

Geospatial Technology for Mapping and Modelling of Urban Population: A Study of Process of Urbanisation in Emerging and Developing Country, India

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ABSTRACT

Geospatial process of urbanisation shows that the urban population increased over the periods as it is accounted for about to 23.73 per cent in 1981 which further increased about to 26.13 per cent in 1991 and about to 27.82 per cent in 2001. And, the urban population proportion further increased about to 31.14 per cent in 2011. In other words, the total population accounted about to 1,210.85 million peoples, out of which about to 377.11 million peoples live in urban areas which is constituting a proportion of 31.14 per cent of the total population in 2011. Whereas, the number of towns increased from 5,161 in 2001 and about to 7,935 in 2011. It is interesting to mention that main feature of urbanization is the growth of large towns and metropolitan cities in different parts in India. There are about 35 cities in 2001 which increased about to 53 cities in 2011. Metropolitan cities altogether accounted for population of about to 108 million peoples in 2001. In other words, all these metropolitan cities accounted for nearly 11 per cent of country's total population and 38 per cent of urban population. However, as a result, the process of urbanization is led by the demographic explosion of population, on the one hand, and widespread of poverty due to rural to urban migration, on the other hand. It is interesting to point out that the process of urbanization is boosted up, due to rural push, not due to urban pull. So, the urban population projections point out that in 2030, the urban population will be about to 575 million peoples which would be constituting over to 40 per cent of total population in India.

Key Words : Geospatial, Urbanisation, Metropolitan Cities, Urban Development, Planning and Policies

INTRODUCTION

The process of urbanization comes with the transformation of rural societies to urban societies due to the economic development over the periods. More appropriately, the movement of peoples sequentially takes place from primary sector to secondary sector and then to tertiary sector of the economy, resulting into the urbanization, as experienced by the developed countries (Carter, 2010; and Aggarwal, 2007). Whereas, the movement of peoples takes place from primary sector and directly jump into the tertiary sector of the economy, especially in the developing countries, as found in case of India. This is resulting into the over-urbanization or pseudo urbanization, because of the inefficient, unproductive informal sector which becomes increasingly apparent (Kingsley

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Davis and Golden, 1954; and Pacione, 2009). Such as, the large size metropolitan cities contains huge population which ultimately resulting into the deterioration of urban quality of life due to lack of amenities as housing, water supply and in-sufficient infrastructure facilities as roads, school, etc.. So, the process of urbanization is led by the demographic explosion of population, on the one hand, and widespread of poverty due to rural to urban migration, on the other hand. It is interesting to point out that the process of urbanization is boosted up, due to rural push, not due to urban pull (Knox, 1994). In other words, the process of urbanization is not only due to migration; but it is also caused by the natural increase or demographic explosion of population. Accordingly, the migration is one of the components of urban growth which occurs due to rural push but not due to urban pull (Breese, 1969). The worldwide economic reform processes as the globalization, liberalization and privatization, are having negative impacts on the process of urbanization (Peter *et al.*, 2013). So, the policy makers and urban planners must focus on operational development and restorative planning for the sustainable urban development (Bhattacharya, 2006; Arthur and Simon, 2005; and United Nations, 2014).

In the recent past, there is experienced a significant increase in pace of urbanisation in the country, India. Urbanization commences with an increase in percentage of population living in urban areas. Urbanization increased from 27.82 per cent in 2001 Census to 31.14 per cent in 2011 Census. There were about 53 metropolitan cities having more than million plus (+) population in India in 2011. So, there have been emerged new forms and patterns of urbanisation in the emerging and developing country, India, at regional levels, in general. The 2011 Census is the 15th Census of India since 1872. For the first time since independence, the absolute increase in population is more in urban areas than in rural areas. The rural and urban population distribution proportion accounted for about 68.84 per cent and 31.16 per cent, respectively in 2011. Whereas, the proportion of rural population declined from 72.19 per cent to 68.84 per cent over the periods from 2001 to 2011 Census, respectively. There was slowing down of overall growth rate of population due to the sharp decline in growth rate in rural areas, while the growth rate in urban areas remains almost the same. There has also been a spurt in growth of population in urban areas in the country. This could be due to the migration, the natural increase and the inclusion of new areas under the urban in form of towns and cities over the periods. Besides this, on the basis of results obtained for the period 2011, there is found that out of the total population of 1,210.85 million, about 377.11 million peoples live in urban areas which is accounting for 31.14 per cent of the total population. The number of different class size towns increased from 5,161 in 2001 to 7,935 in 2011. Such kind of the increasing pace of urbanization resulted into increasing pressure on the amenities and infrastructure facilities in the urban centers. So, by and large, the urbanization has also been accompanied with an increase in the urban poor population. Besides this, there are four components of urban population growth as the natural increase, the rural to urban migration, the reclassification and the boundary changes of the existing urban centers (CoI, 2011). Based on the Census of India reports, it is found that the natural increase during 1991-2001 was about to 59 per cent, on the one hand. And, the rural-urban migration is accounted for about to 21 per cent, during the same period, on the other hand. Moreover, the remaining urban growth is due to reclassification or boundary changes of the towns and cities in the country, India.

Research objectives :

The present research mainly focus on the geospatial process of urbanization since the beginning of the 20th Century till to the present time. It also attempt to examine historical features which laid influences on the scenario of urbanization particularly in context to the important events and miseries.

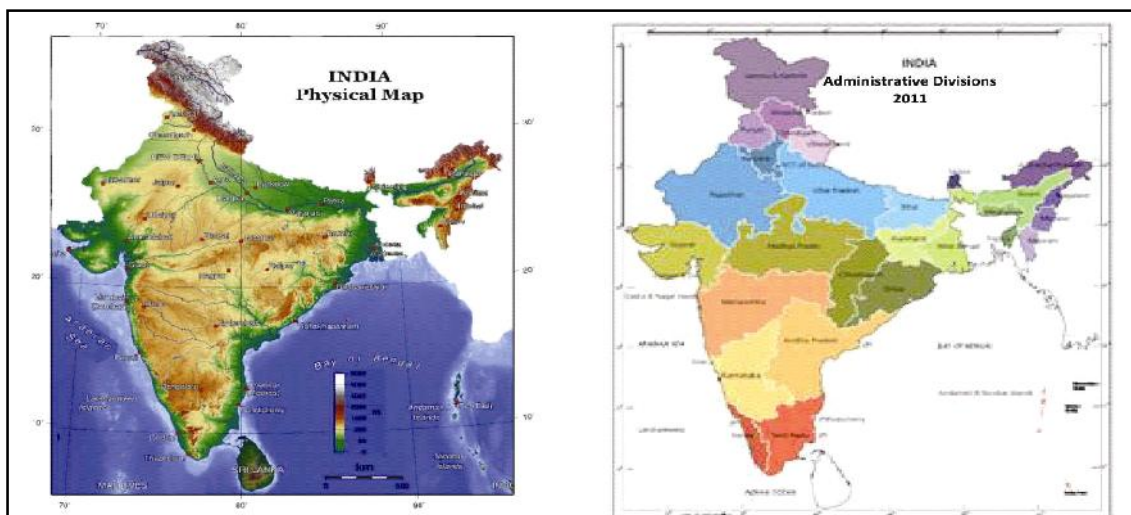
So, the main objectives of present research are mentioned as follows:

- i. to study geospatial chronological events impact on process of urbanization over periods;
- ii. to examine geospatial trends of urbanization in context to cities and urban agglomerations;
- iii. to scrutinize geospatial patterns of urban population concentration and urbanization;
- iv. to suggest suitable strategies for sustainable urbanisation and urban development.

So, the present research has brought out noteworthy issues and facts about the urbanization. Such in-depth research of urbanisation will help to the local, regional and state level urban planners and policy makers to better understand and address issues attributed to urbanisation in context to the Real World, for India.

Study area :

In terms of geographic extent, the study area is lying between 08° 04' and 37° 06' north latitudes and 68° 07' and 97° 25' east longitudes. This geographically demonstrate that India is situated in the north of the equator of the earth. In terms of physical features, there are found wide regional diversity. Based on physiographic features, there are four major regional divisions as the Himalaya, indo-gangetic plain, peninsular plateau and coastal plains which are clearly discern by the Fig. 1. Also, there are number of major drainage systems of rivers as the Ganges river system, Brahmaputra rivers system, Indus rivers system and Peninsular rivers system which are draining to the different parts of the country, India, as evidenced by the Fig. 1. These drainage systems have been the lifeline of the major towns and cities since the time of immortal. So, the well-known ancient urban civilization also prospered on the banks of the rivers. In addition to this, the peninsular plateau is surrounded by water by three sides as the Arabian Sea, Bay of Bengal and India Ocean as evidenced by the Fig. 1.



Source: OUP (2018) *Oxford Atlas for India*, Oxford University Press, New Delhi; and CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi

Fig. 1 and 2 : Physical map of India; and the Administrative Divisions map of India, 2011

So, such physiographic features and drainage systems have largely been influenced to the habitation and concentration of urban population into the different parts of the country. Besides this, there are number of administrative divisions. The major administrative divisions at the States level, based on the Census of India, 2011, are presented in the Fig. 2. For instance, there were 28 States and 7 Union Territories based on the administrative divisions of the country, India in 2011.

METHODOLOGY

The present research is based on the compilation, computation, and interpretation of the available digital census data obtained from the Office of the Registrar General and Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi. So, in order to process the big digital data, a number of statistical techniques, methods and models have been applied for analyses. Such as the percentage shares and ratios and the growth rates have been computed for the towns and cities, states and so on levels for different periods. Besides this, the Lorenz Curve method has been used to measure the inequality in the spatial distribution of attributes as the geospatial concentration of urban and rural population in relation to total population (Gastwirth, 1972; Anand, 1983; and Atkinson, 1970). The Lorenz Curve can generally be symbolized by a function $L(F)$, where F , denotes to the cumulative proportion of the population, which is represented by the horizontal axis. And, L , denotes to the cumulative proportion of the urban population or rural population which is represented by the vertical axis. So, for a probability density function $f(x)$ with the cumulative distribution function $F(x)$, the Lorenz curve L is statistically presented as follows:

$$L(F(x)) = \frac{\int_{-\infty}^x tf(t) dt}{\int_{-\infty}^{\infty} tf(t) dt} = \frac{\int_{-\infty}^x tf(t) dt}{\mu}$$

Where:

The symbol μ represents to the averages.

The variable x is represented by function $L(x)$ as x-axis and $F(x)$ as y-axis for plotting.

The Lorenz Curve cannot rise above the perfect equality. In other words, the line of perfect inequality found exists in Lorenz Curve. Thus, the information in a Lorenz Curve may be summarized by the Gini's Co-efficient. The Gini's Coefficient which is a tool to measure the extent of concentration is used in the present research. This method measure of inequalities which is commonly used to gain an over-all view of the prevailing geospatial inequalities. In spite of the limitations of this measuring method, it has been used in the number of studies to compute the spatial concentration of inequalities of various variables (Lorenz, 1905; and Gastwirth, 1972). The statistical presentation of the equation used for calculation of the Gini's Co-efficient is described as follows:

$$G = \frac{1}{100 \times 100} = \left| \sum_{i=1}^n X_i Y_{i+1} - \left(\sum_{i=1}^n (X_i + 1 Y_i) \right) \right|$$

Where:

X_i and Y_i are the cumulative percentage distribution of the two attributes.

In other words, the X_i and Y_i are respectively the cumulative proportions of number of operational holdings and area operated up to the j^{th} size class of holdings.

So, in the present research, in order to eliminate the bias arises due to the changes in the number of each States, the Gini's Co-efficient for the different periods have been computed. In other words, the concentration of urban population and rural population in relation to total population, in terms of Gini's coefficient, for the different States have been worked out for the periods 2001, and 2011 for the country, India. Apart from this, the State level ratios of the population attributes have been presented with the help of geovisualisation technique of the Geoinformatics. So, the geospatial distribution of ratios have been presented with the help of geospatial analysis techniques in form of the chorochromatic and choropleth maps which have been generated for the different periods 2001 and 2011.

The definition of urban area varies from country to country in the world. Besides this, the periodic reclassification of urban also vary within one country over time. Such reclassification making direct comparisons difficult for the urban areas for the different periods (Premi, 2007). For instance, the urban population prior to 1961 are not comparable, due to change of urban settlement definition of the Census of India. It is preferable to make comparison for urban after 1961 onwards. So, for the last about 50 years urban comparison have been worked out in the present research. However, the urban area can be defined by one or more criteria as followed during different censuses. In the Census of India 2011, the demarcation of urban area is based on the specified criteria which are as firstly, "all places with a municipality, corporation, cantonment board or notified town area committee, etc. (known as statutory town); secondly, all other places which satisfied the following criteria (known as census town) as (a) a minimum population of 5,000; (b) at least 75 per cent of the male main working population engaged in non-agricultural pursuits; and (c) a density of population of at least 400 persons per sq. km." (CoI, 2011). Besides this, the increase in proportion of urban population over time calculated as the rate of growth of urban population minus that of the total population. It is a fact that the positive rate of urbanization result when the urban population grows at a faster rate than the total population. Whereas, there is found an increasing concentration of the population in towns and cities over the periods. So, the pace of urban population growth depends on the natural increase of the urban population and the population gained by urban areas through both the net rural-urban migration and the reclassification of rural settlements into towns and cities.

RESULTS AND DISCUSSION

Geospatial Trends of Urbanisation :

The urban population was about to 25.85 million persons in 1901 which accounted for about to 10.84 per cent of the total population. Such increase in urban population recorded over time as it was about to 377.11 million persons in 2011 which accounted for about to 31.14 per cent of the total population. Table 1 and Fig. 3 also shows such kind of increasing pace of urbanization in over the periods. Whereas, the total population was increased from 1028.74 million peoples in 2001 to 1210.85 million peoples in 2011. Likewise, the urban population was increased from 286.12 million peoples in 2001 to 377.11 million peoples in 2011 as also evidenced by the Table 1. The net addition to urban population during 2001-11 was about to 90.99 million peoples. In other words, the proportion of urban population to total population was about to 27.81 per cent in 2001 which increased about to 31.14 per cent in 2011. The 2011 population is almost four times the population of the country since 1951. So, the history of population growth since 1901 divides itself into many natural parts, the point of divisions are as 1921, 1951 and 1981 (Premi, 2007; and Davis, 1962). The 1921 is known as the year of the "Great Divide". This period distinguished itself by the earlier ones. It recorded checkered

population growth from a period of moderately increasing growth. Whereas, the 1951 marks the beginning of a period of rapid population growth. The 1981 is the breakpoint, after which registered some definite signs of slowing down of population growth over the periods as evidenced by the Table 1.

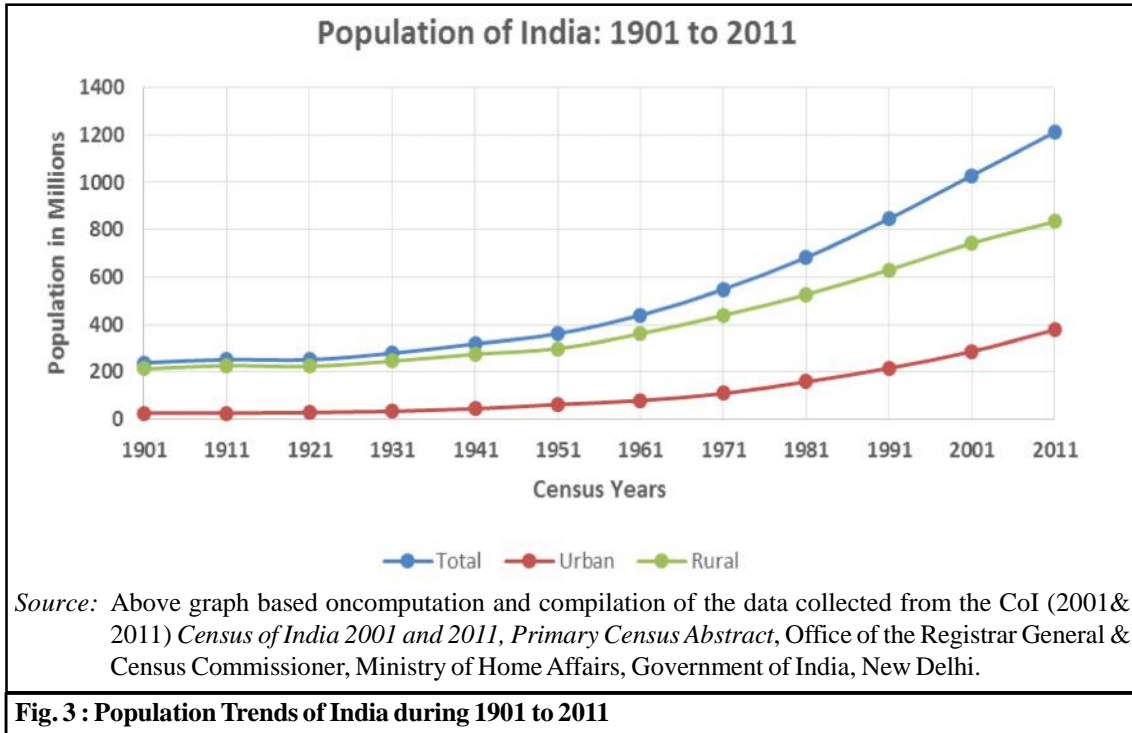
Table 1: Trends of Urbanisation in India: 1901 to 2011

Census Year	Population (in millions)		Percentage of population		% Growth of population			Urban Density/ sq. kms.
	Total	Urban	Urban	Rural	Total	Urban	Rural	
1901	238.40	25.85	10.85	89.15	-	-	-	-
1911	252.09	25.95	10.29	89.71	5.75	0.36	6.40	-
1921	251.32	28.09	11.18	88.82	-0.31	8.26	-1.29	-
1931	278.98	33.46	11.99	88.01	11.00	19.12	9.98	-
1941	318.66	44.16	13.86	86.14	14.22	31.98	11.81	-
1951	361.09	62.44	17.29	82.71	13.31	41.40	8.80	-
1961	439.23	78.94	17.97	82.03	21.64	26.41	20.64	2050
1971	548.16	109.11	19.91	80.09	24.80	38.23	21.86	2513
1981	683.33	157.68	23.08	76.92	24.66	44.51	19.73	3010
1991	846.42	215.77	25.49	74.51	23.87	36.84	19.98	3380
2001	1028.74	286.12	27.81	72.19	21.54	32.60	17.75	3659
2011	1210.85	377.11	31.14	68.86	17.70	31.80	12.27	3688

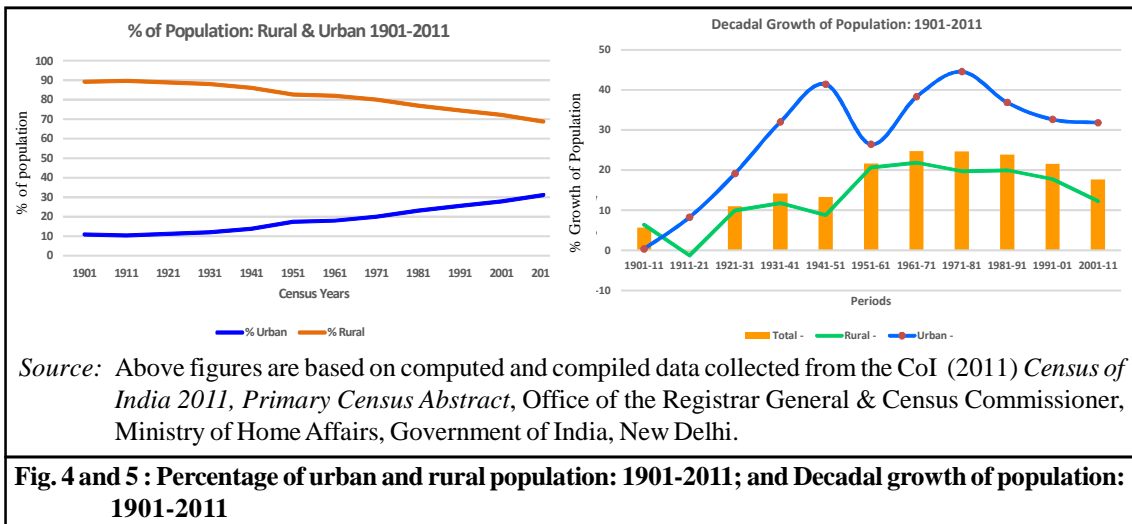
Source: Above table computed and compiled from the data collected from the CoI (2001 & 2011) *Census of India 2001 and 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.

During 1911-21 period, the population was suffered from an influenza epidemic. In other words, the high mortality levels were responsible for the variable growth rate of population before 1921. There were also occurred severe famines and plagues which effected to the large areas of the country. Since 1921, the major causes of high mortality were brought under control. During 1921 and 1951 the population growth risen gradually as evidenced by the Table 1. There was clear indication of gradual increase in population growth from 1931 onwards with a little dip in 1941-51 period as evidenced by the Fig. 4 and 5. It was as a result of large scale movement of population outside and inside of the country. On the other hand, since 1951, there was sharp decline in death rate after independence. In 1951, there were about to 361.09 persons which was nearly doubled about to 683.33 persons in 1981. Whereas, there was a definite decline in population growth rate after 1981 as evidenced by the Table 1 and Fig. 5. Similarly, since 1981 to 2011 there was almost more than double of population from 683.33 persons to 1210.85 persons. But there was recorded a decline in population growth rate from 24.66 per cent in 1981 to 17.70 per cent in 2011.

While dealing with the total and urban population, there were many factors as famines, epidemic, and industrial growth which were responsible for changes over the periods (Michael *et al.*, 2010). For instance, during the first two decades there were occurred famines and epidemics which restricted to total population as well as urban population as evidenced by the Fig. 3. Thereafter, the industrial development was started which contributed an increase of urbanization rate of 13.31 per cent in 1951. On the other hand, due to Second World War and partitioning of the country resulted into an increase in rate of urbanization which accounted for about to 17.29 per cent in 1951. Though, as mentioned earlier that the urban population prior to 1961 are not comparable, due to change of urban settlement definition. Hence, it is preferable to make comparison for the last about



50 years. So, the fast urban growth of 44.51 was recorded during 1971-81. It was due to the reclassification of urban settlements. Thereafter, it was declined to 36.84 per cent in 1981-91 and further declined about to 32.60 per cent in 1991-2001 period. Furthermore, it was declined to about 31.80 per cent during 2001-2011, as clearly evidenced by the Table 1 and Fig. 5.



Whereas, there has been increasing pace of urbanization in terms of proportion of urban population to total population which accounted for 23.08 per cent in 1981. It is found further increased about to 25.49 per cent in 1991, 27.81 per cent in 2001 and 31.14 per cent in 2011 as evidenced by

the Table 1. This is also known as degree of urbanisation. It reflects to a gradual increase in trends of urbanisation over the periods. In other words, there has been an acceleration in the process of urbanization over the periods. In fact, it is also proved by the increasing density of urban population of 2050 and 2513 persons per sq. kms. in 1961 and 1971, respectively, as evidenced by Table 1. Subsequently, it is continuously increased to 3010 in 1981 to 3380 in 1991 and 3659 persons per sq. kms. in 2001. Likewise, it is recorded about to 3688 persons per sq. kms. in 2011. In view of this, it is generalized that there have been increasing concentration of population in urban areas over the periods. India, however, still lives in villages, because the rural population is as high as 68.86 per cent in 2011 as evidenced by the Table 1 and Fig. 5.

i. Growth of Urban Settlements: Towns and Cities :

It is important to mention that the significant feature of urbanization is the growth of large towns and metropolitan cities. Such growth of urban centers are the challenges of urbanization (Vartiainen, 1989) in India. There were about to 12 cities in 1981, which was almost doubled about to 23 cities in 1991. Moreover, their number was further increased to about 35 cities in 2001 and about to 53 cities in 2011 as also evidenced by the Table 2. The metropolitan cities altogether accounted population of about to 108 million in 2001. So, all these metropolitan cities together accounted for nearly 11 per cent of the country's total population and about 38 per cent of the urban population. Urban agglomerations with the population of one million or more were accounted for about 53 in 2011. So, there is found approximately 43 per cent of the urban population living in these cities in India. One of the important aspects of metropolitan growth is that there are favorable geospatial spread of these large cities that may help in achieving the goals of the balanced urban growth in the country, India.

Table 2: Towns, Cities and Urban Agglomerations: 1981 to 2011

Urban Population	1981	1991	2001	2011
Statutory Towns	-	-	3,799	4,041
Census Towns	-	-	1,362	3,894
All Class Towns & Cities – Urban Settlements & Centres (<i>I-VI size classes</i>)	4,019	4,680	5,161	7,935
Urban Agglomerations (UA) & Cities *	216	296	394	475
Urban Out Growth (OG)	-	-	962	981
Metropolitan cities**	12	23	35	53

Notes: * Class-I Town/City with population of 1, 00,000 & above;
** Metropolitan Cities having population more than million plus (+);

Source: Above table computed and compiled from the data collected from the CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.

Whereas, the statutory towns are first category of urban units notified under law by the concerned State and Union territory governments. These statutory towns have local bodies like municipal corporations, municipalities, municipal committees, etc. irrespective of their demographic characteristics. The number of statutory towns are accounted for about 3,799 in 2001 which further increased about to 4,041 in 2011 as evidenced by the Table 2. Besides this, the second category of towns are known as the Census Towns. These are identified on the basis of census data which accounted for about 1,362 towns in 2001 and, later on, increased about to 3,894 in 2011. In addition

to this, the number of all class size towns increased from 4,019 in 1981 to 4,680 in 1991 and further increased to 5,161 in 2001. Furthermore, their number found increased about to 7,935 towns in 2011. So, there by an increase of about to 2,774 towns since the last Census 2001. Many of these towns are part of urban agglomerations and the rest of them are independent towns in the country, India (CoI, 2011).

The urban population projections indicates that by 2030, the urban population will be about 575 million peoples constituting over 40 per cent of total population in India. In lieu of this, there is found that most of the cities are experiencing a steady decline in the quality of physical environment. For instance, there is found a lots of stress on the physical infrastructure, inadequate delivery of basic services, air and water pollution, uncollected wastes, etc. are some of the more recently emerging problems in the urban areas (Smith, 1975). So, the urbanization is inevitable and needs to be considered as positive in national development. The response to increasing urbanization and growth and development of cities needs to be viewed positively. There is no denial of the fact that it should be more balanced and more responsive in context to the national development goals (Turner, 1969). The basic prerequisite of the present is that these cities need to be better managed and efforts are to be made to improve urban governance in the country, India.

ii. Growth Trends of Urban Agglomerations:

The urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths (OGs). In other words, the two or more physically contiguous towns together with or without outgrowths of such towns form the urban agglomeration. The urban agglomeration must consist of at least a statutory town, on the one hand, and its total population including all the constituents put together which should not be less than 20,000, on the other hand, as per the 2001 Census (CoI, 2011). In varying local conditions, there were similar other combinations which have been treated as urban agglomerations satisfying the basic condition of contiguity. There were about 216 cities and urban agglomerations in 1981 which number increased to about 296 in 1991. Likewise, their number was further increased to about 394 in 2001. And, thereafter, it was increased to about 475 in 2011 as evidenced by the Table 2. For instance, the Greater Mumbai and the Delhi Metropolitan, are some of the distinct urban agglomerations of the country, India.

The Outgrowth is a viable unit such as a village or a hamlet, on the one hand. And, an enumeration block made up of such village or hamlet and clearly identifiable in terms of its boundaries and location, on the other hand. Some of the examples of the urban outgrowth are the railway colony, university campus, port area, military camps, etc. All these usually come up near a statutory town

Size of Population	Class/ Category	1981	1991	2001	2011
1,00,000 and above	I	226	322	441	468
50, 000 to 99, 999	II	325	421	496	601
20, 000 to 49, 999	III	883	1,161	1,399	2,047
10, 000 to 19, 999	IV	1,247	1,451	1,563	2,451
5, 000 to 9, 9999	V	920	971	1,041	2,147
Less than 5,000	VI	348	289	232	221
	Total	3,949	4,615	5,161	7,935

Source: Above table computed and compiled from the data collected from the CoI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi.

outside its statutory limits but within the revenue limits of villages contiguous to the town (CoI, 2011). While determining the outgrowth of a town, it has been ensured that it possesses the urban features in terms of infrastructure and amenities such as metalled roads, electricity, tap water, drainage system for disposal of sewage wastes, educational institutions, post offices, medical facilities, banks etc., on the one hand. And, it must be physically contiguous with the core town of the urban agglomeration, on the other hand. There are about to 981 towns outgrowth in 2011 Census as compared to 962 towns outgrowth in 2001 Census in the country, India which is also evidenced by the Table 2.

The Towns and urban agglomerations were grouped on the basis of their population size for different censuses as presented in the Table 3. The towns and urban agglomerations which have at least 1,00,000 population were categorized as Class I urban center. In 1981 census, there were about 226 class I urban centers. Their number was found continuously increased over the periods as evidenced by the Table 3. For instance, these were 322 in 1991 and further increased to 441 in 2001. Likewise, there were about 468 urban centers in the 2011. In other words, out of the total towns and cities of about 7,935, there were about 468 towns and urban agglomerations belonging to Class I category, each one of them having population of one million or more as evidenced by the Tables 3. There were about 160.7 million persons which accounted for about to 42.61 per cent of the urban population settled in these million plus cities and urban agglomerations (CoI, 2011). Whereas, there were about to 18 new towns and urban agglomerations in 2011 which added to this list since the last period 2001.

iii. Growth Trends of Million Plus (+) Cities :

It is noteworthy to mention that there are many million plus cities and urban agglomerations. Some of these large cities and urban agglomerations have more than 10 million peoples. These are known as the mega cities. The Metropolitan cities having population more than million plus accounted for 35 in 2001 and these further increased about to 53 in 2011. During 2011, the largest one was the Greater Mumbai urban agglomeration which accounted for about to 18.40 million population. Whereas, the Delhi urban agglomeration was placed at second which accounted for about to 16.30 million population. At the third place was the Kolkata urban agglomeration which accounted for about to 14.10 million population. While during 2001, the largest urban agglomeration was the Greater Mumbai and followed by the Kolkata urban agglomeration and then by the Delhi urban agglomeration, in term of the ranking based on actual population. Whereas, the population growth of these mega cities were slowed down considerably during the last decade. For instance, the Greater Mumbai urban agglomeration recorded about to 30.47 per cent population growth during 1991-2001 which was decreased about to 12.05 per cent during 2001-2011. Similarly, the Delhi urban agglomeration recorded the growth of about to 52.24 per cent in 1991-2001 which was further decreased about to 26.69 per cent in 2001-2011. Likewise, the Kolkata urban agglomeration recorded the growth of about to 19.60 per cent in 1991-2001 which was also decreased about to 6.87 per cent in 2001-2011. So, all these mega cities growth of population were recorded a considerable decreased over the periods.

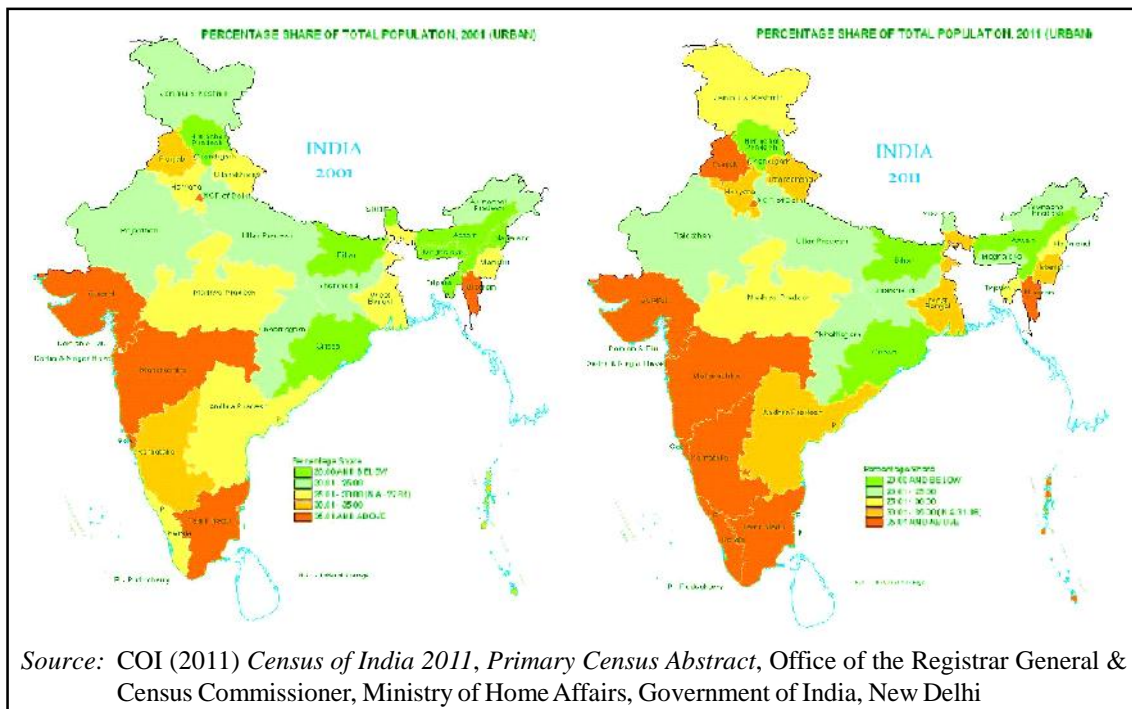
Geospatial Patterns of Urbanisation :

i. State-Level Comparative Urbanisation :

The Geospatial patterns of urbanization in terms of the percentage share of urban population to total population was found high among the industrialized States, particularly, the western and the

southern States as the Gujarat, Maharashtra, Tamil Nadu in 2001 and likewise in 2011 with the addition of Karnataka State in the country, India. So, such comparative scenario of the levels of urbanization in terms of percentage share of urban population to total population at the states levels for the periods of 2001 and 2011 were presented in the Fig. 6 and 7.

During 2001, the low level of urbanisation was found in many States as the Himachal Pradesh, Sikkim, Bihar, Assam, Tripura, Orissa and followed by the Jammu and Kashmir, Rajasthan, Uttar Pradesh, Chhattisgarh, Jharkhand and Arunachal Pradesh. Besides this, during 2011, all these States were also recorded almost the same pattern of low level of urbanization as also evidenced by the Fig. 6 and 7. Whereas, the medium level of urbanization was recorded by the number of States as Punjab, Haryana, Uttarakhand, Madhya Pradesh, Kerala, Andhra Pradesh, West Bengal and Manipur during 2001. On the other hand, such geospatial patterns of urbanization was almost remained the same in 2011, except with some changes which clearly evidenced by comparison of the Fig. 6 and 7.



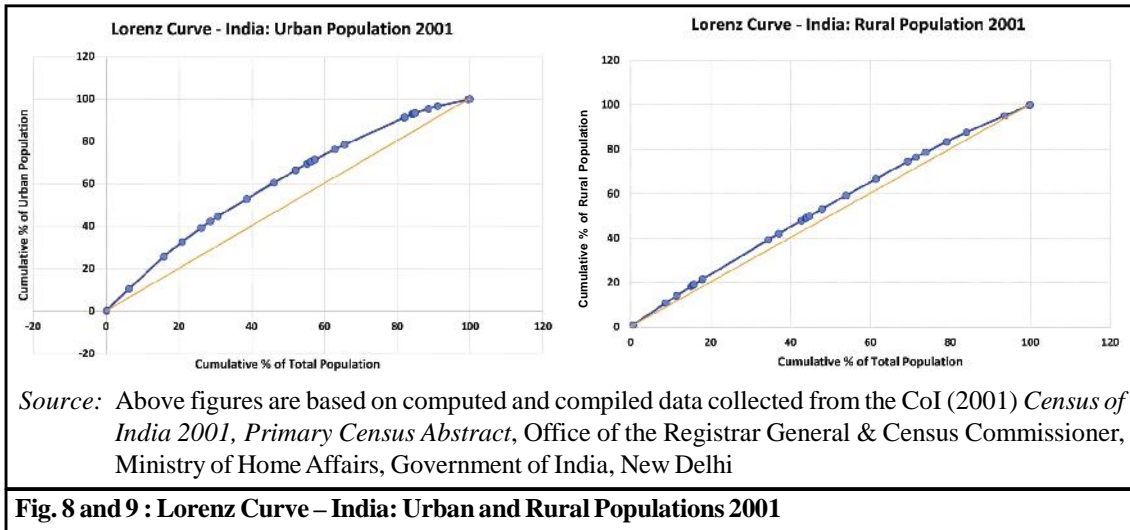
Source: COI (2011) *Census of India 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi

Fig. 6 and 7 : Geospatial Patterns of Urbanisation in India, 2001 and 2011

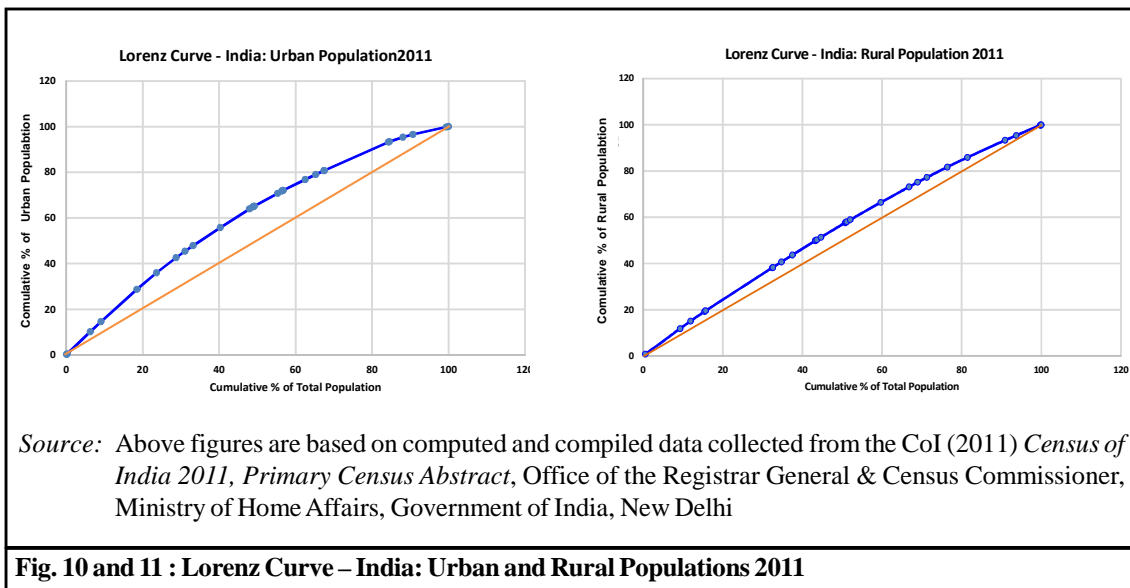
ii. State Level Concentration of Urban Population :

The distribution of geospatial attributes with their inequality was empirically validated in number of studies by use of a measure of the Lorenz Curve. The Lorenz Curve has diagonal line drawn to join beginning and ending points, which is a line of equal distribution (Lorenz, 1905). The deviations of the curve from diagonal line shows the proportional inequality into the distribution of one attribute in relation to the other. In order to comprehend the state of concentration of urban and rural population in relation to total population, it has been used to apply to measure inequality at the States level for the country, India for the periods 2001 and 2011. In other words, the State-wise inequality of the urban and rural population distribution in relation to total population have been computed for

2001 and 2011 periods. So, the concentration of urban and rural population in relation to the total population have been plotted graphically for the periods 2001 in the Fig. 8 and 9.



A close examination of these two curves shows that the distribution of urban population is found more concentrated in relation to total population than that of the rural population in relation to total population during 2001. Because the urban population curve has largely been deviated from the diagonal line than that of the rural population in 2001. So, there is high inequality in distribution of urban population in relation total population in 2001 as evidenced by the Fig. 8. Whereas, the rural population is having less inequality in distribution or is found more equally distributed in relation to total population in 2001 which is clearly evidenced by the Fig. 9.



Likewise, the similar kind of distribution of the urban population and the rural population in relation to total population was found existed in 2011 as evidenced by the Fig. 10 and 11. But, there

is found visible deviation in case of the urban population by the close examination of the two curves, which indicate that the distribution of urban population found more concentrated in relation to the total population. Whereas, in case of the rural population which is not much deviated from the diagonal line shows that it is evenly distribution in relation to total population in 2011, which is also evidenced by comparison of the Fig. 10 and 11. However, it is important to mention that the urban population in relation to total population is found more concentrated over the periods from 2001 to 2011 as evidenced by comparison of the Fig. 8 and 10. While the concentration of rural population in relation to total population is found remain the same or marginally deviated over the periods from 2001 to 2011 as evidenced by comparison of the Fig. 9 and 11. So, such kind of inequality in distribution of the urban population and the rural population distribution in relation to the total population over periods is also found existed over periods which is discernable by comparison of the Gini's Coefficient values as presented in the Table 4.

Table 4: Gini's Co-efficients for Urban and Rural Population:2001 and 2011		
Population	Periods	
	2001	2011
	Gini's Co-efficients	
Urban Population	0.205	0.214
Rural Population	0.075	0.092

Source: Above table computed and compiled from the data collected from the CoI (2001 and 2011) *Census of India 2001 and 2011, Primary Census Abstract*, Office of the Registrar General & Census Commissioner, Ministry of Home Affairs, Government of India, New Delhi

It is a fact that the Gini's co-efficient values shows the overall concentration found in any attributes curves which is also measured numerically in terms of the ratio of the area under the curve and the line of equal distribution to the areas of the triangle formed by the x-axis and the y-axis and the line of equal distribution. Based on the results presented in the Table 5, the urban population values of Gini's Co-efficient of 0.214 shows more concentrated during 2011 in comparison to the value of 0.205 for the period 2001. Such comparison of concentration of the rural population are found varying over the periods from 2001 to 2011. Whereas, the urban population values showed more geospatial concentration in comparison to the rural population over the periods from 2001 to 2011 as also evidenced by the Table 5. So, it is interesting to note that the concentration of both the urban population and the rural population were found varying over the periods, on the one hand. And, these Gini's Co-efficient values are found slightly increased over the periods. However, the distribution of urban population is more geospatially concentrated than the rural population which is evenly found distributed over the periods 2001 to 2011 as evidenced by the Table 4.

Conclusions and Suggestions :

The process of urbanization is led by the demographic explosion of population, on the one hand and widespread of poverty due to rural to urban migration, on the other hand. It is interesting to point out that the process of urbanization is boosted up, due to rural push, not due to urban pull. In other words, the process of urbanization is not only due to migration; but it is also caused by the natural increase or demographic explosion of population. For instance, in the recent past, there is experienced a significant increase in pace of urbanisation in the country, India. Urbanization commence with an increase in percentage of population living in urban areas. Urbanization increased from 27.81 per cent in 2001 Census to 31.16 per cent in 2011 Census. So, there was slowing down of overall growth rate of population due to the sharp decline in growth rate in rural areas, while the

growth rate in urban areas almost remained same. There has been a spurt in growth of population in urban areas in the country, which could be due to the migration, the natural increase and the inclusion of new areas under the urban in form of towns and cities. The definition of urban area varies from country to country in the world. The periodic reclassification of urban also vary within one country over time. Such reclassification making direct comparisons difficult for the urban areas for the different periods.

The Geospatial patterns of urbanization in terms of the percentage share of urban population to total population was found high among the industrialized States. Whereas, a close examination of the Lorenz curves shows that the distribution of urban population is found more concentrated than that of the rural population in relation to total population during 2001 and 2011. So, it is interesting to note that the concentration of both the urban population and the rural population are found varying over the periods, on the one hand. And, these attributes values were found slightly increased over the periods from 2001 to 2011. In addition to this, the significant feature of urbanization is the growth of large towns and metropolitan cities. The Cities act as beacons for the rural population as they represent a higher standard of living and offer opportunities to people not available in rural areas. Megacities grow in urban population; but these are considered neither in urban prosperity, nor in socio-cultural development. Such growth of urban centers are the challenges of urbanization. While glance through the problems of urbanization, there are found many as lopsided urbanization, faulty urban planning, urbanization with poor economic base, on the one hand. Some of the basic problems are as housing, slums, transport, water and air pollutions and so many, on the other hand. Thus, the urban population projections indicate that by 2030, the urban population will be about to 575 million constituting over 40 per cent of total population in the country, India. So, the urban planners and policy makers should emphasized on the new urban areas development and the implementation of urban renewal schemes for sustainable urban development in the country, India.

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