

Urban Growth and Climate Change- A Study in the Context of Bhubaneswar City of Odisha

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I. INTRODUCTION:

The human beings have been building cities for thousands of years, but the global shifting of rural to urban living, has been a defining trend during the past century or so. Even if contemporary urbanization - in terms of the combination of demographic, economic and biophysical changes that make cities what they are unprecedented in its magnitude and rate. More than half of us live in cities today, and by the end of the century, the number of urban dwellers will swell by another three billion. Although megacities with tens of millions of inhabitants are often in the limelight, most of the urban growth is in fact expected to take place in small and medium sized cities of a million or fewer inhabitants.

Urbanization is a process that leads to the growth of cities due to industrialization and economic development, and that leads to urban specific changes in specialization, labor division and human behaviors. The process of urbanization historically has been associated with other important economic and social transformations, which have brought greater geographic mobility, lower fertility, longer life expectancy and population ageing. Cities are important drivers of development and poverty reduction in both urban and rural areas, as they concentrate much of the national economic activity, government, commerce and transportation, and provide crucial links with rural areas, between cities, and across international borders.

In the year 1900, only 150 million people were living in cities, which increased to 290 billion in 2001. By the year 2000, more than half of world's population lives in the urban or highly urbanized area. The World Bank estimates that by 2030 the built up area of industrialized counties will have expanded to some 500000 square kilometers.

II. WORLD URBAN POPULATION

Table 1: Average annual increment of the urban population and distribution of that increment by major area, selected periods, 1950-2050

Major Area	Annual increment of the urban population (millions)					Percentage distribution of annual increment				
	1950-1970	1970-1990	1990-2014	2014-2030	2030 - 2050	1950-1970	1970-1990	1990-2014	2014 - 2030	2030 - 2050
World	121	187	319	236	256	100.0	100.0	100.0	100.0	100.0
Africa	10	23	52	63	114	8.4	12.2	16.2	26.7	44.4
Asia	52	106	206	138	112	43.1	56.9	64.4	58.4	43.8
Europe	26	18	8	4	3	21.7	9.8	2.5	1.8	1.1
Latin America and the Caribbean	19	30	36	20	16	15.7	16.0	11.4	8.4	6.1
Northern America	12	8	16	10	10	10.1	4.5	4.9	4.1	3.9
Oceania	1	1	2	1	2	1.0	0.5	0.5	0.5	0.6

Source: World Urbanization Prospects, United Nation

From the table 1, it is seen that the levels of urbanization have been rising among all the major areas since 1950 and are expected to continue to increase through 2050. Among the major areas of the world, Asia was the second least urbanized in 1950, with 18 per cent of its population living in urban settlements. By 2014,

after Asia experienced average annual rates of urbanization (rate of change of the percentage urban) of 1.5 per cent per year in 1950-1990 and 1.6 per cent in 1990-2014, the level of urbanization had more than doubled, to 48 per cent. Despite a rate of urbanization of just over 1.1 per cent per year that Asia is expected to experience during 2014-2030 (the highest of any major area, although falling slightly below that of Africa during the 2030-2050 period), only 64 per cent of its population is projected to be urban in 2050, when Asia will still be the second least urbanized major area.

Table 2: Percentage urban and rate of urbanization of the world, by major area, selected periods, 1950-2050

Major Area	Percentage urban						Rate of urbanization (per cent)				
	1950	1970	1990	2014	2030	2050	1950-1970	1970-1990	1990-2014	2014-2030	2030-2050
World	29.6	36.6	42.9	53.6	60.0	66.4	1.07	0.80	0.92	0.71	0.50
Africa	14.0	22.6	31.3	40.0	47.1	55.9	2.38	1.63	1.03	1.02	0.86
Asia	17.5	23.7	32.3	47.5	56.3	64.2	1.51	1.54	1.62	1.06	0.65
Europe	51.5	63.0	70.0	73.4	77.0	82.0	1.00	0.52	0.20	0.30	0.31
Latin America and the Caribbean	41.3	57.1	70.5	79.5	83.0	86.2	1.62	1.06	0.50	0.27	0.19
Northern America	63.9	73.8	75.4	81.5	84.2	87.4	0.72	0.11	0.32	0.21	0.19
Oceania	62.4	71.3	70.7	70.8	71.3	73.5	0.67	-0.05	0.01	0.05	0.15

Source: World Urbanization Prospects, United Nation

From the table 2, it is seen that the path of urbanization in Africa has been quite similar to that in Asia. In 1950, Africa had the lowest proportion urban of any major area (14 per cent), but it experienced the fastest rate of urbanization by far during 1950-1970 (2.4 per cent per year) and the second fastest after Asia during 1990-2014 (1.0 per cent per year). By 2014 its urban share had risen to 40 per cent. Africa’s average rate of urbanization over the coming years is expected to fall, thus will result in a level of urbanization of 56 per cent by 2050. That is, by 2050 the levels of urbanization of both Africa and Asia will have long since passed the 50 per cent mark (Asia in 2018 and Africa in 2038), making their populations more urban than rural.

In contrast to Africa and Asia, the level of urbanization of Latin America and the Caribbean was already relatively high by 1950, when 41 per cent of its population lived in urban areas. Although this level of urbanization was lower than that of the predominantly urban more developed areas of Europe (52 per cent urban), Northern America (64 per cent) and Oceania (62 per cent), over the next 64 years Latin America and the Caribbean experienced a rapid increase in the proportion urban, much faster than in those three areas, averaging 1.6 per cent per year in 1950-1970 and 1.0 per cent per year in 1970-1990.

Consequently, its proportion urban had become essentially the same as that of Europe and Oceania by 1990, and in 2014 it surpassed that of both (80 per cent versus 73 per cent and 71 per cent, respectively). With about three-quarters of their populations already living in urban areas, Latin America and the Caribbean and Europe are both expected to experience declines in their annual rates of urbanization, with the result that their proportions urban will increase slowly, reaching 82 per cent in Europe and 86 per cent in Latin America and the Caribbean by 2050.

Oceania, the major area with by far the smallest population (barely one-tenth the population of Northern America in 2014), was the second most urbanized major area in the world in 1950 (62 per cent living in urban settlements), following Northern America (64 per cent). Since then, these two major areas have experienced the lowest rates of urbanization in the world: in 1950-1970, both experienced rates of urbanization around 0.7 per cent per year, but in the subsequent 44 years the rate more than halved in Northern America and became marginally negative for most of the period in Oceania. Nevertheless, Northern America, with 81 per cent of its population living in urban areas, remains the most urbanized major area in the world in 2007; Oceania, with 71 per cent urban, ranks fourth after Latin America and the Caribbean and Europe. Percentages urban are expected to rise to 87 per cent in Northern America and 74 per cent in Oceania by 2050.

Regarding this it is worthwhile mentioning that India is in the midst of a fundamentally transformative urban awakening. In 1991, just fewer than 220 million people lived in the country’s urban areas. This rose to 380 million in 2011 and is forecast to increase to over 600 million by 2030 (Ahluwalia et al., 2014). United Nations estimates suggest that an additional half a billion people will live in Indian cities in the next 35 years, more than doubling the urban population to almost 900 million by 2050

Table 3: The growth trend of urban population in India from the year 1901 to 2011

CENSUS YEAR	URBAN POPULATION(IN MILLIONS)	PERCENTAGE GROWTH OF URBAN SECTOR
1901	25.85	10.84%
1911	25.94	10.29%
1921	28.07	11.17%
1931	33.46	11.99%
1941	44.15	13.86%
1951	62.44	17.29%
1961	78.94	17.97%
1971	109.11	19.91%
1981	159.46	23.34%
1991	217.18	25.72%
2001	286.12	27.86%
2011	377.11	31.16%

Source: Source: Bhagat and Mohanty (2009); Bhagat (2011) and Samantaray (2016)

The table 3 indicates that, there is a persistent rise in urban population from the year 1901 to 2011. In the year 2011 it reached up to 377.11 million. The same is the case with regard to percentage growth of urban areas. It has reached to 31.16% in the year 2011. However as of latest observation, rural-urban migration seems to be surprisingly slow due to both economic and environmental reasons. No doubt the urban life has become stressful and poor people are not able to get toehold in the urban areas.

A demographic census of India is carried out every 10 years and the last census was held in 2011. The demographic data of the last few decades revealed an increasing tendency of urbanization in many states. The rural: urban ratio of population which remained 80:20 in 1971 had changed to 69:31 in 2011.

Table 4: Urban Growth in India and Odisha

Current Year	No: of Urban Area/Town		Percentage of Urban Population to Total Population	
	India	Odisha	India	Odisha
1901	1916	14	10.84	2.47
1911	1908	18	10.29	2.42
1921	2048	20	11.18	2.52
1931	2220	21	11.99	2.54
1941	2427	29	13.86	3.00
1951	3060	39	17.29	4.06
1961	2700	62	17.97	6.32
1971	3126	81	19.91	8.41
1981	4029	108	23.34	11.79
1991	4689	124	25.70	13.38
2001	5161	138	27.78	14.97
2011			31.16	

As per the urbanization trends of 2001 Census, Odisha State is the 25th most urbanized and 5th least urbanized state in India with about 14.97 percent of urban population. The Urban decadal growth is during the last decade (1991-2001) has been enormous with the growth rate of about 30.28 percent, almost matching that of the country which had an urban decadal growth rate of 32.60 percent. Odisha Urban population of 5517238 (as per of 2001 census) is spread across 138 towns/cities in the state. It is noteworthy that Odisha's population during the last decade was grown by about 14 percent while that of the urban population has grown at almost double the rate.

Table 5: Urban Profile in Odisha

S.No.	Title / Description	Particular Data / Information	
1	Urban Local Bodies - Profile	Notified Area Councils (NACs): 63 Municipalities: 37 Municipal Corporations: 3	
2	Urban share of the population	Previous (1941) 3%	Last Census (2001) 14.95%
3	Urban Centres –Growth	Previous (1951) 39 nos.	Last Census (2001) 138

			nos.
4	Most Urbanized districts (% Urban Population)	Khordha (42.93%) Jharsuguda (36.40%) Sundargarh (34.38%)	
5	Least Urbanized Districts	Nayagarh (4.29%) Jajpur (4.49%) Boudh (4.82%) Nuapada (5.66%)	

Source: Housing & Urban Development Department

From the table 5 it is seen that the urban sector of the state comprises 103 urban local bodies (ULBs) comprising 3 municipal corporations and 37 municipalities.

Urban Growth and Climate Change:

Life, as we know today, exists because certain gases like carbon dioxide, methane and nitrous oxide help in maintaining the Earth's temperature at a desired level. These 'green house gases' (GHGs) act like a blanket. They prevent much of the absorbed solar heat from escaping into the atmosphere. This natural phenomenon keeps the Earth warm enough to sustain life. Problems arise when the concentration of GHGs in the atmosphere starts increasing due to human activities. Burning fossil fuels like coal and oil to derive energy, deforestation and biomass burning are some such activities. As the world became heavily dependent on carbon-based fossil fuels, the Earth's temperature has increased consistently leading to global warming and climate change.

The earth's surface temperature has increased by between 0.74 and 1.8 degrees centigrade since 1096. The rise in temperature globally partly is due to different human activity. The global atmospheric concentration of carbon dioxide has risen by 35 percent since 1750 and more than 70 percent of this rise can be attributed to the burning of consumption of fossil fuels that is oil, gas and coal. The fifth Intergovernmental Panel on Climate Change (IPCC) report states with 95 percent confidence that humans are the main cause of the current global warming. Many media outlets have reported that this is an increase from the 90 percent certainty in the fourth IPCC report, but actually the change is much more significant than that. In fact, if it is looked closely, the IPCC says that humans have most likely caused all of the global warming over the past 60 years. The Intergovernmental Panel on Climate Change (IPCC) notes that the rate of global temperature increase in the last 50 years has been twice that of the last 100 years. IPCC estimates that the earth's temperature will rise by 1.8 and 4 degrees Centigrade over the course of the 21st century if the current levels of greenhouse gas emissions are not curbed. Global warming will have severe impact on the planet, including increase flood risk, reducing water supply, decline in crop yield, and increase in vector borne diseases, such as malaria and dengue fever, displacement of hundreds of millions of people from the coastal cities and small islands and significant changes in marine ecosystem. Carbon dioxide (CO₂) comprises 77 percent of global green house gas (GHG) emission, with fossil fuel consumption according for the bulk (nearly 60 percent) of these emission, while deforestation and land use conversion from natural to framed or built areas account for the rest.

Industrialized countries with their energy-intensive lifestyle are historically responsible for the problem of global warming. Each person in such countries emits much more than a person in developing countries. For instance, in 1996, one US citizen's emissions were equal to those of 19 Indians. International negotiations aimed at arresting global warming have failed to address the issue of inequality in per capita emissions. The atmosphere is a common property resource to which every human being has an equal right and it is now the turn of developing countries to demand appropriate 'environmental space' for their future economic growth. Moreover, the maximum impact of global warming will be borne by developing countries like India, which have hardly contributed to the problem.

Cities play an important role as the engine of the global economy, generating 80–95% of the world's GDP (Seto et al., 2011). However, the rapid growth of cities has led to global environmental changes and emerging social costs. Many issues concerning the growth of cities such as climate change, carbon emissions, the urban heat island, urban sprawl, the loss of prime agricultural land, increasing water and air pollution, overcrowding, crime, traffic congestion, poverty, and social exclusion are often associated with urbanization (Bolay, 2012; Hassel and Lathrop, 2003; United Nations Habitat [UN Habitat], 2008; Zhao, 2010). About 75% of global energy consumption and 80% of greenhouse gas emissions occur in cities (Geng et al., 2011). Thus urban areas have also influenced the pattern of energy and land use in the surroundings and more distant areas that affect the livelihood and quality of life of the people who live outside the city boundaries. At the same time, however an increase number of cities are becoming center of innovation in alternative energy, developing resources that may reduce our dependence on fossil fuels and make our societies more sustainable.

Case study of Bhubaneswar:

Table 6: Population Detail and Growth Trends in Population of Bhubaneswar City

Census Year	Population	Decadal Growth (%)	Area (Sq.Km)	Density per sq.km
1951	16512	-	25.90	638
1961	38211	131.41	50.25	760
1971	105491	176.07	65.03	1622
1981	219211	107.80	92.91	2359
1991	411542	87.74	124.74	3299
2001	648032	57.46	135.00	4800

Source: City Development Plan, Bhubaneswar, Odisha

From the table 6 it is seen that Bhubaneswar city had a population of 6, 48,032 no in the year 2001, with a growth rate of 57.46 percent during the period 1991-2001. The growth rate of the city is higher than that of the State (Urban), which stood at 30.28 percent for the period 1991-2001. It was observed that the city always had a population growth rate higher than the city.

In 1948 the master plan of Bhubaneswar was prepared for 40,000 people over an area of 16.41 square kilometer. But the 2001 census revealed that the population of the city to be 6, 48,032. This rapid growth pressure of population, contributed by in-migration and due to development of the city as a major center for trade, commerce, technology and education. This is resulting in a faster rate of developmental activities and thereby rapid growth and expansion of the city. The present Bhubaneswar has grown in all directions covering Chandrasekharpur, Kaling Vihar, Old Town and areas adjacent to Daya West Canal, the tributary of river Kuakhai. In view of the rapid growth of Bhubaneswar, a development Authority was constituted under the Orissa Development Authority, Act, 1982 and is responsible for Bhubaneswar Urban Development Area. The city was originally planned for 40,000 people with an area of 1684 hectare is now accommodating about 7.50 lakhs population in an area of about 135 sq.km. The development process could not be restricted to its development plan. Naturally the thrust of this development process will be towards the periphery of the city. As a result visible effects of development are observed in the fringe areas of the city. But the periphery of the city comprise rural-urban fringe areas consisting mostly fertile agriculture land, archeological sites, wild life sanctuaries and protected forest areas. The table 6 shows the population growth of Bhubaneswar, the rapid growth has taken place since 1951 within the short span of time.

In fact this urban growth of Bhubaneswar has created environmental threat to the fragile ecosystem of Bhubaneswar and its periphery areas. The Chandaka wildlife sanctuary, lying at the north western urban fringe of the Bhubaneswar city is an ecologically sensitive area being threatened by the growth and development of Bhubaneswar. Being closed to this highly populated urban conglomerate on the east, the pressure on the Chandaka –Damapara wildlife sanctuary is tremendous and on the increase. The GIS based analysis and derived areas statistics indicates that the total forest area of the sanctuary (including dense open and scrub forest) was 90.27 percent of the total area during 1970 which has been reduced drastically in 2005 to 62.72 percent (Rath, K.C and N.R., 2008).

With rapid urban growth in Bhubaneswar urban complex land transformation has taken place in large scale from agriculture land, forest land, river banks etc to urban uses, which includes development of residential areas, conversion of agricultural land to plotted land developments (acquired primarily for future residential requirements). Bhubaneswar has also developed as an educational hub in the eastern region of the country so acres of land has been used for institutional purposes mainly engineering and medical colleges and other private colleges. This transformation of land to residential housing and educational institutes was possible due to developed transport facilities, easy communication, availability of natural resource (land, water etc) and urban centers (Cuttack, Khorda, Jatini, Pipili) of which Bhubaneswar is the center. All these development are under the process of converting primarily agriculture land. An estimate reveals that around 15000 ha of agricultural land has been transformed to residential land in the Khorda district in the last decade (The samaj, 2005). The massive and rapid urban development and expansion of the city created a constant threat to the surrounding environment.

Impact of Urbanisation on the environment quality in the smart city Bhubaneswar:

To accommodate rising populations and increasing of land demand for settlement and urban activities, most of cities are growing outward encroaching on fertile agriculture lands. They have insufficient open space and many of them have poor urban infrastructure. As it has been observed in Bhubaneswar city, the growth has taken place in all direction, forming Bhubaneswar as the centre of an urban complex with Cuttack, Jatni, and Pipili as vertex. The major feature of such growth in and around Bhubaneswar is rapid land transformation to urban uses from sanctuaries, forests and river banks. Such destruction of natural ecosystems around the city is

making the city vulnerable towards the impact of climate change. Due to uncontrolled urbanization environmental degradation has been occurring very rapidly and causing many problems like shortages of housing, worsening water quality, excessive air pollution, noise, dust and heat, and the problems of disposal of solid wastes and hazardous wastes.

Cities are major contributors to climate change since they contribute approximately 75% of the greenhouse gas (GHG) emissions. Greenhouse gas emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90 percent of the fuel used for transportation is petroleum based, which includes gasoline and diesel. The total number of vehicles in the city, Bhubaneswar is 9,76,995 by the end of the year 2014 against 3,07,126 of 2004. In two wheelers category, the statistics said, the number of vehicles has increased from 2,46,244 in 2004 to 7,41,386 in 2014. In cars category, the number has increased from 22,244 in 2004 to 1,10,788 in 2014. Within 10 years, the city has also witnessed significant rise in number of other vehicles, goods vehicle (from 9,556 to 39,758), bus (1,586 to 3,151), taxi (6,236 to 18,174), jeep (4,816 to 12,384), auto rickshaw (8,390 to 27,943), tractor (5,159 to 14,988) and others (2,895 to 8,423).

Urbanisation and industrialization influence the quantity of city garbage produced. Bhubaneswar city generates approximately 300 MT of municipal solid waste every day in the year 2006 which has increased to 500 MT in the year 2016 per day comprising both the bio degradable and non bio degradable component. The MSW generation rate in Bhubaneswar is about 360 g per capita per day (gpcd) and the total generation is about 3,00 t d⁻¹ in the year 2014.

The Bhubaneswar Municipal Corporation (BMC) carried out a slum survey during the year 2000 (post super cyclone in 1999) to ascertain prevalent physical features after the devastating super cyclone for under improvement measures. This survey indicates about 146 slums spread across the city. On later date (2002-2001) the BMC carried out another survey to list all slums within the BMC limits. The survey listed 59 notified slums and 131 non notified slums. In the year 1991 the total slum population was 24372 and in 2001 it increased to 71403. It is noteworthy that the proportion of slum population as per 1991 census was about 5.92 percent which has increased to 11.02 percent during the year 2001. It is worth mentioning the fact that the city population is increasing at a rate of 5.75 percent per annum while that of the slum population is increasing at 19.30 percent.

Currently, the Bhubaneswar Municipal Corporation (BMC) is spread over an area of 135 square kilometres, covering 67 administrative wards. According to Census 2011, the city has a population of 885,363 people, with a 'slum' population of 163,983 people (18.5 per cent). And there are 436 recognized slum settlements in Bhubaneswar (identified by the BMC) of which 320 (73 per cent) are unauthorized and 116 (27 per cent) are authorized. The geographic area of the slums ranges from 0.045 hectares to 18.31 hectares.

Water resources are diminishing not just because of large population numbers but also because of wasteful consumption and neglect of conservation. With rapid urbanization and industrialization, huge quantities of wastewater enter rivers. Domestic wastewater (sewage) is generated from residential, institutional, commercial and industrial establishments. It includes household waste liquid from toilets, baths, showers, kitchens, sinks etc. that is disposed via sewers. Sewage may also include storm water runoff. As rain water travels over roofs and the ground, it may pick up various contaminants. Sewage is the major source of water pollution in India, especially in and around large urban centres. There is a wide gap between the demand and supply of water (Sreerangam, 2005). Sewage is mainly composed of 99.9% of water together with relatively small concentrations of suspended and dissolved organic and inorganic solids. Dissolved solids formed the main part of total solids concentrations as compared to the suspended solids (Ayub et al., 2011). It is estimated that, 182 MLD of water is daily supplied to the city, out of which 145.6MLD sewage is generated which is 80% of the total water supplied. There is no integrated sewage treatment facility in the city. In the absence of sewerage system, people are using septic tanks and soak pits. The city has an undulating ridge and valley topology and is covered by a number of natural drainage channels. The city is in the western side of river Kuakhai and to the northern part of river Daya. Apart from this a number of open drains running west to east crisscross the city. The drainage is controlled by Kuakhai and Daya River, as most of the sewage from the city reaches river Kuakhai and river Daya through open drains.

III. CONCLUSIONS:

- From this we can conclude that some causes of damage to the environment due to urbanization lies in the legislation and the regulating agencies of the country.
- Failure of governance in today's cities has resulted in the growth of informal settlements and slums that constitute unhealthy living and working environment.
- Serious attention should be given to the need for improving urban strategies, which promote efficiency in resource use.
- Vehicular pollution control in metropolitan cities and other cities deserves top priority.
- Urgent attention should be given to reduce the generation of solid waste at the sources through mandatory standards and regulation fee and tax incentives, and education and voluntary compliance.

- Suggested that, the domestic wastewater before discharged into outside should be properly diluted or treated in order to reduce its pollution effect on the environment. Since the domestic wastewater contains many essential plant nutrients, through careful study it can be utilized for agricultural purposes.
- In case adequate steps are not taken to prevent pollution and to improve the quality of life by providing more social amenities, the life of the urban dwellers of India may become more miserable this may be the cause of health hazards and worst devastation.

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