AN IDENTIFICATION OF URBAN PATTERN ON 1981 TO 2011 OF THE NASHIK CITY, MAHARASHTRA.

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Abstract:

The growth of urbanization in the world increasing trends and many scholars agree to the estimation of world population in 2030 would be 5 billion. The urban growth in India is on increasing trends with acceleration stage from 1991, as per the Census, 2011 the total urban population is 31.16 %. About 45.23 % of population is urban in Maharashtra state (Census, 2011). The Nashik district has about 24.33 % urban population. It was using the data SOI Toposheets, Landsat TM, Landsat (1991), ETM+ (2001), LISS-III (2011) and with help of Spatial Auto correlation Global Moran's I, settlement theory and visual interpretation techniques. The analysis revealed that the urban growth in Nashik city follow a regular radial pattern. Ribbon pattern of sprawl is observed along the highways and leapfrog pattern towards the fringes of study area due to employment opportunities, cultural and educational facility. Therefore, identification and analysis of the urban growth pattern may help in effective land use planning and making decision for urban landscape planning and environmental management.

Key words: Urbanization, Spatial Auto correlation, Ribbon, Leapfrog.

Introduction:

Urbanization is the process of changing from rural to urban areas (Ourng and Rodrigues, 2001). The growth of urbanization in the world is on increasing trends and many scholars agree to the estimation of world population in 2030 would be 5 billion. The urban growth in India- increasing trends with acceleration stage from 1991, as per the Census, 2011 the total urban population is in India 31.16 %. About 45.23 % of population is urban in Maharashtra state (Census, 2011). The Nashik district has about 24.33 % urban population. It was using the data SOI Toposheets, Landsat TM, Landsat (1991), ETM+ (2001), LISS-III (2011) and with help of the help of Spatial Autocorrelation Global Moran's I, settlement theory and visual interpretation techniques (Gadakh and Jaybhaye,2015).

Urban form is a "pattern", representing the spatial characteristic of the urban area at a certain time. Urban form is also a "process", indicating the spatial change over time. The pattern is the outcome of the process (Ronghua, 2008). Both patterns and processes are closely linked to several factors, such as social, economic and cultural. A settlement which considers buildings as clusters around a particular point, controlled by the natural factors, including flat area, rivers and its intersections and mountains is called a clustered settlement pattern.

Wilson et al. (2003) identified three categories of urban growth: in fill, expansion, and outlying; with outlying urban growth further separated into isolated, linear branch and clustered branch growth. Sprawl development consists of three basic spatial forms-low-density, continuous sprawl, ribbon sprawl and leapfrog development sprawl (Barnes, 2012, Harvey and Clark 1971). Urbanization takes place either in radial direction around a well-established city or linearly along the highways. This dispersed development along highways, or surrounding the existing urban built up area or in rural countryside is often named as urban sprawl (Theobald, 2001). Urban areas have been classified as places attracting people because many facilities, infrastructures, and services are provided. It is the centre of business, economic, education, commercial, industry, and a huge source of income (Ourng and. Rodrigues, 2001, Pacione, 2009). Communities live and work in towns and cities; if society changes, urban form also changes and growths. Meanwhile, monitoring approaches and real-time mapping using Geographic Information System (GIS) and Remote Sensing (RS) integration

are useful techniques to identify urban growth pattern and its rate. A model for urban growth pattern identification is proposed and a case study in Nashik city is explored (Ourng and Rodrigues, 2001)

Study area:

The city of Nashik is situated in the State of Maharashtra, in the northwest of Maharashtra, on between 19° 54'40" North latitude to 20° 05'08" North latitude and between 73° 41'08"East longitude to 73° 54'22" East longitude. It is connected by road to Mumbai (185 kms.) and to Pune (220kms.). Nashik is one of the most important cities of Northern Maharashtra. The city has become the centre of attraction because of its beautiful surroundings and cool and pleasant climate. Nashik has a personality of its own due to its mythological, historical, social and cultural importance. The city, vibrant and active on the industrial, political, social and cultural fronts, has influenced the lives of many great personalities. The river Godavari flows through the city. Temples and Ghats on the banks of Godavari have made Nashik one of the holiest places for Hindus all over the World. Nashik city is one of the five places in India where the famous Kumbh Mela is held once in 12 years (Gadakh and Jaybhaye, 2015).

Objective:

1.In the present study, the emphasis is given the following. However, the specific study objectives are:

2. Identification of urban pattern over period of the study area.

Methodology :

Methodology is one of the important parts of analysis. Output or result of analysis highly depends on the methodology will be used for the data processing or analysis purpose. To achieve the above objective following methodology has adopted Methodology of identification of urban pattern in

Nashik city:

This study used GIS and Remote sensing integrated approach for detecting the land use/land cover especially urban growth pattern from 1981 to 2011. Spatial autocorrelation Global Moran-I, pattern of settlement theory and visualization interpretation are used to identify the urban sprawl in Nashik city. Satellite images have acquired from Landsat TM 1991, Landsat ETM+ 2001 and IRS P6 LISS -III 2011 to produce the land use classification map. The detection of urban area change in Nashik City has achieved generating land use maps in order to identify the pattern of urban sprawl. The urban sprawl and the direction of growth of Nashik City town can be explained with the help of pattern of settlement theory, visualized interpretation, and spatial autocorrelation Global Moran I.
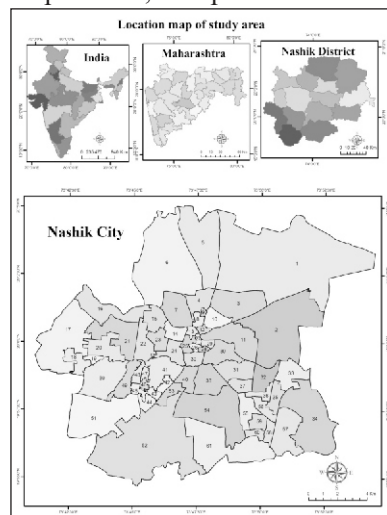

Figure No 1: Location map of the study area

Geographic pattern analysis is very significant tool to understand geographical phenomenon. Statistical analysis has been used to identify spatial pattern. Spatial autocorrelation statistic has been applied to detect the pattern of urban area through time. Spatial autocorrelation statistic measures and analyses the degree of dependency among observation in a geographical space. Global Moran I, a measure of spatial autocorrelation, which is used to measures spatial autocorrelation based not only on feature locations or attribute values by itself but on both feature locations and feature values simultaneously. Given a set of features and an associated attribute, it classifies the pattern as clustered, dispersed and random. The tool calculates index value I ranging from +1 to -1 respectively showing clustering and dispersion, as well as a Z value showing the significance of I.

Global Moran's I evaluates whether the pattern expressed is clustered, dispersed, or random. When the Z score or p-value indicates statistical significance, a positive Moran's I index value indicates tendency toward clustering while a negative Moran's I index value indicates tendency toward dispersion.
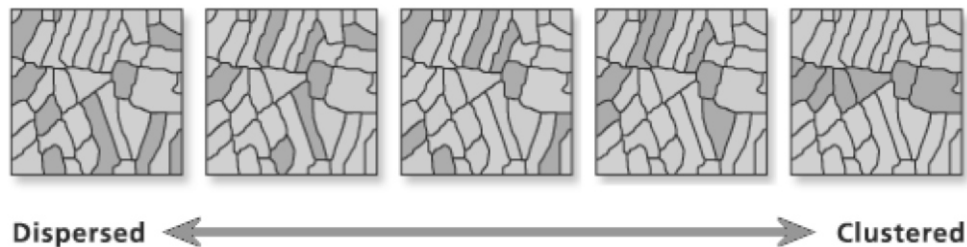
Source-Arc Toolbox

Figure: 02: Spatial Autocorrelation Global Moran-I

After the Spatial Autocorrelation (Global Moran's I) tool has computed the Index value, it computes the Expected Index value. The Expected and Observed Index values are then compared. Given the number of features in the dataset and the variance for the data values overall, the tool computes a Z-score and P-value indicating whether this difference is statistically significant or not. Index values cannot be interpreted directly; they can only be interpreted within the context of the null hypothesis. In the case of the Spatial Autocorrelation tool, the null hypothesis states, "there is no spatial clustering of the values". When the Z score is large (or small) enough to such that it falls outside of the desired significance, the null hypothesis can be rejected. When the null hypothesis is rejected, the next step is to inspect the value of the Moran's I Index. If the value is greater than 0, the set of features exhibits a clustered pattern. If the value is less than 0, the set of features exhibits a dispersed pattern (Arc toolbox, 10.00, Ourng, 2012).

vIdentification of urban pattern:

Urbanization occurs when cities grow at the cost of their surrounding countryside, suburbanization and ex-urbanization when the inner ring or commuter belt grows at the expense of the urban core. Urbanization takes place either in a radial direction around a well-established city or linearly along the highways. This dispersed development along highways (Jain, 2001), surrounding the city and in the rural countryside is often referred as urban sprawl.

This pattern starts with a small number of households and expands to the large size of household with time. A settlement which is opposite to the clustered settlement pattern is called dispersed settlement pattern. Dispersed pattern is considered mainly for farm land which is away from the household. This settlement is mainly for the community center such as temple, market, and school, and also depends on the size of these areas. The mix between the cluster and dispersed settlements is called random settlement. This settlement starts with cluster system. Some people need to be isolated after the settlement expands and settle down away from the village. Finally, linear settlement is a

pattern that follows a line along the road or river, and mostly occurs in the flat area.

In the developed their research on mining the urban sprawl pattern, a case study on Sunan, China (Ronghua et al. 2008). The evolution of an urbanized area by means of complementary approaches, especially different fractal and autocorrelation measures. They employed the spatial autocorrelation Global Moran I and Sprawl intensity index to identify the urban sprawl pattern in Sunan, China. Sunan's urban cluster is becoming more and more homogenous and compact and is growing along the transportation axes (Saravanan et al. 2010). The introduced visualization approach with the help of city model-Mon centric to identify the urban sprawl pattern in Madurai region, India. The urban expansion of Madurai has identified the temporal and spatial development by using multi-temporal RS images and GIS technique.

The pattern of sprawl has been described using visual interpretation techniques. The result showed that the pattern of urban sprawl of Madurai is identified as linear along the major roads (Michael 2009). Moalabi conducted his research on measurement of the urban sprawl pattern in Lokoja, Nigeria (Moalabi, 2008). The study used the GIS approaches and the application of Shannon's entropy theory to measure the behavior of sprawl.

The measurement of entropy is derived based on the two location factors, distance from roads and distance from the town center to reveal and capture spatial patterns of urban sprawl. The results showed that Lokoja is experiencing growing along the major highways. The total entropy value of the town indicated a value -1, which is an indication of the occurrence of sprawl. Huiping and others (2005) have proposed the study of developing urban growth prediction from spatial indicators based on multi-temporal images.

An integrated of remote sensing and GIS technique were applied to detect the spatial distribution of land use and spatial-temporal pattern over the years. Moreover, multivariate model was adopted to determine the relationship between urban expansion and factors related to growth. Finally, land use/land cover pattern was integrated with multivariate spatial model to estimate the spatial distribution of future urban expansion.

Nashik city: Identification of Urban Pattern, 1981

It has been found that Nashik city has been spreading up of with various patterns since 1981. The pattern mainly comprises clustered, isolated, dispersed, Expansion etc. The cluster pattern has found in old Nashik city because of high density of built up area. Some important place like as old area oldest offices, Sarkarwada police station, Bhadrakali area, Kazipura, Nagapura market, Raviwar Peth, Saraf market, Nashik Gyamakhana, Nashik court, M.G. Road, some temple like Kalaram Tempale; Sundar Narayan temple, some religious place like Ramkund, Laxman kund, Sitakund and other place like Shialimar, police ground, Nashik bus stand and core part of the city were developed in the form of cluster.

Isolated pattern was found in the Nashik road area. Nashik Road area situated 10 km away from the Nashik city. Along with railway station, central jail, currency press, Deolali cantonment board was developed in the area. Some villages were also incorporated in the corporation area. The people working in the above said place settled in and around their offices. Because of which the isolated pattern was observed in Nashik road area.

The newly incorporated villeges near boundary of Municipal Corporation shows the scattered as well as dispersed type of settlement pattern. Most of the villagers were vegetable grower. Demand of vegetables is high in city markets and by selling the vegetables they can earn some money. The expansion in built-up area was mainly observed in Satpur and Nashik west region and along Nashik-Trimbakeshwar road and also in Satpur MIDC area.

The Moran's Index based statistical analysis (fig.03) represented outcome value is 0.6583; it is nearer to which +1.0000 indicates clustering pattern. The statistical result is significant which p-value is 0.000000 ($p < 0.05$). Given the z-score is 30.93.

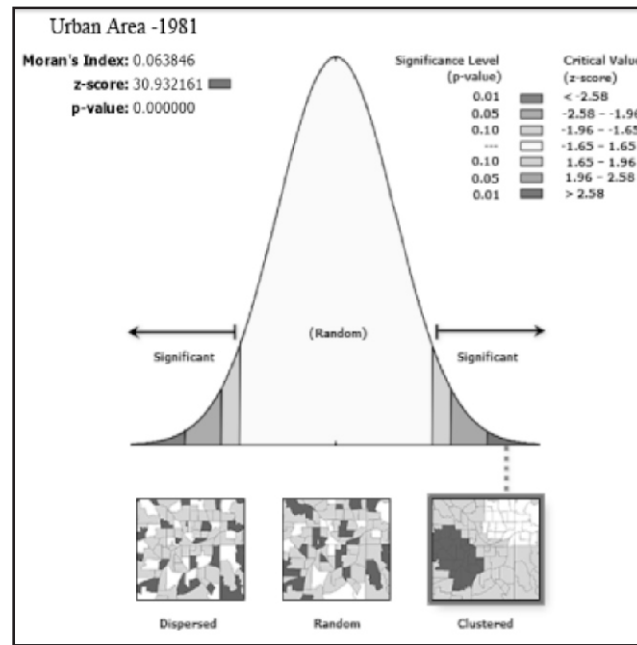spatial distribution of urban pattern in 1981 is clustered (Figure 03).

Figure 03: Urban pattern,1981

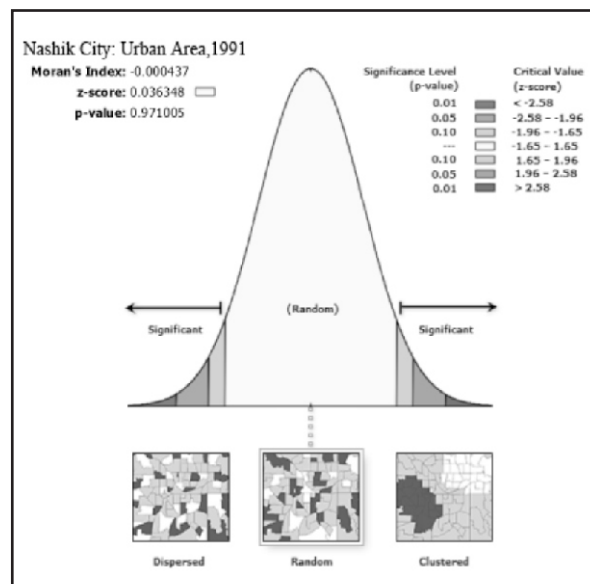**Nashik City: Identification, Urban Pattern, 1991**

Figure 04: Urban pattern, 1991

In 1991, Nashik city was developed with various patterns. It is easily comprehended by visualized interpretation and settlement theory. The scattered pattern was found northern as well as southern part of Nashik city. Scattered pattern observed in this area because of peripheral villages like Mhsrual, Adgaon, and Makhamalabad area and villages to along southern side part of city Pathardiagon, Gulane, Pimpalgaon Bhula etc. The clustered pattern was found in the main city along right and left side of the river. In the area of old city, covered by some Govt. Offices, Civil Court, municipal corporation office, Police ground, Bus stand; market (Shalimar), Hospitals, Govt. Land records office etc.

Linear pattern was found mainly along with National highways Mumbai-Agra (NH-03) National highways, Nashik-Pune (NH-50) National highways. Isolated pattern was found in Nashik road area.

The Moran's Index based statistical analysis (fig.04) represented outcome value is -0.0004; it is nearer to the near to +1.0000 indicates randam pattern. The statistical result is significant which p-value is 0.9710 ($p < 0.05$). Given the z-score is 0.0363. It is clearly represents the spatial distribution of urban pattern in 1991 is randam (Figure 04).

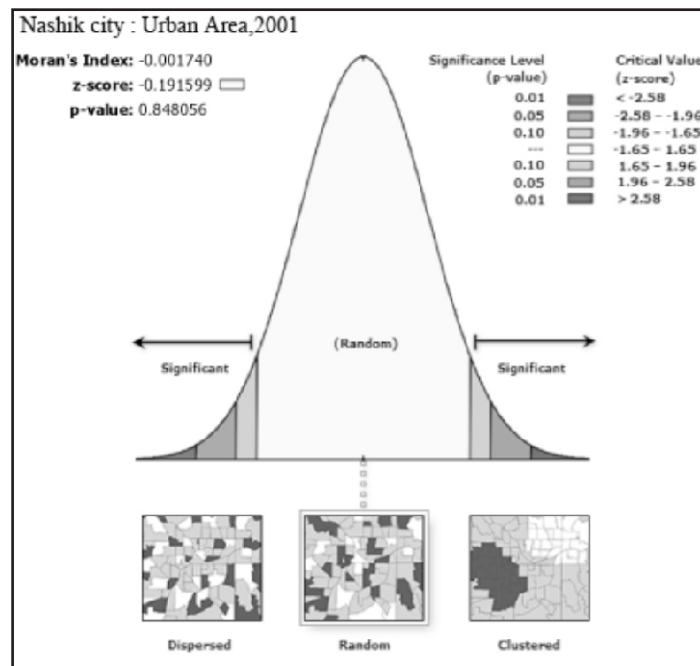**Nashik City: Identification, Urban Pattern, 2001**

Figure 05: Urban pattern, 2001

In 2001, Nashik city comprises various urban patterns. It is clearly identified with the help of settlement theory and visual interpretation of built-up area map of the city. Linear pattern was found on Nashik- Pune highways and Mumbai-Agra highways. Clustered pattern was found in the core part of the city. In the western part of the city and southern part of the city shown new expansion was observed. The cluster pattern was found in Satpur area because numbers of companies were established like as CEAT, ABB Pvt, Graphite India, and Asian electronic Pvt Ltd.

The Moran's Index based statistical analysis (fig.05) represented outcome value is 0.0017; it is nearer

to the near to +1.0000 indicates clustering pattern. The statistical result is significant which p-value is 0.8480 (p < 0.05). Given the z-score is -0.1915. When the Z score or p-value indicates statistical significance, a negative Moran's I index value indicates tendency toward dispersion. It is clearly represents the spatial distribution of urban pattern in 2001 is randam (Figure 05).

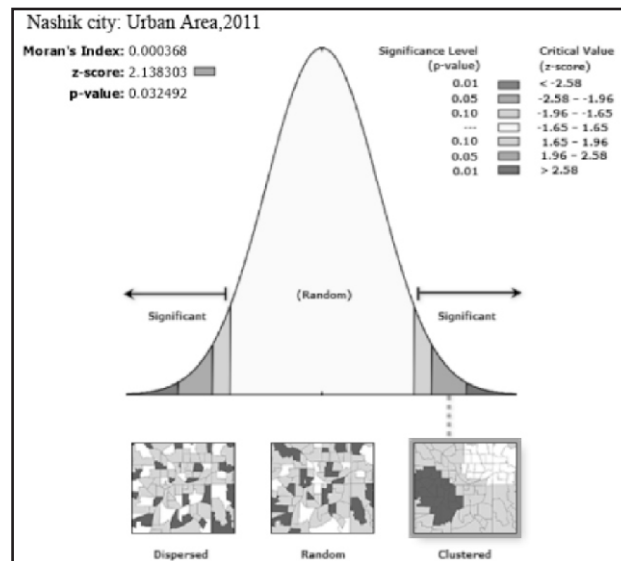**Nashik City: Identification, Urban Pattern, 2011**

Figure 06: Urban pattern, 2011

In 2011, tremendous change was observed in built up area of Nashik city. It was mainly due to linear and expanded area converted in to clustered due to urbanization process (built-up area) was increased. Most of the people like the calm and cool environment of Nashik city, therefore they settle largely on the fringe area of the city. In 2011 Newly suburban areas was found in and around the Nashik city. Nashik road area and surrounding area, adjoining roads in this area now converted cluster area. Linear pattern has observed along with Mumbai-Agra national Highway and Nashik-Pune road.

The Moran's Index based statistical analysis (fig.06) represented outcome value is 0.0003; it is nearer to the near to +1.0000 indicates clustering pattern. The statistical result is significant which p-value is 0.03249 (p < 0.05). Given the z-score is 2.1383. It is clearly represents the spatial distribution of urban pattern in 2011 is clustered (Figure 06).

Findings:

 *Following patterns of urban sprawl has been identified with the help of Spatial Autocorrelation Global Moran's I, settlement theory and visual interpretation of built-up area map:

*In 1981 Pattern of urban sprawl to identified Based on Moran's I statistical analysis, showed that the Moran's I Index value 0.6583, which is near to +1.0000 indicates clustering pattern. The statistical result is significant which p-value is 0.000000 (p < 0.05). Given the z-score of 45.92, the spatial distribution of urban pattern in 1981 is clustered

*In 1991 Pattern of urban sprawl to identify statistical result is significant with p-value is 0.9710 (p < 0.05). Given the z-score of 0.0363, the spatial distribution of urban pattern in 1991 is randam.

*In 2001 pattern of the statistical result is significant with p-value is 0.8480(p < 0.05). Given the

z-score of -0.1915, the spatial distribution of urban pattern in 2001 is Randam.

*In 2011 pattern of the statistically result is significant which p-value is 0.03249 ($p < 0.05$). Given the z-score of 2.1383, the spatial distribution of urban pattern in 2011 is clustered.

*Nashik city: urban pattern (1981): During1981 various found of pattern of urban sprawl mainly in the old Nashik city is clustered, Nashik road was isolated. Nashik city surrounding area was Scattered and Satpur and MIDC area in expansion stage.

*Nashik city: Urban pattern (1991): During the decade ending1991 patterns of urban sprawl were observed. The clustered pattern was found in old Nashik city and core part of it. Liner pattern is mainly along National highways No-03 and No-50. Isolated pattern has mainly occurred in Nashik road area. Expansion pattern is Ambad and Satpur MIDC area due to industrialization. Scattered pattern is found in the villeges of in municipal corporation limit.

*Nashik city: Urban Pattern (2001): Various urban patterns of urban sprawl have been observed in the decade from1991-2001. The most of the area is covered by clustered pattern found mainly in the old Nashik city, core part of the city and MIDC area of Satpur. Liner pattern has been seen along the National highway No-03 and No-50 and state highways like Nashik to Dindori road and Peint road. Isolated pattern is mainly occurred in Nashik road area. Expansion pattern has been found in Ambad MIDC area and Pathardi phata area due to industrialization. Scattered pattern is found of villeges of surroundings area like Adgaon, Pathardigaon, Makhamalabad, Chehadi area.

*Nashik city: Urban Pattern (2011): urban sprawl in the decade from 2001-2011 has been marked by mainly clustered in found the old Nashik city, core part of city and MIDC area of Satpur and Ambad area. Liner pattern is limited to areas National and state highways The analysis has depicted that urban sprawl has been observed as clustered and liner pattern which eventually have been merged into each other to form continuous urban area.

Conclusion:

Urban expansion of Nashik and identifies the temporal and spatial development pattern by using Remote Sensing and Geographic Information System approach. The urban area shall be extended to the east, the west, and the south direction while the north direction. Therefore, identification and analysis of the urban growth pattern may help in effective land use planning and making decision for urban landscape planning and environmental management.

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