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Population Growth and Urban Expansion in Noida City

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Abstract

Since the end of the cold war, the world statistics had seen the population increased in over the world especially in South - East Asia. In this context, the issues are ranging population growth among the cities of India the second largest population in over the world behind China. The pressure of that population growth and their accommodation are become the need for a large understanding of the impact of the correlation between population growth and urban expansion not only for the benefit of a great planning, but also for the sustainability of the city with the climate change. That is why during 1990s in India different projects was undertaken and become an urgent to planning and protects the planet from the higher increase of population.

Increase urban called again urban expansion is determined by three factors namely natural growth, rural-urban migration, and re-classification of area from rural to urban. This process takes place due to the intensification of human activities including marketization and industrialization. Thus, by remote sensing and GIS technology but again with mathematical tools has revolutionized this work and gives the power to handle it in quickly with satellite images of the Noida City to observe with clearly the spatial and social problems. For these facilities of science and technology, our study of the period of 1991, 2001 and 2011 affirm with details the major problems of the City of Noida and showing the different recommendations that can help to stop the evolution in the next year.

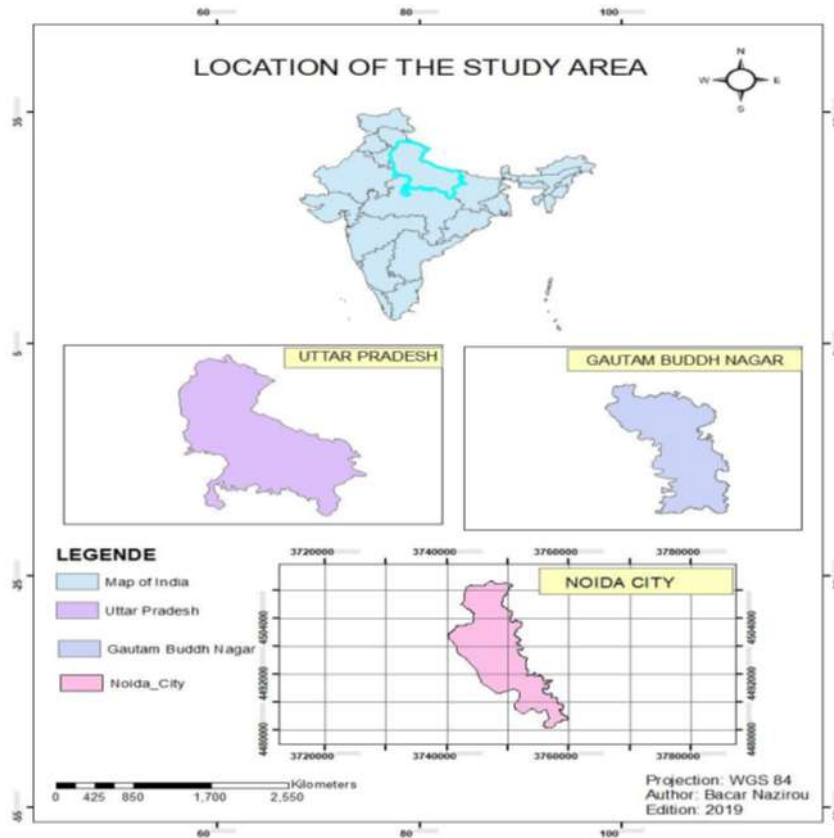
Keywords: Population growth, Urban Expansion, Industrialisation, Noida.

Introduction

Population growth is basically known as the increase in number of populations in a country, state, or city. This phenomenon has been observed in over the world incurious especially in South - East Asia with India, the second largest population in over the world behind China. The resulting process of continuous increasing of the population, allowed to the sustained expansion of the housing growth, behind the reduction of the vegetation areas in many cities of the world. However, the increase of the population and their standard satisfaction has been seen in India as the driving forces of many problems of the cities and the planet in whole.

The Noida city (also called the New Okhla Industrial Development Authority) is a north India city located in Gautam Buddha Nagar district of the northern state of Uttar Pradesh with Greater Noida the administrative headquarters. This district is belonging the National Capital Regional NCR of Delhi that was developed and planned to accommodate population growth influx from Delhi after the UP Industrial Areas Development Act, 1976. The Noida city is located 25 km south-east to the capital city of India New Delhi and the north-west 457 km to Lucknow the capital city of Uttar Pradesh.

The planning area of the Noida is much better compared to other cities in all India but again the study of population growth and urban expansion in Noida has been seen very important to ensure the environmental condition and for the sustainability of the townsfolk. The current study aims to study population growth and spatial urban expansion of Noida city, to understand the sequence in growing of the Noida's population and the link between the population and the urban expansion over the times.



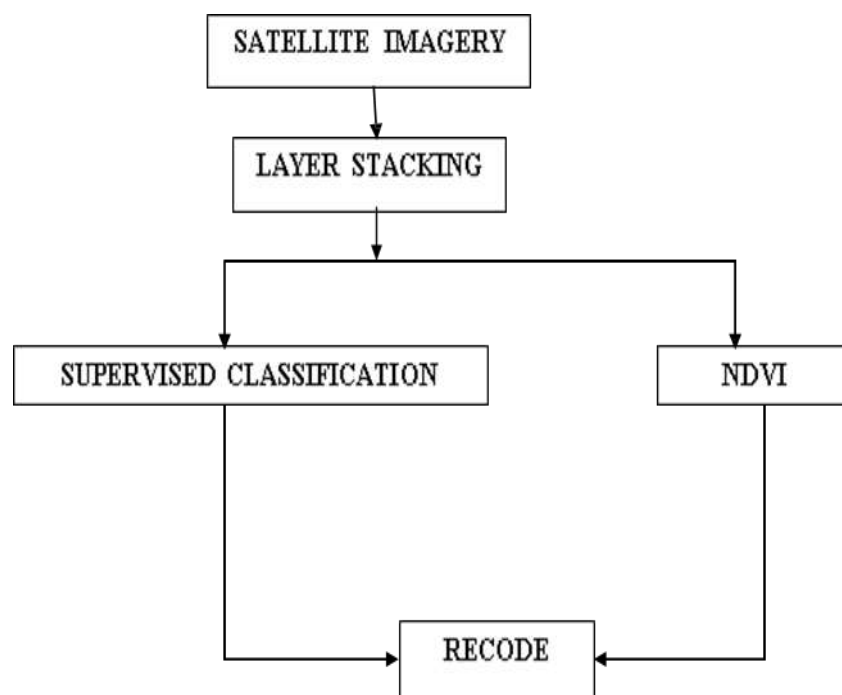
Methods and Methodology

In this study, two kinds of databases are used. The first is the spatial database or map database, which may also be referred to as geographical databases. The other kind of database is on the attribute information of the spatial data. According to the objectives of the study, the spatial digital databases have been developed for various types of map features. Thus, some of the features are developed interactively with the period of the study on various occasions. The map database contains the built-up area and vegetation cover attributes of respective features. These are generally developed with the Arc map and Erdas coverage and at later stage converted into Arc view shape files or

other formats for further analysis.

- To assess the spatial expansion of urban built up areas.
- To assess the correlation between population growth and urban expansion of the area
- To assess the impact of spatial expansion of built up upon vegetation cover of the area
- To suggest measures in preventing the environment degradation and balancing land man ratio

The spatial database that has been created for the following types of map units or the feature



The methodology for fulfilling specific objectives using various sets of created data is described in relevant section of the study. To acquire the results depending on variable kinds of data available to be used to get the best results as per the objectives.

Data models that must be prepared for various operations in Arc map and Erdas image processing need very careful attention, because they are very complex in nature. For practical purposes, the special component of geographic information is represented in the form of co-ordinates, which are ordered measurement inside a spatial reference system as raster models of the representation of the Area study. Quantitative assessment and geographical representations have been made and analyses have been made for various themes individually or in combinations.

The cartographic representations of collected information, calculation of population, integration and analysis of databases have been done by Arc map and Erdas image processing. All the available tools are fruitfully utilized to derive meaningful layer of thematic information and generating spatial models by integrating the databases.

Satellite Imagery: A representation of the measurement of energy emitted or reflected by the Earth in a variety of wavelengths. Earth observation imagery takes several forms, of which the most traditional are optical and near infrared radiation, from about 0.4 (blue) to 2.0 (IR) micrometers. In remote sensing the imagery gathered by the Earth orbiting satellites and the images are in specific wavebands (visible, infrared, etc.) which may be combined for purposes of interpretation.

Layer Stacking: This is a method designed to modify neighboring pixels in a single Landsat, creating a final aesthetic image and guaranteed accuracy by using ERDAS Imagine. In other words, the layer stacked, or bands stacking is a digital image processing technique which combines multiple images taken at a different distance to give a result image with a great depth of field than any of the individual source images. The data requested are satellite image data, computer system and Erdas software.

Clipping Image: In remote sensing Clipping means cutting out of some area from a map, Atlas or from satellite image. This method can be done in ArcMap or Erdas and add the stacked image and shapefile of that area of need, then extract the stacked image and the area shapefile in the same map.

Supervised Classification: For supervised classification, we first start with specifying an information class on the image. An algorithm is then used to summarize multi-spectral information from the specified areas on the image to form class signatures. This process is called supervised training; supervised training is closely controlled by the analyst. In this process, we select pixels that represent patterns or land cover features that we recognize, or that we can identify, with help from other sources, such as aerial photos, ground truth data, personal experience, previous studies or maps, knowledge of the data and of the classes desired, is required before classification. By identifying patterns, we can instruct the computer system to identify pixels with similar spectral characteristics and to assign the pixels into respective class to which it has maximum similarity. If the classification is accurate, the resulting classes represent the categories within the data that we

originally identified. Supervised classification is much more accurate for mapping classes, but largely depends on the cognition and skills of the image analyst.

Recode: This method is to shift the miss class pixel into general categories in the study area image through Erdas Raster Recode. Recode is very important to give more accuracy of the classification map.

NDVI: The normalize Vegetation Index (NDVI) is a single graphical indicator that can be used to analysis remote sensing measurements, typically, but not necessarily, from a space platform, and assess whether the target being observed contains live green vegetation or not. Ranges of NDVI started from -1 to 1. It is the most popular and frequent vegetation index. It is effective vegetation index. It is effective NDVI is calculated as follows,

$$NDVI = (NIR-R) / (NIR+R)$$

Net Change: The percent change from one period to another

$$PR = \frac{(V \text{ present} - V \text{ past})}{V \text{ past}} \times 10$$

PR= Percent Rate, V present = Present or future value, V past = Past or Present value

The annual percentage growth rate is simply the percent growth divided by N, the number of years.

Land Change Analysis and Urban: Modification of the land over the time

$$ALUCRa. ta. t = \frac{(LUa.t - LUa.t - 1) / LUa.t - 1}{(NT - NT - 1)} \times 100$$

LUa.t= Present, LUa.t= Past

Population Density: The measurement of population per unit area or unit volume.

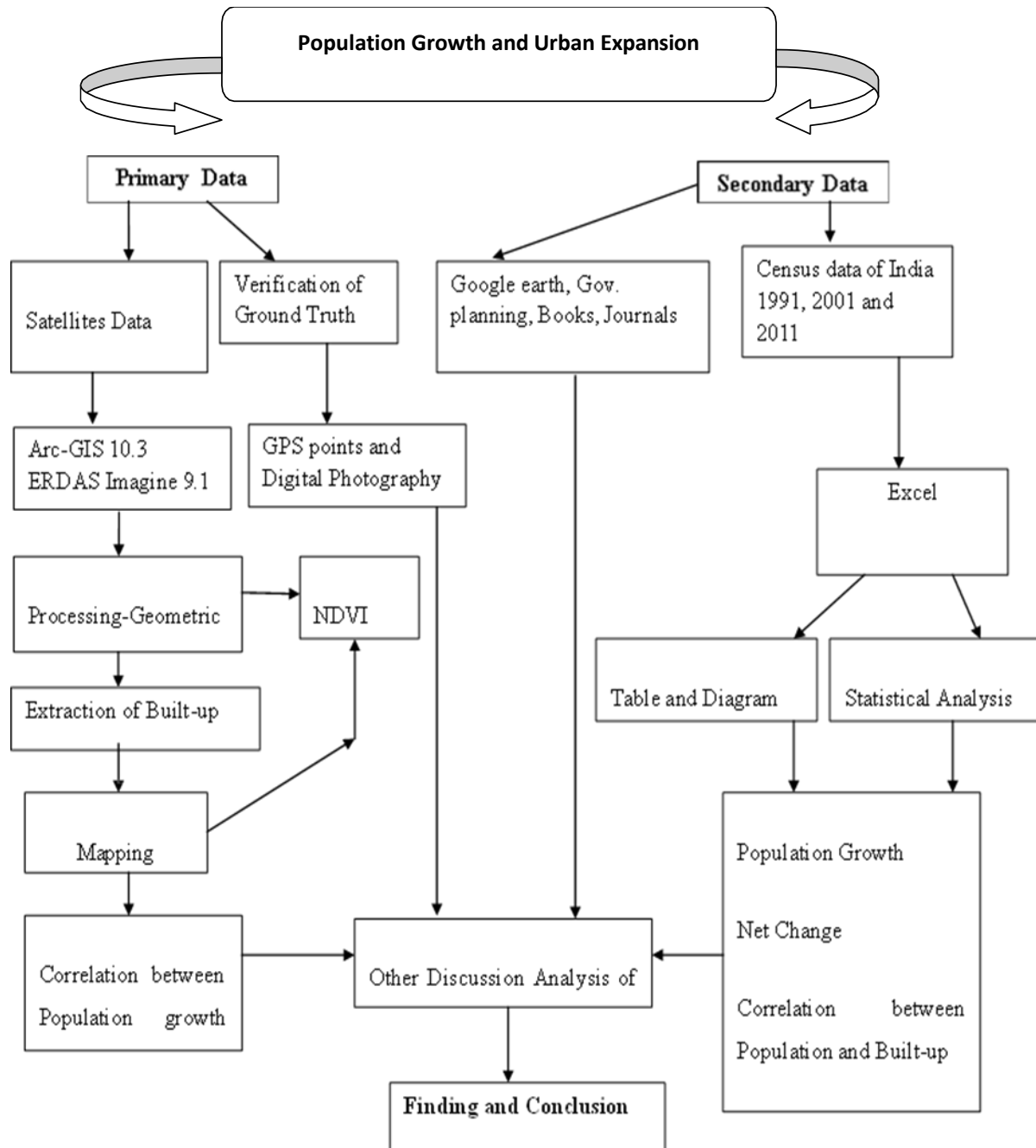
$$PD = \frac{\text{Population of Ward}}{\text{Total Area of Ward}}$$

Built-Up Area: Area such as town or city which has lot buildings in it.

Built-up = carpet area+ wall area

Built-Up Density: Is based on a though that population living in area must have a liner correlation with the place where he/she lives.

$$BD = \frac{\text{Total Area Covered by Buildup Mass}}{\text{Total Area of Ward}}$$



Result and Discussion

In this research work, used machine-learning technique of deep neural net and explored for predicting the spatial structure to explain the trends or pattern for the urban expansion change. For prediction, the Landsat maps of the year 1991, 2001 and 2011 and the population data available are created to show the largest explanation of the study area. The built-up and the vegetation cover changes are the result of the various present modifications that bring up about this study of population growth and urban expansion. In this study, the sensitivity analysis is performed to assess the robustness of the increase in a different combination of Landsat according to the period of study. It is clear in this study that the model performed best when trained with continuous census data of population, maps of built-up, and vegetation cover data are presented. Two different methods are considered for training the deep neural network. In the first approach, the model is trained on the sample datasets downloaded from Internet and created from the study area and in the second approach the model is trained to complete

the explanation of the datasets and how it performed.

It is observed that when the population growth is trained with the continuous process using the land for built-up and it becomes able to establish the relationship between the population growth and the urban expansion. This is because the phenomenon of population growth is trained as increase of built-up, but it is a decrease of the vegetation cover and at the end driving force for many problems of the city.

Population Growth

Population Growth is the increase in number of people in area. In other word, it is an empirical science in geographical meaning. Thus, India is the second most populated country in the world with a population projected to be the world’s populous country by 2024. However, the Uttar Pradesh is the most populous state in India with a population of 200 million people. Furthermore, the Uttar Pradesh becomes the favored tourist destination in India due to the location of Taj Mahal, one of the Eight Wonders of the World, in Agra. For that, in 2017, domestic’s tourist arrivals in the state were 234 million and without including

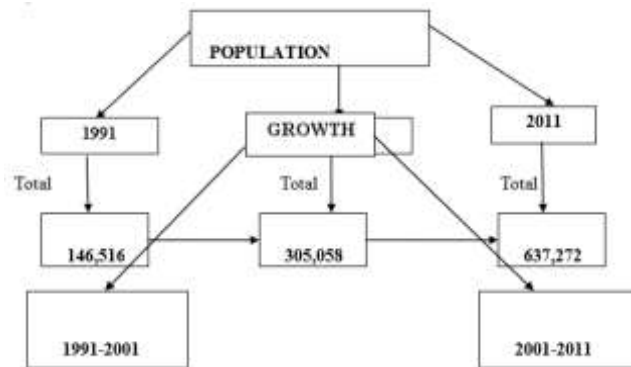
the foreigners' tourists that the come more every year.

The census of the Noida's population has been released by Directorate of census Operations in Uttar Pradesh and classified one of the incurious cities in all the U.P state. To give an idea about Noida's population growth, our study done in the period of the years 1991, 2001 to 2011, and it seems very important and vital to be held as a study.

During the year 1991-2001, Noida was categorized as a census Town and by this time 29 villages were urbanized and constituted the developed urban area of Noida, that had composited by a population of 1,46,514 persons in 1991. However, The Census of 1991 also revealed that in addition the population in the developed urban limits of Noida was 34,489 persons lived in the peripheral village. By the year 2001, the population increased into 305,058 and the population of Noida city had seen grew fast during the year 1991-2001 with 7, 61% year.

In the year 2001-2011, the population of the city was change and still has a recorded increase of 1,648,115 of which males were 45 and female 34 respectively in 2011. An official census 2011 detail of Gautam Buddh Nagar put the district with 40.88% rural and 59.12% urban in the period of 2001-2011. The city of Noida population in that period of times was influenced not only by the birth rate but again the number of immigrations who come because of many facilities that could found in the new city. For that, Noida started to see an incurious population in the period of 2001-2011 with a growth rate of +7, 65% year. The census data of Noida has been classified Noida one of the largest cities in all the of India. This population continuous to become spectacular by the years and whatever the great planning of the city, but between 10 years in Noida city population growing very fast than the normal. This vision can show an increasing due to the new vision of the city rather the large creation facilities of the Gautam Buddh Nagar roles. The census of the population of Noida in the year 2011 had seen like a phenomenon in all the history of the population in all the district of Gautam Buddh Nagar.

Population Growth of Noida city



Source: Census Population Data 1991, 2001 And 2011.

The fact that size, growth, and age structure of population have signification bearings on the material prosperity of people has been recognized since time immemorial. It has also been widely acknowledged that the process of economic development too impacts upon the demographic situation of a country. Indeed, there exists a bi-directional relationship between population and its various attributes on the one hand, and economic development on the other.

Built-up of Noida

Built-up is the function of land or a particular parcel of land used for construction. However, land in generally varies in utility form area to area. It's why in rural area, land use majorly includes forestry and agricultural while, in urban land use could be housing or industry. Land use distribution for different activities is guided by the existing development pattern, potentials of development with relation to land suitability and other large scale or regional level infrastructure development projects and the possible optimum utilization of available land. There is no specific or absolute land use distribution system which can be made equally applicable to all urban areas. Nevertheless, a scheme of land use distribution may be planned with broad guidelines and parameters depending upon the distinct nature and functions of a particular urban settlement. By the change detection matrix, the Built-up of Noida is clearer and becomes easier to observe the changed according to the years.

Table-1: Change Detection Matrix.

2001 Assessment	Built-up	Low	Moderate	High	Total 1991
Built-up	71.43	0	0	0	71.43
Low	0	66.57	0	0	66.57
Moderate	23.46	1.53	31.31	0	56.3
High	0	8.52	0	0.19	8.71
Total 2001	94.89	76.62	31.31	0.19	203.01
Net Change	23.46	10.05	-24.99	-8.52	

Table-2: Change Detection Matrix.

2011 Assessment	Built-up	Low	Moderate	High	Total 2001
Built-up	94.89	0	0	0	94.89
Low	57.5	19.01	0	0.11	76.62
Moderate	28.95	0	2.36	0	31.31
High	0	0	0	0.19	0.19
Total 2011	181.34	19.01	2.36	0.30	
Net Change	86.45	-57.61	-28.95	0.11	

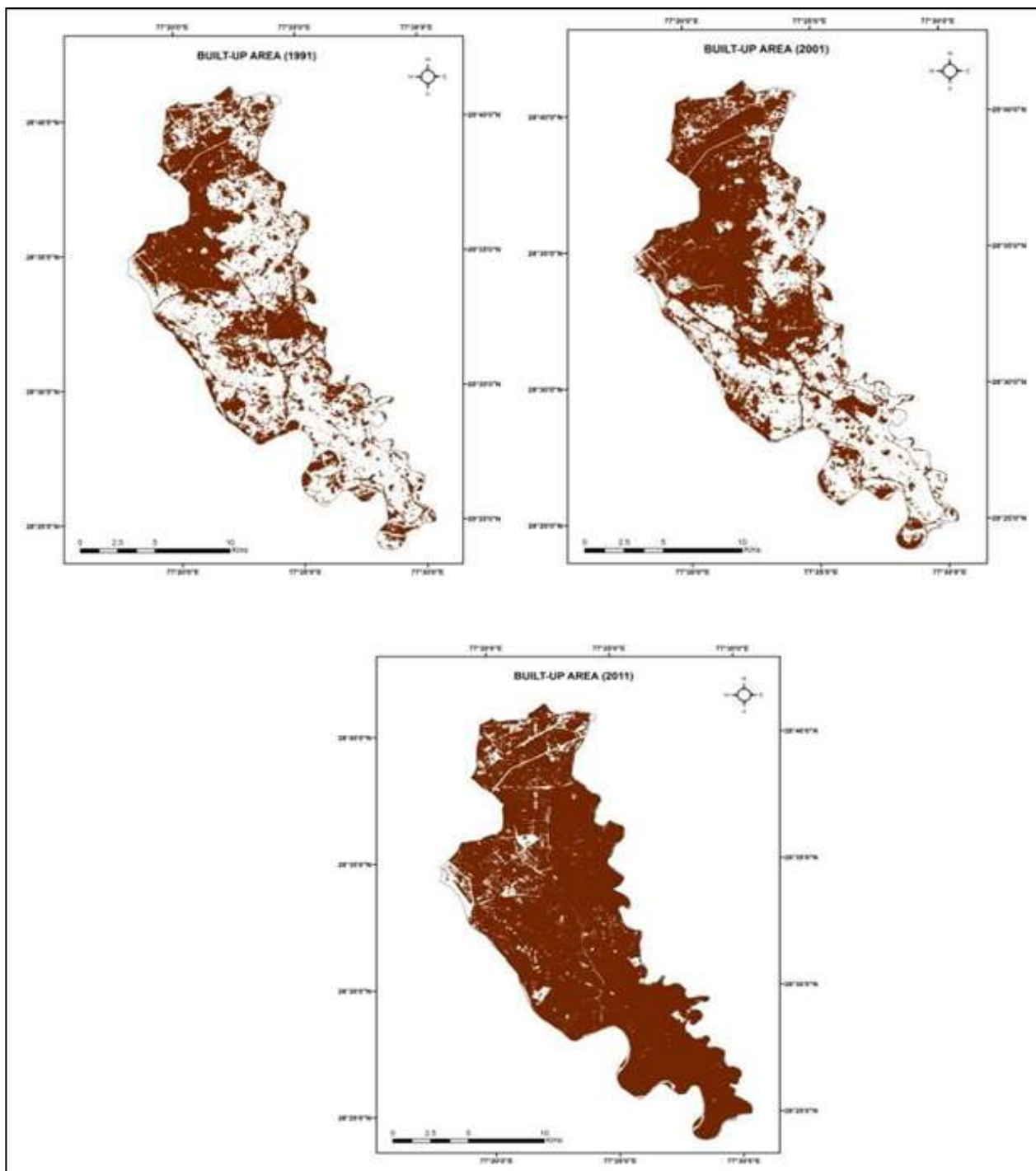
Source: Landsat of 1991, 2001 and 2011.

The change detection in Noida has a large difference and it became very clear in the previous tables. The Noida City losing the vegetation cover every year and the change observed in the year 2011, still the plus remarkable for all the year with 181.34 of Built-up, 19.01 low, 2.36 Moderate and 0.30 of High. This observation, we can conclude that in the Noida in this present time loss with higher quantity the vegetation covers a phenomenon dangerous for the sustainable life of the city with the climate change.

According to change detection analysis, a very wide change has been observed. The vegetation cover classes those have changed drastically are cultivated land and built-up area. Ultimately, out of these two classes built-up area has increased while cultivated land has decreased. In the year 1991, vegetation cover (cultivated area) was the dominating class. Built-up was spread in more than 23.46 of total area while built-up has occupied the total area. In the year 2001,

vegetation was all reduced and having more share in total area that decreased due to planning of recreational area by town development authorities. In the year 2011, Built-up class got an increase of 86.45 in 2001 to 2011. Thus, this year's image analysis shows that the class of Built-up area had grown up very fast and analysis shows that in (table-1 and 2).

the built-up area with 48% share of the total area, having 29% of huge change in comparison of built-up in year 1991 and cultivated area shows a huge loss of 22% in comparison of year 2001. The above records mirror that built-up is the most widespread cause of the loss of arable land, decline in natural vegetation cover as well as habitat destruction. Nearly 300% during 2001–2011 and it became one of the fastest growing towns in the country. In the decade of 1991 2001, population grew with a growth of 108.21% .



The town contained 68% of the total urban population of Gautam Buddh Nagar district completely overshadowing other towns like Dadri, Dankaur and Jewar. The 1991–2001 decade witnessed slowing down of growth, which was 108.21%. The decade 1981–1991 was the take off stage of the new township (Noida Development Authority). Generally, if population increases built-up area will increase. Regression analysis between population and built-up has very strong and provides strength to the above fact. It shows population is proportional to built-up area.

Vegetation Cover

According to change detection analysis observed in the period of our study, a very wide change has been observed. The vegetation cover in the total surface of Noida has changed drastically according to the years. Furthermore, the Net change has been seen and classified according to the year and the result described a large different of decrease as it is visible on table. Ultimately, out of this

three year of study built-up area has increased while vegetation land has decreased, and Loss of vegetation can be seen easily.

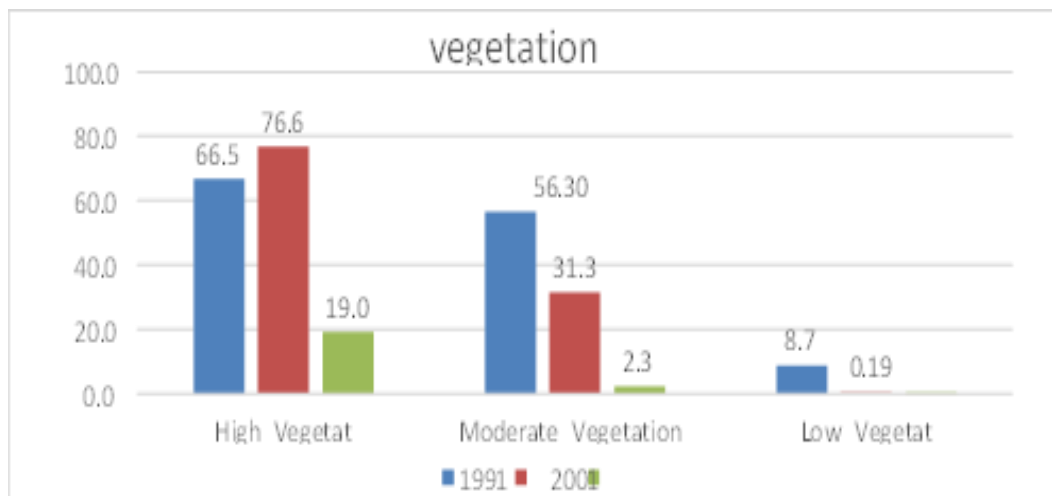
The analysis of the vegetation cover in Noida city has been predicted and showed a result of the incurious decrease of the vegetation. However, some calculations and observation has done and presented on table and chart that is visible that all the year of our study constituted a large modification but the year 1991 was the best year of the history of the vegetation cover in Noida city with 66.57 as High Vegetation, 56.30 Moderate Vegetation and 8.71 the Low vegetation.

Thus, in the other year with the higher domination of urbanization, the Noida started to loss a great part of the vegetation cover with the benefice of built-up. For that the year 2011 becomes dramatically a year considered as no vegetation because the quantity of vegetation has seen decreased very much as all the year of the of study.

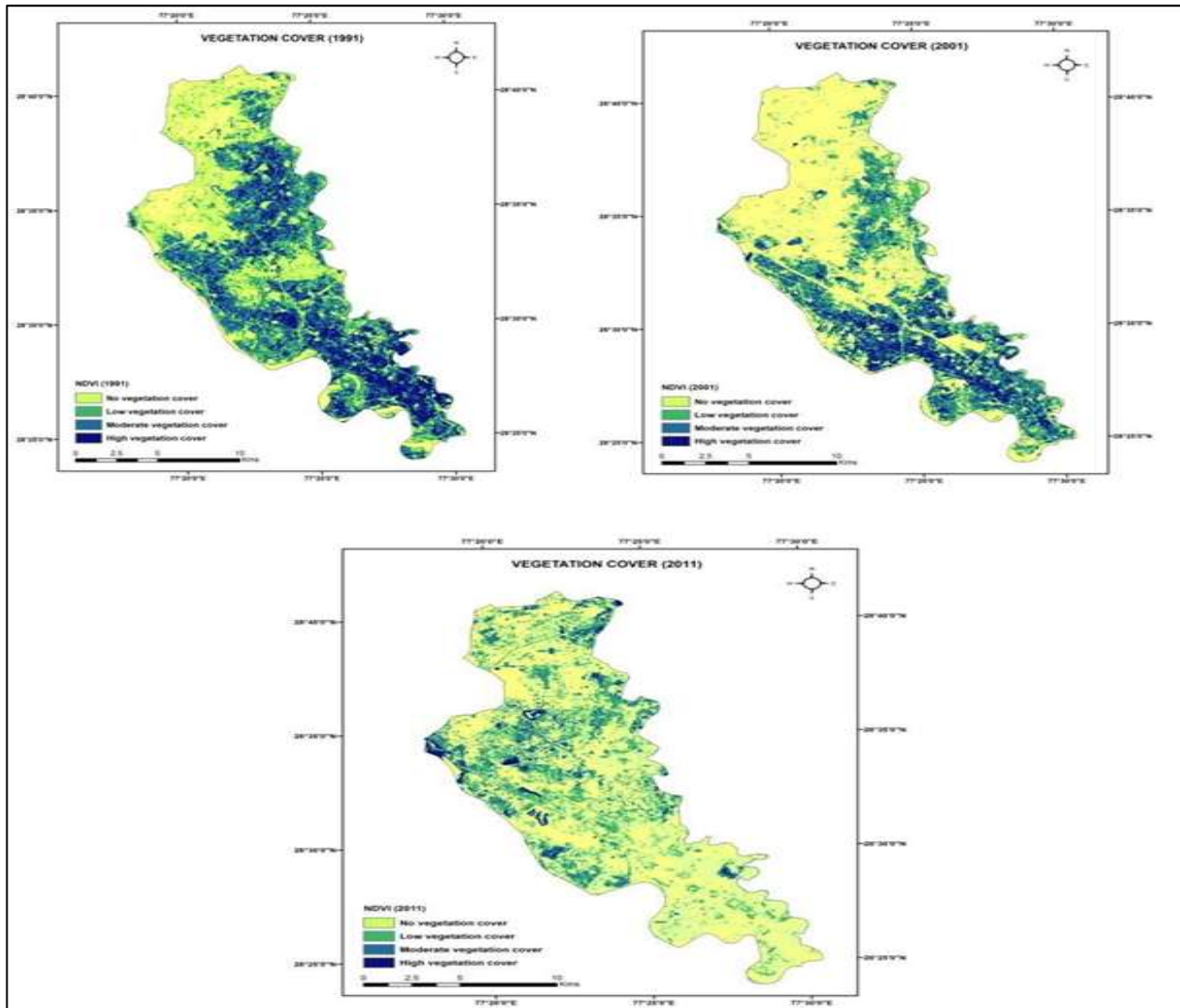
Vegetation Cover of Noida city.

Year	High Vegetation Cover	Moderate Vegetation Cover	Low Vegetation Cover
1991	66.57	56.30	8.71
2001	76.62	31.31	0.19
2011	19.01	2.36	0.30
Net Change	High	Moderate	Low
1991-2001	10.05	-24.99	-8.52
2001-2011	-57.61	-28.95	0.11

Vegetation Cover



Source: Landsat of the Year 1991, 2001 And 2011.



In the year 1991, vegetation cover was the dominating land cover class in Noida City. Agriculture was spread in more than 50% of total area while built-up has occupied 19% of the total area. In the same year, vegetation was all time high (during present study period) having 15% of its share in total area that decreased by 11% in the year 2001 and increased a little (2%) in the year 2011 due to planning of recreational area by town development authorities. In the year 2001, agriculture was the dominating class though it had decreased by 1% and built-up got an increase of 4%.

The size of vegetation in the year 1991 took large considerable places in Noida City. But from the year 2001, with the higher population and the urbanization, the vegetation cover part started to become very less. The year 2011 was considered as the no vegetation year in Noida because the increase rhythm in that period stills very less compared to the previous years.

Social Impacts of population Growth

The world population in the late 1950 and early 1960s experienced the highest growth in the history growth of a man. Furthermore, this fast-incurious growth of population is due because of the sharp decline in death rate in the year following the Second World War and to the better sanitation of health and facilities. However, the population problems vary in space and time and differ from region to region. In India, with the second largest population of the world his population has been growing fast in many cities

and the increase of the population gives several problems in different states of the country. The UP state is becoming after sometimes one of the popular states of India from where population living more in cities. The Noida city is included in the list of the great cities that population growth is a issue problem of concern without thinking. In general population growth has more problems in many cities but for the Noida city and for the objectives of ours study we can list the social Impact of population growth as following:

Over-strained infrastructure: In Noida city the facilities of housing, transportation, health care and education are become very selective and expensive. The overcrowded, slums and unsanitary localities, traffic congestion and crowded hospitals are much more visible whatever the great planning.

Pressure on land and other renewable natural resources: The city as it was seen in the map of vegetation loss more their surfaces because of built-up according to the years. Thus, forest and water are over exploited, and the more demanded permanent constituted the result of deforestation and damage to the renewable resources.

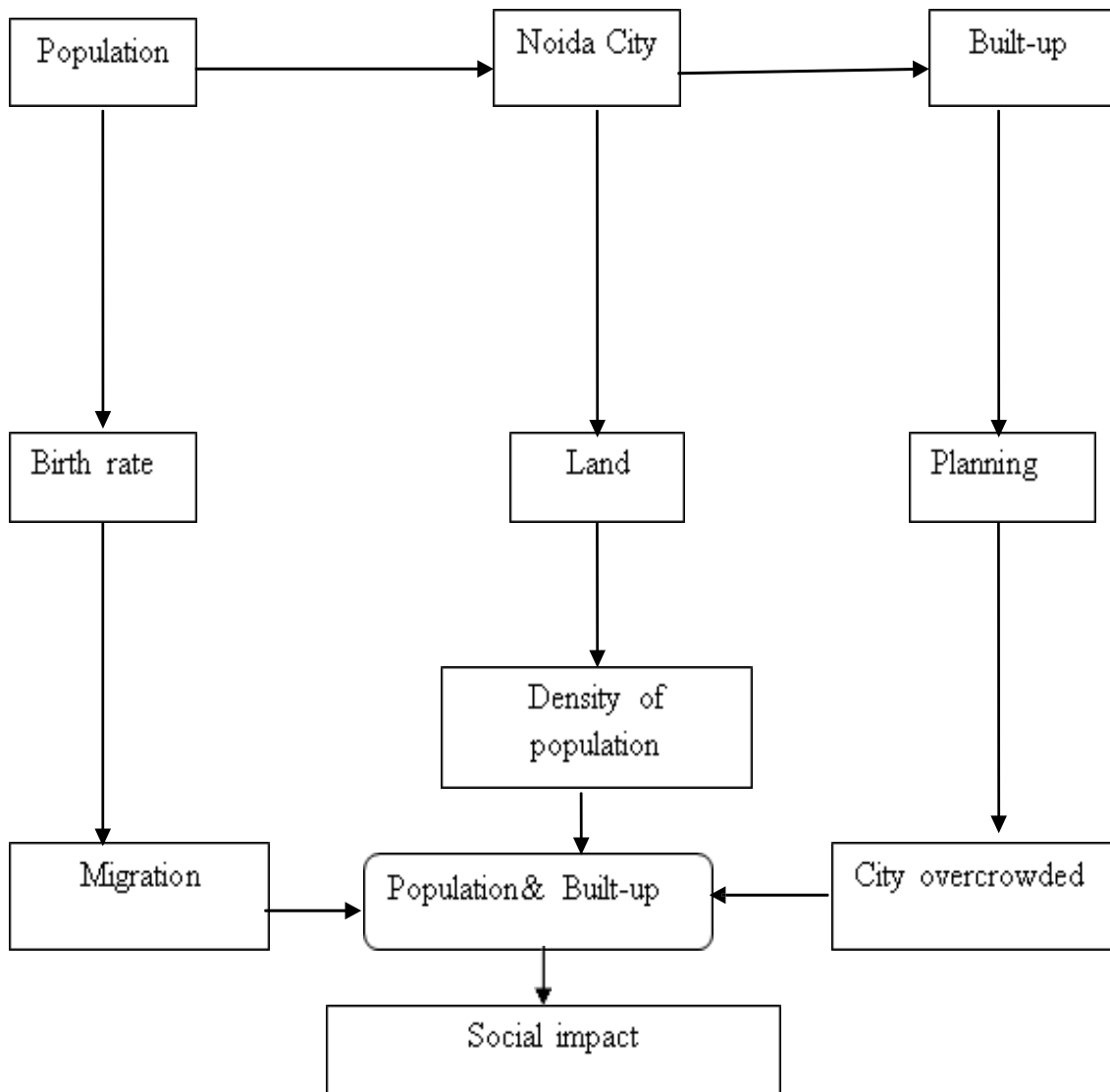
The inter-linkage between poverty and population growth: Low wages (especially for women), inadequate education and high infant mortality rate and contribute to high fertility rates and thus to rapid population growth.

Unemployment: whatever the planning of the City of Noida, but some unemployment problem still considered

because of the increase in furious of the population. For the new job opportunities must be created for almost young people half of them for their satisfaction but again for their control security.

whatever the planning but some problem about distribution of income becomes one of the major problems of the city. Many facilities are there but it is not enough with the increase of the population to talking well about inequitable distribution of income.

Inequitable distribution of income: The Noida City



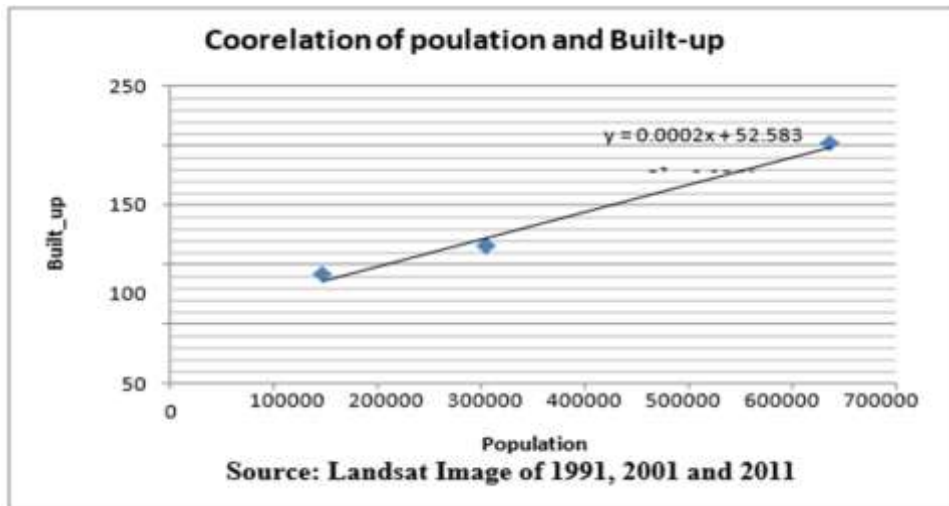
Environmental Impact of Built-up

Urban populations of Noida interact with their environment. Urban people change their environment through their consumption of food, energy, water, and land. And in turn, the polluted urban environment affects the health and quality of life of the urban population. In over world but the problem as seen differently according to the habit of the country. In many great cities of India had seen Built-up as serious environmental problems because it decreases the vegetation areas to get the satisfaction of the population still growing with years. Thus, the increase in number of the population becomes the driving force of the increasing fast of Built-up and still one of the major keys of environmental problems.

The environmental impact of Built-up in the City of Noida is more visible, and the urban environment is an important factor in determining the quality of life in urban areas and the impact of the urban area on the broader environment. Some urban environmental problems include inadequate water and sanitation, lack of rubbish disposal, and industrial pollution. Unfortunately, reducing the problems and ameliorating their effects on the urban population are expensive in the city of Noida. According to our study in the period of 1991, 2001 and 2011 in Noida City the result become incurious and the environmental impact of Built-up can be seen in our representation table. the correlation of the Noida’s population and Built-up

year	Population	Built-up
1991	146516	91.43
2001	305058	114.89
2011	637272	201.34

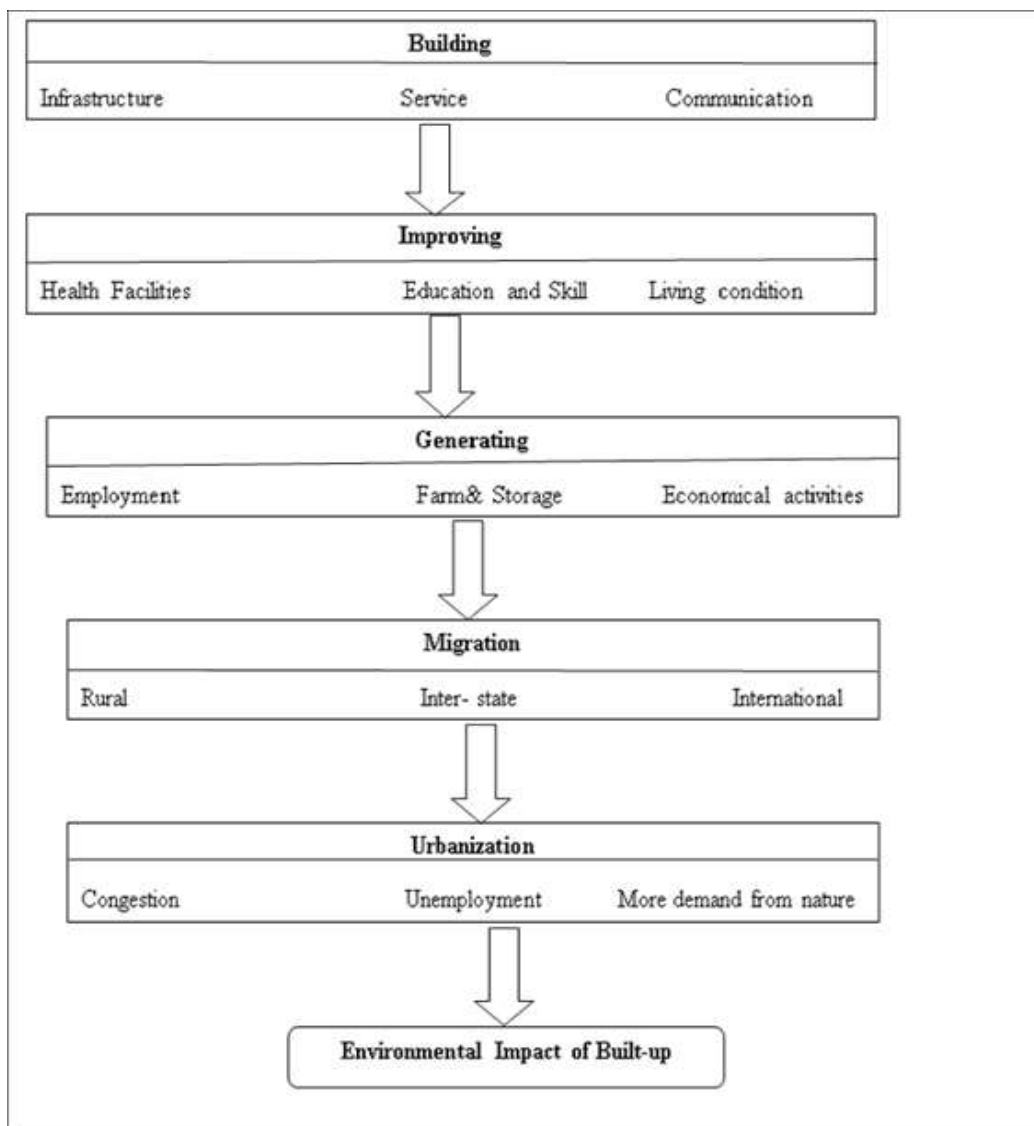
Correlation of population and Built-up



Source: Landsat Image of 1991, 2001 and 2011

The description of the correlation of population and Built-up show a strong relation between the population growth and the urban expansion of Built-up. Urban expansion with significant fluctuations linked with land use change and increase in built-up area. After the city foundation in 1976, it experienced very slow urban population growth. The ultimate effect of rapid population growth resulted very fast

spatial expansion of the city. The research aims to analyze the population growth and urban expansion over past 20 years in the city from 1991 to 2011.



Education: The Noida City has a good educational facility. The urban part of the study Area has very good network of Schools, Colleges. There are several universities, technical colleges spread over the area.

Public Health: Available medical facilities in Noida are hospitals, dispensaries, health centers, public health Sub centers; maternity homes etc. within a range of 5-10 kms, most of the sectors in the Noida have medical facility available in one or the other.

Communication: Transport is the main communication linkage in the City of Noida. All most the entire sectors have access to good transport system including metro and bus services.

Road Network: The city of Noida has well-knit road network. All the sectors are well connected to the road network.

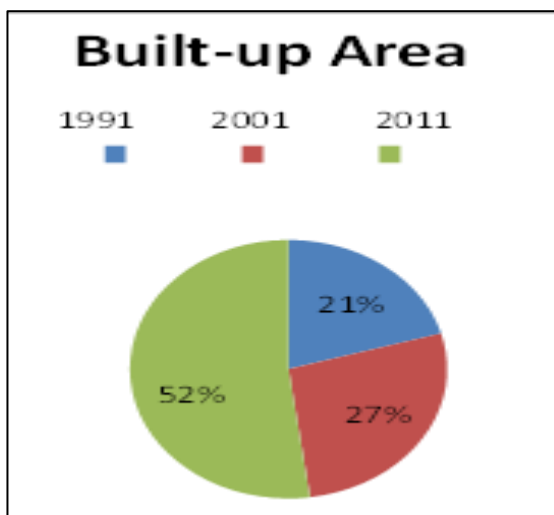
While infrastructure has improved a lot, sluggish and property rates have come down in the last 10 years. Noida has the Jaypee Hospital, Kailash Health Care and Max

Multi-specialty Fortis. There are various CBSE and international schools, as well as the UP Technical University, Amity University, MTU (Mahamaya Technical University) and other technical and B-schools, in Noida. When it comes to shopping and entertainment options, residents can choose from malls such as the DLF Mall of India, The Great India Place, Garden Galleria, the Spice World Mall, Atta Market and Sector 18. Various restaurants and cafés offer a variety of cuisines. The sectors are clean, have good pavements to walk on and the market areas are well-demarcated. Furthermore, connectivity, owing to the existing road network in Noida and Greater Noida, has improved with the rising number of information technology offices in this region. Overall, the infrastructure has improved in big way, in the last decade. However, air pollution and clean drinking water are major issues for residents in Noida.

Net Change and Built-up

Year	Built-up	in Percent
1991	71.43	35.19
2001	94.89	46.74
2011	181.34	89.33
Net Change	Built-up	
1991-2001	23.46	
001-2011	86.45	

Source: Landsat 1991, 2001 and 2011



Conclusion

Apart from the year 1991, the population of Noida city started to be more and considered more in the state of Uttar Pradesh as a Town. Thus, the observation of the impact due to this population growth is clearly visible in the year 2001, from which the population took a large chunk of Built- up area in all the places of Noida City. The study year 2011 shows that the Noida city with the higher increasing in population growth and Built-up that again done more damage in all social and environment classes. Furthermore, the impacts of population growth and urban expansion of Noida are visible in the study without thinking and

contravening measures becomes an issue of concern for the sustainability of the city.

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