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**URBAN SPRAWL OF CUTTACK-BHUBANESWAR REGION USING  
REMOTE SENSING AND ARC-GIS**

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR  
THE DEGREE OF

**Bachelor of technology**

**In**

**Civil engineering**

**By**

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**Under the guidance of**

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**DEPARTMENT OF CIVIL ENGINEERING, NATIONAL INSTITUTE OF  
TECHNOLOGY ROURKELA, MAY 2015**

**CERTIFICATE**

This is to certify that the project entitled, “Urban Sprawl of Cuttack-Bhubaneswar region using remote sensing and ARC-GIS” submitted by “RUMAN RAHAMTULLAH” in partial fulfillments for the requirements for the award of Bachelor of Technology Degree in Civil Engineering at National Institute of Technology, Rourkela (Deemed University) is an authentic work carried out by him under my supervision and guidance.

To the best of my knowledge, the matter embodied in the report has not been submitted to any other University/ Institute for the award of any Degree or Diploma.

DATE:

(PROF. RAMAKAR JHA)

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RUMAN RAHAMTULLAH

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## **ABSTRACT**

The world around us is undergoing complete metamorphosis, which is boosted by the population explosion and technological expansion. The problem is more severe for India which has more towns which have to be transformed in to large cities to accommodate its ever-increasing population. In this study an analysis is done by using ARC-GIS (geographic information system) where map of the region was analyzed for recognizing the distribution of land use types throughout the area; land types considered are-Forest, Agricultural, Industrial, Residential, Water bodies. This analysis was performed for three years: 2005, 2010 and 2015. Results obtained show that the area of barren land, forest and agricultural land is continuously decreasing and that of residential land is rapidly increasing because of increase in demand.

Maps were again analyzed using Buffer analysis in which Acharya vihar was chosen as the point of interest and multiple circle buffer analysis was performed to study the spread of agricultural and residential areas over the buffers and identify the directions in which the city is expanding, and it was found out that north and north-west directions have undergone massive expansion over the span of 10 years.

# **CHAPTER-1**

## **INTRODUCTION**



## INTRODUCTION

The world is experiencing the biggest rate of urban development today. Throughout 2008, more than a large portion of the world's populace was staying in towns. In 2012 this number has crossed the 7 billion imprint. The vast majority of this populace will be amassed in Africa and Asia. The megacities were the centre for the high development potential. Up to the mid time of twentieth century, area utilization change has come about into an enormous issue around the entire world (Lambin, 2001). With the development of our financial aspects and social upliftment, the extensity and force of area spread change had a tendency to be severer. The forecast and reenactment of urbanization is imperative among the investigations of area utilization. Demonstrating is crucial for investigating, particularly for the forecast of the elements of the urban development (Clarke & Silva, 2002). A few disappointments happen for demonstrating the utilization of area however later on there was resurrection in the two-three decades because of better accessibility of information. High registering capacity additionally gives impulse for demonstrating utilization. Various models developed in this time; these models included cell automata sort, recreation sort or some piece of it identified with specialists based sort. Cell automata are amazingly proficient to anticipate area utilization change (Dietzel & Clarke, 2006). Over the span of time, a few models were created to conjecture the future area utilization condition to assess and survey distinctive area use approaches.

Remote sensing and GIS are outfitting new devices for cutting edge administration of biological community. The remotely sensed information encourages the discriminating summary of earth's capacity designing and their progressions all through mainly, locally and internationally (Mishra and Subudhi, 2006). The radiant development in land data science has given us the accessibility of diverse sorts of area utilization models. They vary as far as information gathering, spatial displaying. The information can give a critical association between environmental, national and territorial protection and administration differing qualities (Willkie and Finn, 1996). GIS innovation is necessary piece of the all the area utilization models. The spatial and worldly process can be effortlessly taken care of by the capacity of the GIS innovation. The remote detected pictures give a great deal of information which can be helpful for the advancement of uncommon determination in remote sensing for a period arrangement.

Existing area utilization models vary from tenet based projects that give data and direction on the methodology of dispensing development to distinctive sub regions, to modern models that fuse financial hypotheses and business systems. The models utilize an extensive variety of methodologies, for example, spatial association, spatial data yield, and standard based (Waddell 2004). Spatial connection, spatial data yield, and straight programming models were utilized as a part of the early operational models of the 1960's and 1970's. Miniaturized scale reproduction was not into practice until 1980's despite the fact that it was produced amid the 1960's (Wargon, 2010). The 1980's saw discrete decision models and cell automata turning into the most up to date displaying methodologies. In the 1990's, few area utilization models actualized a guideline based arrangement of techniques to allot populace, vocation and area use on the GIS (Geographic Information System) stage.

Shannon (1948) did the origination of entropy. The second law of thermodynamics expresses that thermodynamic corruption is unalterable over the long haul, e.g., a smoldered log can't be un-blazed and tepid water can't be differentiated unmistakably into boiling hot water and cool water (Jha and Singh, 2008). The issue, disorder or arbitrariness of association of a system is known as its entropy (Miller, 1969). The entropy worth can be taken as the estimation of uncertainty. An irregular variable's entropy is determined regarding its likelihood conveyance and is a decent measure of irregularity or instability (Aggarwal and Rahman, 2011).

Urbanization has turned into one of the fundamental elements of area debasement, basically because of the nature of the rural terrains that have been urbanized (Santibanez & Royo, 2002). Urban development without legitimate arranging has brought about major issues in environment. This prompts deficient framework offices, water lack and activity blockage. Land utilization changes will be useful to interchange foundation and administrations, for example, legitimate zoning transport, medicinal offices, and outlining of schools. Further land use studies can be confirmed to topography, mapping of soils, and other hydrologic highlights. The motivation behind this study is to examine area utilization change in the Bhubaneswar City range and to think that its urban sprawl heading. The goal is to survey the area utilization change and to utilize the entropy way to deal with discover the level of arbitrariness.

**SOFTWARE USED** - Esri's ArcGIS is a geographic information system (GIS) for working with maps and geographic information. It is used for: creating and using maps; compiling geographic data; analyzing mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database.

**CHAPTER-2**  
**LITERATURE REVIEW**

## **Literature review-**

Daniel lozzi sperandelli, Francisco Antonio dupas(2013) performed a case study in Atibaia (a city situated in the metropolitan edge of São Paulo) with the accompanying objectives: (1) comprehend urban sprawl and the spatial advancement of green spaces and empty land in five distinctive time periods (1962, 1972, 1978, 1995, and 2009), (2) examine arrangements that would add to a requested urban improvement, and (3) serve as rules for urban-planning studies, neighborhood powers, and analysts. The consequences of this study demonstrate the accompanying: (1) urban sprawl is a consistent methodology (even in 2009, when 21% of the area was empty) and is energized by an admissible end-all strategy, and (2) the increment of green spaces is the aftereffect of development upon the remaining timberlands in periurban areas.

In many nations spatial control systems went for controlling city development have sober-mindedly been supplanted by methods to oversee development, since development is inescapable at any rate (Urban Foundation 1993, p. 4). Mapping urban sprawl serves to recognize regions where natural and regular assets are basically debilitated and to propose likely future bearings and examples of sprawling development( Simmons, 2007). Various researchers have tended to the issue of precisely checking area cover and area utilization change in a wide variety of situations (Muchoney and Haack, 1994; Singh, 1989; Shalaby and Tateishi, 2007). Diverse sorts of models are utilized to anticipate the urban sprawl in times of time. Brett Hazen (1996) utilized a model called LUCAS to asses area utilization change in Little Tennessee River Basin of western North Carolina. Robert Johnston (2000) utilized another model called UPLAN to help in future urban situation of the city Espanola in New Mexico. While John Landis (2001) went over with a model called Curba which consolidated bio assorted qualities consider urban development pattern. Patterson (2008) anticipated urban sprawl by utilizing URBANSIM model in Brussels.

Merwe (1997) utilized IDRISI GIS package to calculate development for area utilization sorts with an accentuation on their deliberate and weighted criteria. H P Samant (1998) took multi date information of geological maps and Landsat TM information to discover the area Use change in Navi Mumbai. Silva et. Al anticipated urban development in European urban areas utilizing Sleuth model. Carlson (2002) utilized Sleuth model coupled with Landsat Tm imagery to anticipate future changes in surface spillover coming about because of the urbanization. Liu (2003) et. al utilized cell automata calculation with conjunction with fuzzy set technique to

model urban development and discovered sensible and reasonable situations. Liu (2005) et. al utilized the joining of remote sensing, geographical systems and multivariate mathematical models to anticipate urban development. Hu and lo (2006) connected the logistic regression for displaying urban development in Atlanta for better comprehension the variables influencing it. Andrew Manu et. al utilized remote detecting innovations to study the urban development of three noteworthy Sahelian cities.

Jansen et. al gave a spatially explicit land-cover/utilization change flow in the period 1991–2001 utilizing the UNEP Land Cover Classification System for classes with object-oriented geo-database approach to deal with handle changes in the advancement of area spread items, i.e. polygons, with time to withstand change flow investigation. Haack and Rafter (2006) utilized KVGIS layer to locate the urban development in Kathmandu. A lot of this development has happened without successful planning bringing on significant issues including natural contamination, utilizing unemployment, deficient foundation offices and clashing area utilization requests. At the same time, late land utilization change data is helpful for procurement of different frameworks and administrations, for example, transportation, utilities, restorative offices and schools. Henriquez and Azocar (2006) discovered the area spread change in Chillan and Los Angeles through the computerized understanding of flying photos from distinctive time sets. Their study investigated the principle main thrusts that clarify the development of these medium sized urban communities utilizing model for area use and the spatial examinations as prescient instruments. Jha and Singh (2008) utilized entropy approach for examination of urban development in Haridwar which is a vital city along the banks of River Ganga, to create future arrangement for urbanization advancement ranges and urbanization control regions. Rahmann and Aggarwal utilized the Shannon's entropy to model the urban extension of Hyderabad city, India. They discovered wonderful sprawl or urbanization in the city. Mohajeri created urban road designs conduct utilizing the entropy and discovered great relationship among them. Remote sensing, GIS and entropy methodologies were coordinated to satisfy the destinations of the present work. Taubenbock connected multi fleeting remote detecting and time arrangement of Landsat information for checking and comprehension of urban sprawl prepare in India. Ibrahim and Sarvestani (2009) utilized diverse satellite pictures between 1976-2005 and populace statistics of Shiraz city in Iran to show urban sprawl design. Four primary area utilization sorts, for example, developed ranges ,water, vegetation and exposed area zones were arranged from

satellite pictures of Shiraz city. From their work it is encouraged that the urban arrangement will be more centered around security of accessible vegetation and pay of decimated coverage.

Belal and Moghanm (2011) discovered the urban sprawl in twomajor areas in the Egypt. Landsat images like Multispectral Scanner (MSS) in the 1972 and Enhanced Thematic Mapped (ETM) in the 2005 were utilized to survey the progressions of urban infringement, agrarian terrains and water ranges amid this period with coordination by GIS. The primary target of their study was to translate sprawling of urbanization and its effect on farming area utilizing coordinating remote detecting and GIS. Rahman and Aggarwal (2011) utilized the Shannon's entropy model to discover urban sprawl utilizing IRS P-6 information (Rahman, 2011) and topographic sheet in GIS environment for Hyderabad and its Surrounding Area. This study is very applicable as in with the quick city development the urban biological community is changing and it has a negative effect on the vegetation and in addition on human well-being in this locale. Jing and Jianzhong (2011) utilized multi-temporal TM/ETM+ pictures to foresee the urban extension in Lianyungang City between 1987 to 2009. The examination to the model of urban development demonstrated that the urban extension was clearly bicentric, and takes activity streets as development hub.

Chen Zhan-long, Xie Zhong, Wu linag(2008) analyzed the map projection and the math of buffer analysis in light of the summarization of the previous buffer analysis and map projection, and improved the arithmetic of buffer analysis, and after that dissected the problem of the buffer analysis utilizing map projection as a part of the first run through. During the time spent the building of the buffer polygon, this article fundamentally examined how to solve the distortion issue caused by not considering the map projection when made the buffer analysis in the large-scale zone. As per the result of the simulated test, this method is handy and productive.

**CHAPTER-3**  
**THE STUDY AREA**



## About the study area -

Bhubaneswar and Cuttack are the focal point of all the major activities in Odisha, popularly known as the twin city are undergoing exponential expansion day by day.

Bhubaneswar is arranged on the Howrah -Chennai principle south Eastern Railway line at 435km from Howrah and 1215km from Chennai and the NH.5 uniting Chennai and Kolkata goes crosswise over urban focus. The city is in the west piece of the "Mahanadi Delta" on the bank of the stream Kuakhai and the South west of Cuttack city. The stream Daya which has cut off from Kuakhai moves along the south eastern piece of the city. After the autonomy, Bhubaneswar locale has experienced a great deal of development and development. Managerial and institutional exercises have added to the increment in the volume of exchange and trade action. The city lies in the middle of 21° 15' latitudes and 85° 15' longitudes. The normal temperature in winter is 12 degree Celsius and the most extreme temperature is 43 degree Celsius (Figures 1 and 2). The south-west storm shows up in June. Bhubaneswar has a great atmosphere. The city has three distinct seasons. They are summer (from March to June), Monsoon (July to October) and winter (From November to February). As indicated by Kopppen order the city goes under savanna (ISDR Report, 2002). The normal yearly precipitation of the city is 1498 mm (Bhubaneswar primary report). The mean yearly temperature of bbsr lies between 270C to 410C. The atmosphere stays humid for the month of June to month of October.

Cuttack is the former capital and the second largest city in the eastern Indian state of Odisha. It is also the headquarters of the Cuttack district. Cuttack is located at 20°31'23"N 085°47'17"E[16] and has an average elevation of 36 metres (118 ft). The city is located at the central point of four rivers which are the distributaries of River Mahanadi; namely Mahanadi, Kathajodi, Kuakhai, Birupa and further Kathajodi is distributed into Devi and Biluakhai.

## **Demography –**

According to Bhubaneswar Demographics, Census 2011 figured the number of inhabitants in the Bhubaneswar to be roughly 837,737. Around 56% of the aggregate populace are male while 44% are female. Hinduism is the significant religion followed by the individuals living in Bhubaneswar. As indicated by the 2011 registration of India, populace of Cuttack City in 2011 was figured at 606,007; of which male and female are 303,530 and 302,477 separately. Its urban/metropolitan populace is 658,986 of which 331,246 are guys and 327,740 are females. Downright youngsters (0–6) in Cuttack City are 48,585 according to figure from Census India cover 2011. There were 25,358 young men while 23,227 are young ladies.

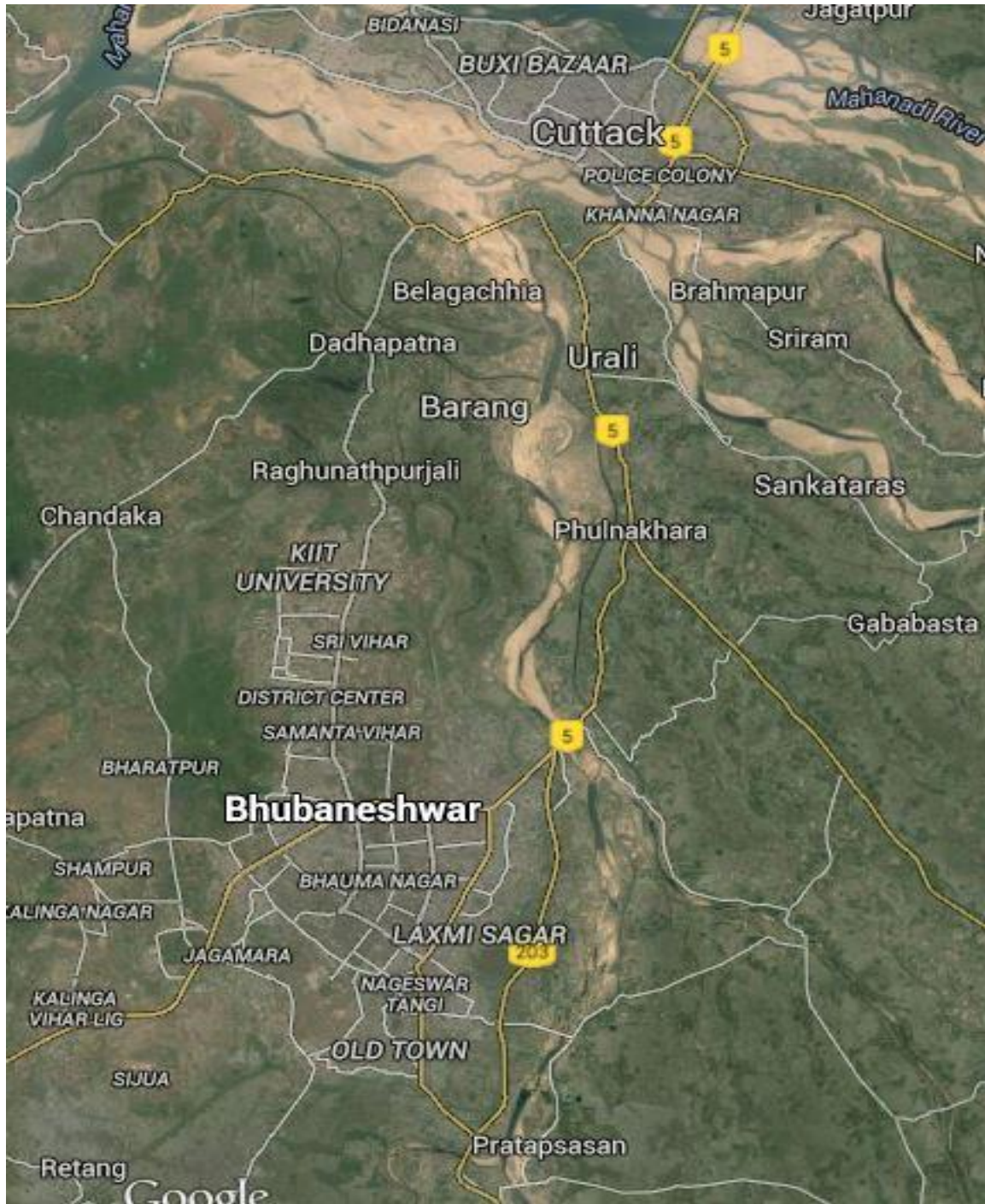


Figure-1, Aerial view of study area

**CHAPTER-4**  
**METHODOLOGY**

## **Methodology –**

### **4.1 Geo-referencing –**

Base map is taken, which is the map of Odisha taken from the survey of India. Geo-referencing is the process in which a given map which doesn't have specified units is aligned with the natural coordinates. this can be done if the coordinates of at least four points in the map are known and the geo-referencing tool is used to specify the unit of the map.

### **4.2 Creation of shape files –**

This process is also called digitization of the map, in this process a part of the map which is required for the analysis can be converted to raster by making shape file of that portion using data management tools present in the ARC catalog menu. This gives the polygon map for study area.

### **4.3 Extraction by mask –**

Aerial image of the study area for the years 2005, 2010 and 2015 captured by LANDSAT 8 are obtained from <http://earthexplorer.usgs.gov/>. bands 1,2,3,4,5 and 7 should be added to the ARCMAPS and then the shape file data superimposed on it, extraction by mask tool is used to extract from LANDSAT image, only the area required for analysis.

### **4.4 Supervised classification –**

This is a process where the masked data is worked upon to differentiate various land use types. This process includes: creation of training samples; creation of signature file; supervised classification.

Various land use types taken in to consideration are –

- 1. Forest**
- 2. Residential**
- 3. Industrial**
- 4. Agricultural**
- 5. Barren land**
- 6. Water bodies**

**1. forest** – land area covered by dense plantation and a habitat for wild animals is classified as forest area.

**2.residential-** the build-up area except the industrial ones which is used by people for residential purpose, recreational buildings, malls, office spaces etc.

**3.industrial** –land area which is used for commercial purposes such as manufacturing, quarrying, warehouses etc.

**4.agricultural** – land area where crop is grown and also the plantation areas present in the city.

**5.barren land** –land which is not used for any purpose yet.

**6.water bodies** – area which is covered by water resources, it includes: river, pond, lake etc.

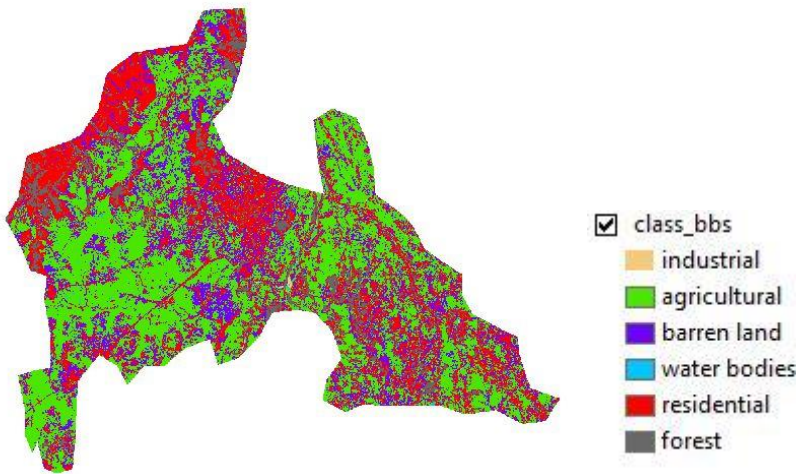


Fig2. Supervised classification

fig3. Color codes for various land types

#### **4.5 Buffer Analysis –**

This can be done by using 2 methods

1.the multiple buffer analysis feature in ARCGIS. In this process a center of interest is chosen at Acharya Vihar, and buffers are drawn with an increment of 2km in radius per circle, 2 land use types are considered for buffer analysis, which are-

1. Agricultural
2. Residential

This analysis gives us the knowledge of direction in which the city is growing so that we can anticipate correctly and accordingly direct our resources.

2.buffer along highway

In this method buffers of 3 km are taken on both the sides of the national highway and analyzed for four land use types, namely-

1. agricultural
- 2 .residential
3. vacant land
4. water

## **CHAPTER-4**

### **RESULTS AND DISCUSSIONS**



**Results and discussions –**

The first step involves the geo-referencing of base map which is taken, then the shape file of the require portion of the base map is created for further analysis. Shape file is shown in fig2.

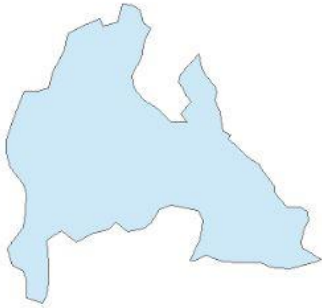


Fig4. Shape file of the region

Next process is to get the landsat data which is superimposed on the shape file of the region and consecutively supervised classification is carried out.

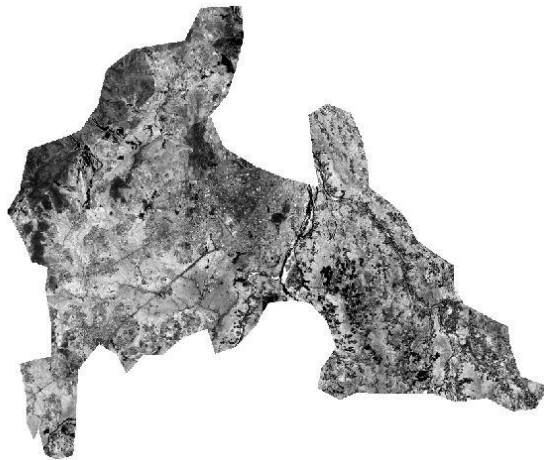


fig5. Masked data

**Classification data obtained for years 2005, 2010 and 2015**

From the below data we can see that land distribution has changed drastically while in the year 2005 distribution was more uniform among all the types of land use, residential area was highest followed by agricultural land and the difference in percentage points between the 2 was not too high. As we move towards 2015 we see that residential land covers about half of the city area because more and more people flocked to cities in search for better opportunities hence, demand for residential land which was compensated at the cost of forest and agricultural land, which show a continuously decreasing trend, while residential land increased from 32.8% to 49.41% over the span of 10 years

**Table1. land classification data for year 2005**

<b>LAND TYPE</b>	<b>AREA(in hectares)</b>	<b>%AREA</b>
<b>Forest</b>	<b>150812.38</b>	<b>21.16</b>
<b>Agricultural</b>	<b>190935.6</b>	<b>26.9</b>
<b>Industrial</b>	<b>34568.78</b>	<b>4.88</b>
<b>Residential</b>	<b>234961.35</b>	<b>32.8</b>
<b>Barren land</b>	<b>48375.68</b>	<b>6.90</b>
<b>Water bodies</b>	<b>68124.07</b>	<b>7.36</b>

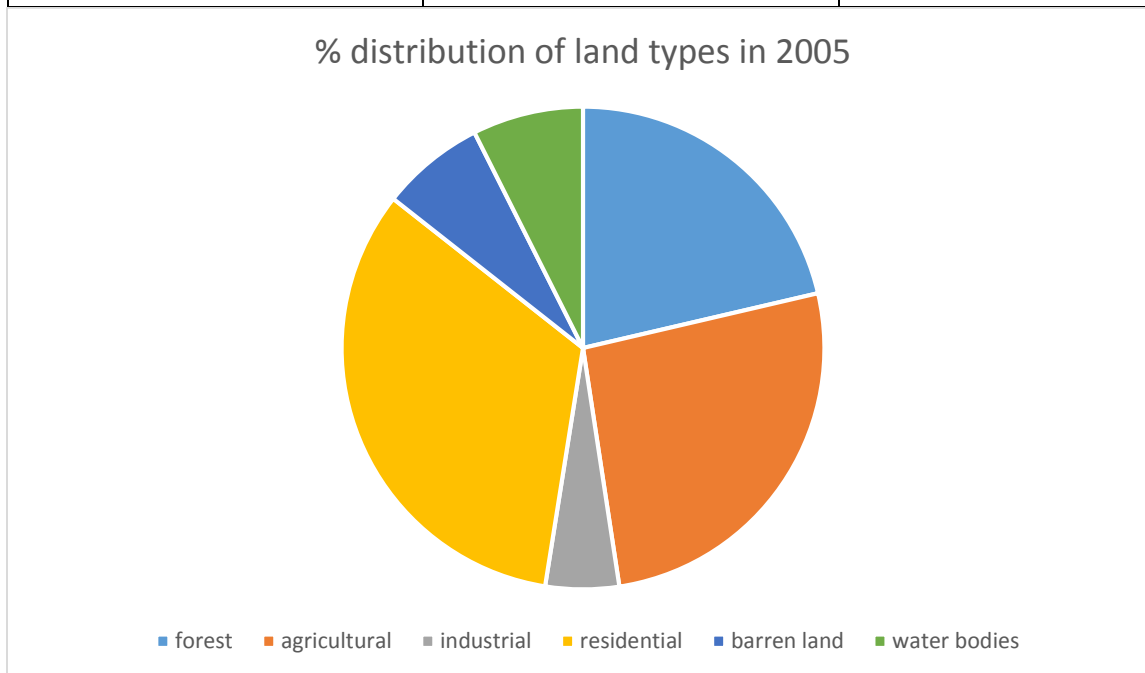


Figure6.

**Table2.land classification data for year 2010**

<b>LAND TYPE</b>	<b>AREA(in hectares)</b>	<b>%AREA</b>
<b>Forest</b>	<b>115191.06</b>	<b>16.14</b>
<b>Agricultural</b>	<b>101284.28</b>	<b>17.11</b>
<b>Industrial</b>	<b>39875.80</b>	<b>6.73</b>
<b>Residential</b>	<b>295839.57</b>	<b>49.80</b>
<b>Barren land</b>	<b>18956.39</b>	<b>3.23</b>
<b>Water bodies</b>	<b>58307.26</b>	<b>9.87</b>

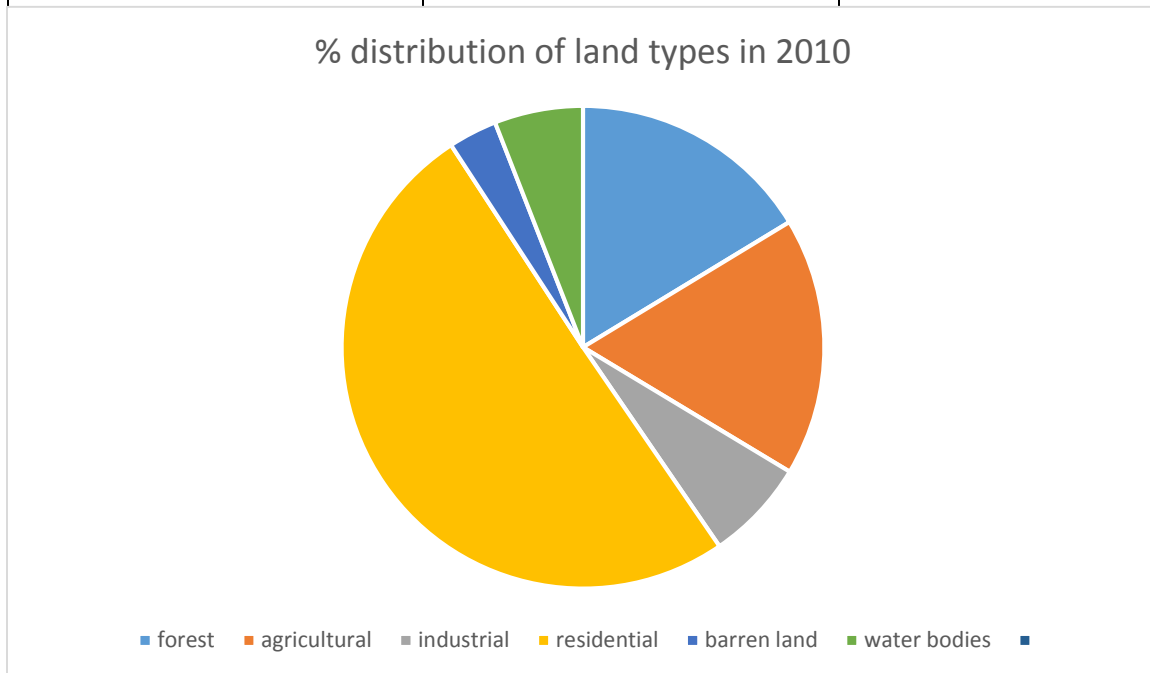


Figure7.

**Table3. land classification data for year 2015**

<b>LAND TYPE</b>	<b>AREA(in hectares)</b>	<b>%AREA</b>
<b>forest</b>	90181.3	14.9
<b>Agricultural</b>	98284.6	16.3
<b>Industrial</b>	46485.7	7.7
<b>Residential</b>	334121.5	56.71
<b>Barren land</b>	13149.76	2.18
<b>water bodies</b>	19146.66	3.5

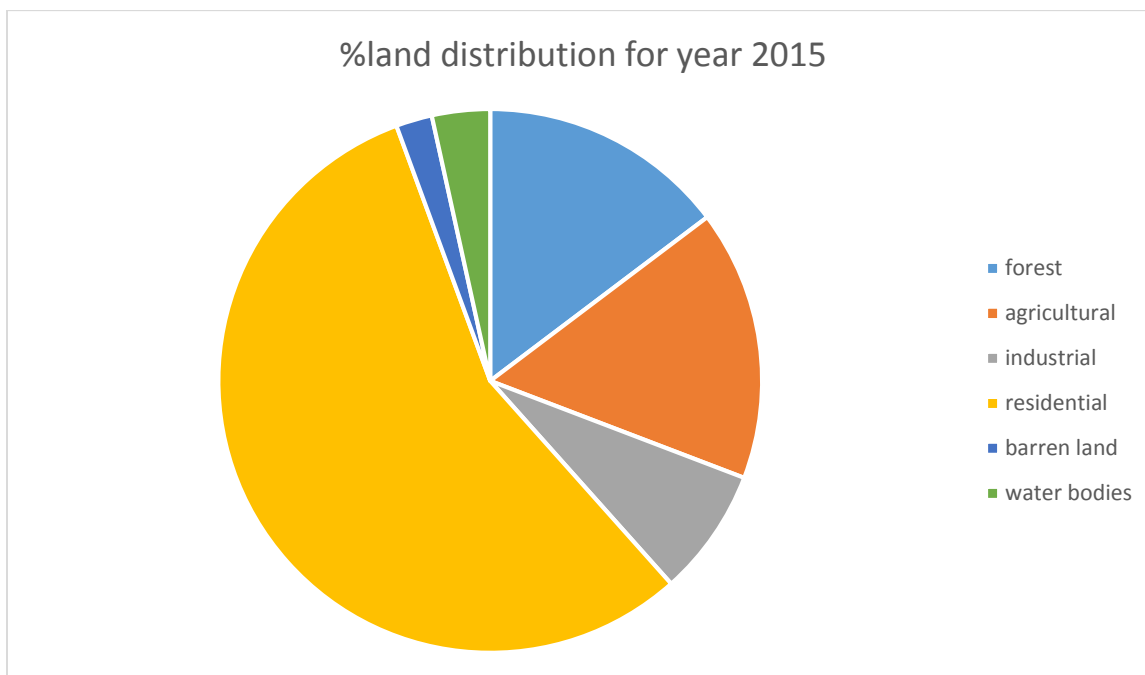


Figure8.

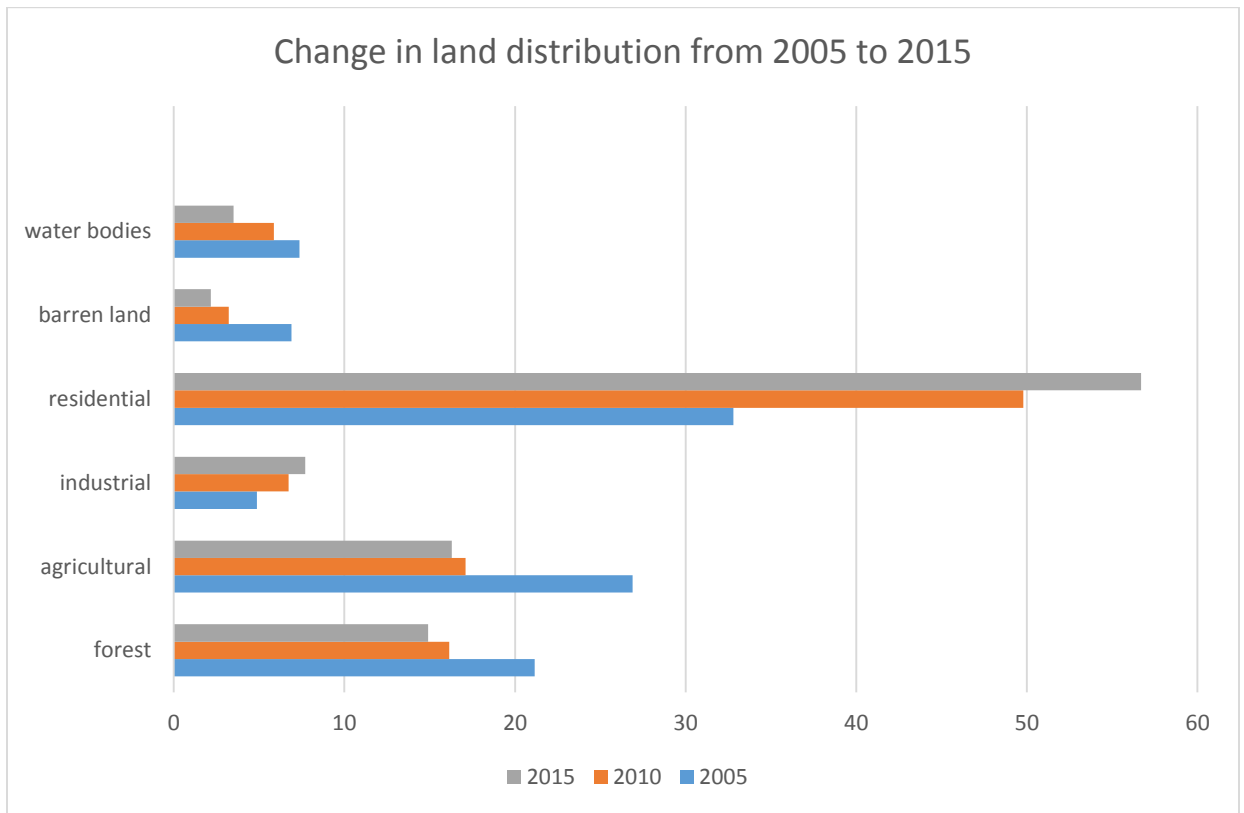


Figure9.

## BUFFER ANALYSIS

### Along the highway

6 buffer zones are taken to the right and left of the highway each buffer zone of 3km each. Left side is mancheswar ,chandrasekharpur region and the right part is master canteen to pipli region region. We see that that is a steep increase in residential areas towards chandrasekharpur as well as towards pipli.

Table4. Area (in hectares) in left buffer region in year 2005

LAND USE TYPE	A1 (LEFT)	A2 (LEFT)	A3 (LEFT)	A4 (LEFT)	A5 (LEFT)	A6 (LEFT)
AGRICULTURAL	1063.1	1109.2	905.56	1298.6	1478.21	1568.69
RESIDENTIAL	241.8	272.16	315.56	220.41	183.7	145.23
VACANT LAND	152.1	83.32	194.2	321.5	392.12	240.5
WATER	30.6	4.8				

Table5. Area (in hectares) in right buffer region in year 2005

LAND USE TYPE	A1 (RIGHT)	A2 (RIGHT)	A3 (RIGHT)	A4 (RIGHT)	A5 (RIGHT)	A6 (RIGHT)
AGRICULTURAL	1133	966.58	1186.23	735.24	528.58	361.29
RESIDENTIAL	518.7	419.2	32.1	18.5	11.44	24.5
VACANT LAND				96.3	169.48	
WATER			287.5	710.6	620.03	299.8

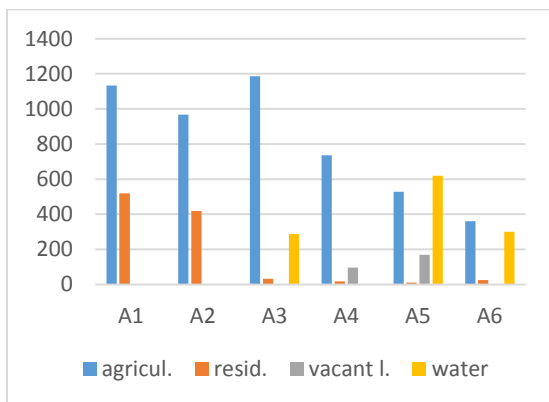


Fig10. Area dist. R 2005

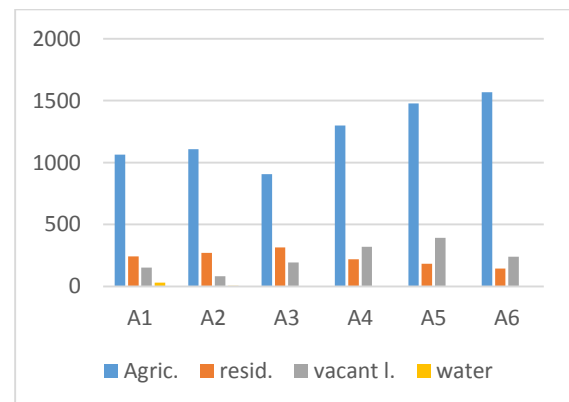


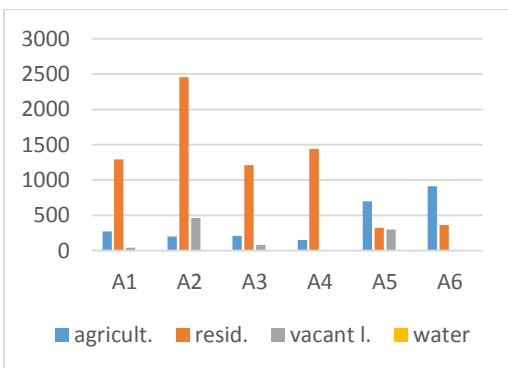
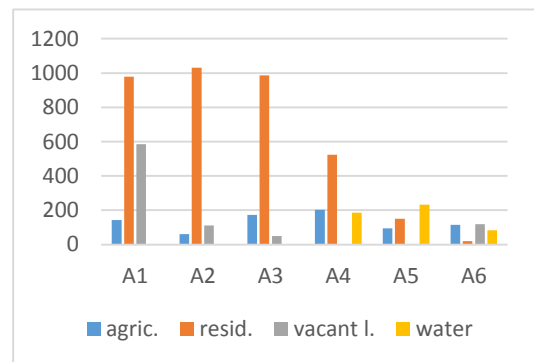
fig11. Area dist. L 2005

**Table6. Area (in hectares) left buffer regions in year 2010**

LAND USE TYPE	A1(LEFT)	A2(LEFT)	A3(LEFT)	A4(LEFT)	A5(LEFT)	A6(LEFT)
AGRICULTURAL	272.1	200.58	209.39	148.22	695.36	811.2
RESIDENTIAL	1292.69	2457.28	1211.1	1440.35	320.8	364.39
VACANT LAND	38	460	83		299	117
WATER						

**Table7. Area (in hectares) right buffer regions in year 2010**

LAND USE TYPE	A1(RIGHT)	A2(RIGHT)	A3(RIGHT)	A4(RIGHT)	A5(RIGHT)	A6(RIGHT)
AGRICULTURAL	142.5	60.1	172.3	203.2	94.6	115.56
RESIDENTIAL	979	1030.26	986.51	523.7	150	19.2
VACANT LAND	586	112	49.8	0	0	118.96
WATER				186.49	232.6	83.45

**Fig.12 area dist. L 2010****Fig13. Area dist. R 2010**

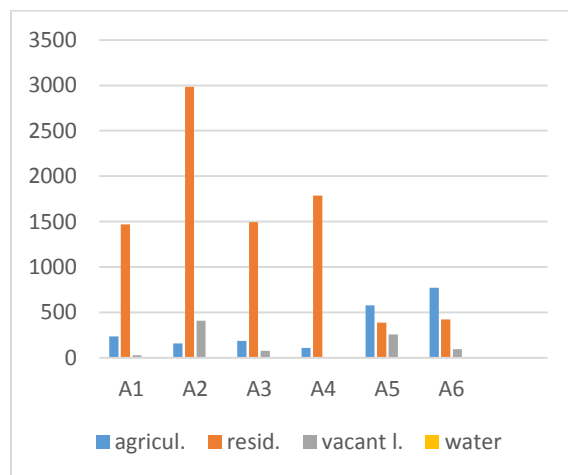
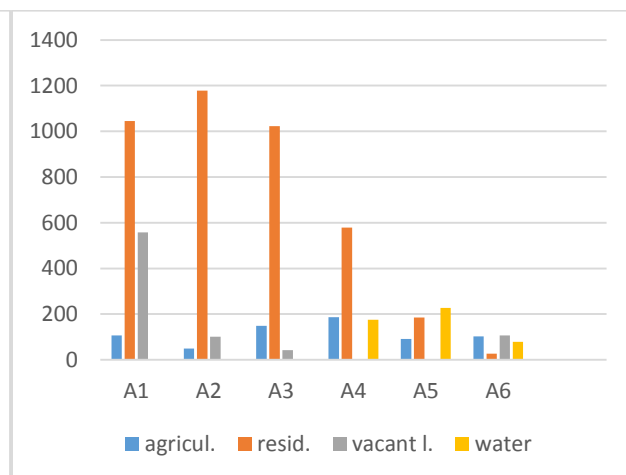


**Table8. Area (in hectares) left buffer regions in year 2015**

LAND USE TYPE	A1(LEFT)	A2(LEFT)	A3(LEFT)	A4(LEFT)	A5(LEFT)	A6(LEFT)
AGRICULTURAL	235.49	157.3	186.58	109.5	578.37	770.59
RESIDENTIAL	1468.69	2986.2	1491.1	1786.35	386.8	423.39
VACANT LAND	27	409.35	76.23		257.74	96.4
WATER						

**Table9. Area (in hectares) right buffer regions in year 2015**

LAND USE TYPE	A1(RIGHT)	A2(RIGHT)	A3(RIGHT)	A4(RIGHT)	A5(RIGHT)	A6(RIGHT)
AGRICULTURAL	106.23	49.26	148.28	186.9	91.5	103.6
RESIDENTIAL	1045.2	1178.23	1023.5	578.8	184.9	25.8
VACANT LAND	557.64	101.23	42.38	0	0	106.9
WATER				175.6	226.9	78.23

**Fig14. Area dist. L 2015****Fig15. Area dist. R 2015**

**BUFFER ANALYSIS WITH A POINT OF INTEREST**

This is a process where the entire region is divided into 12 buffer zones and the area occupied by residential and agricultural type of land is observed for each region for the years 2005, 2010 and 2015.

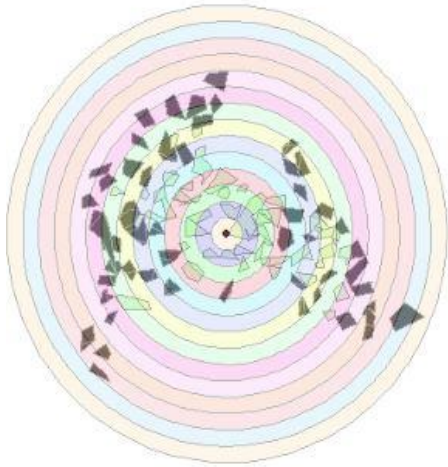


Fig16. Multiple buffer for 2005

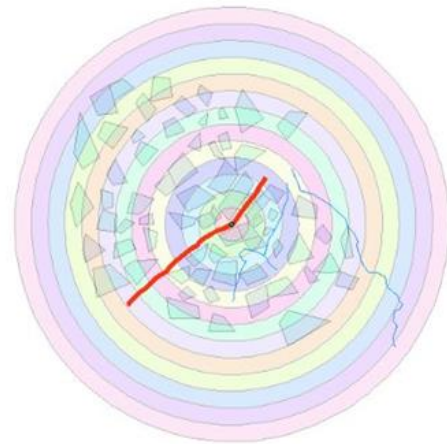


fig17. Multiple buffer for 2010

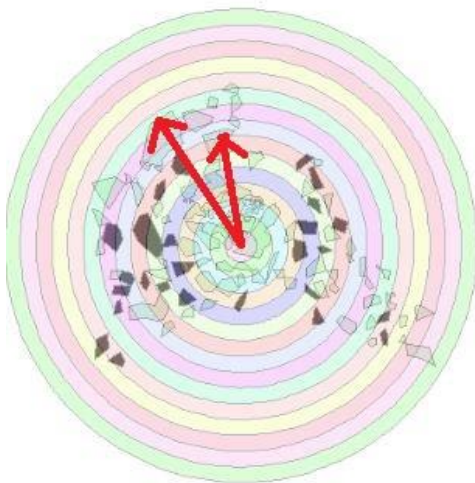


Fig18. Multiple buffer for 2015

The figures show the spread of agricultural and residential land. The red line is NH and the center for this buffer is taken along it at Acharya Vihar. Buffer is created with an incremental radius of 2km.

This shows that city is developing more in the north-west region which is the region towards Chandrasekharpur and Nandankanan and also towards northern direction which is towards Phulnakhara.

**CHAPTER-6**  
**CONCLUSION**

## **Conclusion-**

1. Decrease of agricultural land by 10.6 percent points, a decrease in forest land by around 5.2 percent points and an increase in residential land by 24 percent points was observed.
2. After the buffer analysis along the highway it was confirmed that the area towards master canteen was more densely populated compared to the area of Mancheswar and Phulnakhra. As we moved on towards 2015 residential lands increased drastically both in Mancheswar region and towards Pipili.
3. Multiple ring buffer analysis showed that area in the north-west region which is towards Chandrasekharpur and Nandankanan has seen most amount of growth in the span of 10 years, and area towards north which is towards Phulnakhra region also has a great potential for growth.

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