

# DEVELOPMENT OF LAND USE BY HMDA USING REGRESSION MODEL

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## ABSTRACT

Hyderabad is the state capital of TELANGANA, a recently formed state on 2<sup>nd</sup> June 2014 of southern India and functions as the central administrative, industrial and commercial hub of the state. From its humble origins as a small town founded in 1591, it has developed to become one of India's fastest growing metropolises with a population of approximately 7.7 million (Census of India 2011) which is further expected to increase to about 15.9 millions by the year 2041 and the Hyderabad urban agglomeration area has been increased from the year 1687 (32.4 sq km) - year 2010 (736.1 sq km)

The Present study is undertaken in Hyderabad city for the development of land use composition, traffic flow patterns in various junctions, the demographical data, household capacity and traffic volume, vehicle registration data etc. Detailed analysis of Percentage vehicle registration data in 2015 two wheelers 72%, 18% cars and 3.9% three-wheelers are vehicles operating in the city out of 7.9 million populations. Total land cover area of HUDA in 2000(186500 Ha) and it has been increase in HMDA of 2011(188500 Ha). Total Percentage land cover area in 2000 Developed Area (29%) and in the year 2011 slightly increases to 36%. and Total Percentage land cover area in 2000 undeveloped Area (71%) and in the year 2011 slightly decreased to 64%.

**Key Words:** Land Use Composition, Land Use Planning, Road Length, Road Density, Urban Growth By Population Density.

**1.1 General**

At this juncture, it is important to understand that unless the City is made self-reliant in managing its own resources and wastes, the idea of sustainable city will be limited to concept itself. This effort requires a careful understanding of urban planning and development process and its impact on the various natural, social and economic factors that determine the nature and status of the urban ecosystem. Reliable and up-to-date geo-referenced information on land use is required to provide a basis for the sustainable development of land resources in both urban and rural contexts and to inform the development of policies across all areas of human activity at national, regional and local levels, including planning and regeneration, housing, employment, transport, agriculture, environment and recreation.

**1.2 LAND USE PLANNING (LUP)**

The Land Use Planning (LUP) process covers all steps extending from the collection of data and information through its processing, analysis, discussion and evaluation right up to the negotiation for a consensus concerning the form of land use to be practiced.



Source: Connecting People to Cities (PDF)

Figure1 Integration land –use & transport

**1.3 Need of Study**

A variety of alternative centers of growth and concentration of population in the cities has led to acute exploitative condition in terms of access to land, economic opportunities and provisions of transport infrastructure. Hence it is the responsibility of urban planners to minimize travel demand in urban areas. To minimize travel demand one has to understand the urban characteristics such as size of city, urban form and urban structure. There is need to establish a relationship between city parameters and travel pattern quantitatively.

**1.4 OBJECTIVE OF STUDY**

Based on the above discussions the present study was taken with the following objectives:

1. To establish a quantitative relationship between travel pattern and identified city parameters.

2. To establish a hypothetical city for various parameters population range, population density, traffic volume and land use compositions.
3. To formulate alternate land use options for policy decision making based on identified city parameters.

## **II. LITERATURE REVIEW**

Most of Indian cities are growing in size quite rapidly. They are based on assumption that cities and regions are made up of sub systems, which interact with each other to form the whole city. The present chapter deal about the various land use models developed by researchers across the world.

### **2.1 Earlier Works On Land Use Plans**

Ebenezer Howard (1902) developed the concept of Garden city. Howard's proposal emphasized the integration of the town, the country Green space or greenbelt and agricultural land will be as major component in the garden city whereby the permanent green space would separate the city, towns and serving as a horizontal fence of farmland. Areola et.al (1995) explored the built landscape of the downtown area of Mexican border cities in an urban morphological frame work to focus on the urban models that have been used to describe border cities. Hag gag and Ayad (2002) developed the urban structure typology approach originated through the utilization of remotely sensed imagery to capture the urban physical form and its comparison building structures for the field of urban morphological analysis.

### **2.2 Early Land Use Transport Models**

Hansen (1959), developed accessibility model, this was based up on concept that the more accessible the area was to various activities and the more vacant the land area the greater the growth potential. Lathrop, et. al (1965) was developed intervening Opportunities model the spatial distribution of an activity is viewed as an activity is viewed as the successive evolution of alternative opportunities for sites which were rank ordered in time from an urban center. S.A. Mohaddes, M, Gazali, et.al (1970) developed economic models for land use planning .Land use was the most important issue in sustainable management of resources because economic benefits obtained from the land should take into account environmental aspects.

### **2.3 Intermediate Era Models**

Lowry (1964) incorporated within its structure both generation and allocation of activities .the activities which the model defines are population, service employment and these activates correspond to residential, service and industrial land uses. It assumes an economic base mechanism where employment is divided into basic and non-basic sectors. Hill (1965) developed an Empire Model for Boston regional planning project, designed to distribute or allocate exogenously supplied growth forecasts of activities such as population and employment along the zones and sub divisions of the region considered for the study. Garin Lowry model (1966) the model expressed the fundamental Lowry algorithm in matrix format. Using this notation, the iterative process used by Lowry to generation population, services employment was replaced by elementary matrix operation to obtain an exact rather than an approximate solution.

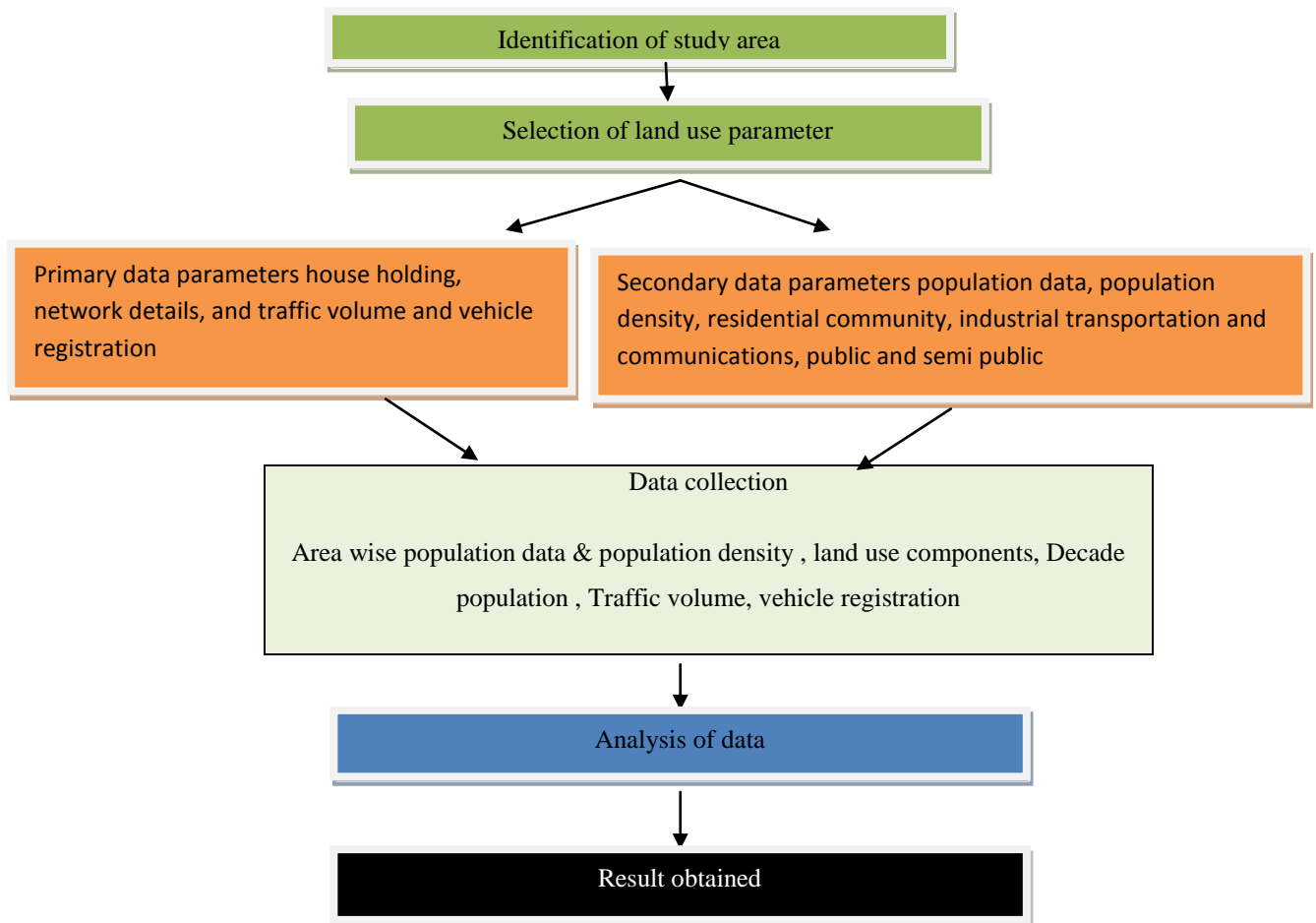


Figure 2 Proposed Structure of Study Methodology

#### IV. DATA COLLECTION AND ANALYSIS

##### 4.1 Identification of Study Area

Hyderabad Metropolitan Development Authority (HMDA), the sixth largest extends from 17°21'57'' to 17°36'66''N Latitude and 78°28'33'' to 78°47'6''E Longitude covering more than 775 sq.km area and it has population of about 6.8 million and metropolitan population of about 7.75 million, making it the sixth most populous city and fourth most populous urban agglomeration in India. At average altitude of 542 m (1778ft), much of Hyderabad is situated on hilly terrain around artificial lakes, including HUSSAIN SAGAR, predating north of city centre.

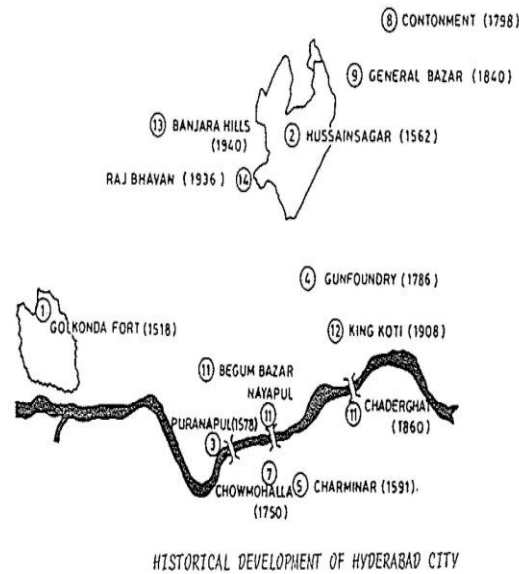


Figure 3 Historical Development of Hyderabad city

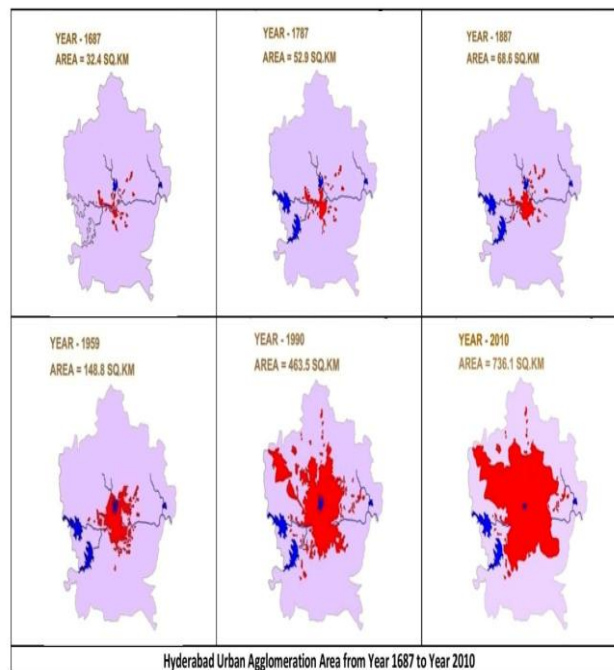


Figure 4 Hyderabad Urban Agglomeration Area from year 1687 to year 2010

### 4.2 Jurisdiction of Hyderabad Metropolitan Development Authority

It contains the entire area of Greater Hyderabad Municipal Corporation and its suburbs. The enlarged jurisdiction of HUDA now extends to 54 MANDALS located in five districts with a total area is covered 7,228 Sq.km.



Figure 5 the New Extended Area of HMDA

Table 1: Components of HMDA

Components of HMDA	Approximate Area (sq.km)	Percentage
Greater Hyderabad Municipal Corporation	625.00	8.747
Rest of HUDA area *	1104.48	15.456
Hyderabad Airport Development Authority	458.96	6.423
Extended Area of HMDA ( Outside HUDA area)	4917.00	68.811
SECUNDRABAD Cantonment Board	40.17	0.563
Total	7145.61	100

### 4.3 Demography of HMA

The jurisdiction of Hyderabad came into exists in 1975. The Census Urban Agglomeration is much smaller than HMDA area even in 2001. The geographical spread of Hyderabad’s urban area has considerably changed over the decades, in keeping with its population. The demographic figures of Hyderabad are presented in figure 1.2.

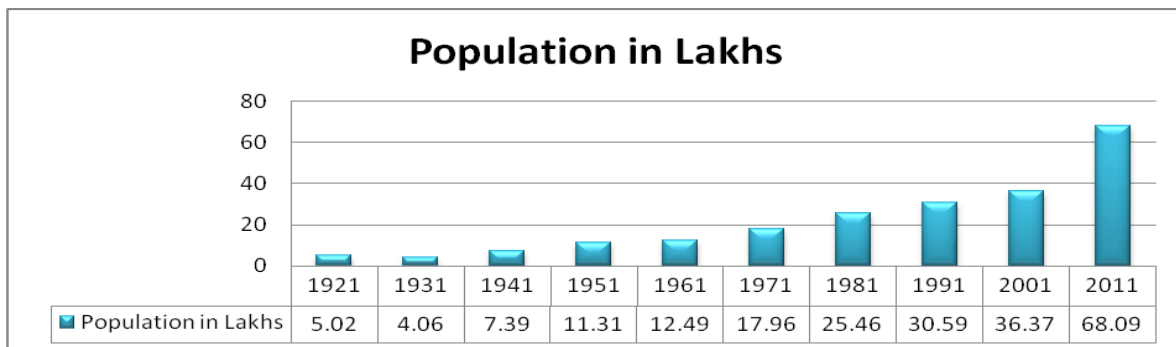


Figure 6 Population of Hyderabad (1921-2011)

Source: Hyderabad Metropolitan Development Authority

Figure 6 clearly indicates a steep highly rise in population from 2001-2011, and then a slow down between 1921-1931. This is in line with general decline in ratio of population growth of the state as a whole as well as the urban and rural growth rates. The changing pattern o review of the population projection for Hyderabad Metropolitan Development Authority (HMDA) area.



Figure 7 Total Zones Area Map in GHMC

#### 4.4 Population of various different zones

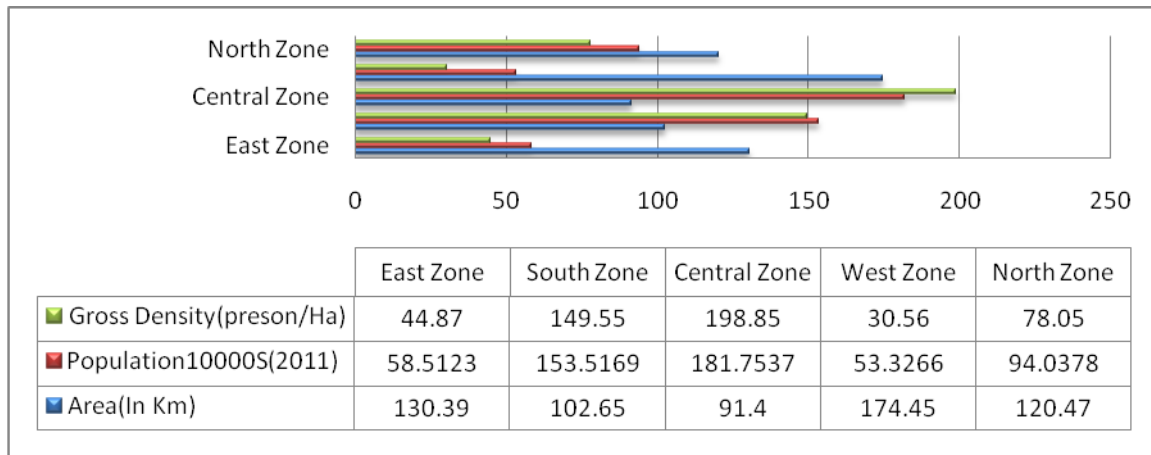


Figure 8 Population Area Wise

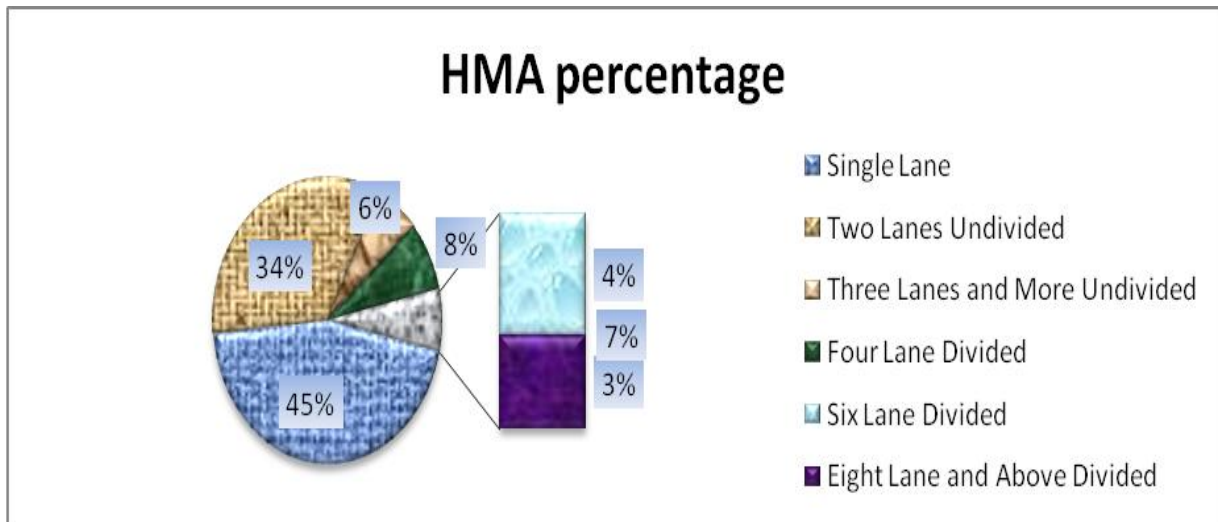
From above figure 8 showing central zones is highest population 181.7537, lowest population is west zone 53.3266 and overall Gross density is about 87.37km/sq.km and overall population is about 514.1473.

#### 4.5 Category wise roads in HMDA

Important roads in the study area are identified and road reconnaissance survey is carried out for 4,917Km of roads. Category wise distribution of these roads (Table 2) shows that about 45% of the roads have single lane carriageway and 34% of the have two lane undivided carriageway. Only 15% have more than four lane road configuration.

**Table 2: percentage of Category wise roads in HMA**

Lanes	MCH	Rest of GHMC	Rest of HMA	HMA
Single Lane	10%	11%	56%	45%
Two Lanes Undivided	42%	46%	31%	34%
Three Lanes and More Undivided	25%	10%	2%	6%
Four Lane Divided	13%	19%	6%	8%
Six Lane Divided	6%	9%	2%	4%
Eight Lane and Above Divided	3%	5%	2%	3%
Total	100%	100%	100%	100%
<b>Total length in km</b>	<b>583</b>	<b>660</b>	<b>3,674</b>	<b>4,917</b>



**Figure 9 Total Percentage of roads in HMA**

From Above figure single-line road (45%) having maximum road length covering in HMA and eight -lane road (3%), having minimum road length covering in HMA.

#### 4.6 Land Use in Hyderabad City Area

The first land use survey for M.C.H was carried out by the director of town planning, Government of Andhra Pradesh in the 1960s as part of the process of formulation of Development plan of Hyderabad. – The land use structure prevailing at that time and the existing scenario is quite different. The city attained multifunctional character with haphazard growth and irregular pattern of circulation. The first development plan for the corporation area was prepared and notified in 1975. The land use survey had covered HUDA area of 1865 sq.km which is covering 674 sq.km of GHMC.



**Table 3 Land use Details of HUDA Area in 2000 and 2011**

Land use composition	Total area in (ha)2000 HUDA	%	Land use composition	Total area in (ha)2011 HUDA	%
Residential	28900	15.5%	Residential	32300	17.1%
Commercial	2200	1.19%	Settlement	2900	1.52%
Manufacturing	6400	3.43%	Commercial	2300	1.22%
Public & Semi public (incl. Military)	11100	5.96%	Public & Semi public	9000	4.79%
Multiple use	0	0.00%	Manufacturing	7300	3.86%
Utilities & Graveyards	200	0.08%	Mixed	300	0.13%
Open Space Zone	800	0.45%	Transportation & Communication	6700	3.53%
Agricultural & Vacant	113800	61.0%	Special Area	6700	3.56%
Forests	8800	4.74%	Agriculture	200	0.10%
Water bodies	9300	4.98%	Conservation	35000	18.5%
Special reservation	000	0.02%	Forest	7200	3.84%
Transportation & Communication	4900	2.62%	Recreational	1700	0.91%
-	-	-	Undeveloped	67600	35.8%
-	-	-	Water Bodies	9400	5%
Total	186500	100	Total		100

## V. MODEL DEVELOPMENTS AND DATA ANALYSIS

### 5.1 Modeling of Land Use Parameters

The Linear regression estimate models and Geometrical increase method for land use and land cover have been developed using Microsoft Excel Package The relation between each land use parameter with their influencing variables has been developed in Microsoft Excel Packages and the combination of variables for modeling is taken based on the influence of the variables using R<sup>2</sup> value and logical sign of the variable. Statistical tests such as Multiple Correlation Coefficient (R<sup>2</sup>), Standard Error (SE), t-test etc., are conducted for checking the adequacy of the model. The value of R<sup>2</sup> lies between 0 and 1, where 1 denotes the strong relation between the dependent and independent variables.

### 5.2 Land Use Models

The decadal data of natural increase, population road length and road density within the limits of Hyderabad Metropolitan Area (HMA) and Hyderabad Urban Development Authority (HUDA) is used for development of

land use model influence of these variables has been taken for modeling of land use including statistical data has analyzed.

**Table 4: Land use Models for Hyderabad Metropolitan Area (HMA)**

Variables	Constant	Coefficient Correlation	R <sup>2</sup>	SE	SD
Road Length ( in Sq.km)	307.95 (1.8902)	0.9959 (-3.3375)	0.971	297.59	515.45
Population (in Lakhs)	20.2575 (2.6599)	0.9557 (-3.3815)	0.862	11.65	20.19
Road density (km/sq.km)	0.04823 (1.4334)	-0.9635 (1.70749)	0.741	0.105	0.182

From Table 4, the land use model with the population as influencing variable has highest R<sup>2</sup> value is 0.971. All the variables taken for modeling of land use are logically signed with land use. The model with the population variables has highest R<sup>2</sup> value with low percentage in standard error is 0.105. The t-value for population variable in regression is more compared to the other variable in land utility composition in Hyderabad Metropolitan Area (HMA) and Hyderabad Urban Development Authority (HUDA).

The General form of the suggested model is as follows: Land use parameters = Functions (Demographic Parameters, traffic & transportation parameters etc).

$$\text{Land Use Parameters} = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + \dots + a_nx_n \quad (\text{Eq.1})$$

$$\text{Land Use Area (sq.km)} = 20.2575 (2.6599)^* + 0.9557(-3.38150) * \text{Population} \quad (\text{Eq.2})$$

\*Value presented in parenthesis is related student t-test statistics.

### 5.3 Land Cover Area

**Table 5: Land Cover Area Models for Hyderabad Metropolitan Area (HMA) and Hyderabad Urban Development Authority (HUDA)**

Variables	Constant	Coefficient correlation	R <sup>2</sup>	SE	SD
Total Land Area(Sq.kms)	671.499 (3.4251)	0.8310 (-1.3225)	0.762	323.17	559.76
Employment( Lakhs)	6.954 (3.8522)	0.9669 (-3.3150)	0.886	3.371	5.896
Population density( PPH)	14.65695 (3.1773)	-0.181 (-2.4721)	0.065	7.9529	13.7749

**Dependent Variable: Land Cover Area in sq.km**

From Table 5, the land covers area shows good Statistical relation with population density, Employment and total land area covered. The following equation represents land cover area model with population density as the influencing variable.

$$\text{Land Cover Area (sq.km)} = 14.6569(3.1773)*-0.1818(-2.4721)* \text{Population Density} \quad (\text{Eq.10})$$

\*Values Presented in parenthesis are student t-test statistics

### 5.4 Application of the Models

Different models have been developed for finding the land cover area and population forecasting for transportation parameters (vehicular population, trip length and per capita trip rate). The prediction accuracy of the models is explained in terms of the linear regression estimate. The future prediction of the land cover area can be obtained from the developed models with projected input data for the future.

## 6 CONCLUSIONS

- ORR & HMR will give information about total transportation problems.
- Agricultural land is being converted into non-Agricultural land because rapid expansion of Hyderabad city and also commercial area has been increased in the central part of the city, that too along the main roads. These areas are in very high land residential area away to the outer part of city.
- MCH has 10 municipalities with total covered area is 172.6 sq km .MCH has been merged into GHMC. Present GHMC has 18 circles including with MCH with total covered area is 625 sq km.
- The total Jurisdiction of HUDA is 1864.87 sq.km and including SECUNDERABAD Cantonment Board with area 40.17 sq.km for making Hyderabad Metropolitan Area nearly 1905.04 sq.km. HUDA has been merged into HMDA. The enlarged jurisdiction of HUDA into HMDA now extends to 54 Mandals located in five districts with a total area is covered 7,228 Sq.km.
- HMDA was formed in 2008 by merging three Development Authorities. Hyderabad Urban Development Authority (HUDA), Cyber bad Development Authority (CDA) and Hyderabad Airport Development Authority (HADA).
- The total length of roads in GHMC is about 1250 km. GHMC roads has been subdivided into ORR, IRR ,RR,PRRR,IRRR,SH and NH.
- According to 2041 HMDA planned to increase total length of transportation sector up to 32126 km. Transportation sector in HMDA has been subdivided into total road network, Radial Roads , Intermediate Ring Road ,MMTS phase (I,II,III & IV) , Potential Public Transport Corridors. Overall cost estimation for 2041 of urban infrastructure is about INR 1.76 Lakh Crores.
- Percentage vehicle registration data in 2015 two wheelers 72%, 18% cars and 3.9% three-wheelers are vehicles operating in the city out of 7.9 million populations.
- With the growth rate of the 1921-2011 taken into account then we get a projected population is 159.82 lakhs for GHMC area in 2041 and According to 1991 total employment is 11.08 lakhs and with the growth rate of the 1991-2011 taken into account then we get a projected employment is 54.01 lakhs.
- Total land cover area of HUDA in 2000(186500 Ha) and it has been increase in HMDA of 2011 (188500 Ha) and form 1991-2011 taken into account then we get a projected total land covered area (194283.72 Ha).

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