# IMPACT OF GROWING URBAN POPULATION ON ENVIRONMENT- SPECIAL EMPHASIS ON NORTH 24 PARGANAS DISTRICT, WEST BENGAL USINGGEOSPATIAL APPROACHES.

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***Abstract***
*Presently the population growth is increasing in alarming rate which threat to our daily life and for our future generations. Urban spatial areas have expanded in an accelerated speed during the last five years. Basically the greenness of environment has decrease due to trends of growth of urban population and urbanizations, as a resultant transformation of permeable land surfaces into impervious land surfaces that may have impacts on the ecosystem, hydrological system, biodiversity and livelihood of daily life. Rising of urbanized extent areas has intruded on adjacent valuable natural lands like agricultural cultivation, forest cover or surface water bodies etc. The North 24 Parganas district has faced fast growing urban population based on urban activities of west Bengal, near about 57% of the population of the district belong from urban areas, this district is the most urbanized district of West Bengal, the decadal growth of urban population is about 18% in this district. The methodology can be broadly divided into image handling, vector handling, data validation, final result generation and identification of potential future. The main objective of this study is to bring to light that impact of highly increase urban population on surrounding natural environment of north 24 Parganas district with help of Geo-spatial analysis using different indices.*

**Keywords:** Urban Population growth; Urbanization; Application of Remote sensing and GIS.

## Introduction

Rapid urban growth rate and urbanization is a global issue in all over the world. Urban spatial areas have expanded in faster speed during the last five decades and urban population growth rate are higher in most of the countries because urban areas are the locus of economic activity and transportation nodes.(Masek, Lindsay, & Goward, 2000). Expanded urbanized areas encroached on surrounding valuable natural lands such as agricultural fields, forestlands or wetlands(Xu, Wang, & Xiao, 2000). Urban land surface are mostly conquered by built-up lands with impervious surface, these alteration of the natural lands into impervious built-up lands may have important impacts on the ecosystem, hydrological system, biodiversity and local climate which can result in negative aspects such as the urban heat island phenomenon.

Urbanization is the process through which the productive agricultural lands, forest, surface water bodies and groundwater prospects are being irretrievably lost (Kumar, Pathan, & Bhandari, 2007).( Pathan & Jothimani, 1989). Urbanization leads to ended utilization of resources and high increasing population settlement with asymmetrical regularity which can make difficulties of management of sustainable urban planning.

Remote sensing and Geographical information System have already shown their significance in mapping of land use and land cover, urban growth trends and to monitor the changes in land use/land cover (Pathan, Sampat, & Rao., 1993)(Donnay , Barnsley, & Longley , 2001).

The study of impact on urban growth trend can be analysis using remote sensing data with high resolution by the different process including index based models. Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI),Normalized Difference and Built up Index (NDBI) are applied for detection of changing patterns of water surface areas, percentage of vegetation cover,and urban build up areas are increasedduring study period this region. In this paper, it has been identified 27 years of changing patterns of vegetation cover and different land use patterns using three different Landsat imageries 1990 (Landsat TM), 2000 (Landsat ETM+), 2017 (Landsat 8).

## Study area

The North 24 Parganas district is situated in southern part of west Bengal of India .The study area is locatedon the left bank of Hugli River and lies between 21° 25′ 30″ and 23°16′50″N latitudes and 88° 01′10″ and 89° 06′15″E. longitudes. The geographical area is about 0.42 million hectares.The study area is an administrative unit had its origin in 1986 when the old 24 Parganas district was bifurcated in two separated unit. The shape of district is looks like irregular triangle. It shares internationally its eastern boundary with Bangladesh and west boundary with Kolkata district and the river Hooghly. The Bay of Bengal lies to its south and Nadia district to north. In this district, there are 22 C.D.Blocks, 27Municipalities 29 statutory towns, 78 census towns, two out growthsand one cantonment board area.

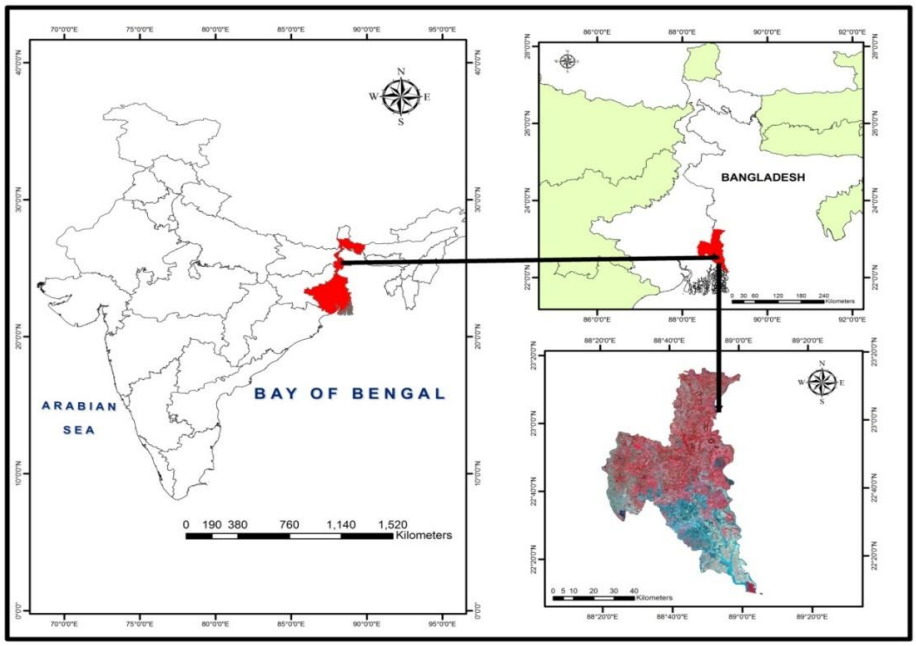


Figure 1. Study Area.

## Objectives

The following objectives have been formulated on the bases of problems of the study they are; To study the growth rate of urban population in blocks level of the study area during three decades. To calculate how much percentage of vegetation cover area, land surface area has degrade due to increasing growth of population during three decades, using

geospatial models. To analyses how much built up areas are increased during years of investigations using model indices.

## Data and Methodology

The methodology can be broadly divided into image handling, vector handling, data validation, final result generation and identification of potential future.To study the objectives of this papers, some following tasks were achieved, definition of study area, collections of data, image processing, different image based indices are built for change detections of vegetation, surface water and built up areas over one particular time periods using Arc GIS 10.1.3 and ERDAS Imagine 2014, and collect census data from census of India published hand books.

Flow chart diagram shows the overall methods to adopt for this research paper.

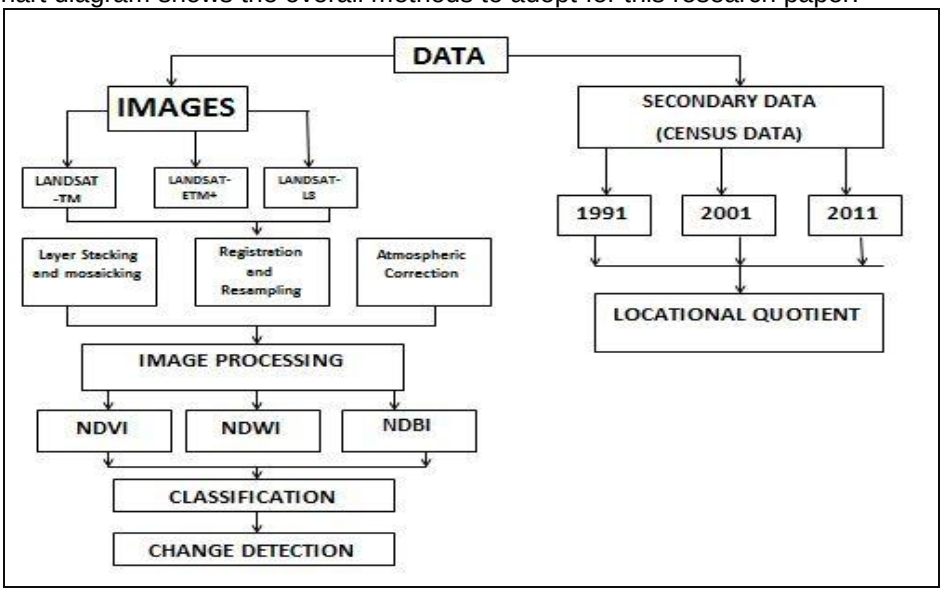


Figure 2. Flow Diagramme of Methodology

Table 1. Series of Landsat Imageries.

| Sl.No. | Date of Images | Satellite | Sensors | Resolution (m) | Bands | Thermal Band |
|---|---|---|---|---|---|---|
| 1. | 14/11/1990 | LANDSAT-5 | TM | 30 | 7 | 6 |
| 2. | 17/11/2000 | LANDSAT-7 | ETM+ | 30 | 7 | 6 |
| 3. | 14/02/2017 | LANDSAT-8 | OLI/TIRS | 30 | 11 | 10,11 |

## Result and Discussion

The term urbanization is process of growing urban population which basically influenced by the industrial revolution, which characterized by form production in western world. The impact of industrial like development of transport and communication facilities, expansion of infrastructure and better employment facilities which pulls rural population towards urban centres. Rapid growth of urban areas is the result of two factors for the population growth: one is natural increase in population and another is migration to urban areas. Natural growth rate means where excess of birth rate over deaths.

## Urban population Growth Rate

Primary interest of Geographer's is finding patterns and distributions of phenomenon in spatial dimensions. In micro level urbanization distributions like block levels of district are taken into consideration because block level data which is accessible with greater accuracy. In this study, it is bring to highlight the distributions of urban populations at blocks level and attempt to find the changing and growth rate of population during last three decades i.e., 1991, 2001 and 2011of census years. As per 2011, the total population of North 24 Parganas is 1,00,09,781. The decadal growth of this district has been increased by 12.03%, where the rate of decadal growth of India and West Bengal during 2001-2011 had been 17.64% and 13.93%respectively.In fact, the population growth rate in the district was higher than the India's average.Among all the districts in India, after THANE (Maharastra) the North 24 Parganas ranks second in terms of population. (North 24 Parganas was largest district in terms of population after bifurcate of Midnapur) (DISTRICT HUMAN DEVELOPMENT REPORT, NORTH 24 PARGANAS., 2010).The concentration of urban population, decadal growth of North 24 Parganas is 18.16% (Fig no. 3). According to census data 2011, the percentage of urban population of India and West Bengal was 31.16 and 31.89 respectively, while percentage of urban population of North 24 Parganas was 57.26.The study area has experienced high rate of urbanization than other districts of the state.In 2011, 57,33,162 persons stated to exist in the study area.

The urbanization level in the district has stayed much higher than other district of West Bengal. There are six blocks in terms of density of urban population is high which are Barrackpur-I, Barrackpur-II**,** Barrasat-I, Barrasat-II, Rajarhat and Habra-I which all located near Kolkata (the capital of West Bengal).The Socio-economic facilities: are trades, communication and connectivity of capital with those blocks has put a distinct impact to grow rapid urbanization.The least urbanization blocks are located mostly in southern part of the district under sub-division of Basirhat. This part is almost covered by the rural villages under GramPanchayat except Basirhat Municipality and Hasnabad block. But in 2011 census most of the blocks are comes under urbanizations excluding Sandeshkhali-I, II and Haroa (Fig no.4).The northern part of the study area sparsely populated. Taking consideration of northern zone, we can see that, except Bagda district other two blocks of Bangaon are under urbanization.The present paper,shows that in three decades of urban population growth in block levels (1991, 2001, 2011). LQ (Location Quotient) are a statistic analytical method which used to determine different spatial clustering or dispersal of a phenomenon in a district comparative to an entire region. This is an index for comparing the rank of a phenomenon's share with the general phenomenon over a certain area. Locational Quotient is mostly used in human geography, demography, economics and any types of location analysis (IB Geography). The formula of Locational quotient is:

Formula: $LQ = \{(e/\sum e)/(s/\sum s)\}$. Whereas, e= Individual value, S= Total Population

The Locational quotient is an index by using this,it has been calculated the most concentration of urban population in a particular regionis compared withnational average. Locational quotient of three decades(Fig no. 5)indicate that, in 1991 value <0.5 means low urbanization concentration, 15 blocks of the districts are comes under these values. Moderate concentration of population are found in only three blocks value ranging from 0.5-1.0 and remaining 4 blocks are under high concentration of urban population rangingfrom above 1.0 to 1.8. In 2001 high urban population are found in 5 blocks with ranging value above 1.0, moderate values are found in only one block (Basirhat) with range of 0.8 as well as rest of other blocks falls under low concentration of urbanization with value range below 0.5. On other hand in the year of 2011 it is observed that most of the blocks are comes

under growing urban centres. As compare to 1991, where 15 blocks out of 22 were low range of quotient but in 2011 its decreases below 0.5 ranges are found for 11 blocks of the districts. In (table no. 4)it has been noticed that there was highest percentage of urban population in Barrackpur-II block and 2.60% urban growth from 1991 to 2011. After that, Rajarhat block of Barrasat subdivision has challenged most decadal percentage of urban growth with 65% from 1991 to 2011.

Table 3. Urban Population of North 24 Parganas(1991-2011)

| **Sub Division** | **BLOCK** | **Urban Population** | | |
|---|---|---|---|---|
| | | 1991 | 2001 | 2011 |
| Bangaon | Bagda | Nil | Nil | Nil |
| | Bangaon | 79,571 | 1,02,163 | 10,8,864 |
| | Gaighata | 6,244 | 15,466 | 64,761 |
| Barrackpur | Barrackpur I | 9,9,0193 | 11,88,575 | 11,65,143 |
| | Barrackpur II | 18,19,008 | 23,38,093 | 25,73,967 |
| Barrasat | Amdanga | Nil | Nil | 6,659 |
| | Barrasat I | 1,75,957 | 4,06,848 | 5,93,964 |
| | Barrasat II | 79,844 | Nil | 11,994 |
| | Deganga | 7,388 | Nil | 9,663 |
| | Habra I | 2,47,341 | 3,03,735 | 3,63,739 |
| | Habra II | Nil | 15,476 | 35,815 |
| | Rajarhat | 1,47,348 | 27,8540 | 5,03,130 |
| Basirhat | Baduria | 41,762 | 47,417 | 59,768 |
| | Basirhat I | 101409 | 113159 | 146347 |
| | Basirhat II | Nil | 4170 | 17290 |
| Basirhat | Haroa | Nil | Nil | Nil |
| | Hasnabad | 30,421 | 37,305 | 44,511 |
| | Hingalganj | Nil | Nil | 15,076 |
| | Minakhan | Nil | Nil | 7111 |
| | Sandeshkhali I | Nil | Nil | Nil |
| | Sandeshkhali II | Nil | Nil | Nil |
| | Swarupnagar | 3,814 | Nil | 4,360 |
| | | 37,30,300 | 48,50,947 | 57,32,162 |

***Source: Compiled and calculated by the author from Census of India source***

Table 4. Percentage of Urban Population and Locational Quotiento(1991-2011)

| Sub Division | BLOCK | % of Urban Population | | | Locational Quotient | | |
|---|---|---|---|---|---|---|---|
| | | 1991 | 2001 | 2011 | 1991 | 2001 | 2011 |
| Bangaon | Bagda | Nil | Nil | Nil | Nil | Nil | Nil |
| | Bangaon | 21.27% | 22.89 | 22.22 | 0.42 | 0.42 | 0.39 |
| | Gaighata | 2.42 | 5.14 | 19.6 | 0.05 | 0.09 | 0.34 |
| Barrackpur | Barrackpur I | 91.36 | 91.32 | 92.51 | 1.78 | 1.68 | 1.62 |
| | Barrackpur II | 95.53 | 96.66 | 98.02 | 1.87 | 1.78 | 1.71 |
| Barrasat | Amdanga | Nil | Nil | 3.4 | Nil | Nil | 0.06 |
| | Barrasat I | 49.94 | 65.1 | 77.21 | 0.98 | 1.20 | 1.35 |
| | Barrasat II | 33.3 | Nil | 5.96 | 0.65 | Nil | 0.10 |
| | Deganga | 3.1 | Nil | 3.02 | 0.06 | Nil | 0.05 |
| Barrasat | Habra I | 62.84 | 64.76 | 67.43 | 1.23 | 1.19 | 1.18 |
| | Habra II | Nil | 10.32 | 20.29 | Nil | 0.19 | 0.35 |
| | Rajarhat | 51.51 | 66.76 | 84.88 | 1.01 | 1.23 | 1.48 |
| | Baduria | 16.49 | 16.07 | 17.69 | 0.32 | 0.30 | 0.31 |
| | Basirhat I | 45.35 | 51.03 | 49.29 | 0.89 | 0.80 | 0.86 |
| | Basirhat II | Nil | 2.14 | 7.6 | Nil | 0.04 | 0.13 |
| | Haroa | Nil | Nil | Nil | Nil | Nil | Nil |
| | Hasnabad | 16.75 | 17.36 | 18.43 | 0.33 | 0.32 | 0.32 |
| | Hingalganj | Nil | Nil | 8.6 | Nil | Nil | 0.15 |
| | Minakhan | Nil | Nil | 3.57 | Nil | Nil | 0.06 |
| | Sandeshkhali I | Nil | Nil | Nil | Nil | Nil | Nil |
| | Sandeshkhali II | Nil | Nil | Nil | Nil | Nil | Nil |
| | Swarupnagar | 1.9 | Nil | 1.69 | 0.04 | Nil | 0.03 |

***Source: Compiled and calculated by the author from Census of India source***

## Analysis of Impact of Urban Population

Remote sensing techniques are useful tool for measuring and monitoring different spatial distributions and patterns of factors on the earth surface. We can observed and analyzed growth and changing patterns of different phenomenon using remotely sensed imageries.The environments degradation like green vegetation, agricultural land, forestry, surface water has been affected by rapid growth of urban population in recent decade. For better understanding we have been used few models of NDVI (Normalized Difference Vegetation Index) which used to measure the density of green vegetation through the Earth's landscape, researcher used satellite sensors that observe the separate wavelengths of visible and near-infrared of a particular band that is absorbed and reflected by the vegetation.

The ratio of visible band and near-infrared band has been calculated and the result of this calculation is called NDVI. The formula is ***(NIR BAND -RED BAND)/(NIR BAND +RED BAND)***.The different factors affect the values of NDVI i.e., plant photosynthetic, biomass, plant and soil moisture, total plant cover, plant stress etc. It can possible to make comparisons between two decades images plant density variation by using this indices.The normalized difference vegetation index (NDVI) has been widely used for remote sensing of vegetation for many years. This index uses radiances or reflectances from a red channel around 0.66 μm and a near-IR channel around 0.86 μm. The red channel is located in the strong chlorophyll absorption region, while the near-IR channel is located in the high reflectance plateau of vegetation canopies(Gao, December 1996). NDWI (Normalized difference Water Index) is a remote sensing based indicator to calculating the density of water contents over the land surface. The formula of NDWI is ***(GREEN BAND-NIR BAND)/ GREEN BAND +NIR BAND)***.Usually this index uses green channel 0.54 μm to 0.60 μm and near infrared channel around 0.86 μm..

In this study, the threshold vales of NDVI of threedifferent years are -0.920-0.736, -0.66-0.659, -0.520-0.502 (Fig no.5). Negative values (-) are rivers, lakes and snow cover. 0-0.1 values are barren soil and settlement, the 0.1 to +1 range vegetationcover. After getting the values, it has shown that the amount of vegetation become reduced year to year. NDWI model value range is -1 to +1. Positive values from 0.1 to +1 indicates are land water surface. Threshold range of

NDWI of three years are -0.641-0.923, -0.471-0.718, -0.599-0.284 (Fig no.6).A value of NDWI of different years has shown that surface areas are degrade in day by day.The NDBI stand for normalized difference built up index which used to measure the built up areas over the land surface of the earth. Scientists are used different sensors infrared wavelengths for buildup index. The formula of infrared index is ***(SWIR BAND- RED BAND)/(SWIR BAND+RED BAND)***. The Wavelength range of Short wave infrared channel is 1.66 μm and IR channel around 0.86μm, although the normalized difference built-up index (NDBI) is useful to map urban built- up areas, but it has some limitations (Xu, Wang, & Xiao, 2000). The threshold range of NDBI (Fig no.7) are -0.92-0.88, -0.95- 0.44, -0.1 –0.9. This ranges shows that, built up areas increased day by day.

After analysis the models, it has been observed that vegetation area of north 24 parganas has decreased 37.53 % during twenty seven years(1990 to 2017).The area of land surface except rivers has decresed 19.41% due to fast growth urbaanization. The urban Built up areas are increased with rate of 27% from 1900 to 2000 and since 27 years it has increased around 38.8%. It is impact of urban growth on environment, that the results shows in Fig no.9 that, decadal decreasing rate of vegetation and water surface area were 2.5 % and 2.7%. respectively. After that decade from 1990 to 2000, areas of water and vegetation

were 15% and 28.34%, from 2000 to 2017 4.2 % of surface water area and 13% of vegetation area has decreased..

## Conclusion

This study explain the possibility of using Remote sensing and Geographic Information system to develop sustainable environmental with respect to urban expansion. Loss of vegetation,Loss of surface area, urban expansion and temperature has been increased day to day. It has shown that the surface temperature of the urban catchment area of thestudy area has been increasing de to anthropogenic influence on the land use and land cover. The planners, decision makers and buerocrats have to take precoutionary methods to retain the natural vegetaion and water resources which is need for sustaible development for future.

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