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GEO-INFORMATICS FOR UNDERSTANDING POPULATION DENSITY AND DISTRIBUTION OF NATIONAL CAPITAL OF INDIA

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Abstract

Delhi today is one of the largest growing cities in the world; the growth rate of the Delhi, the national capital of India always shows the positive results. It is attracting a large number of immigrants from other states of India. As per census records of India it accounts for 1.34 percent of the total population of the whole India and occupies 18th rank amongst all the states and union territories. As per 1991 census Delhi was a single district and later on in 2001 census it was divided into nine districts In the present study data of all the nine districts has been presented and an attempt bas been made to make population assessment of national capital of India Delhi, using Geo-informatics technology. The primary dataset that were employed in the present study are satellite data of Landsat ETM imagery (1999-2000) coupled with ground truthing using global positioning system. By comparing these two multi-date images, and statistical assessments over satellite image an assessment about the distribution of population of Delhi was drawn (No2). The present study holds significance keeping in view the ever expanding population of Delhi and use of Geo-informatics in redressing those issues. The Study will also try to explore new age of technical path to give the results in the areas where manual methods are being dominated.

Keywords: Landsat, Population assessment, Distribution.

Introduction

Delhi's population was 4.05 lakes at the beginning of 20th century and as per Provisional Population Totals 2001 it rose to 1378 lakes. It is interesting to note that being the capital of India, Delhi has always being depicting growth rate above the all India growth rate as it is attracting a large number of immigrants from nearby states. It accounts for 1.34 percent of the total population of the country and occupies 18th rank amongst all the states and union territories. Delhi was a single district in 1991 census and has been divided into nine districts in 2001 census. Therefore the data in the present paper is given for all the nine districts. Population data basically derived from the national organization namely Census of India. It conducts the survey for the entire population of the nation after every decade. One of the important uses of a social RS & GIS is to provide a database in spatial mode for public policy and planning in socio-economic fields. It helps in analysis of data to know the factual position of the population growth, its composition, and trend and thus provide a base for socio-economic development planning. Geo-informatics technology i.e. remote sensing (RS), geographical information system(GIS) and global positioning system(GPS) can contribute substantially in a more supplementary fashion to some of the interactive operations that should become an asset for assessing, understanding ,mapping utility and service facility using GPS and solving complex urban environmental issues. By utilizing remote sensing data and implanting GIS mapping techniques, Population Distribution Assessment urban areas can be monitored and mapped for specific development projects. In the present study Geo-informatics as a valuable tool was used to derive out the population distribution maps of one of the important cities of India viz; Delhi. The study explored in-depth a new technique for making assessments about population just by inferring the satellite data and putting this valuable data to good use by exploring it in Geo-informatics technology. In the present study systematic multilevel approach was followed in this work which envisages mainly remote sensing based studies, followed by laboratory exercises using GIS in assessing the population using remote sensing &GIS techniques of the study area.(No 7) Modern remote sensing system has the ability to provide instantaneous views of the surface of the earth at different scales for selected wavelength of reflected and emitted radiation .With the right combination of different filters and processing of the satellite data (Band rationing, stretching, density slicing etc) selected type of information can be extracted from or enhanced image or satellite data.

Study Area

The present area that was adapted for studying the dynamic change in population using Geo-informatics is Delhi- the national capital of India. This area was chosen for study as this

is the only city in India which is expanding at an alarming rate at present. Delhi, being the capital city of India holds a place of importance and so it is necessary to have a clear idea about the location of Delhi. The metropolitan city of Delhi lies in the northern part of India, in between 28.38°N latitude and 77.12°E longitude. Delhi is located at 28°37′N 77°14′E28.61°N 77.23°E / 28.61; 77.23, and lies in northern India. It borders the Indian states of Uttar Pradesh on East and Haryana on West, North and South. Delhi lies almost entirely in the Gangtic plains. Two prominent features of the geography of Delhi are the Yamuna flood plain and the Delhi ridge. The low-lying Yamuna flood plains provide fertile alluvial soil suitable for agriculture. However, these plains are prone to recurrent floods. Delhi lies just in the central part of the Indian sub-continent, in between the Aravallis Range and the Himalayas. Delhi stretches over an area of about 1483 square kilometers and its breadth ranges in between 30 to 33 miles. Delhi lies almost 300 meters above the sea level (No 5).

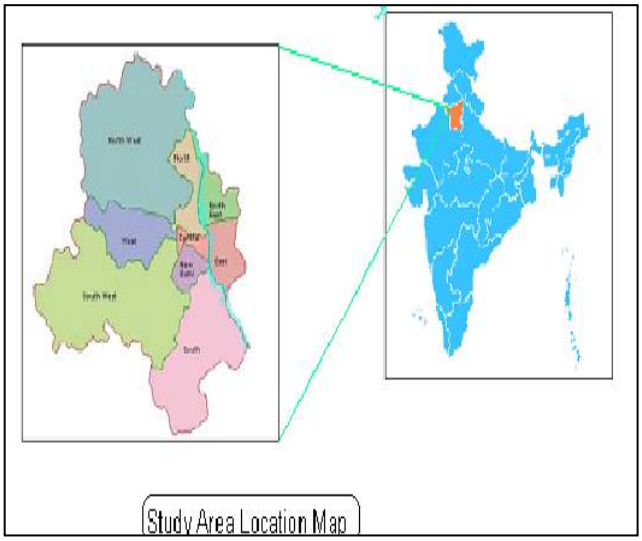


Figure 1. Shows the Study area

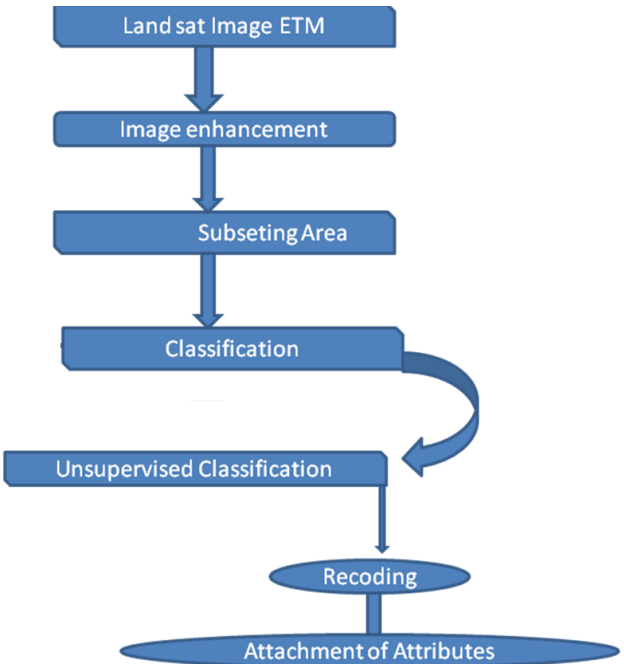
Materials and Method

Dataset Used

This study Employed Landsat ETM Data of 1999, 2000 remotely sensed data of two different dates to classify urban land cover. Landsat image is an invaluable record of land cover and land cover change, provided in a consistent manner that allows for use in a wide range of activities including population assessment, environmental assessment, planning, land management, urban development and many Earth science research activities. The digital data used in this study were collected by Landsat ETM on 17th November 1999 with 30m spatial resolution. Along with this data was used the economic survey report of Delhi for year 2001-2002. The data was used in various GIS software viz; Arc Map, ERADAS8.2, Map Info 6.2 to carry out various analysis .

Data Analysis

The satellite data was enhanced before classification by using histogram equalization in ERDAS Imagine 9.2 software for the better quality of the image and to achieve better classification accuracy. The process was required to exactly locate the area on a definite projection and on a definite scale. The exact boundary of the study area was extracted by the process of subset. After subseting, the whole area is classified. Classification is performed in two ways, Supervised and Unsupervised. The supervised classification was avoided because it requires training site selection for all classes & when computation is done, the intermixing of pixels may occur. This will ultimately affect the accuracy of result. It was better to take the advantage of unsupervised classification, because it does not require any training site selection. The whole area was classified on the basis of spectral values. The classified image was recoded into various classes like open area, high dense urban, dense urban, urban, villages, airport, transportation, inland water, river, grassland etc. The attribute i.e., population distribution data was attached with the classified thematic layer. In order to generate population distribution maps. This was followed by quality check (QC) and accuracy assessment (AC). When the results were found satisfactory then the final population distribution map was generated. The following figure (7) shows the flowchart of the methodology followed.



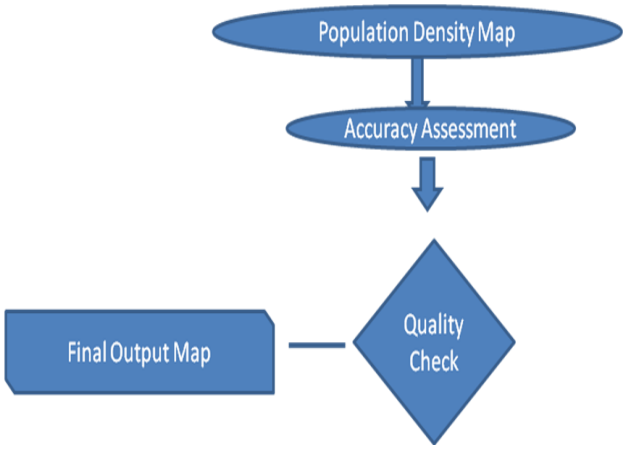


Figure 2. Shows the Methodology

Result and Discussion

Section 1.1

Delhi today is one of the largest growing cities of the world; the unprecedented growth in the population in Delhi is increasing a tremendous pressure on already choking environment of Delhi as well as land resources of Delhi, which are fasting turning into built-up structures(NO 3),

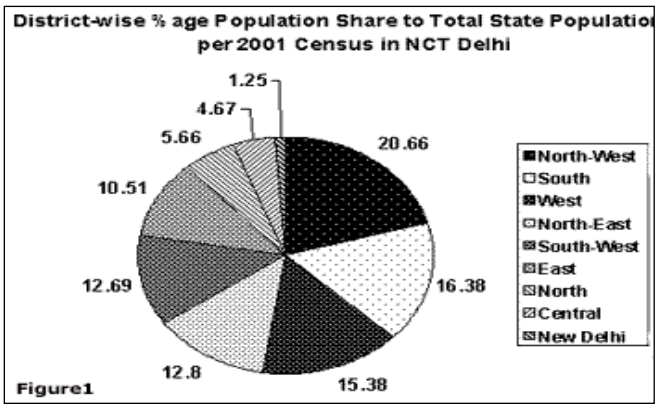


Figure 3. District-wise %age Population Share to population per 2001 census in NCT Delhi.

The North-West district with 2.85 million populations constitutes 20.66% of Delhi and thus occupies the first position. The South district occupies the second position with 16.38% population of the total population of Delhi. The New Delhi district with 1.72 million population shares only 1.25% of Delhi's population and thus is placed at the lowest rung of the ladder as far as ranking of districts by population size is concerned. (No 8)

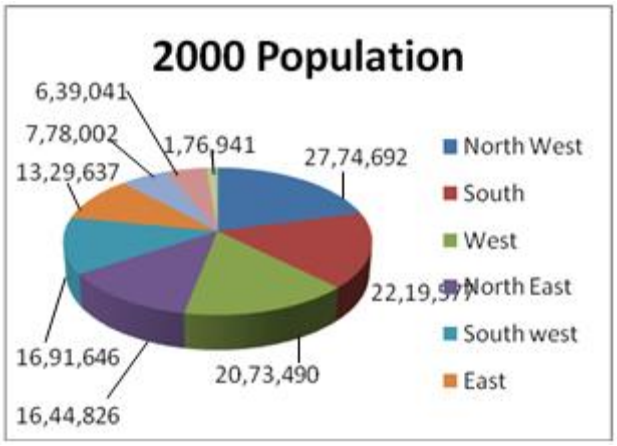


Figure 4. Pie bar Showing Population of Delhi in 2000

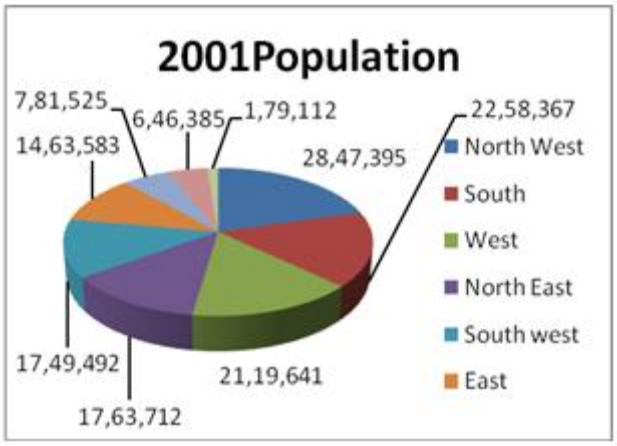


Figure 5. Pie bar Showing Population of Delhi in 2001

Table-1 Shows the comparison of population census of Delhi with satellite imagery data

Row	District Name	2001Population - Census Internet*	2000 Population - Satellite Imagery (Landsat)	Difference (from 2001 to 2000)	Percentage of Variation
1	North West	2,847,395	2,774,692	72,703	2.55
2	South	2,258,367	2,219,577	38,790	1.72
3	West	2,119,641	2,073,490	46,151	2.18
4	North East	1,763,712	1,691,646	72,066	4.09
5	South west	1,749,492	1,644,826	104,666	5.98
6	East	1,463,583	1,329,637	133,946	9.15
7	North	781,525	778,002	3,523	0.45
8	Central	646,385	639,041	7,344	1.14
9	New Delhi	179,112	176,941	2,171	1.21
	Total	13,782,976	13,327,852	455,124	3.30

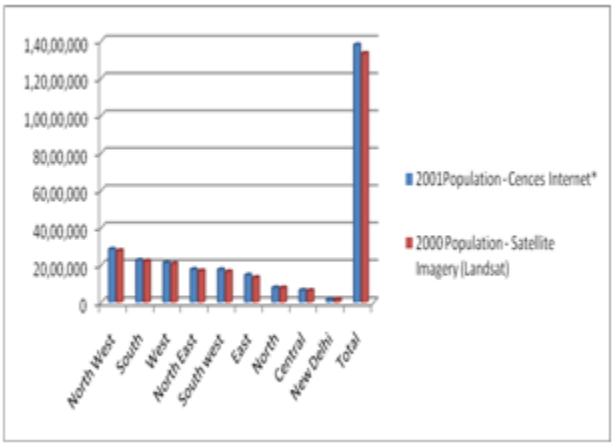


Figure 6. Bar graph showing increasing of population From 2000_2001

As per 2001 census, population of nine districts of Delhi is shown in above table. Population in year 2000 has been obtained from the satellite imagery by using remote sensing techniques in the present technique an assessment about population was carried out by sampling method wherein samples were taken in the field about the people living in particular area and based on those sapling sites, the population was drawn by multiplying the total number of persons living per pixel with the total area covered by such pixels, in this way final population was derived out and later on by comparison of satellite imagery data with 2001 population census, the variation is identified as below 10%, even though some of districts narrowly varied i.e. even < 1%.

In North, south, New Delhi districts of Delhi, percentage of variation ranges from 0.45-1.72. Rajiv-Chowk, which is located in New Delhi formerly known as Connaught Place, one of northern India's largest commercial and financial centers, is located in the heart of New Delhi. Adjoining areas such as Barakhamba Road and Chankyapuri are also major commercial centers. The main reason behind the rise in population between 2000-2001of New Delhi is the establishment of commercial and financial centers.

While in East, Southwest, North East districts of Delhi, percentage of variation comes from 3.30-9.15, which is notable. In east district of Delhi, the rise of population is 133946.It can be calculated from the known facts, this rise of population may be because of rapid Urbanization, high living life standard, migration of people from rural areas to urban areas in search of food, job etc (No 4).

Section 1.2
Population density Map

Using remote sensing and Geographical information system the population density map of Delhi as well as of various districts of Delhi was generated. The generated population density maps shows the area in (sq-miles) as occupied by each class of land and also shows the areas within the NCT of Delhi which are facing the acute pressure of rapid urbanization, and also those areas were the probability of getting urbanized is more.(No 6) Following figures 7& 8 below show the distribution as well as the density of population of Delhi and certain districts as derived out using landsat satellite. Land use/land cover maps were produced from Land sat ETM satellite images.

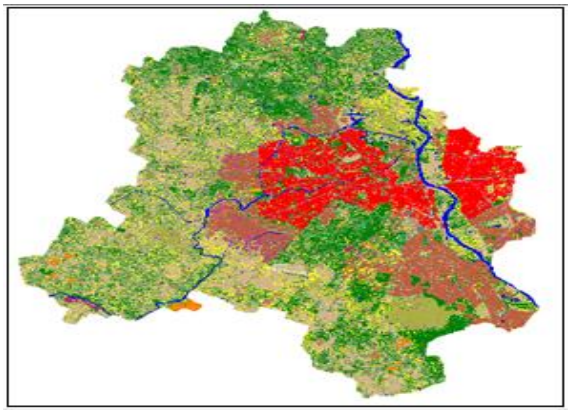


Figure7. Delhi District Map (1999)

Table-2 Shows area in (Sq. Miles) occupied by each class.

Class Names	Color	Histogram	Area in sq mile
Unclassified		0	0
High Dense_urban		182817	57.3334
Dense urban		191595	60.0863
urban		71062	22.2858
villages		17128	5.37153
Open		455227	142.764
Inland_water		8010	2.51202
River		28360	8.89401
Fallow_land		7383	2.31539
Forest		263491	82.6337
Low_tree		411855	129.162
Agriculture		3328	1.0437
Grassland		144361	45.2732
parks		2984	0.935815
Air_port		1127	0.35344
Major_road		20542	6.4422
Minor_road		7278	2.28246
canal		2125	0.666423
Industrial_commercial		15434	4.84027

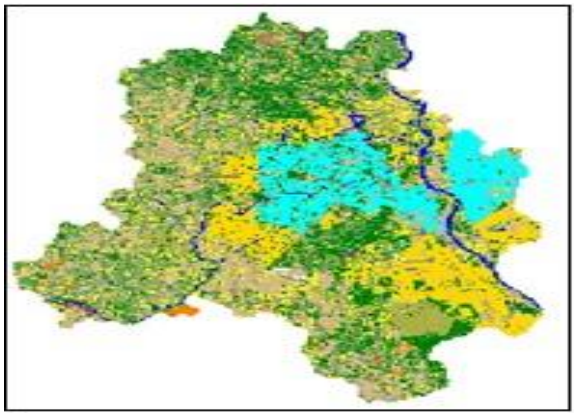


Figure8. Delhi district map (2000)

Table-3 Shows area in (Sq. Miles) occupied by each class.

Class Names	Color	Histogram	Area in sq mile
Unclassified		0	0
Dense_urban		187817	58.9015
Urban		192595	60.3999
Sub_urban		73062	22.913
Villages		17228	5.40289
Open		454227	142.451
Inland_water		8009	2.51171
River		28260	8.86265
Fallow_land		7383	2.31539
Forest		262120	82.2037
low_tree		411466	129.04
Agriculture		3228	1.01234
Grassland		144372	45.2766
parks		3213	1.00763
Air_port		1127	0.35344
Major_road		20642	6.47356
Minor_road		7378	2.31382
Canal		2135	0.669559
Ind_com		15534	4.87163

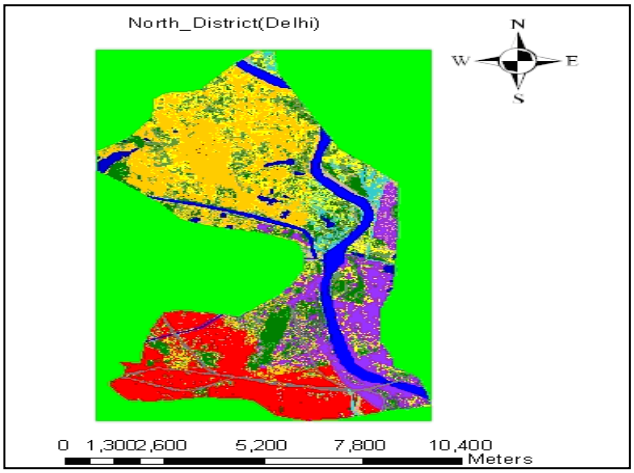


Figure 9. Population Distribution Map North Delhi (1999 in Sq-miles)

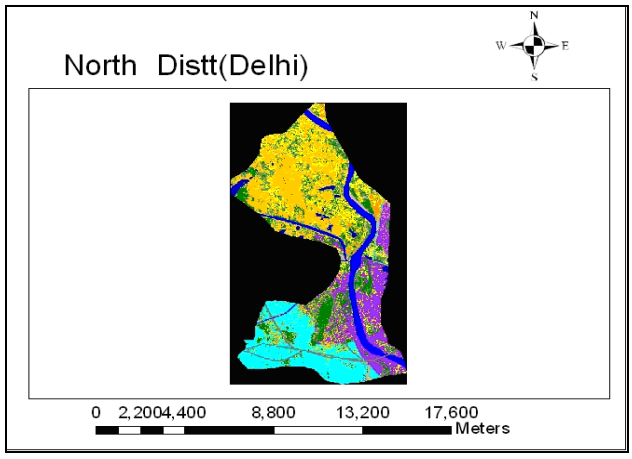


Figure 10. Population Distribution Map North Delhi (2000 in Sq-miles)

Table -4 North District Showing Populations in Sq. Mile in 1999

	Class Name	Histogram	Area in Sq mile	Pop *	Pop-1999
1	High Dense Urban	14402	4.51663	23	331246
2	Dense Urban	18971	3.15555	19	360449
3	Urban	10062	5.94951	7	70434
4	Village	1918	0.601506	6	11508
Total		45353	14.223196		773,637

Table -5 North District Showing Populations in Sq. Mile in 2000

	Class Name	Histogram	Area in Sq mile	Pop *	Pop-2000
1	High Dense Urban	14555	4.51663	23	334765
2	Dense Urban	18972	3.15555	19	360468
3	Urban	10163	5.94951	7	71141
4	Village	1938	0.601506	6	11628
Total		45628	14.223196		778,002

The above table reveals that how the population is undergoing a dynamic change in such a short span of time i.e., one year. The variation as show by the data from census data is quite low thereby showing how Geo-informatics can be a valuable tool in assessment of population in the areas which are otherwise inaccessible and in such a short span of time. (No 1.)

Conclusion and Recommendations

Delhi- The national Capital of India today is becoming one of the largest cities of the world. Its population of Delhi is increasing at an alarming rate as a result, of which there is a phenomenal pressure on land, housing, transportation, network and services. Total area of Delhi ,as derived from satellite imagery assessments and other indexes is about 1483sq km about 50% among this area has already been urbanized and the rest is under heavy pressure of urbanization. The study has demonstrated the application of Geo-informatics as a valuable tool for assessing the population of this important city of India. The main aim was to assess the population and compare the results with the census records in order to see as to how accurately Geo-informatics can be used to make population assessments in such a short span of time. This can help as technical alternative which can assess the population in very less time and with moderately good accuracy. Geo-informatics technology gives fairly good results of assessing the population with small amount of field survey and has a tremendous advantages in terms of Comparatively saving time in assessing the population, Identifying the rapid urbanization areas Direction of spreading of city Planning in

the direction of spreading side of city Environmental issues. The study will go in long way to redress the future population challenges that Delhi will face and will help planners to come out with certain concrete measures and policies to address the issues arising out of population rise.

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