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Analysis of the relationship between Population Dynamics and Landuse change: A case study on North 24 Parganas, West Bengal, India

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Abstract:
Population growth has become almost a part and parcel of our daily lives. Since time immemorial, the world has witnessed significant change in population growth. Population is highly dynamic as it is a subject of continuous change. This change in population has brought about remarkable changes in different environmental and socio-economic pursuits. Change in land-use and land-cover has turned out to be one of such manifestations. With growth of population, an area undergoes notable changes in its land-use and land-cover pattern. Vegetations are destroyed and waterbodies are filled up for the sake of construction of residential and industrial areas and also for expansion of agricultural lands. An attempt has been made in this paper to analyse the scenario of population dynamics and landuse change of North 24 Pargana district of West Bengal using Geospatial technique. The study revealed that there has been a noticeable change in population parameters between the census years 2001 and 2011. The landuse maps prepared for the similar years also revealed that there has been a massive decline in waterbodies and meteoric rise in the built up areas over time.
Keywords: *Population Dynamics, Landuse landcover change, Geospatial Technique*.

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I. INTRODUCTION

Population is considered to be a highly dynamic variable because it changes at a very faster rate. Population is a subject of continuous change. The world has been witnessing a rapid growth in its population since time immemorial and it has reached about 7.7 billion by middle of 2019. Being the second most populated country of the world, India has also exhibited a population growth rate of 17.64% according to census 2011. This dynamic nature of population has also laid a significant impact on the Land use and land cover changes of the area (Sarkar *et al.,* 2020). An attempt has been made in this paper to analyse the change of demographic structure of North 24 Parganas district of West Bengal in the last two census years of 2001 and 2011 along with change in land use and land cover of the same area for the same periods of time. The major goals of the study were:

1. To analyse and compare the demographic parameters between the year 2001 and 2011.
2. To analyse and compare the land use and land cover change of the study area between 2001 and 2011.
3. To analyse the relationship between the two events.

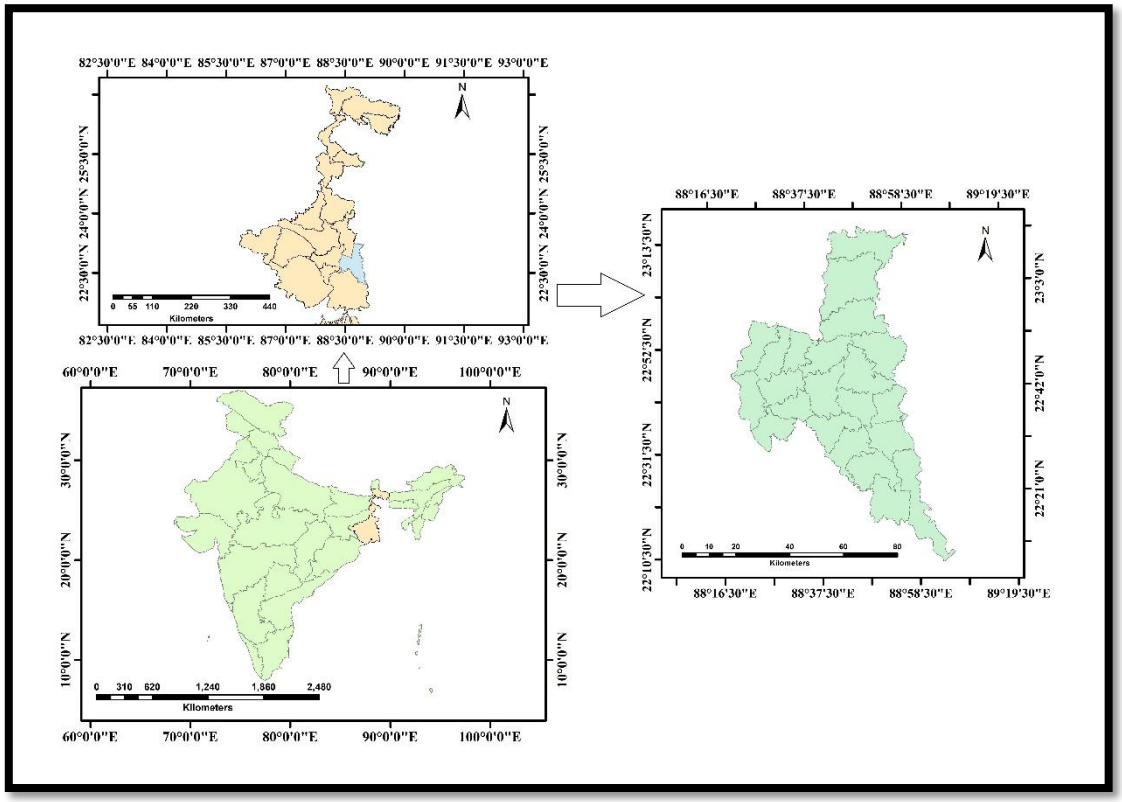

Figure 1: Location Map of the Study Area

II. METHODOLOGY

In order to accomplish the task, secondary data were collected from census website. Satellite images of Landsat 5 were downloaded from USGS Earth Explorer. All the secondary data collected were tabulated and calculations were performed in MS Excel. Maps were prepared using ArcGIS 10.3 software. Finally, all the graphs and maps were analysed and interpreted to arrive at the necessary results.

III. RESULTS AND DISCUSSIONS

Demographic characteristics:

According to 2011 census, the total population of North 24 Parganas is 10009781. Out of this total population, 5119389 are male and the rest 4890392 are females accounting for about 51% and 49% total population respectively. The decadal growth rate of population according to 2011 census in the period of 2001-2011 was 12%. Out of this total population, 4277619 population resided in the rural areas that accounted for about 42.7% of total population while 5732162 resided in the urban areas that accounted for about 57.3% of the total population. The population density of the district according to 2011 census was 2445 persons per square kilometre and sex ratio of the district was noted to be 961 persons per square kilometre. Hence, from the above discussion, it is seen that male population is higher than female population and majority of the population resides in the urban areas.

Total Population of North 24 Parganas:

The total population of the district of North 24 Parganas have undergone significant changes in the years. This paper takes into account the total population of the Community Development Blocks only. In 2001, the total population in all the districts was 4083338 and out of this 2102208 (51%) were males and the rest 1981009 (49%) were females. The highest population was recorded in Bongaon (344044) while the lowest population was recorded in Barrackpur II (80716). In 2011, the total population in all the districts was 5019553 and out of this 2575061 (51%) were males and the rest 2444492 (49%) were females. The highest population was recorded in Bongaon (380903) while the lowest population was recorded in Sandeshkahli II (160976).

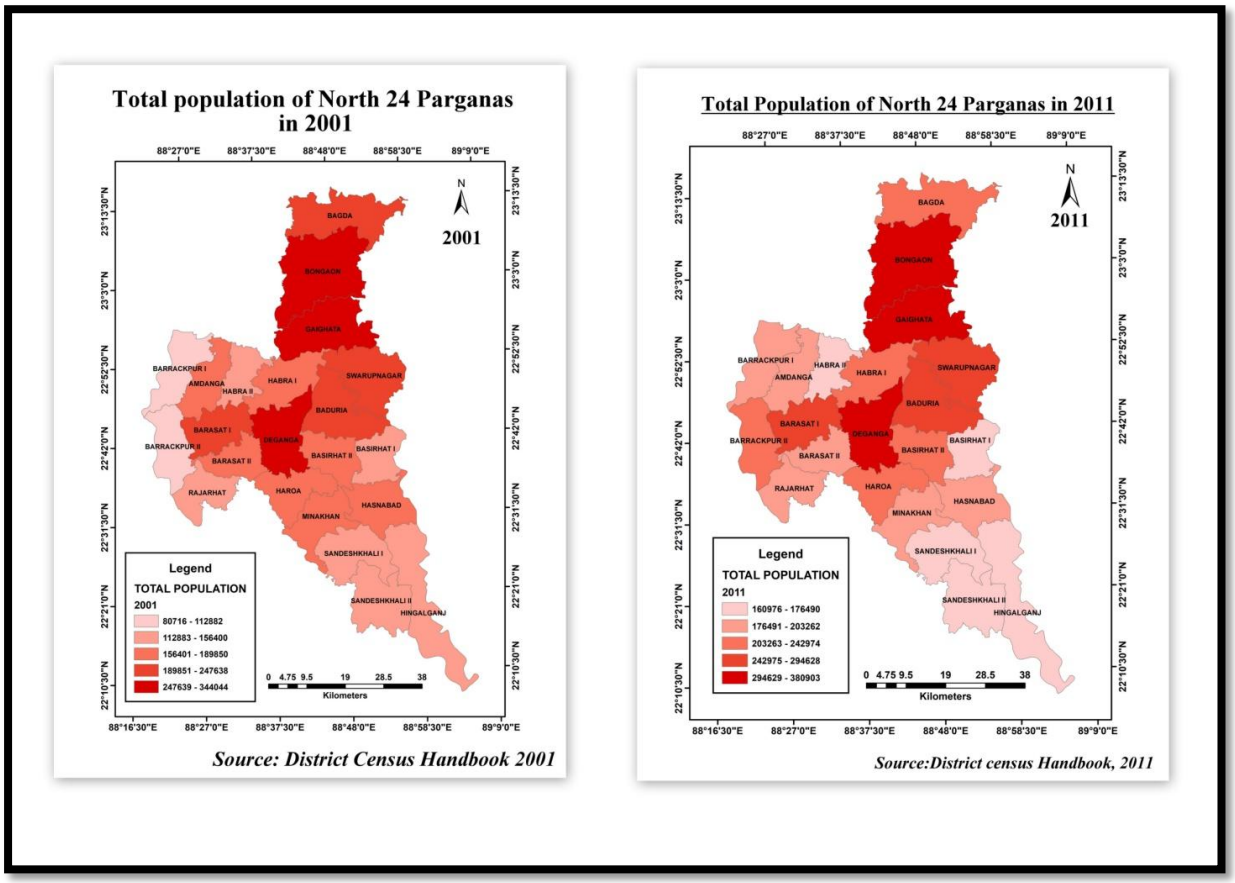

Figure2: Total population scenario of North 24 Parganas in 2001 and 2011

On analysing the growth rate of population between the census years 2001 and 2011, it was noticed that the maximum growth rate of 169% was recorded in case of Barrackpur II sub division in the period of 2001-2011 while the lowest population growth rate of 10.5% was recorded in case of Bagda. According to census 2011, the population growth rate of West Bengal in 2011 was 13.8%. Out of 22 Community Development Blocks, about 18 blocks exhibited population growth rate above the state average value. Only 4 Community Development Blocks namely Hingalganj, Swarupnagar, Bongaon and Bagda exhibited population growth rates lower than the state average of 13.8%. However, the proportion of male and female population with respect to total population remained the same in both the census years of 2001 and 2011 with values of 51% and 49% respectively.

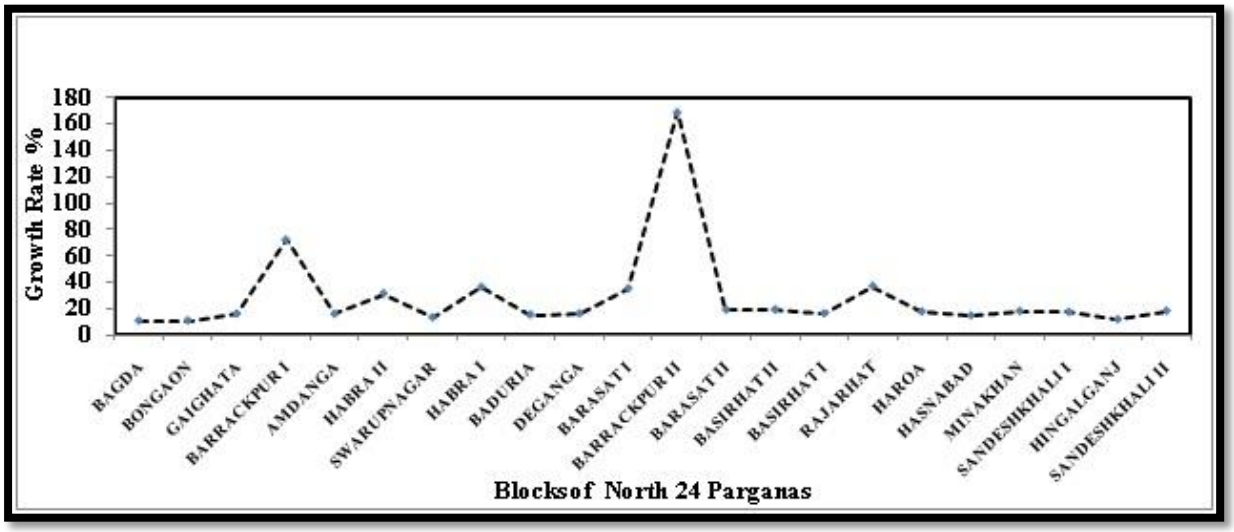

Figure 3: Change of Population Growth Rate between 2001-2011

Population Density:

Population density is one of the major parameters through which the degree of pressure of population on land can be analysed. It is defined as the total population present in per square kilometre of a given area. According to census 2001, the highest population density of 2146 persons per square kilometre was seen in Barasat I while the lowest population density of 655 persons per square kilometre was recorded in Hingalganj. In 2011, the highest population density of 5331 persons per square kilometre was seen in Barrackpore II while the lowest population density of 731 persons per square kilometre was recorded in Hingalganj. In 2001, out of 22 blocks, only 3 blocks had population density below the state average of 903 persons per square kilometre while in 2011, out of 22 blocks 3 blocks had their population density below the state average of 1028 persons per square kilometre. This feature was exhibited by Sandeshkahli I and II and Hingalganj in both the years.

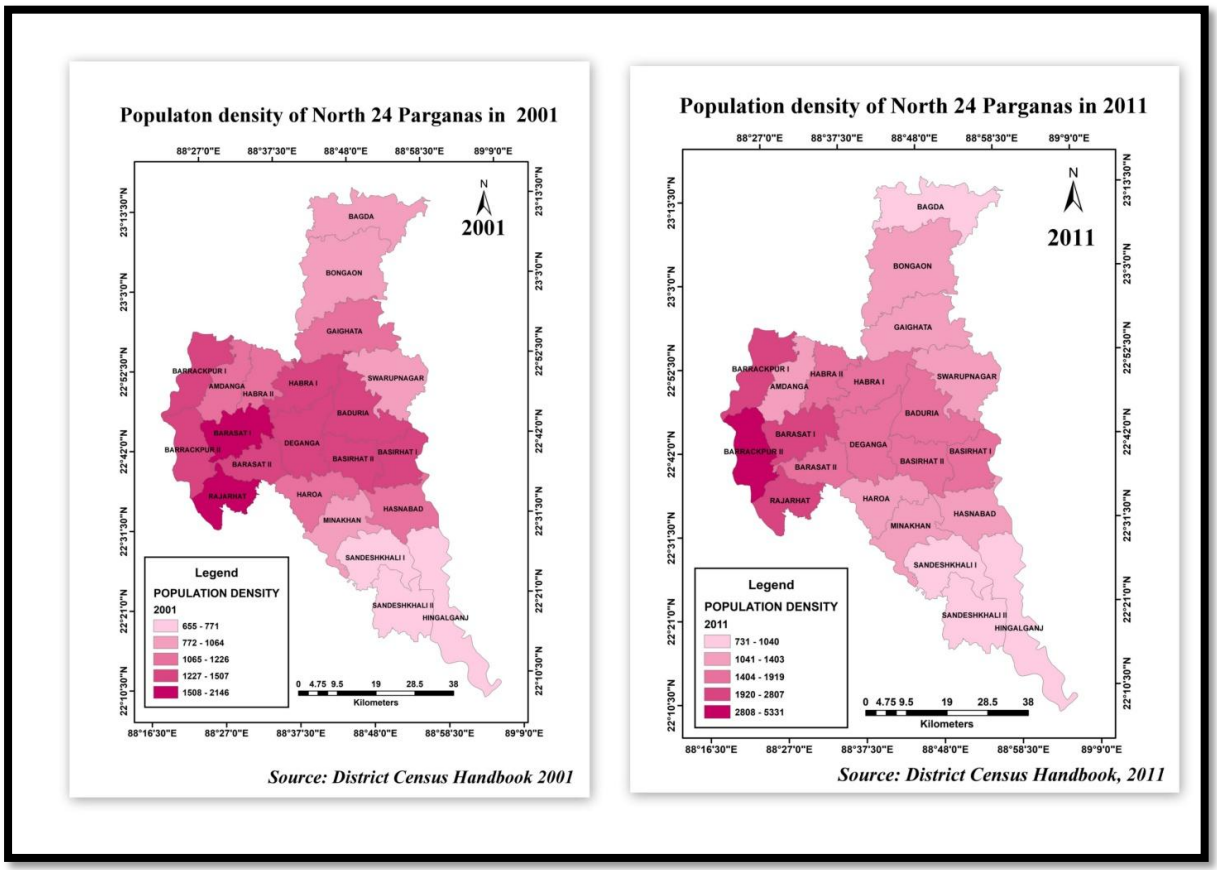

Figure 4: Population Density Scenario of North 24 Parganas in 2001 and 2011

On analysing growth rate scenario of population density in the period of 2001-2011, it has been seen that Barrackpore II has registered the highest change in population growth rate (267%) within the stipulated time period of 2001-2011 while the lowest growth rate (10.4%) was recorded in Bagda CD block of the study area.

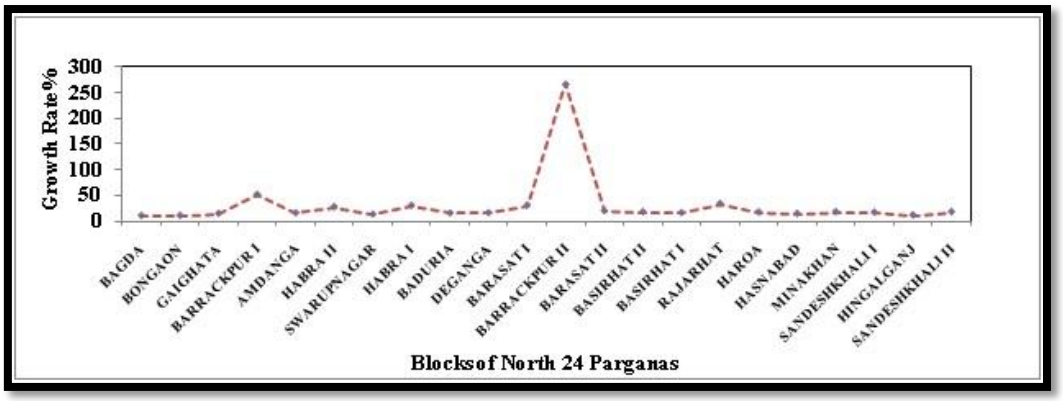

Figure5: Change in population density growth rate between 2001 and 2011

Scheduled Caste Population:

Dominance of Scheduled caste population plays a vital role in determining the level of development of any region. The scheduled caste population has also undergone marked change between 2001 and 2011. According to census 2001, the total scheduled caste population of North 24 Parganas was 1364977. The highest and lowest scheduled caste population was noted in Bongaon (161918) and Basirhat II (16255) respectively. According to census 2011, the total scheduled caste population of North 24 Parganas increased to 1453191. The highest and lowest scheduled caste population was noted in Bongaon (177503) and Amdanga (17968) respectively.

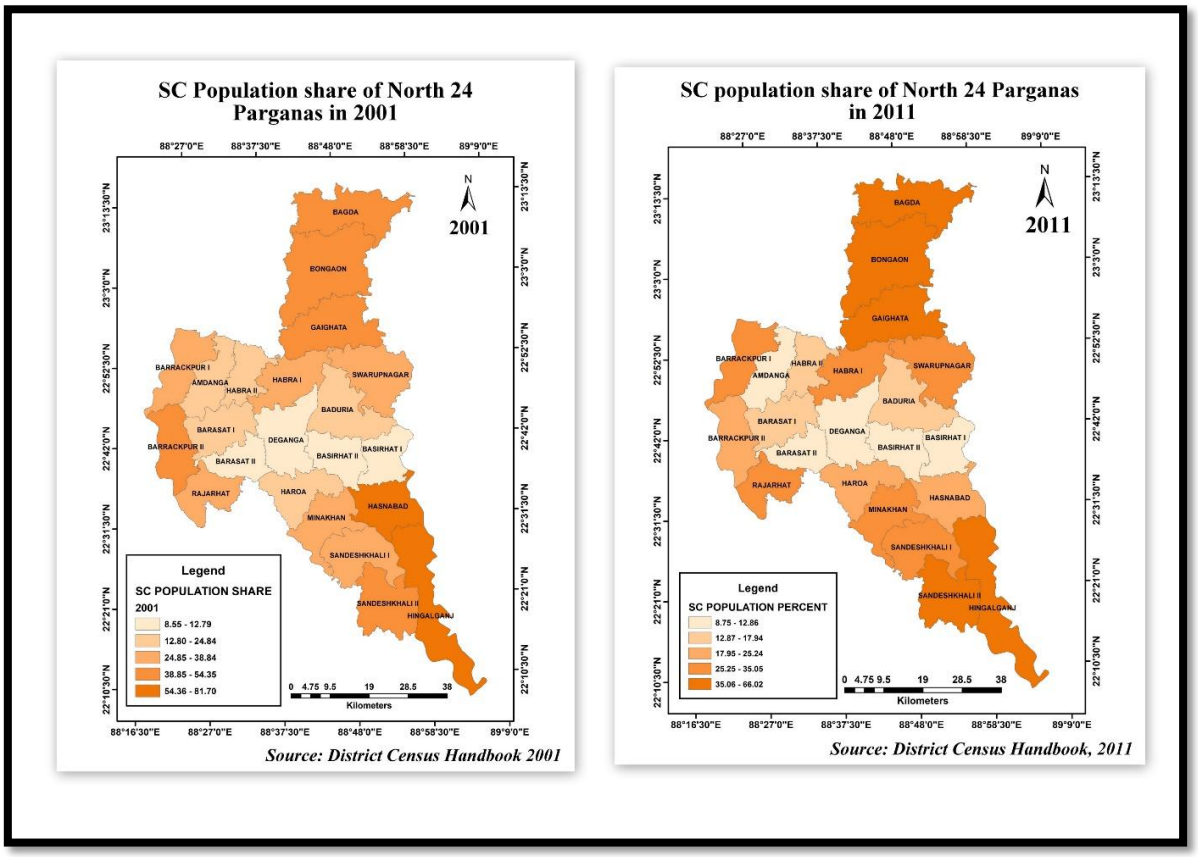

Figure 6: Scenario of SC population of North 24 Parganas in 2001 and 2011

While analysing the growth rate of scheduled caste population of North 24 Parganas between 2001 and 2011, it was noticed that out of 22 blocks, 20 blocks have registered a positive growth rate in scheduled caste population between 2001 and 2011. Only 2 blocks namely Amdanga and Hasnabad have shown a negative growth of scheduled caste population within the same time period. Maximum growth rate of about 31.5% was noted in Barrackpur II while the lowest growth rate of -64.6 was recorded in case of Hasnabad.

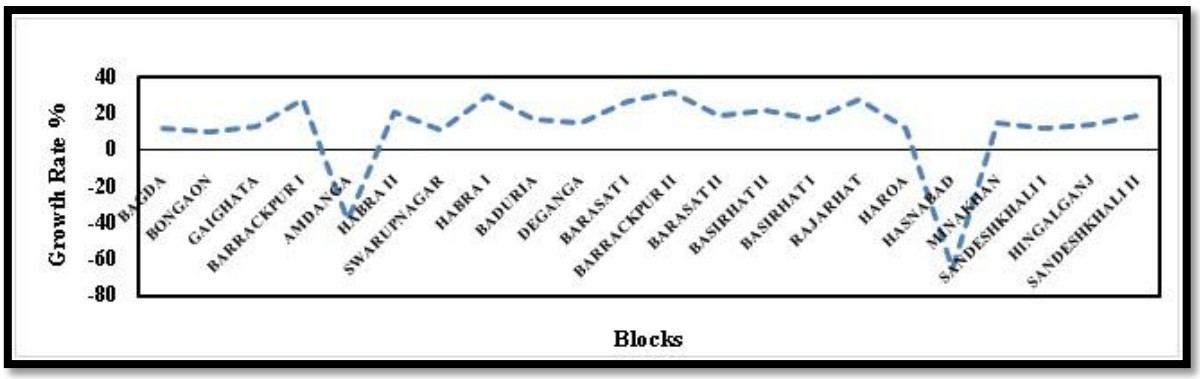

Figure 7: Growth rate of Scheduled Caste Population in North 24 Parganas in 2001-2011

Sex Ratio:

Sex ratio is defined as number of females per 1000 male population and it acts as an indicator for measuring the degree of equality between male and female population. According to 2001 census, the average sex ratio of blocks of North 24 Parganas was 940 females per 1000 males. The highest sex ratio was recorded in Baduria (959) while the lowest sex ratio was noted in Barrackpore II and Barasat II (915). Out of 22 blocks, about 5 blocks exhibited a sex ratio value lower than the state's sex ratio of 934 females per 1000 males. According to 2011 census, the average sex ratio of all the CD blocks of North 24 Parganas increased to 950. The highest sex ratio was recorded in Sandeshkhali II (965) while the lowest sex ratio was noted in Barasat II (927). Out of 22 blocks, about 7 blocks exhibited a sex ratio value lower than the state's sex ratio of 950 females per 1000 males.

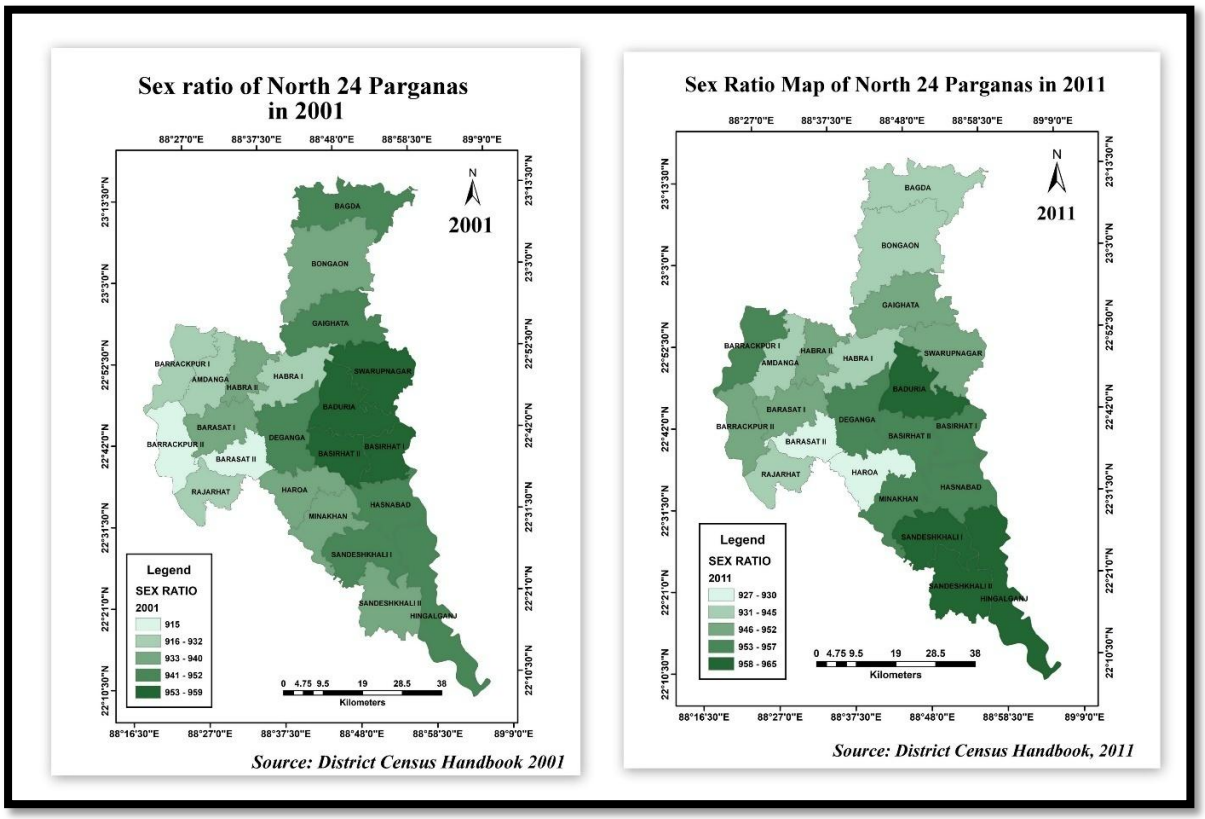

Figure8: Sex ratio of North 24 Parganas in 2001 and 2011

On analysing the sex ratio trend of the blocks of the district in the time span of 2001-2011, it has been seen that blocks of North 24 Parganas have undergone significant changes in the sex ratio. Some blocks even have exhibited a negative growth rate. The maximum positive growth rate in sex ratio was noted in Bagda (1.15%) while the lowest growth rate percentage was noted in Barrackpore II (-4.04%). Out of 22 blocks, about 17 blocks have recorded a negative growth in sex ratio in the time span of 2001-2011 with Barrackpore II recording the highest negative growth rate. Baduria recorded 0% growth in sex ratio as the sex ratio of the block remained same both in the year 2001 and 2011.

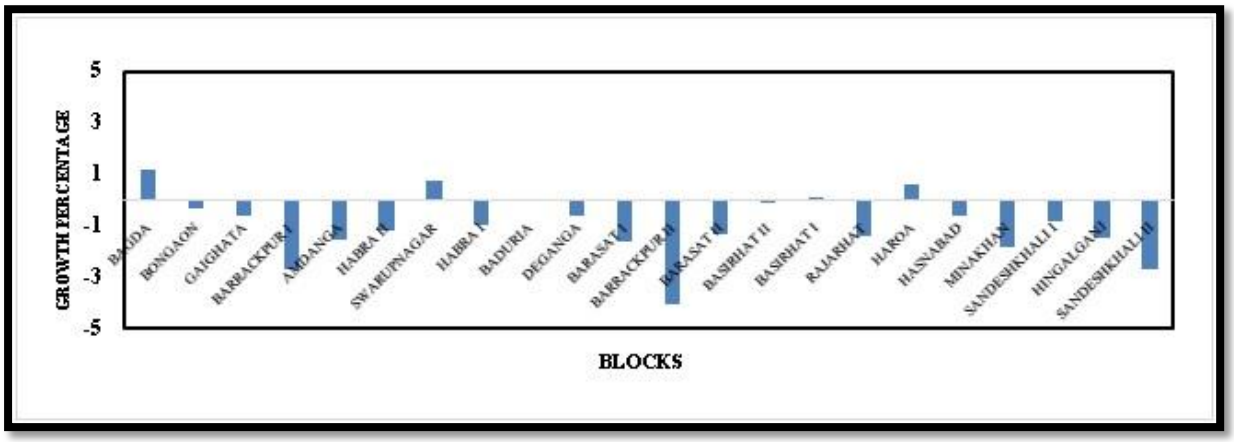

Figure 9: Change in sex ratio of the districts of North 24 Parganas in 2001-2011

Landuse and Land Cover Scenario of North 24 Parganas:

Land use and land cover of any place highly manifests the impact of human activities on the area. With change in population, land use and land cover of an area also undergoes significant changes. As population is a highly dynamic parameter undergoing changes in each and every moment of time, land use and land cover changes can also be noted.

Year 2001:

Out of the total area of 394389 hectares, most of the land was dominated by vegetation (159514 hectares) accounting for 41% of total land cover. Waterbody, barren lands and built up areas accounted for about 26%, 21% and 12% of land use and land cover respectively.

Year 2011:

Out of the total area of 394389 hectares, most of the land was dominated by vegetation (156437 hectares) accounting for 40% of total land cover. Waterbody, barren lands and built up areas accounted for about 18%, 19% and 23% of land use and land cover respectively.

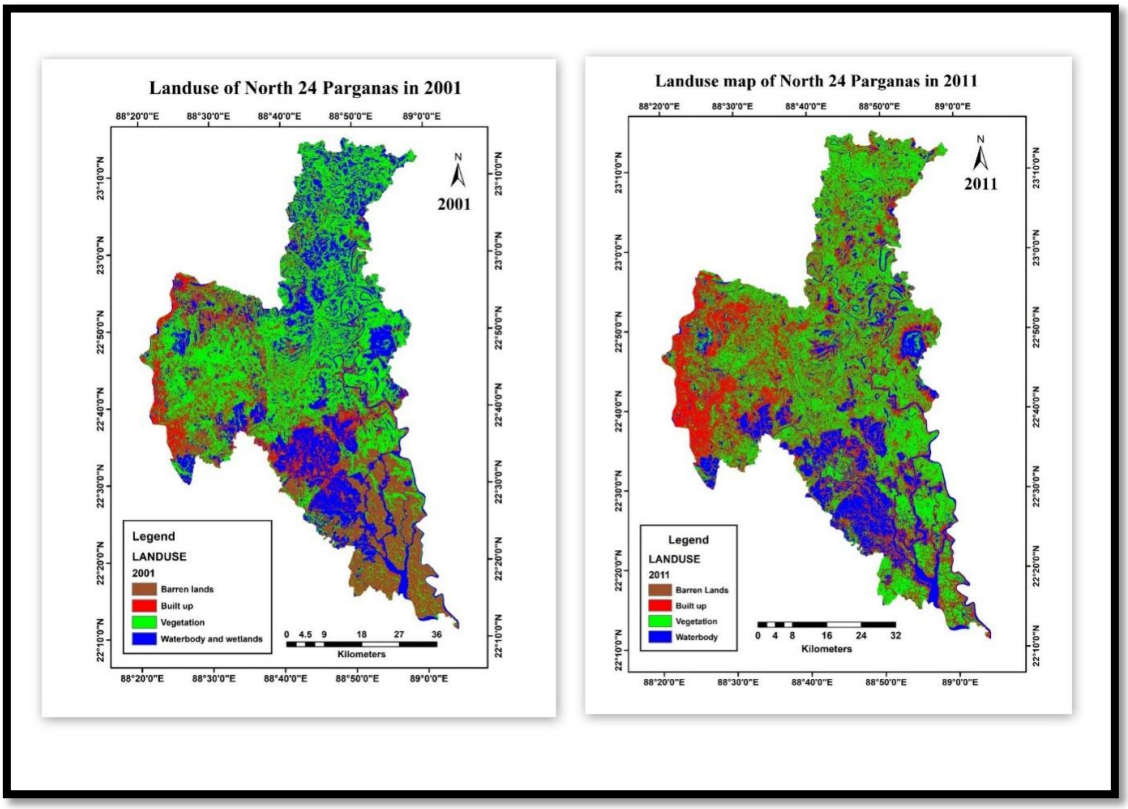

Figure10: Land use and Land cover of North 24 Parganas in 2001 and 2011

Temporal analysis of Landuse and land cover between 2001 and 2011:

Through the temporal analysis of land use and land cover maps, significant changes were noted between the years 2001 and 2011.

- **Barren Lands-** In 2001, out of the total area of 394389 hectares, barren lands occupied about 836861 hectares (21%). However, in 2011 it declined to 75984.4 hectares (19%) and thus registered a 2% decline. This was because large scale conversion of this barren lands into residential areas and agricultural areas for the purpose of fulfilling the residential and food demands of continuously rising population of the district.
- **Water body-** In 2001, out of the total area of 394389 hectares, water bodies occupied about 103972 hectares (26%). However, in 2011 it declined to 71033.8 hectares (18%) and thus registered a sharp decline of 8% over the decade. The reason attributed behind this is large scale conversion of waterbodies for agricultural purpose and construction of residential complexes.
- **Vegetation-**In 2001, out of the total area of 394389 hectares, vegetation occupied about 159514 hectares (41%). However, in 2011 it declined to 156437 hectares (40%) and thus registered a negligible 1% decline.
- **Built Up-** In 2001, out of the total area of 394389 hectares, built up occupied about 47222 hectares (12%). However, in 2011 it increased to become 90934.3 hectares (23%) and thus registered marked rise of 11% over the decade. This is mainly due to rise in the urban residential areas especially in the districts bordering the river Hugli and rise in rural settlements all across the district.

Hence, from the above discussions it can be seen that waterbody, vegetation and barren lands have exhibited a negative growth rate while built up areas have recorded a positive growth rate over the decade and thus clearly reflects the impact of human activities on land use and land cover of North 24 Parganas.

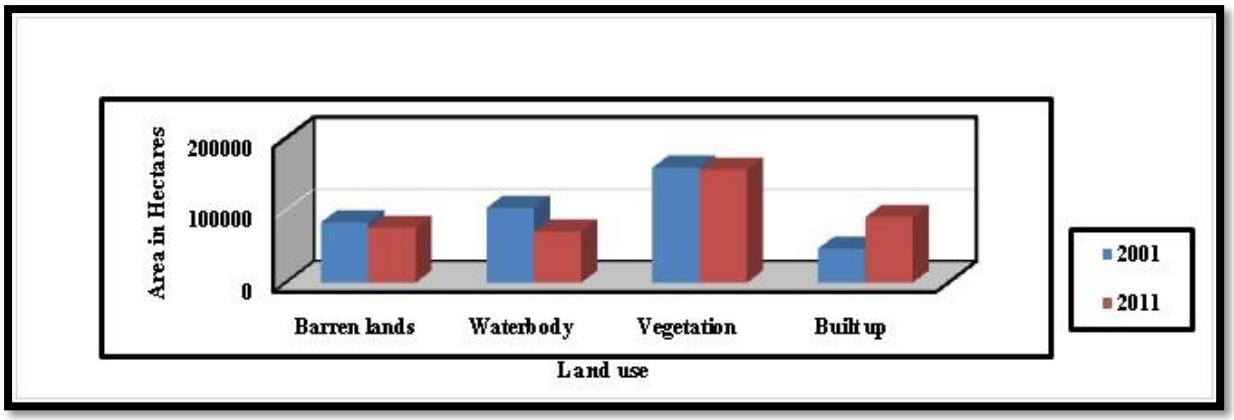

Figure11: Decadal Change of Land use and Land Cover of North 24 Parganas in 2001-2011

Relationship between population dynamics and Land use and Land Cover:

From the above discussions, it has become clear that the population of North 24 Parganas has undergone changes between the census year 2001 and 2011. This change of population has also brought about notable change in the land use and land cover of the study area (Basu & Saha, 2017). With increase in population there has been a decline in the areal extent of barren lands, water bodies where a large portion of these land were converted into agricultural lands and built up areas. Vegetation has shown a negligible decrease in time period from 41% in 2001 to 40% in 2011 and the decrease is mainly attributed to conversion of grasslands into agricultural lands or built up. On the other hand, certain portion of barren lands and water bodies which were converted for use of agriculture and built up purposes were left open and as a result grasses, shrubs and small to medium sized vegetation developed in those areas. However, built up areas have significantly shown a rise between the year 2001 and 2011 and can be stated as a manifestation of impact of population growth on land use and land cover (Mhawish & Saba, 2016).

IV. CONCLUSION

There is no doubt of the fact that land-use and land-cover undergoes rapid changes with change in population of the area. These changes are necessary to provide these increasing population with their needs and requirements. However, the nature often gets exploited when man tries to fulfil his continuous increasing needs without taking into account the harm it has been continuously doing to the environment. Changes should be

brought about in such a way that man can satisfy his needs without causing any harm to the environment. This can be achieved through proper planning and developmental strategies.

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