Temporal Changes in Urban Population in Maharashtra State Using GIS

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Abstract

Maharashtra is the third largest urbanized state in India after Tamil Nadu and Kerala. The growth in urban population rose by 23.7 per cent during the last decade. The trends of urbanization show that there has been a steady increase in urban population in Maharashtra State since the year 1901 and there has been a rapid increase during the last decade. This paper attempts to study the trends of urban population in districts of Maharashtra during the last century with the help of Geographical Information System (GIS). A study of the level of urbanization also gives an insight into the varying trends of population growth. An attempt is also made to study the trends in urban literacy and urban sex ratio in districts of Maharashtra state. The study of the patterns of male and female literacy and the resultant gender gap in literacy is also explored. It is alarming to note that child sex ratio has decreased in some districts.

This study would help in the planning and resource allocation in the districts which are lagging behind in these parameters of development. The use of GIS techniques applied to this study for mapping the distribution proved beneficial for representation of the data.

Keywords: GIS, Level of Urbanisation, trends in urban population

I. INTRODUCTION:

The forces and processes of technological developments, globalisation and population growth accelerates the dynamics of urbanization process in the developing countries.[1]India is also experiencing a rural to urban transition due to industrialisation and migration. Urbanisation in Maharashtra has also taken place by leaps and bounds. For the first time since independence the absolute increase in the urban population in Maharashtra is more than the rural population.

The level of urbanization rose from 27.81% in 2001 to 31.16% in 2011. The number of urban units in India has increased by 2774 during the last decade [2].

The growth in urban population rose by 23 per cent during the last decade. The urban population in Maharashtra State has increased fourfold since the year 1961 from 1.2 million to 40 million .With an urban population of 45.23 per cent, Maharashtra is the third most urbanized among major Indian states - behind Tamil Nadu (48.45%) and Kerala (47.72%).It was the second most urbanized in 2001, however, in the Census of India-2011, it is slipped to number three. Within Maharashtra in terms of urbanization, Mumbai is followed by Thane, Nagpur and Pune District. As per the 2011 provisional census data of Maharashtra, there are 11.23 cores people of which 6.15 cores are in rural and 5.08 cores are in urban areas.[3]

Maharashtra has the higher number of people living in the urban areas. In terms of percentages, 45.23 percent population is urban as against 31.16 per cent at the national level. The growth of urban population for Maharashtra from 2001- 2011 show the urban population has grown by 23.63% in comparison with the rural population 10.34%. The respective figures at national level are 31.8 per cent and 12.2 per cent. During 2001-11, about 1.5 crore population is added to the State; of this 97 lakh is only in urban centres and the remaining 57 lakh is in villages. In terms of percentages 62.8 percent of population added during 2001-11 is in urban area only whereas this figure at the national level is 50.1 per cent.

This paper attempts to study the variations of urban population in the different districts of Maharashtra state during the last decade. This paper tries to analyse the trends in sex ratio and child sex ratio in the districts of Maharashtra .The study of the literacy patterns in the urban areas of the districts is also included. Population studies dealing with gender gap in literacy indicates the variations in literacy patterns between the sexes. This study also includes the gender gap in the literacy patterns within the urban areas in the districts.

A brief historical preview into the process of urbanization in Maharashtra will show that there were different phases in this process. Three phases of urbanization can be identified. Firstly the political processes

that led to fortified towns during the medieval period. Secondly due to colonialism several towns developed due to urban transport. The large towns of Mumbai developed with port facilities. Urban primacy set in during this time. After independence the national policy of promoting economic growth by rapid industrialization led to further urban development. Finally the impact of the global forces after the liberalization in the nineties led to the new developments in cities and dispersal of economic activities. The three largest towns in the state of Maharashtra are Mumbai, Pune and Nagpur. These account for more than 50 % of the urban population of Maharashtra. The level of urbanization of the stat in 1901 showed than only 16 .5 per cent of the population lived in the towns in 1901 and by 1991, 30.5% of the population was urban.

HYPOTHESIS
The study hypothesis that (1) Male literacy remained same for 2001 and 2011; and (2) the child sex ratio is not the same as overall sex ratio for the districts of 2001 and 2011.

II. AIM AND OBJECTIVES

The aim of the study is to analyze temporal changes in urban population in Maharashtra State using GIS. In order to fulfill this aim the objectives are:
1.   to analyze the sex ratio and the child sex ratio in the urban areas of Maharashtra state for 2001 and 2011;
2.   to find out the district wise spatial pattern of male and female literacy and the gender gap in literacy growth for 2001 and 2011;
3.   To understand the district-wise temporal change in level of urban population from 1901-1951, 1951-2001 and 2001-2011.
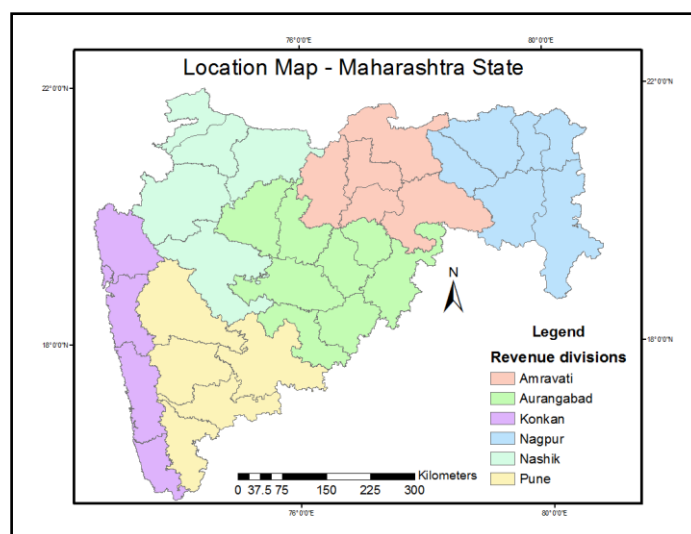

Fig.1 Location Map (source- Compiled by Authors)

Maharashtra extends from 15º 35´ north to 22º 2´ north latitude and 72º 40´ east to 80º 30´ east longitude. Six divisions in Maharashtra state and 34 districts are including in Maharashtra state. Maharashtra encompasses an area of 308,000km2, and is the third largest state in India. It is bordered by the states of Madhya Pradesh to the north, Chhattisgarh to the east, Andhra Pradesh to the southeast, Karnataka to the south, and Goa to the southwest. The state of Gujarat lies to the northwest, with the Union territory of Dadra and Nagar Haveli sandwiched in between. The Arabian Sea makes up Maharashtra's west coast.

The Maharashtra landscape includes the Deccan trap topography which has three major subdivisions namely the coastal section known as the Konkan, the plateau known as Desh and the Western Ghats or Sahyadris which separate the Konkan and Desh. The rivers of Maharashtra are divided into east flowing and west flowing rivers. The major east flowing rivers like Krishna and Godavari are separated by the mountain ranges. These valleys provide wide plains   which are suitable for agriculture. As a consequence the economic development, transport and settlements could have developed along the plateau region. However, Mumbai which was an important harbor was developed during the colonial past. Hence the pattern of urbanization was mainly oriented to Mumbai and the north western parts of the state.

DATA

The study was performed on the secondary data collected from different sources. The population data (non-spatial data) was collected from Census of India. The population data for the year 2011 provisional was obtained from the website of Census of India and the data for the previous years was taken from the compiled works of Demographic data. [4]

The Map of Maharashtra (spatial data) at the scale of 1:500000 are collected from the Maharashtra government press and were scanned and digitized and labeled.

III. METHODOLOGY

The entire study was categorized in two parts; firstly the   analysis on urban population data (non-spatial) level of urbanization, urban literacy rate and urban sex ratio and secondly mapping the output of those analyses, interpretation and applying GIS techniques.

The study of level of urbanization was done using the formula [5]

Level of Urbanization = Urban Population/ Total Population*100

The level of urbanization was calculated for 100 years. This data was summarized to be represented in the maps. The rate of change of the population was calculated for fifty years for last century i.e. 1901-1951, 1951-2001 and then for a decadal basis i.e. 2001-2011. This was calculated with the formula:

Rate of change of population (%) = $(P_1 - P_0 / P_0)$ *100

Where, P_1 = Population of the next year;

P_0 = Population of the previous year.

The sex ratio, literacy and level of urban population were classified by Mean ± Standard deviation and maps were prepared for the last decade (2001-2011). Decadal variation in per cent was calculated. Statistical tests were performed to study the trends of literacy and sex ratio. Spatial query analysis was performed to retrieve data for different time periods.

The overall sex ratio and child sex ratio were overlaid on each other to understand the spatial distribution of these two parameters and it significantly helped to know the hot spots of the high child sex ratio when compared to overall sex ratio. Similarly, sex ratio and literacy rate were also overlaid on the map to understand the correlative impact on urban population in the State.

Since the urban population of Mumbai was 100 per cent since the last century it was the only outlier in the data analysis. Hence for the parameters the maps which were prepared did not include Mumbai.

IV. RESULTS AND DISCUSSIONS:

The State of Maharashtra is an agrarian state which has undergone several changes in economic development with time. The Mumbai has become the major port and economic centre after independence which influenced other districts for development in the proximity. The development projects and 5 year plans of the central government of India enhanced the industrial sector and that also triggered the urbanization in the small pockets of the State. The source of mining led the basis of development in Vidarbha region of the State. To study these temporal changes was understood using the level of urban population.

The T test with paired two samples for means was done for male literacy rate 2001 and male literacy 2011. The P value (T <= t) with two tail test was 0.0018 and T critical value was 2.034. Pearson correlation was 0.162 The inference for this was tested Ho: Percent Literacy in 2011 is the same as % Literacy in 2001. Ha: Percent Literacy in 2011 is not the same as percent Literacy in 2001. Hypothesis test is conducted at 5% significance (alpha=0.05). P value of two tailed hypothesis is 0.0018 which is lower than the significance level of the test. Also t (observed) > t (critical). Hence there is an enough evidence to reject the null hypothesis. Hence Ha is accepted at 5% significance. Male literacy rate in 2011 is not the same as in 2001. A declining in male literacy was recorded.

The paired two samples for means T test was conducted for sex ratio and child sex ratio 2011. The inference for this was test Ho: Child sex-ratio is the same as Adult sex-ratio. Ha: Child sex-ratio is not the same as adult sex-ratio. t test for a two tailed hypothesis at 5% significance (alpha = 0.05). P value is very low; close to 0.000 i.e. Smaller than the significance level of 5%. Also t (observed) > t (critical). There is enough evidence to reject the Ho. Inference: child sex-ration in the state is not the same as the adult sex-ratio.

The level of urbanization is an index of which shows the change of an economic from a traditional to modern one. The growth of secondary and tertiary sectors boost economic development. Due to the rapid pace of economic development the state has witnessed a rapid growth in the level of urbanization during the last century [6]. The maps which show the decadal variation in Maharashtra bring about the following results.
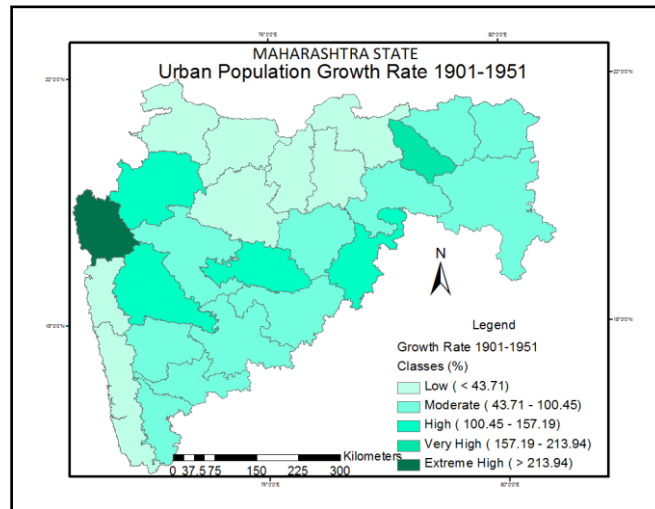
Fig. 2 Urban Population Growth Rate 1901-1951. (Source- Compiled by authors)

1901 – 1951

The district of Thane has extremely high growth rate of urbanization due to the industrial belt at Thane and Kalyan. High growth rate of urbanization in Pune, Nashik and other parts of Maharashtra is observed due to rapid industrialization which took place. The growth of Mumbai Pune industrial belt has increase the rate of urbanization in these areas.
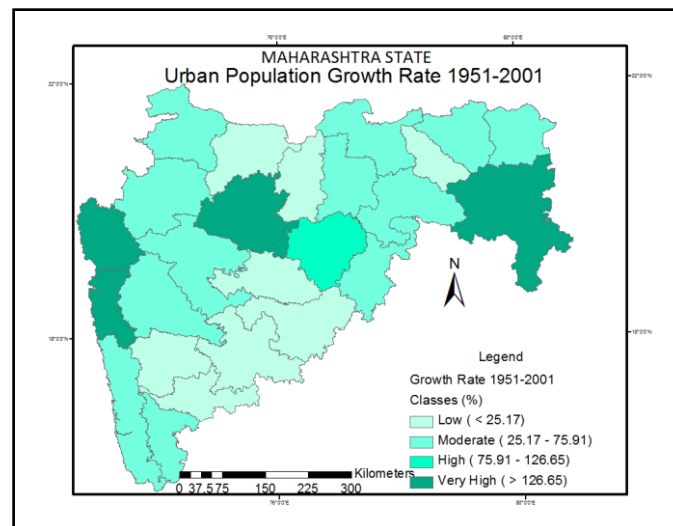

Fig. 3 Urban Population Growth Rate 1951-2001. (Source-Compiled by authors)

1951 – 2001

The districts of Thane and Raigarh become rapidly urbanized in these fifty years. This is also due to impact of highest urbanization in Greater Mumbai and Mumbai suburban. Chandrapur in Eastern Maharashtra and Aurangabad in Marathawada also exhibit higher rates of urban growth.
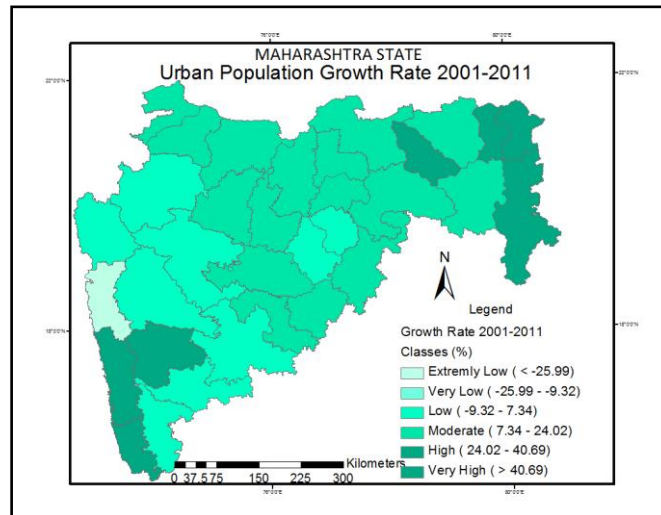
Fig.4 Urban Population Growth Rate 2001-2011. (Source-Compiled by authors)

2001 – 2011

Very high rates of urbanization can be observed in Ratnagiri, Sindhudurg and Satara districts. This is also found in Wardha and Gondiya as well as Gadchiroli districts of Vidarbha region (figure 4). These districts have recently shown higher rate of growth of urban population. Western Maharashtra, Vidharbha and Marathwada are not rapidly urbanized in the last decade as in the previous year when rapid urbanization took place in these areas.

Hence an overall pattern shows that some district of Konkan and Vidharbha are experiencing rapid trends in last decade.

Some social indicators were also considered to understand the nature of the urban population. These were sex ratio and literacy rates. These parameters represent social structure of in the population within that area.
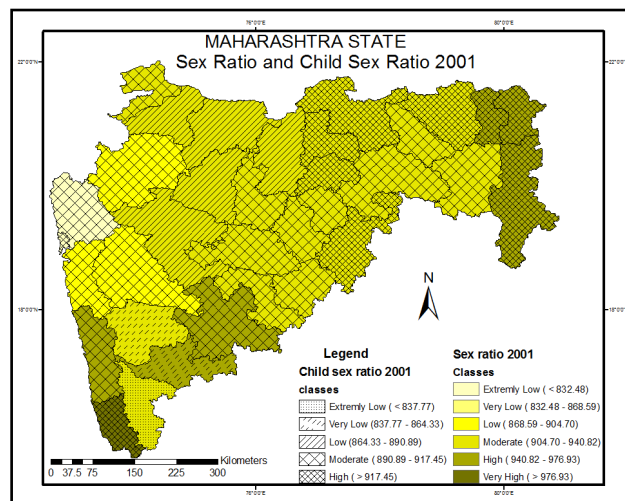

Fig. 5 Sex Ratio and Child Sex Ratio 2001. (Source- Compiled by authors)

The sex ratio for the year 2001 conforms to the previous pattern that reflects the fact that the large metropolitan cities have large number of age specific male migrants. This has an impact on the sex ratio of the districts of Mumbai and Thane which have the maximum male migrants in the state. Hence the sex ratio of Mumbai and Thane are low to moderate.

Conversely the high sex ratio is found in the districts of Sindhudurg and Ratnagiri in the Konkan regions is due to the large number of male migrants' .Gondia and Gadchiroli, which are comparatively tribal and less developed districts also exhibit very high sex ratio due to the male migrants to Nagpur and nearby towns. The districts in south Konkan and eastern Maharashtra also exhibit high child sex ratio. The other districts which are in the range of low to moderate sex ratio also have low to moderate sex ratio in adults. The districts of Satara and Sangli show very low child sex ratio although the adult sex ratio is high and very high.
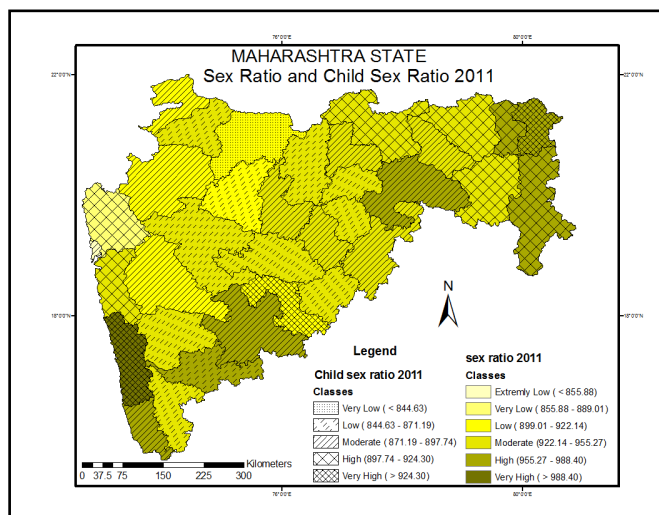
Fig.6 Sex Ratio and Child Sex Ratio 2011. (Source- Compiled by authors)

In the next decade the districts in south Konkan and eastern Maharashtra have shown a similar trend to that of the earlier decade. However many districts have much lower child sex ratio than the earlier decade. This is an alarming fact considering these entire districts have moderate sex ratio. The declining sex ratio of the districts of Kolhapur, Dhule and almost all the district of Marathwada are a matter of serious concern since the issues like female infanticide are coming to the fore front.
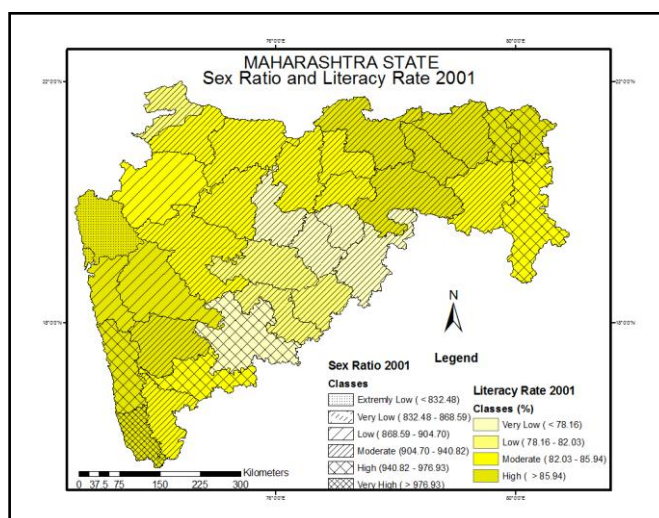

Fig. 7 Sex Ratio and Literacy Rate 2001. (Source- Compiled by authors)

The spatial pattern of literacy and sex ratio show a great degree of similarity. The overall pattern of sex ratio when compared with the literacy in the year 2001 show that there most of the districts having moderate to high literacy rate also have fairly high and very high sex ratio (figure 7). There are only few districts which have very low literacy, but the sex ratio is moderate to high. These districts include Jalna, Hingoli, Parbhani and Nanded from Marathwad and Solapur. Most of these districts have higher percentage of rural population. There are large numbers of male migrants to the metropolitan areas which provide employment due to industrialization d hence the sex ratio is extremely low even though the literacy rates are high.
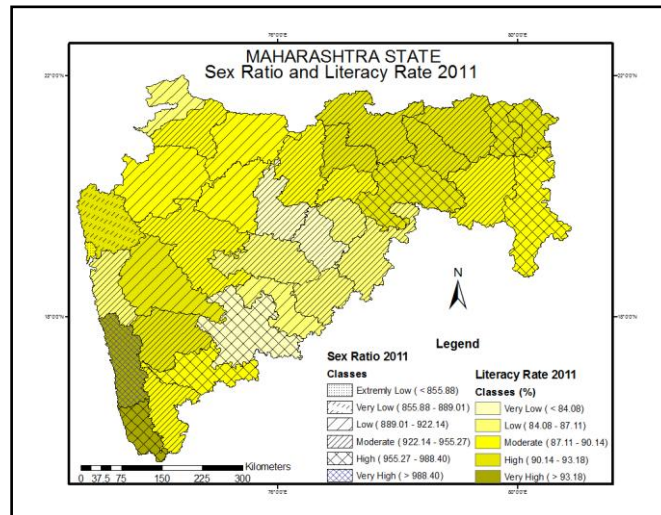
Fig. 8 Sex Ratio and Literacy Rate 2011. (Source- Compiled by authors)

There are some changes in the trends of sex ratio when compared to the literacy rates 2011 (Figure 8). The districts of Solapur, and Jalna and Parbhani have low literacy rates. The sex ratio has is moderate to high for all the districts. The same trend continues for the districts of Mumbai and Thane in 2011. Very high literacy as well as sex ratio can be seen in Ratnagiri and Sindhudurg districts
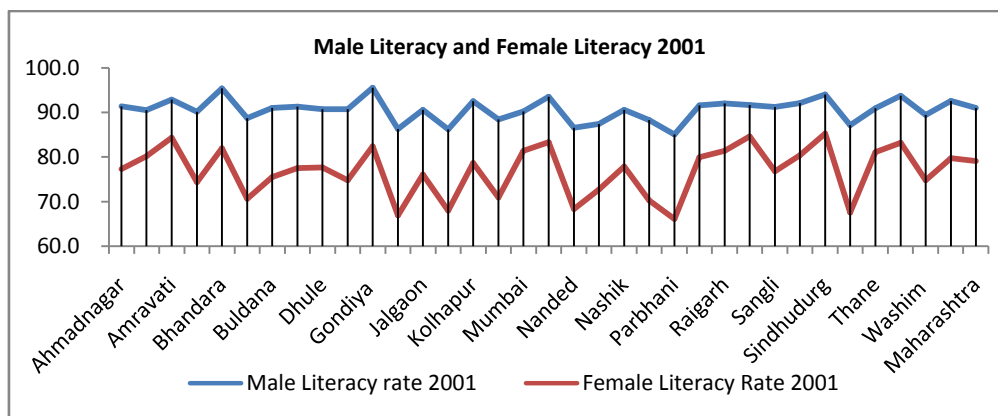

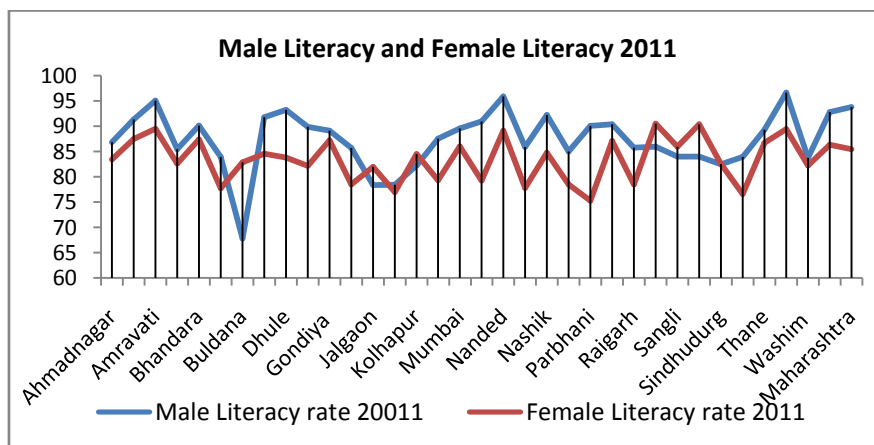**Fig. 9** Male and Female Literacy 2001. . (Source- Compiled by authors)

Fig.10 Male and Female Literacy 2011. (Source- Compiled by authors)

The gender gap in literacy pattern from 2001 and 2011 clearly shows a rise in the female literacy. The male literacy was about 20 per cent higher than the female literacy in all the districts of Maharashtra. However by the next decade this gap has been reduced to a great extent. The initiatives taken by the government to increase the female literacy by providing free education to girls is reflected in the rise of female literacy by the

end of the decade. Some districts like Ratnagiri, Sindhudurg, Buldhana and Kolhapur have experienced a rise in the female literacy which has exceeded the percentage of male literacy. Hence the urban population in the start of Maharashtra has experienced a major change in the gender gap.
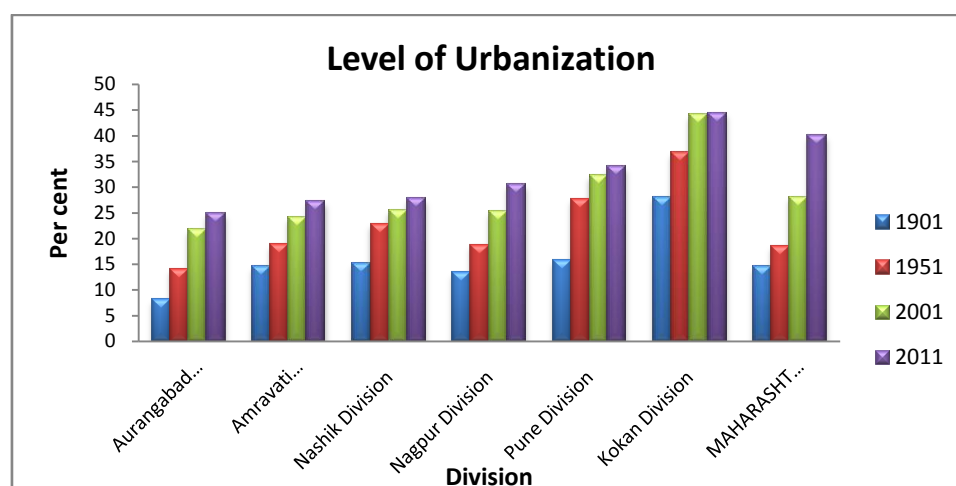

Fig. 11 Level of Urbanization (1901-2011). (Source- Compiled by authors)

The predominance of the Konkan division is clearly understood. These are followed by Pune and Nagpur. The other three divisions are almost at par.1951- 2001 are the years when maximum urbanization has taken place

V. GENERAL FINDINGS

Highest percentage of urban population (i.e., cent per cent) is found in two districts - Mumbai and Mumbai (suburban).
Other districts having highest percentage share of urban population are Thane (76.92 per cent), Nagpur (68.30 per cent) and Pune (60.89 per cent).
On the other hand, the highest percentage of population in rural area is found in Gadchiroli (89.00 per cent) followed by Sindhudurg (87.40 per cent) and Hingoli (84.83 per cent).
        It was seen in the past that the population is shifting from rural to urban due to various reasons. Growth rate of population in Maharashtra during 1991-2001 was 15.25 per cent in rural and 34.57 per cent in urban and collectively 22.73 per cent of growth rate was recorded for the State as whole. The same pattern is seen in provisional data of 2011 census, where the growth rate during 2001-2011 is 10.34 per cent for rural and 23.67 percent for urban and collectively 15.99 per cent over all. Sex-wise urban growth rate of population during 1991-01 was roughly the same for both males and females (34.7 and 34.4 respectively). But during 2001-11, the growth rate of females 25.58 percent is higher than for males (21.99 per cent).

VI. CONCLUSIONS

The major conclusions of this paper are:
1.   Male literacy has shown a slight fall from 2001 to 2011. This indicates the level of male literacy has not had any improvement. This is partly due to the type of jobs available in the large cities which are related to tertiary activities and the demand for highly qualified professionals and ordinary workers has increased.
2.   The sex ratio is low for the urbanized towns of   Mumbai and Thane where the majority of the migrants who constitute the growth of population include the male migrants. As a consequence, the sex ratio from where the migrants have moved out has extremely high sex   ratio.
3.   The child sex ratio has not increased to that extent as the adult sex ratio. these results are not very heartening due to the recent happenings in some districts.
4.   The level of urbanization has highlighted the main urbanized areas of Mumbai, Pune and Nagpur In the in the pre- independence era. The post independence era saw the new districts of Thane, Aurangabad and Raigarh emerging as the rapidly urbanized districts. The districts of Pune, Nagpur and Mumbai are fairly saturated. New development in the industrial sector in Raigarh district where MIDC is being developed have resulted in rapid urbanized. Due to IT sector Aurangabad has generated jobs which created condition for urbanization. In the last phase of urbanization in the decade of 2001 to 2011 the highly urbanized districts include Ratnagiri, Sindhudurg, Satara and Bhandara, Gondiya and Gadchiroli. The other districts in Maharashtra show a steady growth of urbanization with the development of large urban centers within the districts.

5.   A comparison of the sex ratio and the child sex ratio revealed the final results. The child sex ratio has changed compared to the sex ratio. The   reasons may highlight the recent irregularities in the cases of female infanticide.

6.   Sex ratio when compared with literacy shows uniformity in the increase of both. Only in a few interior districts it is high there are some areas where the literacy is low and the sex ratio is moderate. In Maharashtra the increase in the female literacy pattern has had an impact on the sex ratio of the districts.

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