be helpful to develop shopping trip generation model on the urban road network. Looking at the above, this study is aimed to study about the shopping trip generation in the urban residential area. Very few researchers have tried to develop the model of trip generation of shopping activities for the urban area in India. In this study highly dense populated residential area of Gurukul of Ahmedabad city is selected. Home interview of house-hold, inventory of shopping area, shopkeepers' personal interview, and other required data are collected. By statistical analysis significant parameters for different types of commodities are determined for the trip generation of shopping activities and different models are developed. For the selected area, average daily trips of shopping are estimated based on total population of the area, total shopping area, average distance from the wholesaler and average daily consumption of the commodities. The results indicate that it is possible to estimate daily shopping trips for the similar type of residential area.**

Keywords **- Transportation planning, shopping activities, Trip generation, urban level**

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1. INTRODUCTION

Urban transportation covers the movement of both people and goods within an urban area. At the individual level, urban transportation can be characterized by a trip. However, at the metropolitan area level, millions of these individual trips define urban transportation (Barber, 1995). A trip is as a journey made by an individual between two different points. Each trip is performed using one or multiple transportation modes for a defined purpose at a given time. Personal trips are commonly classified based on their main purpose (Barber, 1995); work trips, shopping trips, social trips, recreational trips, school trips, home trips and business trips. This paper focuses on shopping trips, and the factors that determine the aggregate number of shopping trips generated in metropolitan areas. A shopping trip can be defined as a trip to any retail center, irrespective of the size and type of the store or shop, and whether a purchase is made or not (Barber, 1995). Thus, going to a retail center, or a store by any means of transportation at any time period of the day is a sufficient condition for an individual to perform a shopping trip.

This report attempts to answer two specific questions. The first one is: What are the factors that affect the total number of personal shopping trips generated in Ahmedabad metropolitan areas? The second one is an extension to the first question: Do the demand for technology-related products, and telecommunication technologies, particularly on-line shopping, have any observable effect on personal shopping trips generated in these areas? The report tries to answer these questions via an empirical model based on cross-sectional data at the metropolitan level.

2. TRIP GENERATION

Trip generation is the first stage of the classical first generation aggregate demand models. The trip generation aims at predicting the total number of trip generated and attracted to each zone of the study area. In the other words this stage answers the questions to "how many trips" originate at each zone, from the data on household and socioeconomic attributes. Trip generation provides the linkage between land use and travel. Figure 1.1 gives an idea about trip generation process which may be separated into two phases. In the first, an understanding and quantification of travel-land use linkage is developed. In the second phase, the results of the quantification are applied to forecasted land use characteristics to develop future travel estimates.

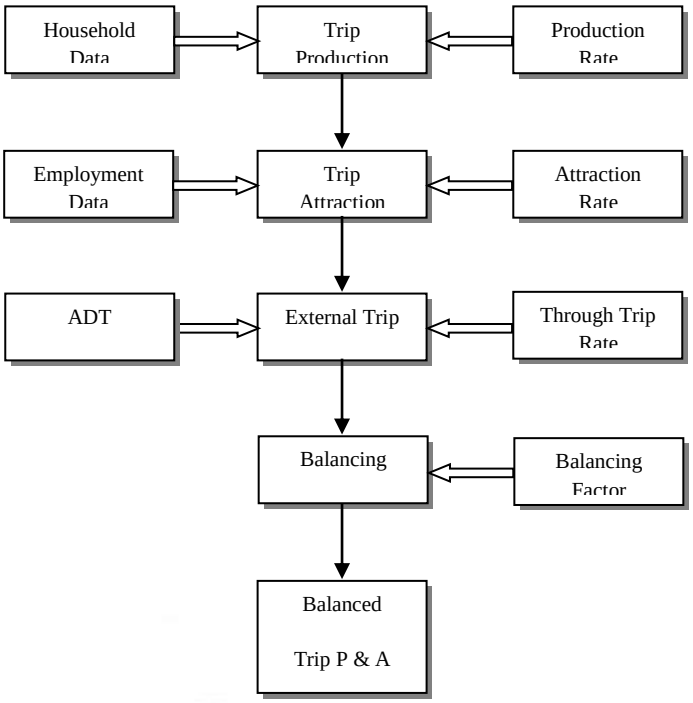


Figure 1.1: Trip generation Process

3. ONLINE SHOPPING ACTIVITIES WITH IMPACT ON LOCAL MARKET

Searching product information and buying goods online are becoming increasingly popular activities, which would seem likely to affect the shopping trips. However, little empirical evidence about the relationships between e-shopping and in-store shopping is available. The aim of this study is to describe how the frequencies of online searching, online buying, and non-daily shopping trips relate to each other, and how they are influenced by such factor as attitudes, behavior, and land use features.

Questionnaires data were collected from 826 respondents residing in four municipalities (one urban, three suburban) in the center of the Ahmedabad. Structural equation modeling was used to examine the variables multiple and complex relationship. The result shows that searching online positively affects the frequency of shopping trips, which in its turn positively influences buying online. An indirect positive effect of time-pressure on online buying was found and indirect negative effect of searching on shopping duration.

Figure 1.2: Online shopping activities

E – Commerce is constantly implementing a larger amount of consumer time and spending. There are several driving aspects for consumers to shop online with reliable price, ease in shopping and wide range of availability of products being the primary. The main judgments of the study are as follows:

a. Turnover and profit margin of the retailers has considerably decreased in the past few years.
b. Retail stores are now-a-days more engaged in service related to customer satisfaction.
c. Although the retailers are not able to keep a wide variety in their stock, they attempt to keep the best of them so as to affect more sales.

d. Customers are seen to make window shopping at an alarming higher rate to have a physical look at the product and buy that product online at a reduced rate.
e. Retail stores are now starting up with home delivery services of their various products at the door step of their customers.
f. The consumers become more comfortable with the experience of purchasing online with the convenience and product range become relatively more important as a deciding factor for shopping online.

4. LITERATURE REVIEW

Plaut (1997) examined that developments in technology and expansion of the market for technologically advanced products stimulate an interest in the relation between telecommunications and transportation. However, none of the above-mentioned studies has tried to include variables related to demand for technologically advanced products or on-line shopping in their models. A vast literature has been developed on the possible effects of such improvements on trip-making patterns, although empirical research remained limited.

Badoe and Steuart (1997) estimate the total number of housing shopping trips by using such variables as household size, number of workers, number of licensed persons, and number of vehicles. Regression is used with 1964 and 1986 data for Greater Toronto Metropolitan area. The different model specifications provide little explanation of the variation in household shopping trips. Household size, which is one of the most common variables in previous studies, is found to have much less explanatory power, compared to previous studies. Badoe and Steuart (1997) conclude that different approaches are needed to explain the variation in non-work trips, including shopping trips.

Jones et. al. (1990) developed a comprehensive definition of activity analysis: it is a 'framework in which travel is analyzed as daily or multi-day patterns of behavior, related to and derived from differences in life styles and activity participation among the population.' The 'emerging features' of an activity analysis are identified (Jones et. Al., 1990) as:

- Treatment of travel as a demand derived from the desires, demand to participate in other, and non-travel activities.
- Focus on sequences or patterns of behavior, not discrete trips.
- Analysis of households as the decision-making units.
- Examination of detailed timing and duration of activities and travel.
- Use of household and person classification schemes based on differences in activity needs commitments and constraints.

Salomon and Koppelman, (1988) derived that trip generation models relate trip generation rates to land-use and household characteristics. More often than not, the focus of research is the number of trips generated and their geographic distribution. The accuracy in trip generation models is particularly important, since subsequent stages of transport modeling are highly dependent on the trip generation output.

Sheppard (1986) studied cross-classification (category) models have been more widely used for long range residential trip generation analysis to overcome some of the inherent problems with regression analysis. Cross-classification models were explored in the late 1960s. Similar to regression- based approaches, cross-classification models relate characteristics of households to demand for travel. Cross- classification models differ in the number and type of individual and household characteristics that are related to travel demand.

5. METHODOLOGY

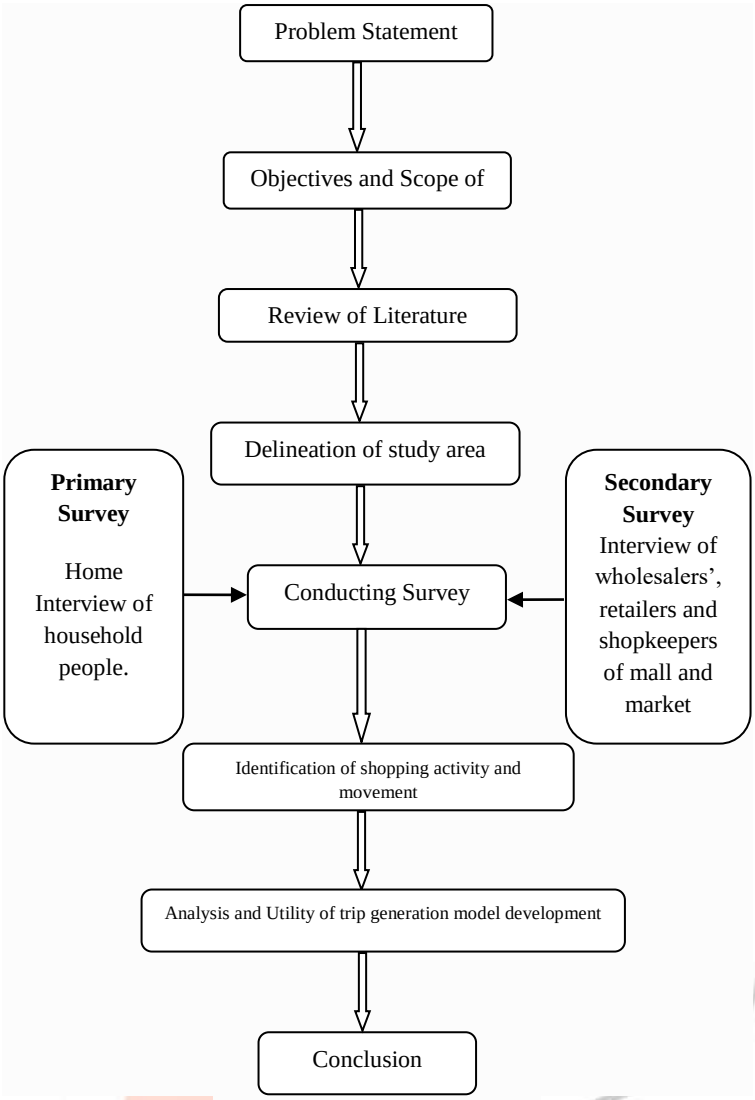


Figure 1.3: Methology Chart

5.1 Cross-classification Model

The cross-classification model, sometimes referred to as category analysis model, is based on the assumptions that the number of trips generated by similar households or households belonging to the same category is the same. According to this model if in Zone i there are n_k^i there are households in category K and g_k is the average rate of trip generation per household in category k then the relation of trips generated (or produced) by Zone i, Ti is given by:

$$T_i = \sum_{\forall k} n_k^i g_k \quad \text{…….. (1)}$$

5.2 Regression Model

Early trip generation models were commonly developed by regression analysis because of its power and simplicity. The independent variables in such models were usually zonal averages of the various factors of influence. Trip generation equations developed by regression are still used by some planning agencies, more commonly for attraction models than the production models.

Linear regression equation evaluate the number of generated trips that attract research area (dependent variable) from independent variables,

$$Y = a + b_1 x_1 + b_2 x_2 + \ldots\ldots + b_n x_n \ldots\ldots \quad (2)$$

Where,

Y = the dependent variable (trips/household),

x_1, x_2 = independent variables (population, number of apartments),

b_1, b_2 = regression coefficients that shows to what extent Y changes, if x_n variable increases.

5.3 Growth factor modeling

Growth factor modes try to predict the number of trips produced or attracted by a house hold or zone as a linear function of explanatory variables. The models have the following basic equation:

The growth factor f_i depends on the explanatory variable such as population (P) of the zone, average house hold income (I), average vehicle ownership (V). The simplest form of f_i is represented as follows:

$$f_i = \frac{P_i^d \times I_i^d \times V_i^d}{P_i^c \times I_i^c \times V_i^c} \quad \text{..... (3)}$$

Where,
Subscript'd' = the design year,
Subscript 'c' = the current year.

6. STUDY AREA

Gurukul area - Coordinates: 23° 3' 5" N, 72° 32' 6" E**.**
Gurukul is in the new west zone of Ahmedabad. Majority of the residential development in Ahmedabad is concentrated in West Ahmedabad. In this area many shops and shopping complexes are established. Many different areas developing very rapidly in present and it will also develop in future. Public transport facilities and delivery vans are the main media through which shopping activity done by road. Location of Ahmedabad and Gurukul are shown in figures 1.6 and figure 1.7. Commodity wise shops locations in the study area are shown in figure 1.8. Figure 1.9 shows the different road stretches used for traffic volume count in the study area.

Figure 1.4: India map

Figure 1.5: Gujarat map

Figure 1.6: Ahmedabad map

Figure 1.7: Gurukul area map

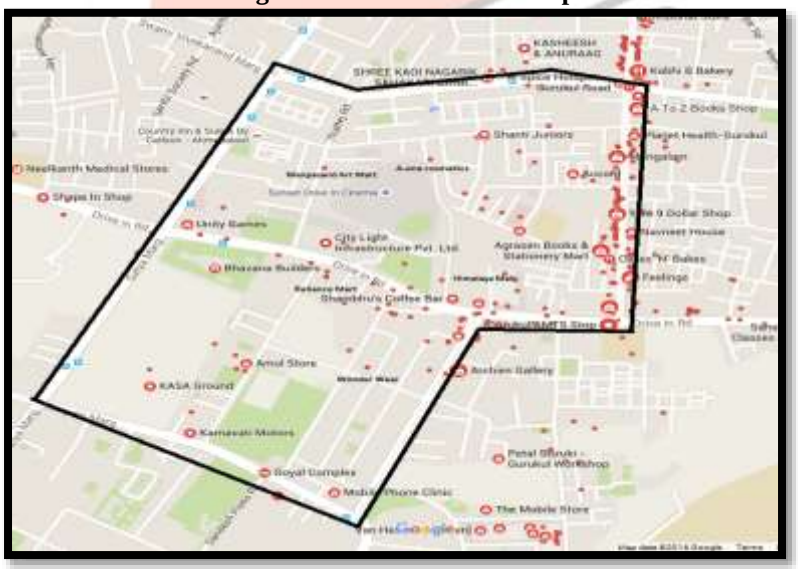


Figure 1.8: Location of shops

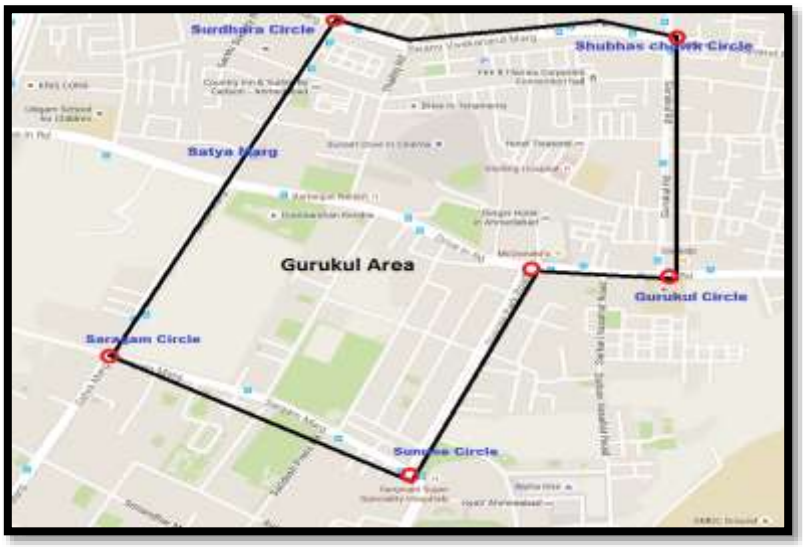


Figure 1.9: Study area map with different road stretches

7. DATA COLLECTION

Interview survey had taken at five locations of road stretches divided into study area. The process consist collection of origin and destination data. The survey is essentially intended to yield data on the travel pattern of the residents of the household and the general characteristics of the household influencing trip making. The information on the travel pattern includes number of trips made, their origin and destination, purpose of trip, travel mode, time of departure from origin and time of arrival at destination and so on. The information on household characteristics includes type of dwelling unit, number of residents, age, sex, race, vehicle ownership, number of drivers, family income and so on. Based on these data it is possible to relate the amount of travel to household and zonal characteristics and develop equations for trip generation rates.

The sections are described below:

Road Stretch A: Gurukul circle to Subhash Chock circle
Road Stretch B: Subhash Chock Circle to Surdhara Circle
Road Stretch C: Surdhara Circle to Sargam Circle
Road Stretch D: Sargam circle to Sunrise Circle
Road Stretch E: Sunrise Circle to Gurukul Circle

Table 1.1: Data collections of House hold Interview

	H.H	No. of Worker	Vehicle ownership	Avg. Distance From Shop	Shopping trips/day
Stretch A	**117**	**72**	**107**	**65.5**	**119**
Stretch B	**144**	**79**	**130**	**88.6**	**153**
Stretch C	**127**	**84**	**114**	**68.7**	**141**
Stretch D	**119**	**81**	**117**	**59.3**	**145**
Stretch E	**122**	**90**	**108**	**69.4**	**160**

Table 1.2: Data collection of Trips / Day

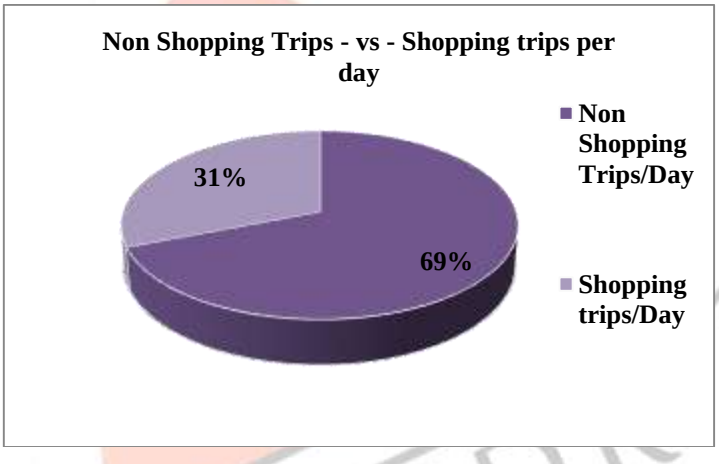
Total Trips/Day	Non-shopping trips/day	Shopping trips/day
2416	**1668**	**748**
100%	**69.03%**	**30.97%**

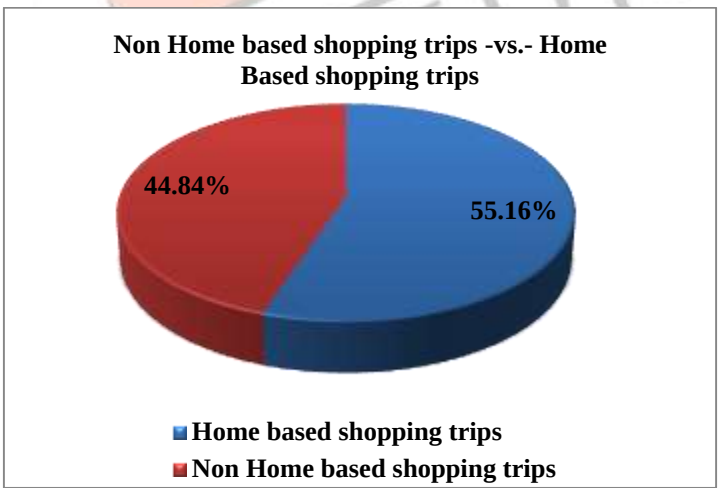
Table 1.3: Opinion survey of shopkeeper

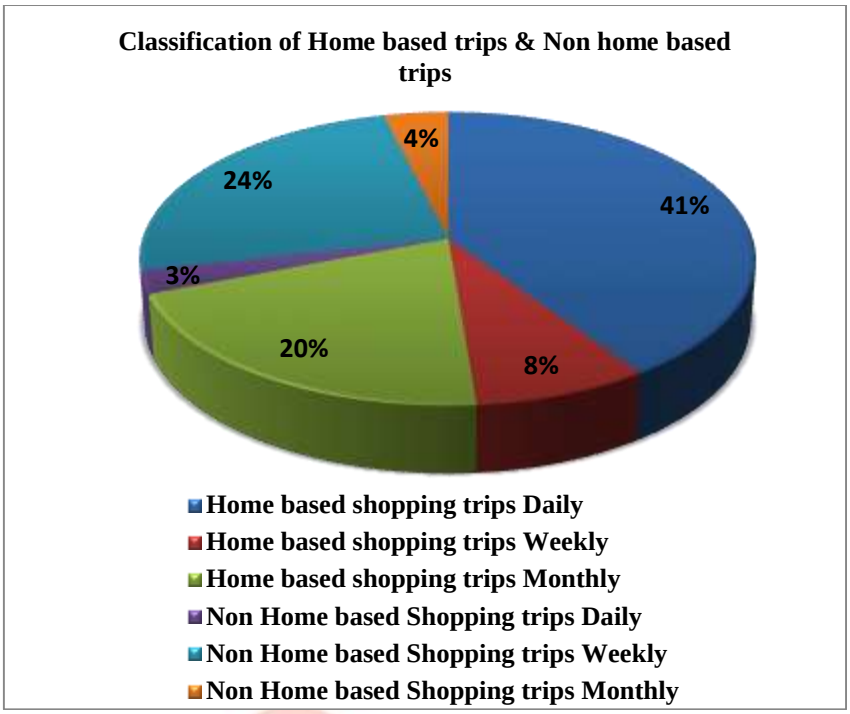
Commodity	No. of shops visited in Study Area	Total Area of all Shops (Sq .m)	Total number of Cust /Day	Total number of employee
Bakery	**5**	**117.99**	**514**	**49**
Grocery	**13**	**233.06**	**1648**	**42**
Pharmacy	**8**	**156.76**	**589**	**21**
Dairy	**3**	**51.09**	**395**	**6**
Electronics	**13**	**259.29**	**377**	**74**
Food / hotel	**32**	**1160.2**	**4011**	**349**
Florist	**3**	**12.23**	**76**	**4**

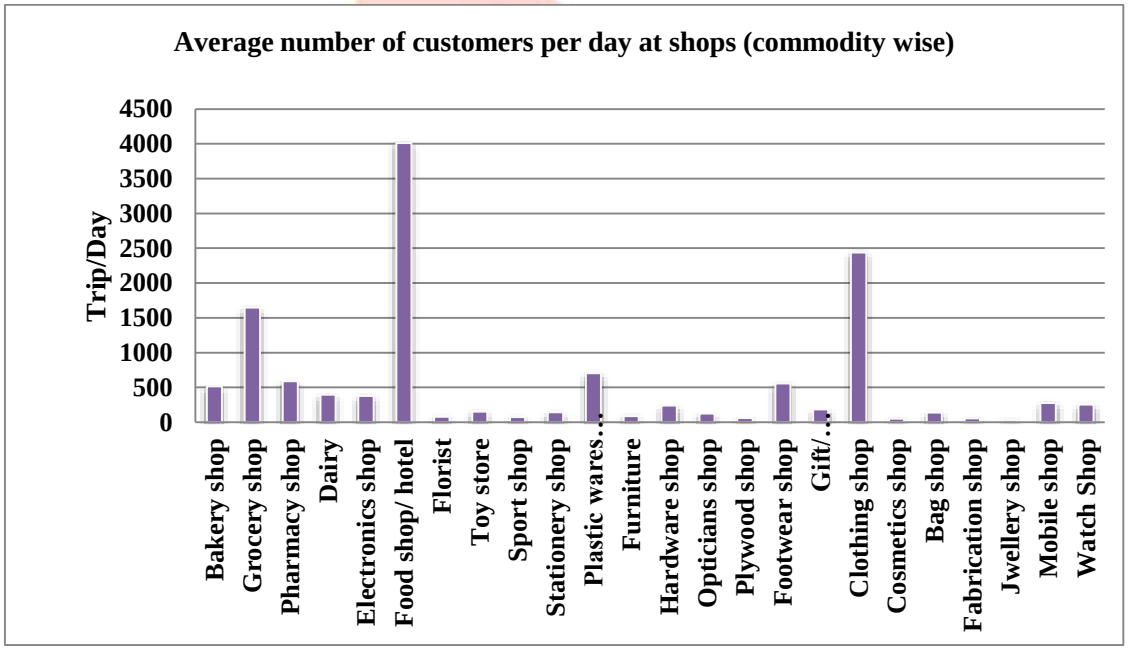
Toy store	2	71.82	150	18
Sport shop	3	31.59	75	15
Stationery	3	99.24	140	10
Plasticware/Homeap	12	309.44	703	99
Furniture	4	261.53	87	16
Hardware	5	125.87	237	23
Opticians	7	110.18	123	23
Plywood	2	279	60	8
Footwear	8	202.8	554	59
Gift/ Décor	5	102.57	184	20
Clothing	29	857.57	2439	289
Cosmetics	2	30.66	52	4
Bag	6	101.27	137	23
Fabricatio	5	102.55	56	10
Jwelery	3	51	30	13
Mobil	10	142.14	277	28
Watch	7	74.78	252	22
Total	190	4944.45	13166	1225

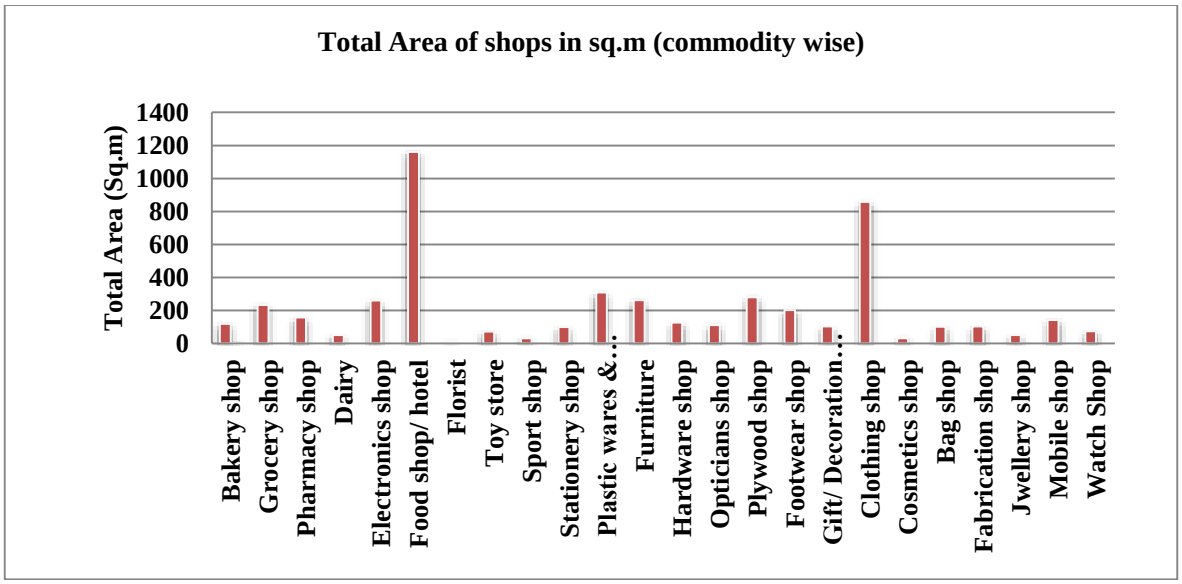
8. DATA ANALYSIS:






Classification of Home based trips & Non home based trips
4%
24%
41%
3%
20%
8%
Home based shopping trips Daily
Home based shopping trips Weekly
Home based shopping trips Monthly
Non Home based Shopping trips Daily
Non Home based Shopping trips Weekly
Non Home based Shopping trips Monthly


Average number of customers per day at shops (commodity wise)
Trip/Day
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Bakery shop
Grocery shop
Pharmacy shop
Dairy
Electronics shop
Food shop/ hotel
Florist
Toy store
Sport shop
Stationery shop
Plastic wares…
Furniture
Hardware shop
Opticians shop
Plywood shop
Footwear shop
Gift/…
Clothing shop
Cosmetics shop
Bag shop
Fabrication shop
Jwellery shop
Mobile shop
Watch Shop



9. CONCLUSION

- The share of shopping trips per day is observed about 31% of the total trips.
- From the knowing that, variables for model generation is not figured out perfect significance, a category analysis has been carried out using commodity, travel distance, travel time and mode wise for house hold for shopping trips per day. It is observed that average daily shopping trips for the house hold size 2 and 3 are more.
- Percentage share of non home based shopping trips with respect to home based shopping trips per daily, weekly and monthly is also determined. It is observed that (i) Daily home-based shopping trips are more than daily non-home based shopping trips; (ii) Weekly non-home based shopping trips are more than weekly home based shopping trips; (iii) Monthly home-based shopping trips are more than monthly non-home based shopping trips. Overall home based shopping trips are about 55% and non-home based trips are about 45%.
- It is observed that large amount of shopping trips per day are at dairy and food shop, cloths and grocery shop.
- The floor area of food/hotel and clothing shops are more compared to all other commodity shops.
- From the collection of data, it is observed that on-line activity of shopping is also made by people. But, there is no consistent information about the frequencies of online shopping by people. Therefore, the quantification of reduction of daily shopping trips due to on-line shopping could not be carried out.

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