



## RELATIONSHIP BETWEEN POPULATION GROWTH WITH CHANGING LAND-USE PATTERN AND ENVIRONMENTAL CHANGES IN KOLKATA, WEST BENGAL

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**ABSTRACT** Given that urbanization is considered as one of the most significant anthropogenic alteration of the overall environment, the present study attempts to understand spatial-temporal characteristics of urban population growth and its implications on land-use as well as understanding their relationship with environmental degradation with special focus on the Kolkata, the capital city of West Bengal.

Urbanization is one of the major driving forces behind the development of today's land-use and land cover system. A large number of contemporary urbanization has been characterized as urban sprawl namely in an extensive form of land-use for urban uses that have environmentally detrimental effects. There are indications of Urban sprawl and city expansion in our Study Area of Kolkata indicating expansion of settlements and built-up area and thus causing environmental degradation in the city area.

The process of urbanization always had significant implications that can affect cumulative changes in demographic characteristics and/or transformation of the physical environment; unplanned, unsystematic and rapid urbanization can cause intense impacts on various environmental aspects, specifically on land and air and water. A thorough understanding of the dynamic relationship between urbanization and its generated land-cover changes thus becomes completely essential for managing environmental changes and enabling sustainability of the environment and its resources.

**KEYWORDS** : Urbanization, Natural Increase, Decadal Growth of Population, Regional- Variation, Developing Countries.

### INTRODUCTION:

Historically, the process of urbanization sped up in the wake of industrial revolution in the western world leading to the expansion of infrastructure such as transport and communication, overall standard of living also propelled which further increased rural to urban migration. The agglomeration of population in city centres, dominance of non-agricultural activities in urban centres and better provision of social amenities including health and educational infrastructure emerged as distinguishing features of urban settlements following the industrialization of societies.

In the present-day however, the settlement patterns have become increasingly intricate. Therefore, it becomes imperative to understand how urban areas are defined from the demographic point of view and how the level of urbanization is dependent and influenced in terms of percentage of population living in the study area and their impact on limited natural resources.

The number of urban centres is a necessary factor in the study of urbanization and national development as well. Small urban centres have already achieved utmost importance, mainly in Urban centres of developing countries. Because these small towns act as the main centres for growth and services for their rural hinterland and thus they are critical as they assist in the development of rural economy and also reverse the growth of large cities which in turn mitigate the urban problems that we are about to look it.

### LITERATURE REVIEW:

The process of urbanization always had implications for changes in the demographic characteristics and transformation of the physical environment, unplanned, unsystematic and rapid urbanization has profound impacts on different physical environmental components, like land and water. A detailed understanding of the subtleties of urbanization induced land-cover change is necessary for coping with environmental changes and enabling environmental sustainability. This is mainly because most of these urban areas consume most of the global energy and cause serious environmental complications and degradation of the natural ecosystems through air, water and soil degradation (Yan et al., 2016, Battista and de Lieto Vollaro, 2017).

It is probable that the Indian Urban Population will nearly double by 2031 reaching 600 million (2012 Heilig). The problem is grave in India as it contributes nearly 16 percent of world's total human population with only 2.5 percent of the total geographical area (UNEP, 2001). The degree of urbanization India has also increased pointedly over the years, from 27.7 percent to 31.1 percent, reporting a growth rate of over 3.3 percent during 2001–2011 as compared to 2.1 percent increase during 1991–2001 (Bhagat, 2011).

Rapid urbanization and changing environment in the still developing country of India raises three important research questions:

1. What is the rate of Population Growth Rate in West Bengal and its districts? What affect does it have on the Urbanization Levels of Kolkata and its urban sprawl?
2. How does urbanization cause spatial-temporal changes in the

LULC of Kolkata?

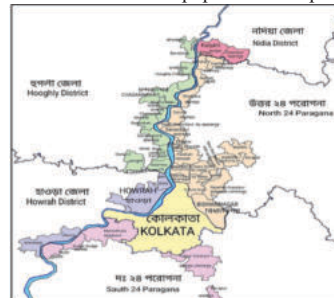
3. What are the interrelationships amongst environment parameters under rapid and uncontrolled urbanization levels?

Rapid urbanization seems to have transformed the urban landscape in India leading to considerable changes in land-use and land-cover over the years and causing severe pressure on the limited natural resources. It is expected that with degree of unchecked and unsystematic levels of urbanization, Indian cities will suffer from micro and local environmental problems and unhealthy living conditions (Mohan et al., 2011, Kantakumar et al., 2016). A large number of research papers that have attempted to observe land use and land cover changes using remote sensing and GIS systems. It is observed generally through spatial-temporal indicators that anthropogenic activities greatly influence urban setting and ecology (Alberti et al., 2003 and Andersson, 2006.), and hence greater attention is vital when observing the changes in land use and land cover in urban areas (Stow & Chen, 2002).

A number of climatic indicators are co-dependent on the substitution of vegetation by urban spaces and settlements to provide food and shelter to the growing population (Cui and Shi, 2012 and Zhao et al., 2006.). It is seen that converting the agricultural and low-population density lands of other use into urban settlements and built-up area changed the hydrology of the study area (Blanco, McCarney, Parnell, Schmidt, & Seto, 2011). Evidences suggest that continued extreme urbanization will affect more than one-half of rainwater runs off and only a fraction of it goes for deep infiltration (Arnold & Gibbons 1996).'

### Study Area:

Kolkata is the capital of West Bengal, an Indian state that shares it's boundary with the neighboring country of Bangladesh. Located on the Eastern edge of the River Hooghly, the city is roughly 80 kms to the west of the border. It is the main commercial and financial hub of Eastern India region and the main point of communication with the North-Eastern part of India. According to the 2011 Census of India, Kolkata is the 7<sup>th</sup> most populated city in India with a total population of around 4.5 million residents within the delegated city limits. It alsohas a total population of over 14.1 million residents in the Kolkata Metropolitan Area, which makes it the third-most populous metropolitan area in India.



**Figure 1: Map Of Municipal Corporations And Municipalities**  
Source: Sourav G. Manna, Wikimedia Commons. (License: <https://creativecommons.org/licenses/by-sa/4.0/deed.en>)

**OBJECTIVES:**

The objectives of my study is to find the following factors:

1. To find out the existing levels of urbanization in terms of emerging spatial patterns in West Bengal.
2. To evaluate the regional variation in levels of urbanization in West Bengal and assign plausible cause for the marked regional imbalances in the degree of urbanization in West Bengal.
3. How does urbanization cause spatiotemporal changes in LULC throughout the 3 decades of study.
4. To suggest, if any, plan strategies to cope up with the distortions introduced in the patterns of urbanization of West Bengal.

**Data Base and Methodology:**

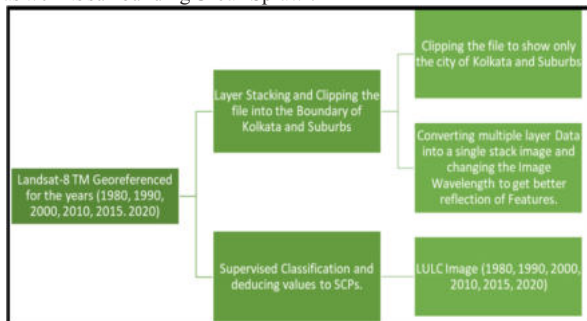
The study is based on both primary and secondary data obtained from and USGS and BHUVAN and directorate of Census operation of West Bengal, Statistical Handbook and Census of India. Districts of West Bengal are taken as a unit of study for analysis and mapping purpose.

The methods adopted to determine the trend and level of urbanization of West Bengal are-

1. **Level of urbanization** = (Total Urban Population / Total Population) x 100.
2. **Decadal Growth Rate** (say) between 2001 and 2011 = ((Urban population in 2011 - urban population in 2001) / urban population in 2001) x 100
3. **Rate of urbanization (say) between 2001 and 2011** = ((percentage of urban people in 2011 - percentage of urban population in 2001) / percentage of Urban population in 2001) x 100. Data thus collected are interpreted and represented cartographically by using choropleth technique using ArcGIS software.

The spatial patterns emerging from the maps are analyzed and interpreted by correlating the degree of urbanization with various demographic, socio- economic and cultural variables. The empirical approach of the paper is based on land use/land cover (LULC) changes computed using remote sensing and GIS techniques. We have also used choropleth maps to show the decennial growth rate in the Population of the districts throughout the state.

Spatiotemporal satellite images and secondary data sets are used to characterize the urban growth process, whereas Supervised classification technique is used for LULC changes throughout the city as well its surrounding Urban Sprawl.



**Figure 2: Methodology For Land Use/ Land Cover Map**

**RESULTS AND ANALYSIS:**

As per data collected from the Census 2011, West Bengal has a population of approximately 9.13 Crore. Out of the total population of West Bengal, 31.89 percentage people lives in urban areas which is roughly 29,134,060 in total figures. Total population of rural areas of West Bengal state was 62,213,676 which is roughly 68.11 percentage of the total Population. Compared to Census 2001 where the total population was 80176197 of which 57748946 persons lived in rural areas while the remaining 22427251 persons lived in urban areas.

**Table 1: Urban/ Rural Population Growth Rate In West Bengal (1901-2011):**

Census Year	Percentage of Urban Population to Total Population	Percentage of Rural Population to Total Population
1901	12.2	87.8
1911	13.05	86.95
1921	14.41	85.59
1931	15.32	84.68

1941	20.41	79.59
1951	23.38	76.12
1961	24.45	75.55
1971	24.75	75.25
1981	26.47	73.53
1991	27.48	72.52
2001	28.03	71.97
2011	31.89	68.11

**Source: Census of India**

**Table 2 : Land Use/ Land Cover Classification Statistics From 1975 To 2011:**

		1975		2000		2009		2015	
		Area	perce ntage	Area	perce ntage	Area	perce ntage	Area	perce ntage
Sl. No.	Land Use Type	(in km <sup>2</sup> )		(in km <sup>2</sup> )		(in km <sup>2</sup> )		(in km <sup>2</sup> )	
1	Agricultural Land	13.12	25.37	6.47	12.51	3.13	6.04	1.16	2.23
2	Built-up Area	9.86	19.05	28.02	54.15	35.55	68.7	39.95	77.21
3	Vegetation Area	11.2	21.65	7.46	14.41	5.67	10.96	4.15	8.02
4	Water Bodies	9.49	18.34	5.65	10.9	4.51	8.72	3.5	6.77
5	Wet Lands	8.07	15.6	4.15	8.02	2.9	5.59	2.99	5.77

The table-1 clearly indicates that the extent of urbanization was very limited in West Bengal. Between 1901 to 1931 the percentage of people living in urban areas increased only by 3 percentage, from 12.20 per cent to 15.32 per cent.

However, between 1931 and 1941 there was a rapid increase in the levels of urbanization in West Bengal as is evident by the almost 5 percentage growth in the Urban Population. The first independent census which took place in 1951 which reveals that about 24 per cent of total population of West Bengal lived in urban areas. This percentage improved nominally in the period of the next two censuses and became 26.47 per cent and 27.48 per cent respectively in the censuses of 1981 and 1991. According to the 2001 census data, more than 28 per cent of total population lived in urban areas. In 2011 census, the level of urbanization had increased in India as well as in West Bengal and reached up to 31.89 per cent.

**Levels and trends of Urbanization in West Bengal across different districts:**

**Inter-district Urbanization level is measured by two ways:**

1. The level and growth of urban share of total population and its distribution by size classes of cities and towns. This is called demographic approach. We will mainly work on this approach.
2. Monitoring the changes in the number and growth of urban Centres and their Urban sprawl i.e, the spread of urban centres towards their periphery. This is called geographical approach. The trend of urbanization across the districts of West Bengal is not very prominent, where apart from a few urban centres the growth rate is very slow.

Table 3 shows the population figures for West Bengal from the year 1901 to 2011 and the corresponding rate of change . Except for the year 1921 which reported a fall and except the initial decades when the growth rate of population was rather low, the population of West Bengal has been rising constantly at a steady rate. Highest decadal growth rate of 33 percentage was recorded during 1951-61 while in the subsequent decades the rate of growth has been declining and as per the latest Census 2011 it stands at around 14 percentage.

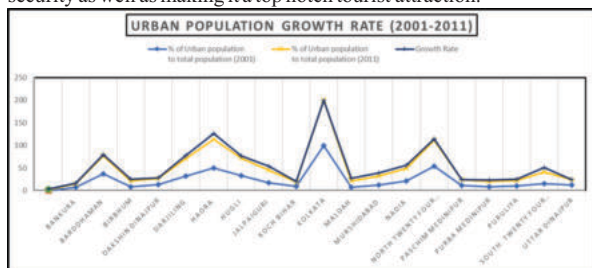
However, the growth rates have varied significantly across the districts. In the past four decades only Kolkata has exhibited a negative growth rate (-1.88 percentage) whereas Murshidabad, Maldah and Uttar Dinajpur respectively have displayed very high growth rates of 21.07 percentage, 21.5 percentage and 22.9 percentage respectively. Apart from Kolkata, the districts that has displayed moderately slower growth rates in the last decade are Hooghly (9.49 percentage), Dakshin Dinajpur (11.16 percentage) and Howrah (13.31 percentage).

Following table-3 depicts the scenario of the Urbanization Process in West Bengal:

**Table 3: Urban Growth Rate In The Districts Of West Bengal (2001-2011)**

State	Percentage of Urban Population to Total Population (2001)	Percentage of Urban Population to Total Population (2011)	Growth Rate
Bankura	7.37	8.36	0.99
Bardhaman	36.94	39.87	2.93
Birbhum	8.57	12.8	4.23
Dakshin Dinajpur	13.1	14.13	1.03
Darjeeling	32.32	38.99	6.65
Haora	50.36	63.3	12.94
Hugli	33.47	38.62	5.15
Jalpaiguri	17.84	27	9.16
Koch Bihar	9.1	10.25	1.15
Kolkata	100	100	0
Maldah	7.32	13.8	6.48
Murshidabad	12.49	19.78	7.29
Nadia	21.27	27.81	6.54
North Twenty Four Parganas	54.3	57.03	2.73
Paschim Medinipur	11.9	12.03	0.13
Purba Medinipur	8.29	11.65	3.36
Puruliya	10.07	12.75	2.68
South Twenty Four Parganas	15.73	25.61	9.88
Uttar Dinajpur	12.06	12.07	0.01

The mountainous areas in Northern WB like Darjeeling had experienced an improvement in urbanization levels during 2011 census mainly due to Government schemes and plans to remodel that area to help the locals attain a certain level of economic and social security as well as making it a top notch tourist attraction.



**Figure 3: Urban Population Growth Rate (2001-2011)**

**Table 4: Urban Population Distribution among various districts of West Bengal**

Nature	Value	No. Of Districts	Districts
High	39.9 to 100	3	Kolkata, Howrah, North 24 Parganas.
Moderate	25.6 to 39.9	6	Hooghly, Nadia, Burdwan, Darjeeling, Jalpaiguri, South 24 Parganas.
Low	12.8 to 25.6	4	Birbhum, Murshidabad, Malda, South Dinajpur.
Very Low	8.3 to 12.80	6	East Medinipur, Purulia, Bankura, North Dinajpur, West Midnapore, Cooch Bihar.

**Areas with High and Lower Levels of Urbanization**

Among the 19 districts in West Bengal, three districts that are present in the “Highly Urbanized” category are namely, Kolkata, North 24 parganas, and Howrah. It is detected that Kolkata has the highest degree of urbanization among all the district of West Bengal as it is metropolitan town and the capital city of West Bengal and a major commercial hub in India as well. High concentration of urban population may be attributed to a very high level of industrial development, their strategic location along the well-developed roads and railway lines and higher levels of literacy amongst males and females.

Six districts specifically East-Midnapore, West Midnapore, Purulia, Bankura, North Dinajpur, Cooch Bihar fall under the category of *Low levels of Urbanization*.

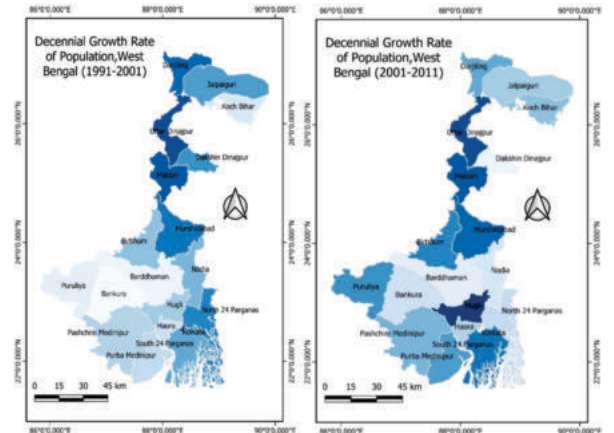
These districts are agriculturally under-developed, socially backward and have poor transport and communication facilities leading to lower concentration of Urban Population.

**Decadal changes in Population Density and Change in Growth Rate (1991-2011):**

In Figure 2 we see that the highest Growth rate of Population is highest in districts of Darjeeling Uttar Dinajpur, Maldah, Murshidabad. The growth rate has since reduced in the decadal period of 2001-2011. With Darjeeling slowing the growth rate of 23.79 percentage to 14.49 percentage. Kolkata has one of the lowest Population growth rates as compared to other metropolitan cities in India. If we compare the two maps we see that overall Population growth has dropped in majority of the states with Kolkata going into negative -1.88 percentage. Only the districts of Purba Medinipur and Puruliya recorded growth rates of less than 1 percentage each.

The population density of West Bengal in 2011 has reached a total of 1029 per sq km which is second highest right after Bihar. However the national average in 2011 was 382 per sq km. Kolkata with 24,252 persons per sq Km embodies one of the most densely populated areas globally. Adjoining districts of Howrah (3300), North 24 Paraganas (2463), Hooghly (1753) , Murshidabad (1334) also exerts severe pressure on land and water resources due to higher density of population compared to the other districts.

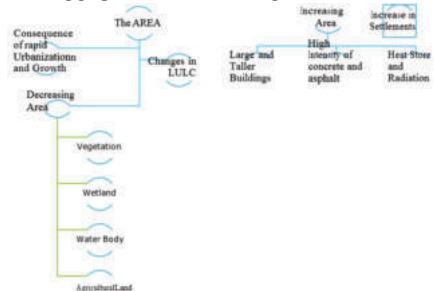
**Decennial Growth Rate Of Population In West Bengal (1991-2011):**



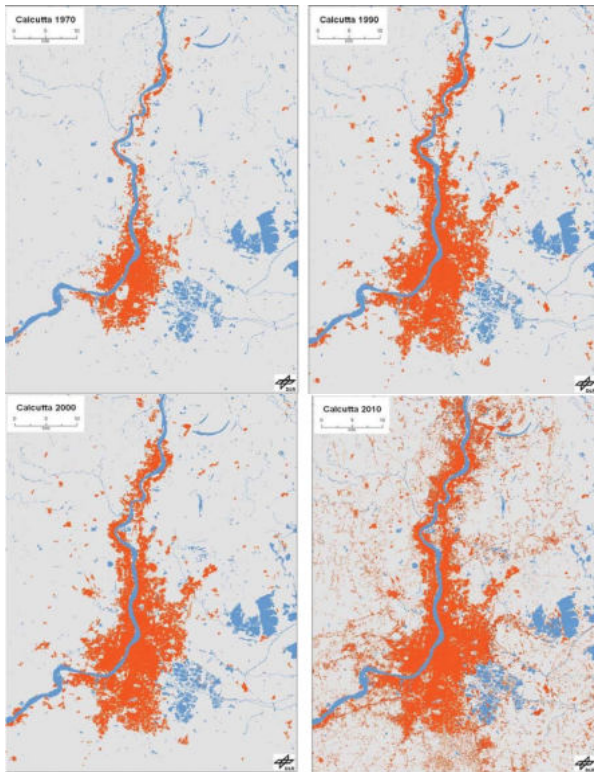
**Figure 4: Map showing Population Growth Rate of the districts of West Bengal (1991-2001)**      **Figure 5: Map showing Population Growth Rate of the districts of West Bengal (2001-2011)**

The density of Population is highest in Kolkata consequently in the 3 census period of 1991, 2001 and 2011. This is mainly because it is the hub of Industries and Trade and Commerce in West Bengal. People from other districts and also Bangladesh flock here to get opportunities for better standard of living. Districts like Hugli, Haora North 24 Parganas that surrounds Kolkata also has a higher density of Population. People in these districts generally commute daily from their place of residence to the Capital City. So in my study I wanted to look into the changes in Land Use/ Land Cover of Kolkata throughout 4 Decades namely- 1991, 2001, 2011 and 2020. The changes in Land use indicates as to the impact Population Growth and Urbanization have on the Land use patterns and the stress it has on the resources.

To understand the process of Urbanization and its effect on Land Use/Land Cover the following graph can be looked at to get a easier flow of ideas.



Attached below is the LULC Image of Kolkata in the Year 1991/2001/2011 and 2020. This gives us a better understanding of the changing patterns of settlements, water bodies, built-up Area and Transport and Communication Line changes throughout the Temporal and Spatial Area.



**Figure 6: LULC changes of Kolkata from 1970 to 2010.**

**Source: Deutsch's Zentrum fur Luf-und Raumfahrt, Earth Observation Center (DLR-DFD)**

#### **Environmental Issues faced by Kolkata and its adjoining Urban Sprawl:**

During the early 19th century, Kolkata witnessed huge industrial investments made by the Britishers and later by Indian businessmen in jute, textiles, chemicals, heavy engineering, cement, pharmaceuticals, food processing, leather and other industries.

As a result, the city came to be recognized as India's and even Asia's one of the most important commercial and industrial hub. Consequently, this led to considerable strain on the natural environment of Kolkata and its surrounding areas that fell within its urban sprawl. As a growing metropolitan in a developing country, Kolkata has to confront substantial urban pollution, traffic congestion, poverty, overpopulation and other forms of socioeconomic problems.

During the last two decades, the population of Kolkata has been growing at the rate of 2 per cent per decade. In contrast, the KMD, which includes the rural tracts and smaller towns that connect the city Centre has been expanding spatially at a decadal rate of over 18 percent (Census of India, 1991; Roy, 2003). This is alarming enough for the government and planners to rethink the magnitude of damage such a high rate of expansion could have on the environment of the city.

The authorities have time and again overlooked the possible environmental degradation that might set in due to the gradual filling up of the city wetlands in the east. The fastest growth in terms of both urbanization and population growth is occurring on the eastern fringes of the KMD. This involves state government initiated development projects such as Salt Lake City and the proposed project of 'New Calcutta' at Rajarhat, as well as a flurry of private buildings especially in the domain of middle-class housing complexes. (Roy, 2003).

In 2009, a report by the *Scientific and Environmental Research Institute* states that the atmospheric suspended particulate matter (SPM) in Kolkata was approximately 511 which made Kolkata the most polluted metropolitan city in India followed closely by Mumbai.

In a 6-yearlong study completed in 2007, the Chittaranjan National Cancer Institute (CNCI) found that 70 percentage of residents of Kolkata suffer from respiratory diseases, like lung cancer, dyspnea and asthma, caused by high levels of air pollution in the city.

According a report in 2010 by the Central Pollution Control Board (CPCB), Kolkata is among the worst impacted Indian cities when it comes to air pollution along with the Indian capital of Delhi. Between 2009 and 2011, it was reported that the highest number of lung cancer and other respiratory ailment cases in the country originated from Kolkata, Delhi and Mumbai. According to the World Health Organization's (WHO) ranking of cities by air pollution, Kolkata ranks 25th among a total of 1100 cities which points to a very grave reality that must be handled accordingly.

The levels of Air pollution in Kolkata is high despite the city's relatively low rates of vehicle and automobile ownership as compared to other large Indian cities and their strong public transport systems. It is probable to reduce Kolkata's energy emissions through measures that are cost effective as well as energy saving such as parking demand management and improved vehicle efficiency standards.

Even in terms of Water Management and Pollution, Kolkata falls behind as revealed by a 2003 report released by the *Federation of Consumer Associations* (FCA) that observed that a large proportion of the drinking water in Kolkata was polluted with human fecal matter. According to this report, 87 percentage of reservoirs supplying water to residential buildings were contaminated with human excrement. Significant traces of fecal matter was found in 63 percentage of faucets, and 20 percentage of the water samples collected from various city hospitals and nursing homes were also found to be contaminated. The study reported that approximately one-fifth of the deep-water wells and hand pumps operated by the Kolkata Municipal Corporation were polluted with human waste.

A study conducted by me for my Graduation paper in 2017 was based on the water quality of Kolkata and its suburbs and samples were collected from faucets, Handpumps and Ponds across the city to test their iron content and Brackishness of the water and if they were safe for consumption. 7 out of 9 samples collected from the city centers from ponds and Lakes reported high levels of Iron and low levels of Oxygen. They were labelled unfit for consumption. There were 2 out of 20 water samples collected from Handpumps and Wells across the city that recorded high levels of Iron Content and Total Dissolved Particles where 2 samples recorded 400-500 mg/liters which is not very suitable for consumption purposes. Although some of the water from the Tallah Water Pumping Station and Garden Reach did record very good quality of water fit for consumption as well as multipurpose uses. The ex-director of the All-India Institute of Hygiene and Public Health said that the ongoing water pollution in the city center was due to a leaky sewer system and water pressure irregularities.

#### **Suggestions to have a better sustainable and Inclusive Development for the Cities Future:**

To curb such unwarranted and uncontrolled spread of urbanization and haphazard land-use pattern one must devise a multi-pronged strategy to limit the growing environmental degradation that must include development of appropriate technology to curb industrial as well as other pollution triggering agents and introduction of environment guards. The points mentioned below are some of the author's personal suggestions that might help the cause.

- **Promote an integrated spatial planning approach to maintain and organize urban growth:**

The key instrument to achieve systematic urbanization in Kolkata and its suburban districts is spatial planning. The primary role of spatial planning methods is the integration of various LULC, strategic and urban infrastructure development and improvement in local governance.

- **Increase urban greenery and promote afforestation projects periodically:**

Vegetation is a natural cooling agent as it encourages evapotranspiration, and energy is dissipated more through latent heating rather than sensible heating. It can also act as a sink for CO<sub>2</sub> gas which can help in ground water recharge and conservation of soil by preventing surface water runoff. The households of the area should be guided by their respective government representatives in terms of the proper mix of crops to be cultivated and the various measurements of inputs to be used as needed to sustain ecological growth.

### • Conservation of Water Bodies, Wetlands and Marshes:

Preserving and retaining water in an urban topography enhances evaporation and as vegetation and marshes tends to absorb the surrounding heat, the ambient air temperatures are likely to drop. This is especially true during daytime which records the maximum temperatures. Hence, water sensitive and retentive urban design is necessary to sustain urban climate and maintain a proper working and balanced ecosystem. There should be suitable regulatory structure for the conservation and restoration of such wetland and water bodies throughout the urban centres and its urban sprawl.

### • Promoting sustainable groundwater as well as industrial pollution management plan:

A ward wise sustainable planning design should be created to mitigate an alarming stage of air pollution condition in the city caused due to high proportion of industries. The sustainable air and soil pollution and land use planning should be made after taking into account the of physical and socio-economic characteristics and limitations pertaining to each ward.

### • Provision of Equitable Distribution of Essential Services among the Urban Population:

Governments must ensure that all population within the urban agglomeration have equitable access to adequate essential services like education, health, clean water and sanitation, electricity, shelter and food. The main objective here should be to provide and implement employment opportunities so that the average person is able to earn themselves a living to pay for the continued maintenance of the services. Government subsidies can also be availed to lower the costs of basic healthcare, education, energy consumption, education, public transportation and communication systems.

### CONCLUSIONS:

The present paper is an attempt to examine changes in LULC and the dynamics of urban expansion in the Kolkata suburban area during a period of 3 decade using the RS data. We notice that with each passing census year most districts of West Bengal as well as Kolkata and its urban agglomerations has recorded an increase in the urban population though the growth rates varies wildly among the different districts. The increasing population has also led to widespread creation of industries and settlements that eventually led to very rapid environmental degradation.

Although a positive note is that Kolkata is getting less dense by the day. The Census of India (2011) showed that every additional resident of the Kolkata's urban zone was added to its suburbs<sup>1</sup>. The city center of Kolkata remains very dense but its population is slowly declining from 4,573,000 people in 2001 to 4,487,000 people in 2011. During the same decade, the population of the urban and metropolitan zone of Kolkata grew by nearly 1,000,000 people and that reported for nearly 110% of the population growth.

The continuous and mass scale expansion of urban features like concrete that absorb and store the incoming solar radiation has led to increase in the average maximum and minimum temperature and has also recorded a decrease in rainfall in the area during the past three decades. Unsystematic, rapid, unplanned urbanization threatens the sustainability of the development process by affecting the critical environmental components like inadequate rainfall, fluctuating temperatures, and low levels of groundwater adversely. In order to mitigate these issues, there is a need for systematic and comprehensive planning for sustainable development and urbanization of the cities with the healthy urban environment and conservation of natural resources. This necessitates an integrated approach to urban planning to ensure the conservation of energy resources, moderation of climatic conditions through water conservation at the micro and macro level, etc.

In addition to appropriate policies for sustainable urban development, there is also a need for regulation of unsystematic urban growth particularly with respect to the use and management of the critical natural resources like land and water and soil. This requires strict enforcement of laws and formation of implementation and execution agencies with necessary incentive/disincentive structures. While such incentives by the people in power are expected to encourage systematic and sustainable growth of urban areas, the consequences will restrict illegal expansions and wastage of resources thus leading to a sustainable growth of the city.

This is termed as the "Urban Agglomeration" which the Census of India used to denote urban areas, sprawls of continued urban development outside the City Centre. The Census of India also

includes the entire land area of any municipality in the urban areas or in the agglomeration. Thus, where municipalities are predominantly large in area, as in the case of Kolkata and Mumbai, considerably more land area is reported to be under the Urban category. This can however lower the urban area densities by the inclusion of large areas that are predominantly rural in nature.

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