



Analysis of Urban Growth Pattern of Durgapur Municipality and its Surrounding Areas 5 Km by using the Geospatial Techniques

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Abstract

Urbanization, which is caused by economic and population growth, has far-reaching socioeconomic as well as environmental effects, such as pollution and land degradation. Future studies should develop reliable techniques for recognizing and forecasting urban growth trends in Asia. Rapid development and rising temperatures have led to significant changes in Durgapur Municipal Corporation's urban landscape and surface temperature, with the western sector experiencing the most growth, necessitating sustainable urban planning and resource management. In Durgapur-Faridpur, Andal, and Kanksa CD Blocks, the study surveys urbanization, population change, the relation between physical growth and population, and the LULC pattern in 2001-2011. Changes in land cover and urbanization are analyzed at the city level with Landsat 5 TM imagery obtained from 2001 to 2011. For improved classification and change detection analysis over a ten-year period, secondary data such as Census data and Google Earth maps is utilized. Supervised Classification using Maximum Likelihood Classification (MLC) was applied to prepare LULC maps of the study area. From this LULC maps by using Intersect Overlay tools from Arc Gis software the change detection map has been prepared. Durgapur Municipality Corporation and its surrounding areas 5 k.m. is a potential region marching towards urbanization due to the presence of Iron – steel industry and mining activities in this area. This paper emphasizes on the growth of urban area and effects of urbanization on environmental components mainly climate, biosphere, landuse pattern, water resources, waste disposal etc. Significant changes in landuse are as follows in this study area barren land 6.04% to 12.61% from 2001 to 2011, settlements 20.70% to 34.42% from 2001 to 2011, Ground 19.78% to 1.87% from 2001 to 2011. Major changes in population growth and built up area are 46.69% to 53.30% (2001 to 2011) and 42.37% to 57.62% (2001 to 2011). Urbanization and Industrialization are one of the major factors to increase environmental degradation.

Keywords: Urban Growth, Landuse Pattern, Barren Land, Settlement, Environmental, Maximum Likelihood Classification, LULC, Durgapur Municipality Corporation

1 Introduction

Urbanization is a worldwide process enabled through economic and population growth. It is characterized by fast growth and land appropriation at various places, and it is anticipated to persist with growth in the subsequent decades [22, 38]. Cities, peri-cities, and rural regions all have varying regimes and growth rates of growth, each with their particular issues and effects. With regard to

cities, for example, compared to peri-urban and rural regions, cities in the metropolitan area of Mexico City have the highest growth rates [13]. Similarly, Jakarta Metropolitan Area was spreading suburbia, and the same particularly applies to commuter response in mobility and also socioeconomic and psychological concerns [36]. Peri-urbanization is particularly prevalent among developing nations, resulting in fragmented development and

heterogeneously diversified regional and local impacts [21]. By taking into account factors including population growth, land elevation, road connection, and existing urban centers, researchers have developed models to forecast urban expansion and sustainable management [6, 14]. Urban planners can mitigate environmental externalities of economic growth by utilizing diffusion-coalescence theory, which suggests a gradual shift from dispersed growth to compact development in urban areas [8, 26]. The transport-led development pattern of Tokyo since the late 19th century has remained the major engine of urban growth, while transport system and policy adjustments have been driven by economic and social necessities [23]. Metropolitan and urban regions can have growth trajectories that are very disparate; medium-sized and small cities in the Yangtze River Delta and big cities in Beijing, Tianjin, and Hebei are growing at a quicker pace [40]. Future studies should create reliable techniques for recognizing and forecasting urban growth trends in Asia, a region that is expanding quickly and has important ramifications for social structures, economic growth, and environmental sustainability (Roberts, 2018). In South Asia, where the urban share of the population increased from 27.3% in 2000 to 30.9% in 2011, this urbanization tendency has been especially noticeable [30]. Urban growth patterns in Asia vary across countries and regions, with East Asia encompassing global metropolises like Tokyo, ascending world cities like Hong Kong, Seoul, Taipei, and developing megacities like Jakarta and Ho Chi Minh City [35]. In the meantime, a study of 15 cities in Southeast Asia utilizing data on nighttime light showed significant temporal and spatial trends in urbanization, with core-urban and peri-urban areas typically growing over time [19]. It's interesting to note that Asian urbanization hasn't always followed Western trends. However, other cities like Doha in Qatar are developing in ways that are comparable to those of many cities in the West [33]. Others have taken other approaches to deal with the problems caused by the fast urbanization of society. For instance, with the introduction of economic growth policies, Shanghai's urban growth in China has been influenced by seven primary expansion typologies [7]. The disparity in urban growth patterns throughout Asia suggests that various economies can achieve socioeconomic objectives at varying rates of growth [10]. Rapid, diverse, and highly influential, urban growth in Asia contributes to economic growth and, in many nations, generates four-fifths of

national GDP [29], additionally, it has resulted in issues like poor public services and environmental damage [17]. In order to encourage sustainable and fair urban development, Asian nations are realizing more and more how important planned urban expansion and smart growth concepts [12]. Over the past few decades, India's urban growth patterns have been marked by substantial shifts in land usage and fast expansion. Urban land share has been steadily rising in many Indian cities, according to studies; one prominent example is Kolkata, which saw urban expansion from 4.1% in 1990 to 11.58% in 2017 [32], as well as a forecast rise to 14.94% by 2025. Similarly, Kolkata Urban Agglomeration's contribution to urban land rose from 20% in 2000 to nearly 50% in 2018 [11]. In a quest to manage the issues emanating from rapid urbanization and its environmental impacts, such trends put emphasis on sustainable urban planning and management [2]. Urban areas have undergone rapid urbanization, leading to large-scale land use and spatial structure transformation. It increased from 4.1% in 1990 to 11.58% in 2017 and is projected to be 14.94% in 2025 [32]. Expansion outward has been characteristic of this expansion, particularly in the periphery areas around the city center [31, 32]. More sophisticated is the form of urban expansion that occurs in the urban periphery of Kolkata, driven by urban real estate development, industrial parks, and linkages [25].

Overall, the urban growth pattern of Kolkata is complicated and comprised of horizontal and vertical expansion. As a result of the saturation of city centers, land is put under more pressure and the costs rise, causing development in the outskirts [24]. It was expected that the urban growth would persist in the future, especially in the northeast and southeast region of Kolkata City.

Additionally, city expansion has benefited greatly from its initial population, capital city status, and accessibility to other cities. Urban growth is more influenced by industrial, infrastructure, and socioeconomic factors than by biophysical ones. Substantial development in the urban areas took place between 1991 and 2001 due to road-side urbanization, mining areas, and industrial parks; the densest in the direction South-South-East [15]. Urbanized area intrusion into other purposes is resulting in land-use sustainability concerns in the Asansol-Durgapur Planning region study area, which questions sustainable

development [34]. Mass urbanization and a growing trend of development over the last 20 years have produced drastic alterations in Indian urban growth patterns after 1991 [18]. After economic reforms and neo-liberalist thinking, there is an impact on Indian city development, leading to new employment patterns in globally linked industries around and in major cities. India's highly top-biased urban configuration has also been seen to discourage regional growth from becoming balanced. In a bid to decimate such issues and enhance sustainable urban development, improved infrastructure development and health initiatives are increasingly becoming essential.

Remarkably, many municipal councils' urban growth rates exceed their population growth rates, indicating a distributed growth pattern in peri-urban areas [4, 28]. Infrastructure, environmental sustainability, and flood susceptibility are all significantly impacted by this expansion pattern, particularly in light of climate change projections [27]. Sustainable urban planning techniques that prioritize environmental concerns and wise resource management are crucial for the effective administration of DMC and its peri-urban areas in order to handle the difficulties brought on by this expansion [15, 37]. Through the creation of land-use maps and the analysis of urban development over time, urban growth pattern analysis employs remote sensing techniques and GIS to track spatial and temporal changes in metropolitan regions. These maps serve as the foundation for applying spatial metrics and models to identify growth patterns. Urban growth patterns can be efficiently categorized into five groups using spatiotemporal measures, such as Weighted Euclidean distance and Weighted mean expansion: expansion, compact, dispersed, road-based, and leapfrog. Researchers have developed modified indices like the modified urban growth index (Sm) to better recognize multi-temporal patterns compared to the simple urban growth index (S) [8].

2 Objectives

1. To find out the urban growth in the CD Blocks of Durgapur-Faridpur,vz and Kanksa.
2. To examine the changes in the population growth in the Study Area.
3. To find out the relation between the physical expansion and population changes in the Study area.

4. To find out the changes in the LULC pattern of the Study Area.

3 Study Area

Durgapur is located at 23.48°N and 87.32°E. DMC is a part of Faridpur- Durgapur block, but to its importance it is administered separately. Andal is situated at the west portion, Faridpur block is situated at the northern portion & Kanksa is situated at the eastern part of DMC within 15 km. It has an average elevation of 65 metres (213 ft). Durgapur subdivision is surrounded by Asansol Sadar subdivision on the west, Purba Bardhaman district on the east, Bankura district across the Damodar in the south, and Birbhum district across the Ajay River to the north. Durgapur is situated in the Paschim Bardhaman district of West Bengal, on the bank of the Damodar River, just before it enters the alluvial plains of Bengal. The topography is generally undulating types with laterite deposition. The coal-bearing area of the Raniganj coalfields lies just beyond Durgapur; some parts intrude into the area. The area was characterised with deeply forest cover till recent times, and some streaks of the original Sal and eucalyptus forests can still be seen [Fig. 1].

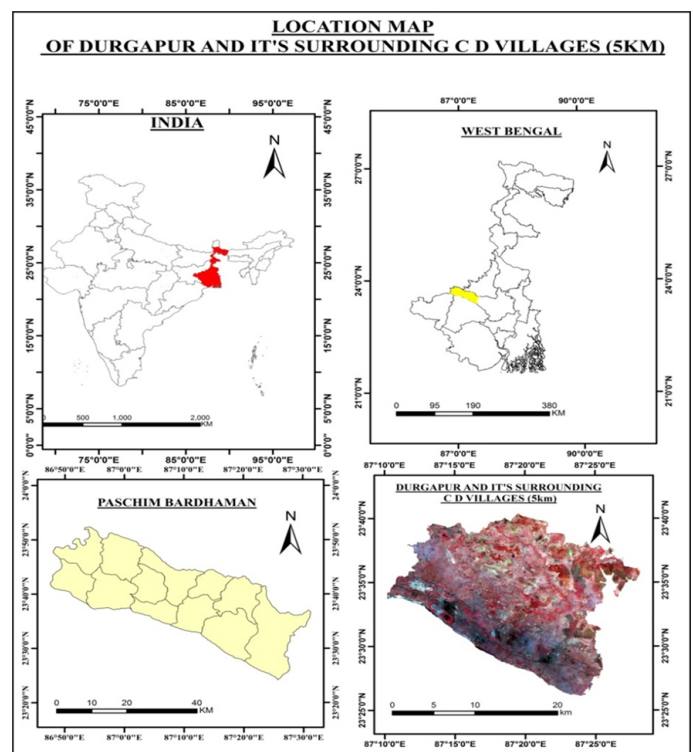


Fig. 1: Study Area

4 Data Base and Methodology

Roads, transportation networks, land use, population, and urbanization are some of the variables that have been incorporated into the analysis of urban sprawl phenomena using temporal GIS databases. Landsat data and other satellite photos have been widely used to evaluate urban land transformation and changes in land use and land cover [31]. To measure the degree of urban growth and its effects on other land types, these studies frequently use land use/land cover change matrices. Studies show contradictions between urban growth patterns and planning objectives, as seen in Beijing's expansion, with growth centers shifting towards the northern part despite the city's General Plan. Planning objectives depend on tracking urban growth, and combining statistical methods such as Shannon's entropy model, GIS, and remote sensing has shown promise in examining trends in growth, logistic geographically weighted regression, and urban sprawl matrix techniques [31] have been effectively used to quantify and visualize urban growth trends. Land use and land cover maps were created using multi-temporal Landsat data and the Maximum Likelihood Classifier (MLC) technique.

For the present study the following data are used-

- Landsat 5 TM
- Census data

4.1 Data Collection

Landsat 5 TM satellite imagery: The Landsat 5 TM photos for 2001 and 2011 can be obtained from satellite data repositories or the USGS Earth Explorer. Landsat TM's 30 m spatial resolution makes it appropriate for city-level analyses of land use change and urban areas.

For better categorization results, make sure the photos are cloud-free or choose photos with little to no cloud cover.

Secondary Data: 2001 and 2011 Census Data and 2021 data to comprehend the socioeconomic and demographic shifts that occurred during this time.

Maps of Google Earth: supplying information on current transportation systems, infrastructure, and natural elements as a baseline.

Land Use and Land Cover (LULC) data: prior studies or secondary data on the region's trends in urban growth.

4.2 Preprocessing of Satellite Data:

- **Georeferencing and Registration**
 - Ensure both the 2001 and 2011 Landsat images are correctly georeferenced to a common projection system (e.g., WGS84, UTM).
 - Perform image registration if required to align both datasets accurately.
- **Atmospheric Correction (if necessary)**
 - Apply atmospheric correction techniques (such as the Dark Object Subtraction method) to reduce atmospheric interference and enhance the image's interpretability.
- **Image Enhancement**

Apply radiometric and geometric corrections to improve image quality for better visual interpretation and classification.

4.3 Land Use and Land Cover Classification:

- **Image Classification**
 - Use **Supervised Classification** (e.g., Maximum Likelihood Classification) or **Unsupervised Classification** (e.g., ISODATA) to categorize land cover types.
 - Typical classes might include: urban/built-up areas, agricultural land, forest, water bodies, barren land, etc.
 - Use training sites from both the 2001 and 2011 images, based on ground truth data or ancillary data. 2021 data also interpreted in this study.
- **Change Detection Analysis**
 - After classifying both the 2001 and 2011 images, perform a change detection analysis to quantify the extent of urban growth or land cover changes over the 10-year period.
 - Post-classification comparison can be used to identify the areas that have transitioned from one land cover type to another (e.g., agricultural land converted to urban areas).

The methodology for the following study is showing by this chart [Fig. 2].



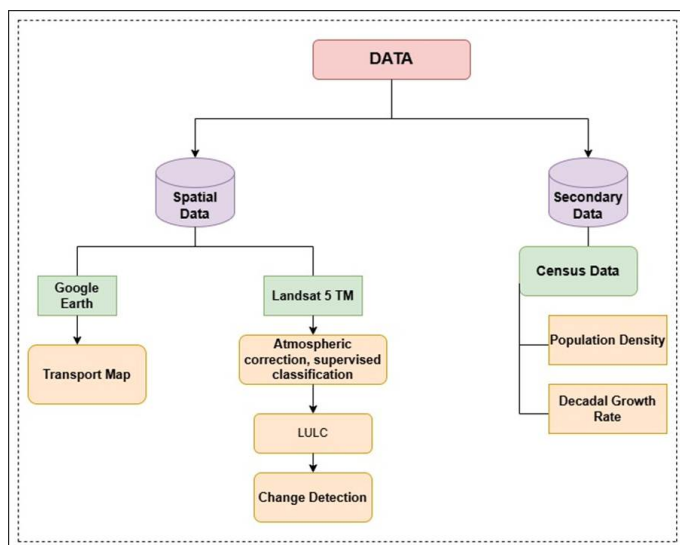


Fig. 2: Methodology of this study

5 Result and Discussion

5.1 Urban Growth in CD Blocks

The core city of Durgapur and the main transportation routes that lead into Andal and Kanksa were identified to have the most urban expansion. The Durgapur-Faridpur block's built-up land grew by more than 40% between 1991 and 2021, mostly as a result of shopping malls, residential colonies, and transportation infrastructure. Andal's development was fuelled by its closeness to Durgapur Airport and industrial facilities. More sporadic growth was seen in Kanksa, frequently close to highways and mining areas. From the above map Durgapur Faridpur, Andal, Kanksa divided into 5 section. This distribution is uneven, some area's population density very high and some area's population density is very low in the both year of 2001 & 2011. Six villages of my study population density is 0 there is no changes of population in both years 2001 and 2011, the villages are Chak Bistupur (Kanksa), Chak Loudoha (Faridpur) Chunamudafa (Kanksa) Bagabanpur (Kanksa), Panchafukluria (Kanksa) and Bishnupur (Kanksa). In 2nd class ranges within 1500 are considered as low density, in this class 58 villages are from 2001 map, and 55 villages are from 2011 map and the 3rd class which considered as 1500-3000, where 11 villages are in 2001 and 9 villages in 2011, it is conclude as low population density. In the 4th part which belongs to 3000-4500 here in 2001map 4 villages and 2011map 6 villages are includes where the population density is high and in the last 5th class which

belongs to greater than 4500 population density here in 2001 map 2 villages and in 2011 map 2 villages are including with very high population density. There are many factors that affect or create the differences population density in one village to other villages. In 2nd and 3rd classes where 58 villages in 2001 and 55 villages in 2011 are included found to be occurred as very low population density because in this villages soil are not good fertile that's why agriculture productivity is very low and the poor transportation system that makes a major obstruction in connectivity from the near town that's why this villages have much low or very low population density. Near this towns. Compared to the previous classes the 4th and 5th classes are shown to have high to very high population density. Mainly large & famous towns are located in this category, but there are some villages also under this category because of the facility they received as they situated. Basically, the Land Use and Land cover (LULC) changes are affected by human intervention & natural phenomenon such as agricultural demand, population growth, urbanization & economic growth. Basically, in urban area the land is used for building up residential & commercial areas. Remote sensing data are primary sources extensively used for change detection in recent decades. For the present study of LULC pattern change through time in DMC, Andal, Kanksa and Faridpur 2 years data have been used i.e., 2001, 2011.

LULC of 2001: In the study area the LULC map has been classified into 8 classes, such as Sand, Water body, Dense Forest, Scattered forest, Ground, Barren land, Agriculture land, Industry and Settlement. Durgapur is one of the biggest industrial hubs of India and was planned as an integrated industrial town. It lays on the banks of Damodar river and coalfields of Raniganj. The economy of this area depends on the industrial activity, educational institute, shopping mall activity etc. By studying LULC map of 2001 that made by Landsat 5 TM image made by supervised classification techniques, showing that the barren land, settlement, ground, Dense vegetation, agricultural land, scattered forest, sand, water body, industry covers 6.04%, 20.70%, 19.78%, 6.78%, 17.84%, 8.86%, 0.21%, 1.35%, 18.39% area respectively [Fig. 3].

Table 1: LULC OF 2001

Class Name	Area (sq km)	Percentage (%)
Barren land	26.326147	6.045421
Settlement	90.165318	20.70517
Ground	86.143697	19.78166
Dense vegetation	29.568101	6.789889
Agricultural land	77.705888	17.84404
Scattered forest	38.60779	8.865723
Sand	0.944262	0.216836
Waterbed	5.918284	1.359049

LULC of 2011: By studying LULC map of 2011 made by Landsat 5 TM with supervised classification it is shown that the barren land, settlement, ground, Dense vegetation, agricultural land, scattered forest, sand, water body, industry covers 12.61%, 34.42%, 1.87%, 8.60%, 17.91%, 1.52%, 1.37%, 2.86%, 18.79% area respectively. As we compare with 2001 image we show that settlement, industry zones are increasing correspondingly. The agricultural land, barren land, vegetation zones are occupied by settlement. But it is shown that the amount of water body increased in 2011 as many tanks, ponds are made by those industries for their activity [Fig. 4].

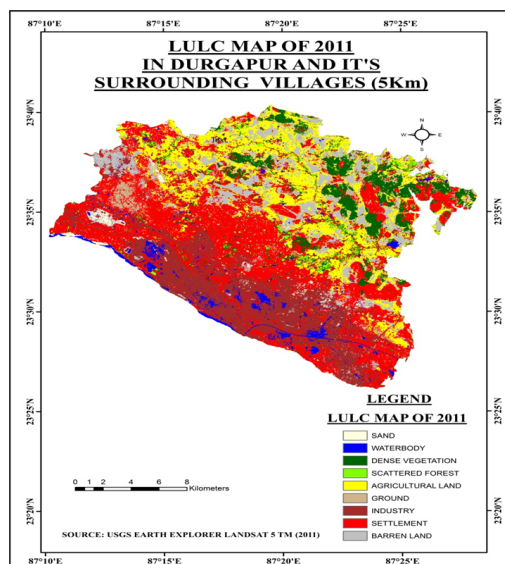


Fig. 4: LULC Map of 2011

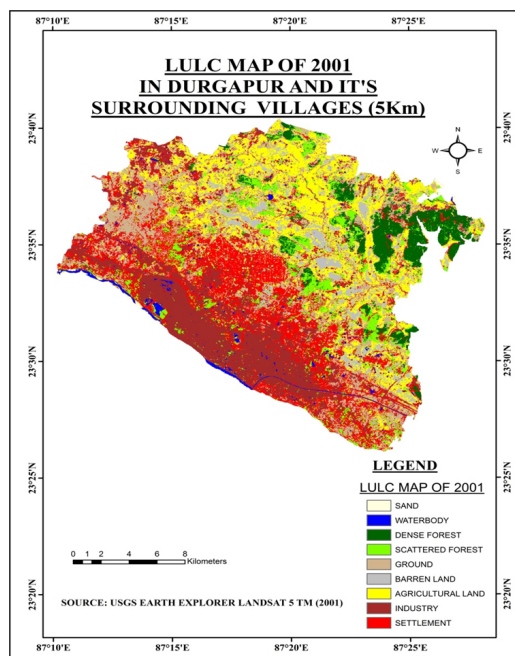


Fig. 3: LULC Map of 2001

Change Detection: Mapping and monitoring of land use land cover (LULC) change is vital for sustainable development, planning and management. Based on remote sensing (RS) and geographic information system (GIS) techniques, the study is an attempt to monitor the changes in LULC patterns for the periods 2001- 2011. Supervised Classification using Maximum Likelihood Classifier (MLC) was applied to prepare LULC maps of the district. From this LULC maps by using Intersect Overlay tools from ARC GIS software the change detection map has been prepared. Significant changes have occurred over the past three decades, according to the LULC analysis. These changes include a notable decrease in agricultural land, a rise in built-up regions, a decrease in vegetated land, a modest expansion of mining areas, and a slight decrease in water bodies. Major roadways and industrial regions are the main locations for urban expansion [Fig. 6] & [Fig. 7].

Table 2: LULC OF 2011

Class Name	Area (sq km)	Percentage (%)
Barren land	54.886134	12.61867
Settlement	149.734103	34.42481
Ground	8.1482	1.873323
Dense vegetation	37.445503	8.608957
Agricultural land	77.933911	17.9175
Scattered forest	6.633421	1.525065
Sand	5.969817	1.372499
Water body	12.452264	2.862854

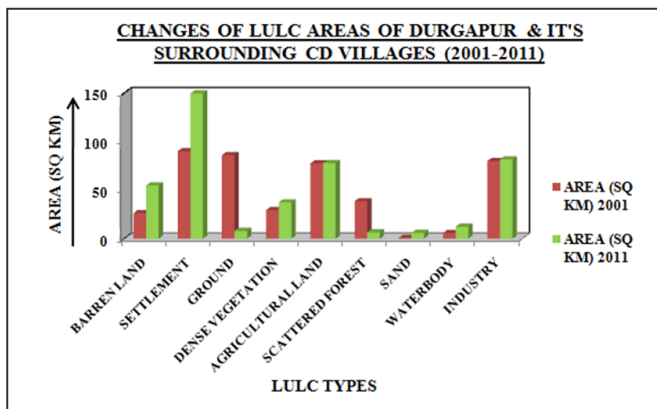


Fig. 5: Changes of LULC Areas from 2001-2011

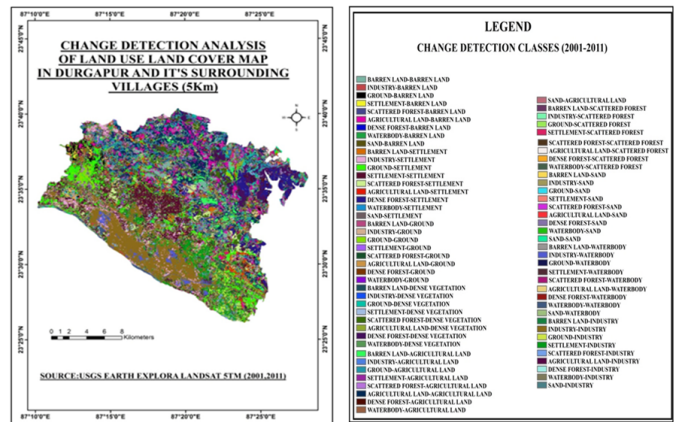


Fig. 6: Change Detection Analysis of Land Use and Land Cover Map (2001-2011)

[Table. 3] shows the changes of LULC pattern from 2001 to 2011. The settlement & industry occupy most of the region 34.43 % & 18.80% respectively. The agricultural lands, barren lands are occupied by settlement. The dense vegetation which is mainly protected types is not so much affected by the urbanization process compare with the scattered forest. Deforestation activity is increase for residential purpose. One of the major problems in Change detection analysis is the Mapping of water bodies. It was difficult due to the shallow water and dense canopy along the rivers. Moreover, in the case of industrial region the amount of aerosol is always high which also make great difficulty in the time of mapping. Difficulty was further increased with 30 m spatial resolution.

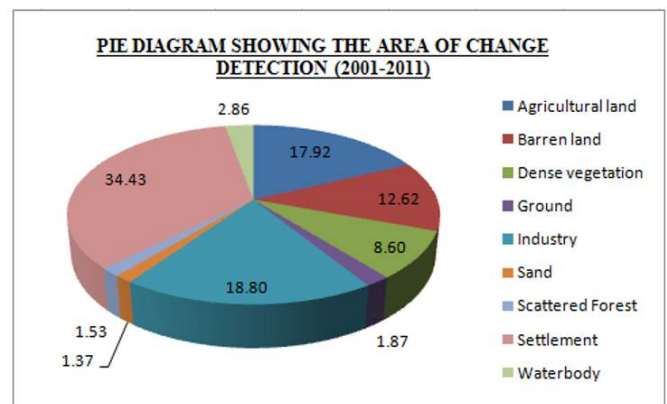


Fig. 7: Change Detection Analysis 2001-2011

		LULC classes 2011								
		Agricultural land	Barren land	Dense vegetation	Ground	Industry	Sand	Scattered Forest	Settlement	Waterbody
LULC classes 2001	Agricultural land	36.58692	22.87437	3.367192	0.532247	0.772745	0.506027	1.590164	10.961455	0.410372
	Barren land	7.810229	11.82394	0.985908	0.090237	0.780856	0.34853	0.407336	3.595046	0.22028
	Dense vegetation	1.89294	0.339406	13.02065	0.752713	0.148386	0.085016	0.209334	13.035903	0.01786
	Ground	19.86925	9.9435	7.130262	4.210625	5.112759	1.446164	1.387631	36.448236	0.484653
	Industry	1.091083	1.80091	0.684942	0.416253	50.43651	1.066251	0.148315	18.389843	5.978778
	Sand	0.013828	0.132327	0	0	0.046831	0.429016	0	0.025164	0.28344
	Scattered Forest	5.489615	3.030743	8.603242	0.443644	3.1427	0.29074	1.88274	15.2121	0.472152
	Settlement	5.076691	4.69678	3.515271	1.697639	20.21706	1.372486	0.955164	51.321846	1.258614
	Waterbody	0.068765	0.219681	0.085946	0.00283	1.081848	0.414892	0.049481	0.676141	3.306604
Total		77.89932	54.86166	37.39341	8.146188	81.73969	5.959122	6.630165	149.66573	12.43275
Percentage (%)		17.91909	12.61977	8.601565	1.873858	18.80249	1.37077	1.525129	34.427439	2.859892

Table 3: Change Detection Analysis 2001-2011

LULC changes' spatial distribution in Durgapur Municipal Corporation's rural and peri-urban communities during 1991 to 2021: Remarkably, the study finds that one important determinant of built-up development is the distance to the city core [15]. The study challenges the widely held belief that urban growth is exclusively influenced by proximity to transportation networks by examining how development intensity changes over time using spatial measures and analytical methodologies [15]. LULC changes' spatial distribution in Durgapur Municipal Corporation's rural and peri-urban communities during (a)- 1991–2001, (b)- 2001–2011, (c)- 2011–2021, and (d)- 1991–2021 [Fig. 8]. The Durgapur Municipal Corporation (DMC) and the rural and peri-urban areas around it saw substantial changes in land use and land cover (LULC) between 1991 and 2021, which was



indicative of the quickening rate of industrialization and urbanization. The conversion of agricultural land into built-up areas, mining zones, and fallow land was one of the most noticeable changes, demonstrating how urban growth frequently occurs at the price of traditionally farmed areas. This change is explained by the rising need for commercial, industrial, and residential infrastructure as a result of Durgapur's development as a significant West Bengali industrial center.

5.2 Population growth and built-up area (2001-2011):

Population growth means rapidly increasing population in an area. As the city grows, the built-up area also grows. Because Population growth always forces the built-up area to expand. In this study, the population of each village for recent two census years (2001-2011) was calculated by adding the census population of all villages. In this study the rate of population increase does not match with the total built-up area [Fig. 9].

In 2001 the rate of total population is 46.70% whereas the built-up area is 42.39%. But in 2011 built-up area increased with 57.62% and the total population also increases with 53.30%. The main reason behind this is urbanization. As the migration of people from the villages & the surrounding areas increase in high rate, the total build up land becomes low with comparison to the population growth. It causes deforestation activity, for the utilisation of all lands for development initiative, like commercial, educational, residential establishments & other purpose.

The region's built-up area grew significantly between 2001 and 2011, mostly as a result of urbanization close to roads, mining areas, and industrial zones [15]. The western sector and the area next to National Highway-2 (NH-2) saw the most growth, while the South-South-East (SSE) direction showed the highest built-up density [15]. This expansion pattern aligns with the general trend of urban sprawl observed in many developing regions. Remarkably, the study finds that one important determinant of built-up development is the distance to the city core [15]. The study challenges the widely held belief that urban growth is exclusively influenced by proximity to transportation networks by examining how development intensity changes over time using spatial measures and analytical methodologies [15]. In addition to helping with urban planning, resolving environmental issues, identifying growth hotspots, assessing landscape fragmentation, and

forecasting future expansion, geospatial tools offer a thorough understanding of urban growth trends [3, 20]. Urban planners and decision-makers can create better-informed plans for sustainable urban growth and efficient land use management by applying these principles [1, 37].

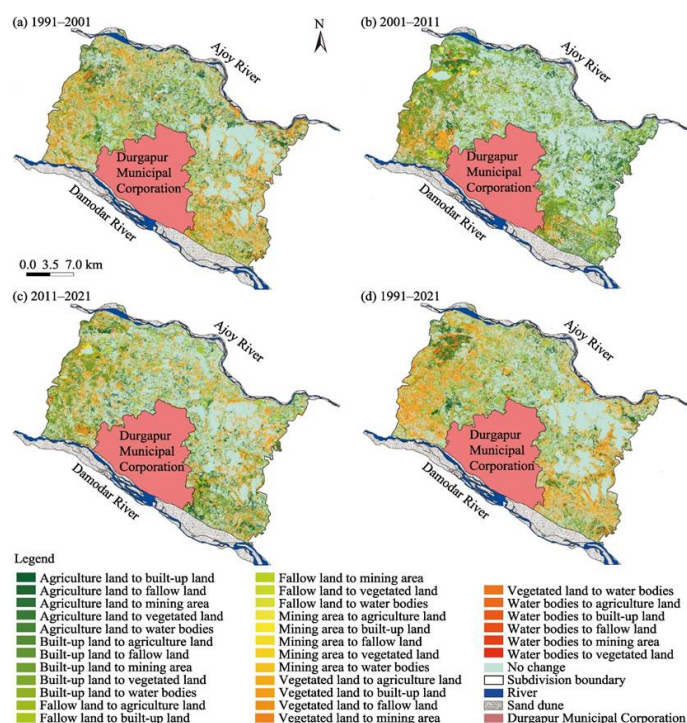


Fig. 8: LULC changes' spatial distribution in Durgapur Municipal Corporation's rural and peri-urban communities during (a)- 1991–2001, (b)- 2001–2011, (c)- 2011–2021, and (d)- 1991–2021 [16]

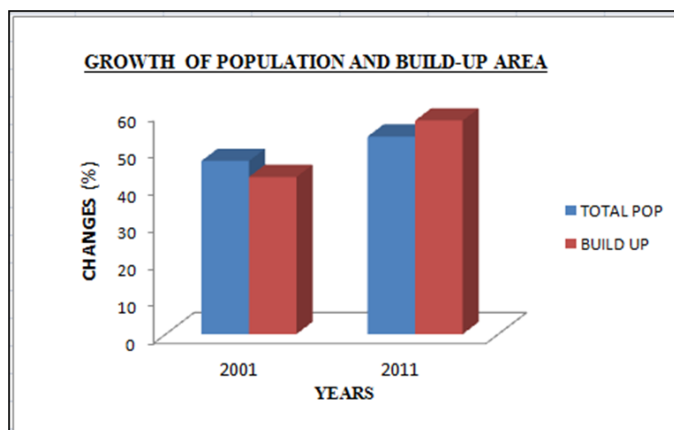


Fig. 9: Population growth and built-up area



Table. 4: Population growth and built-up area

Year	Total pop	Per (%)	Built-up area	Per (%)
2001	719514	46.69422	170.2584	42.3793
2011	821392	53.30578	231.4906	57.6207
Total	1540906	100	401.749	100

5.3 Comparison of Population density between 2001-2011:

Here we discovered what population density is and how it varies from one year to another year, one area to other areas. Here we consider 2 years (2001, 2011) where we see how the density changed through 2001 to 2011. Density of population is the indicator of the concentration of the people in an area. If the density is high, it means that people have concentrated there because of some opportunities [Fig. 10] & [Fig. 11].

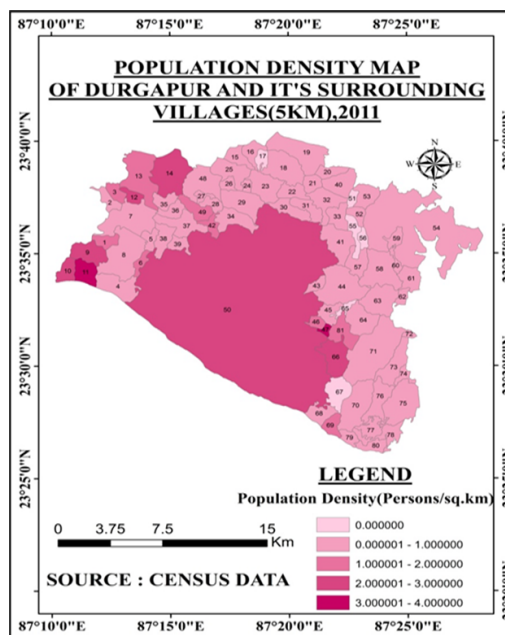


Fig. 11: Population Density Map of 2011

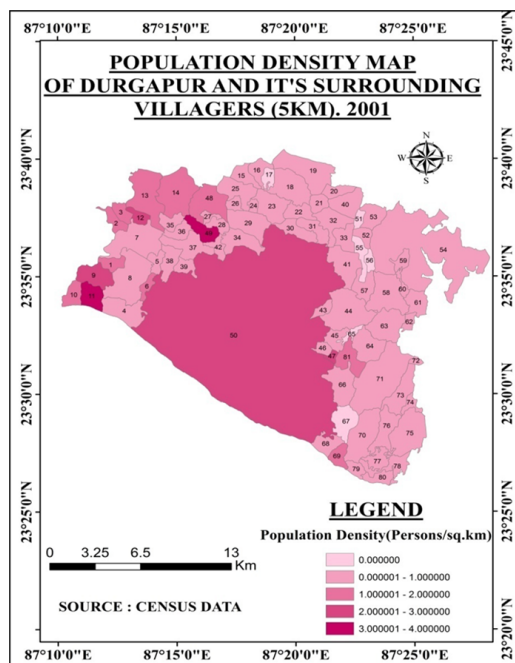


Fig. 10: Population Density Map of 2001

5.4 Analysis of urban growth:

Urban growth can refer to any type of growth in urban environment, such as population; land area, intensive land use etc. In this study I just try to find out the causes of growth rate in the year of 2011 at my study area Durgapur and its surrounding villages. In this area there is huge difference in growth from one village to other villages. For analysis the urban growth I prepare a growth analysis map in the year of 2011 [Fig. 11]. In [Fig. 11], the general growth pattern of study area, the rate of urban growth is increasing faster in low and middle income areas. Gaidhoba, Mahira, Shyampur, Sarpi, Ichhapur, Pathardiha, Amlajora, Mubarakganj, have negative growth rate. In this area the job opportunities are very poor, so the people are migrated near to the city, that's why here growth is very low. But in the opposite side Bhadrapur, Bamunara, Shankarpur, is situated near Durgapur Municipal Corporation. Durgapur is an industrial region so, it has high job opportunities as well as better transportation system that helps the people living in this villages get high opportunity for better travel for their daily uses. There is also good medical facility & education system which help these areas for better growth. Manikara, Brindabanpur, Bistupur, Bansol also have high growth, as it has better paid jobs & an expected higher standard of living and more reliable food that work as the pull factor from the surrounding areas. Whereas Amlauka, Nachan, Babnabera

have moderate growth, because people migrate to other towns for better jobs, education, and other facilities.

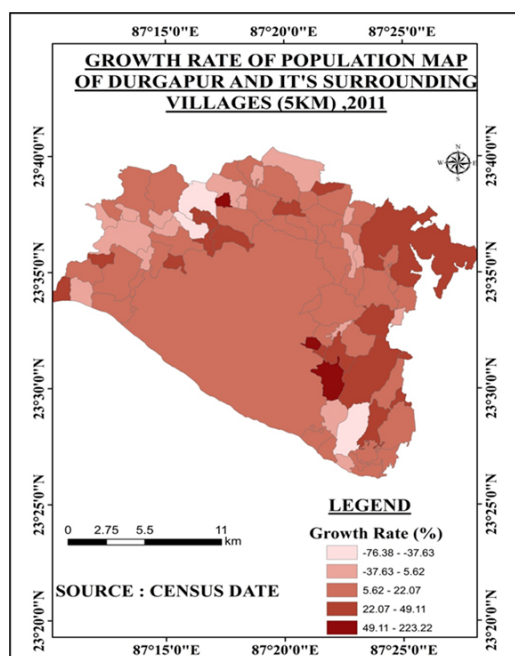


Fig. 12: Growth Rate of Population Map of 2011

5.5 Transport system of Durgapur and its surrounding areas:

Transport network of the region may be grouped under three distinct modes viz, land surface, airways and waterways. Land surface – roadways and railways that course permit for an effective economic development and spread of social services in a region [Fig. 12].

Durgapur emphasizes the linear pattern of growth of the surrounding areas. The east-west extent of the urban built up areas is approximately 10 miles along the Grand Trunk Road while the north-south extent is only 5-6 miles thereby establishing the linear, elongated pattern of growth within the Grand Trunk Road which was recognized as the National Highway No.-2 the main spinal of intra-regional movement connects the complex with the metropolis of Calcutta 158 kms. To the east and rest of Northern India in the west. There are also certain district and village roads in this region. Two most important intra-regional roadways are, firstly The Durgapur – Ranijang-Bankura State Highway and secondly the Durgapur-Illambazar-Dubrajpur-Suri State Highway which is vital link

connecting Durgapur-Calcutta Expressway as well as railway connection is also good. Kazi Nazrul Islam Airport is a domestic airport located at Andal. The airport is roughly 15 km from Durgapur’s City Centre Bus Terminus and 25km from Asansol’s City Bus Terminus. There transport network is well planned, and connectivity is also good that’s why Durgapur and its surrounding areas is grown up.

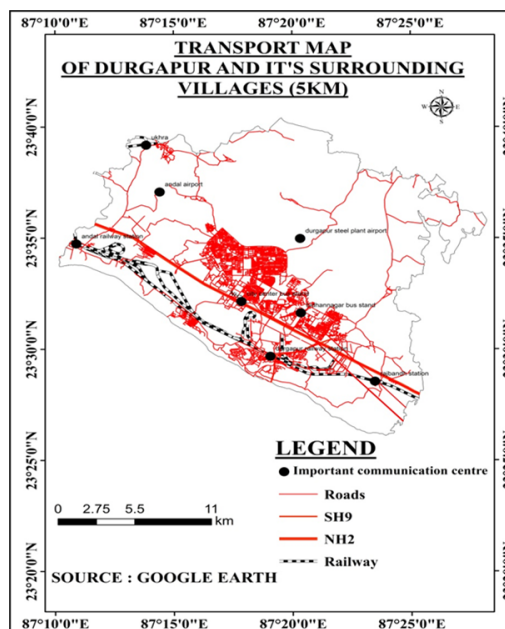


Fig. 13: Transport Map

5.6 Observation

In the study area this is observed that there are average changes between the years of 2001-2021. The changes of the area are discussed below. In this observation the settlement and industry zones are increasing correspondingly.

- The agricultural land, barren land, vegetation zones are occupied by settlement.
- The changes of LULC pattern from 2001 to 2011 the settlement and industry occupy most of the region 34.43% and 18.80% respectively.
- In this area the urban growth is rapidly increase.
- In 2001 the rate of total population is 46.70% and 2011 the total population is increase with 53.30%.

- In the study area the population density was 1652 and 1886 per sq/km in the year of 2001 and 2011. The mainly populated areas of the region is Durgapur Municipality and their surrounding areas.
- The Durgapur Municipal Corporation (DMC) and the rural and peri-urban areas around it saw substantial changes in land use and land cover (LULC) between 1991 and 2021, which was indicative of the quickening rate of industrialization and urbanization.
- Field survey regarding urban growth pattern in Durgapur municipality and its surrounding areas observed that -Urban growth outside area, Large building near city centre, Well transport among the city, Junction Mall, Urban development periphery area, Large building in CBD area [Fig. 14].

6 Conclusion

Fast transformation of land use/land cover because of urban expansion profoundly influences biodiversity and ecosystem function, as well as local and regional climate. One of the more serious impacts of urbanization is the formation of urban heat island (UHI) effect. Asansol-Durgapur Development Region is the second largest urban identity in West Bengal just after Kolkata urban agglomeration. Rapid urban growth in Durgapur and its surrounding areas has brought about fast transformation of LULC pattern. In this area, faced with some environmental problem due to rapid urbanization, however, we conclude that LULC map, explicitly showing the urban growth and changing pattern time to time. This paper examines the urban growth of Durgapur Municipality between 2001 and 2011, highlighting the necessity of sustainable development principles, inclusive planning, and careful resource management for future expansion [15]. Moreover, the precision and efficacy of urban growth evaluations have been enhanced through the integration of machine learning techniques, such as Random Forest classifiers, with geospatial approaches [41]. A study of the urban growth trends in Durgapur Municipality from 2001 to 2011 revealed significant transformations in land use, urban sprawl, and other factors including migration, infrastructure development, and industrialization. The challenges posed by infrastructural pressure, loss of agricultural land, and the need for environmental sustainability necessitate future urban planning.

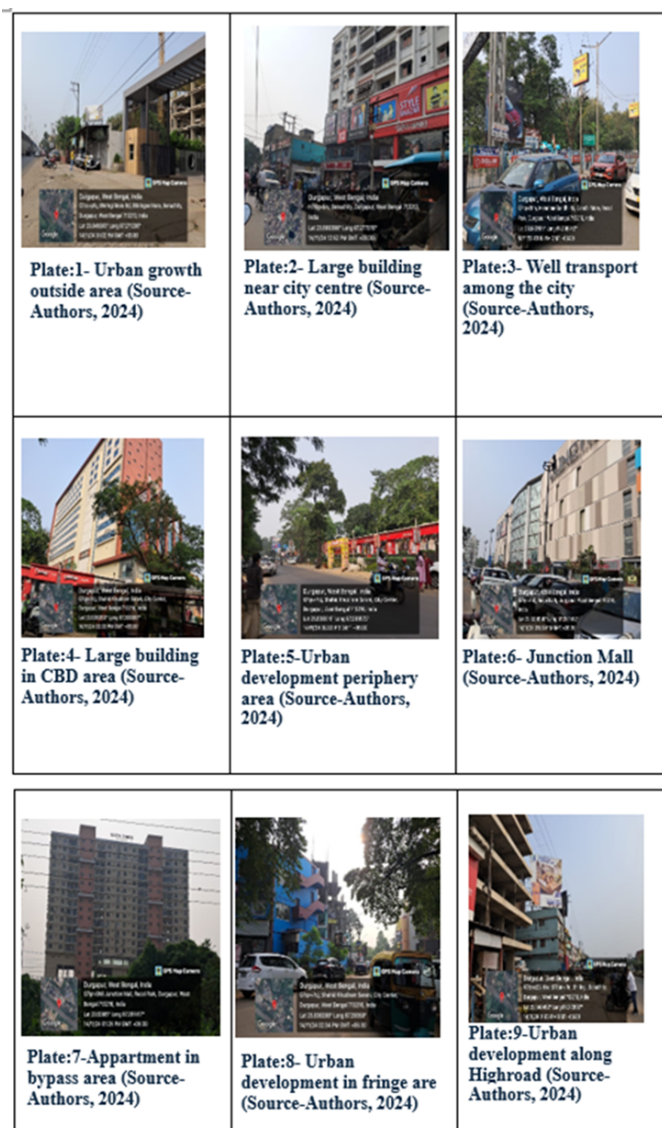


Fig. 14: Urban Growth Pattern of Durgapur Municipality and its Surrounding Areas (Source-The Authors, 2024)

The urban area of Durgapur has expanded beyond its municipal boundaries due to population and infrastructure growth, resulting in environmental degradation. Geospatial techniques underscore the importance of integrated urban planning to reconcile growth with ecological sustainability and to ensure that infrastructure development does not adversely affect agricultural and natural resources.

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