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## **Projection of populations by age and sex for States in North East of India for 2011- 2031**

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### **Abstract**

So far the studies dealing with the population projection are at the national level and only a few studies have shown the size of the population in the future at state level. There are scanty studies in population projection for North Eastern states. The present projection is based on the Cohort component method. The two decades increase in population from 2011 to 2031 for Arunachal Pradesh is 24.8 %, Assam is 21.8 %, Manipur is 33.7%, Meghalaya is 31.8%, Mizoram 26.7%, Sikkim is 5.3% and Tripura is 14.7%. Findings in this paper will help the state government in formulating the policy to improve the overall socioeconomic development.

**Keywords:** Population projection, Cohort component method, Life expectancy, Total fertility rate.

### **Introduction**

Population projection is a scientific attempt to peep into the future population scenario, conditioned by making certain assumptions, using data relating to the past available at that point of time. Assumptions used and their probability of adhering in future, forms a critical input in this mathematical effort. Predicting the future course of human fertility and mortality is not easy, especially when looking beyond in time as medical and health intervention strategies, food production and its equitable availability, climatic variability, socio-cultural setting, politico economic conditions and a host of other factors influence population dynamics, making it difficult to predict the growth with certainty.

The population of any state in the country is a state of flux both in terms of its size and characteristics. The periodic census enumeration obtains data on the size and composition of the population at the time census was taken. But for many purposes, it is important to know the number and characteristics of the people at different dates between the two censuses. With the Government of India commitment to stabilizing the population of India by 2045 as stated in the National Population Policy (NPP) 2000, it is imperative to have an idea of the likely growth of the population in the state in future. At the same time, various development schemes targeting to improve the quality of life, require information on the number and proportion of persons in future in different age-groups, their rural-urban distribution etc. Surprisingly, unlike in the past, the need for the projected population is not only being felt by the official agencies alone, even private sector need age-sex wise projected population for better planning of their business.

### **Previous Projections**

Since 1971, various Expert Committees have been appointed by the Registrar General of India for population projection and for using the projected figures for various planning purposes. In 1971, the projected population was higher than the actual population, but in 1981, it was just the reverse. The projected population as estimated by the standing committee for that census was very close to actual population in 1991. For 2001 Census, there is a gap of around 14 million between the projected and actual population (Census of India, 2001, Provisional Population Totals).

The Technical Group on Population Projections constituted by the planning commission in 1996 based on the results of 1991 census had estimated probable year by which the replacement level fertility (Total Fertility Rate (TFR) of 2.1) will be achieved, if the recent pace of decline in TFR (observed during 1981-1993) continues in the future years. It was estimated that the country would achieve the replacement level fertility by the year 2026 (Report of the Technical Committee on Population constituted by Planning Commission 1996, RGI, India).

Some of the other Scholars and organization which contributed to projecting India's population are Natarajan and Jayachandran (2001), Srinivasan and Shastri (2001), Kulkarni (2001), Bhat (2004), Dyson et al. (2004), Datta and Mohanty(2005), Population Foundation of India(2007).

### Need of Study

So far the studies dealing with the population projection are at the national level and only a few studies have shown the size of the population in the future at state level. In most of the above mention studies of population projection, only the consolidated total population of the entire North Eastern states is projected. In some studies where individual North Eastern states population projection is done, the figures depicts only the total population characterize by sex. There are scanty studies on the state level population projections of North Eastern region and therefore, study like this will help the state government in formulating the policy for identifying the thrust areas to be emphasized to improve the overall socioeconomic development. On this background, the importance of this study is explained below.

The economic projection for the sectors such as labor force will appraise the likely magnitude of supply of labor, employment as well as unemployment trends. Similarly, the GDP per capita will enable us to understand the economic progress of the country. On education, the projection of school going children, requirement of new schools as well as other infrastructure helps us to make the educational planning of the country. Similarly the health requirement with respect to the requirements of health professionals enables us to formulate the health sector planning.

### Methodology

The methodology that will be adopted in the projection is the *Cohort component method*. The method makes specific assumptions (Table 1) about the future levels and patterns of fertility, mortality and migration and applies them with the age-sex structure of the base year population.

The mathematical expression of the Component Method is as follows (Pathak and Ram, 1998):

$${}_5P_{x+5}^{t+5} = ({}_5P_x^t) * {}_5S_x \quad \dots\dots\dots(1)$$

where 
$${}_5S_x = \frac{{}_5L_{x+5}}{{}_5L_x}, \quad x = 0, 5, 10 \dots\dots ] \dots\dots\dots(2)$$

${}_5P_x^t$  denote male/female population in age group  $x$  to  $x + 5$  at time  $t$

${}_5S_x^t$  denote 5-year survival probability

${}_5L_x^t$  is a life table function, denoting the number of persons in the age interval  $[x, x + 5]$

The 5-year survival probability is obtained using South Asian Model life table (1982) corresponding to projected levels of life expectancy at birth ( $e_0^0$ ) obtained by Khongji, 2017.

By using equation (1), population would be projected to the next five years for both sexes. It is to be noted that  $P_{80+}^{t+5}$  is estimated as

$$P_{80+}^{t+5} = ({}_5P_{75}^t) * {}_5S_{75} + ({}_5P_{80}^t) * {}_5S_{80}$$

In order to obtain 0-5 age population at the end of each projection period we have to estimate the number of births which would take place in each 5 years interval. As data on birth by age sex is in general not available in census, the total births during  $t$  to  $t + 5$  is obtained by using *age specific fertility rates* ( ${}_5f_x$ ) pertaining to period  $[t, t + 5]$  by the following formulation

$${}_5P_0^{t+5} = B = \frac{{}_5L_0}{2} \sum_{x=A}^{B-5} \left[ {}_5P_x^t + {}_5P_{x-5}^t * \frac{{}_5L_x}{{}_5L_{x-5}} \right] * {}_5f_x \dots\dots(3)$$

where  $x = A, A + 5, \dots, B - 5$  in which A and B are the lowest and highest limits of the reproductive period.

In the present study, respective state total Age specific fertility rates (ASFR) for the year 2011 is obtained and adjusted from the Compendium of India's Fertility and Mortality Indicators, 1971 – 2013 given by RGI. The ASFR for all the projection years is adjusted to match the total fertility rate, obtained in National Health and Family Survey (NFHS 2 & 3) and extrapolated using appropriate curve fitting for all the projection years.

The birth of male and female children can be obtained as

$$B^m = \left[ \frac{SRB}{1 + SRB} \right] * B \text{ and } B^f = \left[ \frac{1}{1 + SRB} \right] * B$$

where SRB is the sex ratio at birth which is obtained by extrapolating the SRB of 1971 through 2011 (Sex ratio, Census - 1901-2011) by appropriate curve fitting upto the end of the projection year 2031.

In order to project population for the successive 5 year period, the output of  ${}_5P_x^t$  will be the input data for  ${}_5P_x^{t+5}$  and the whole procedure is repeated till the end of the projecting year. This projection is done by residences (Urban/Rural) and gender for each of the North eastern States of the country (except for Nagaland where ( $e_0^0$ ) value is not available). It is also to be noted that state level  $e_0^0$ , TFR and SRB is utilized for the projection of both Urban and Rural Regions as these parameters are not available by type of residences in all the states under study.

Base Population in five year age-group by residence and sex obtained in 2011 census C-14 data is smoothed according to that followed by Census as done by Khongji (2013).

In the above mentioned projection, it is assumed that migration does not play significant role in the population growth.

### Findings and Discussions

The present population is based on latest available data from census of India and the National family health survey. The general population characteristic shown in all the states (Population Pyramids) is the bulging of middle age group with increasing number of projecting years. The two decades increase in population (Table 2) from 2011 to 2031 for Arunachal Pradesh is 24.8 %, Assam is 21.8 %, Manipur is 33.7%, Meghalaya is 31.8%, Mizoram 26.7%, Sikkim is 5.3% and Tripura is 14.7%.

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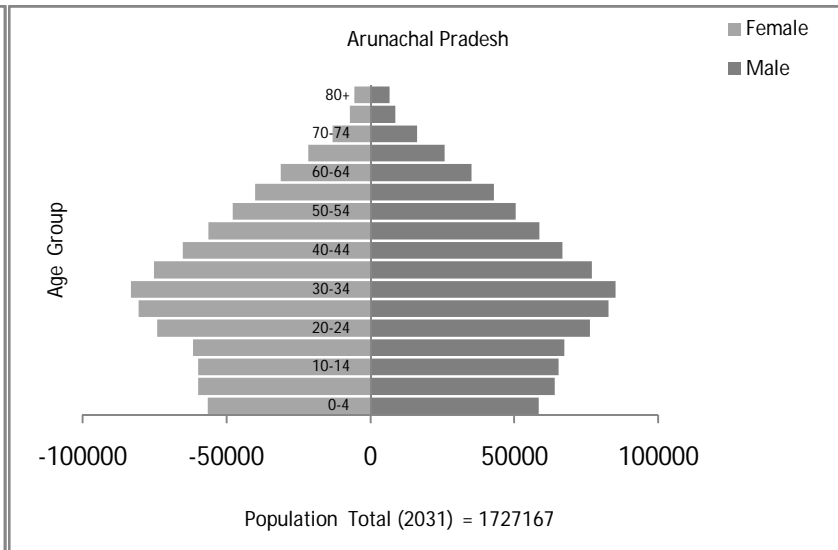
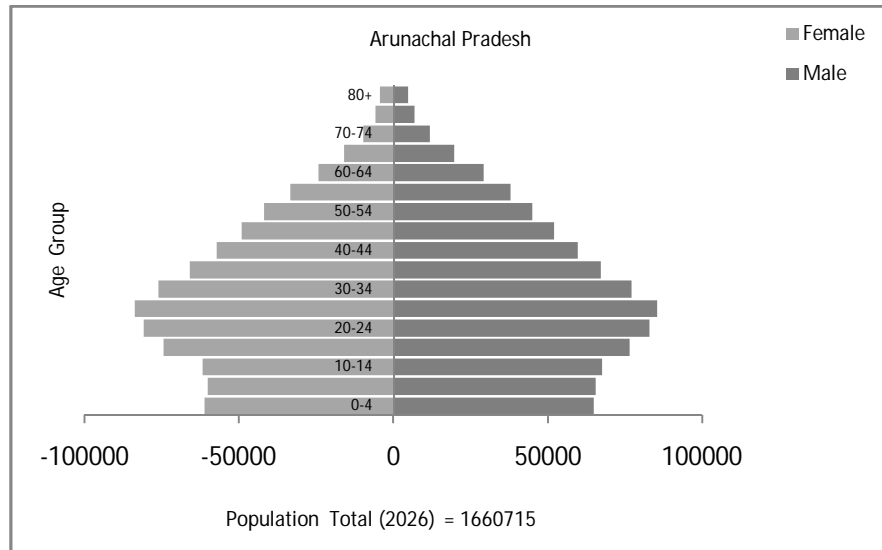
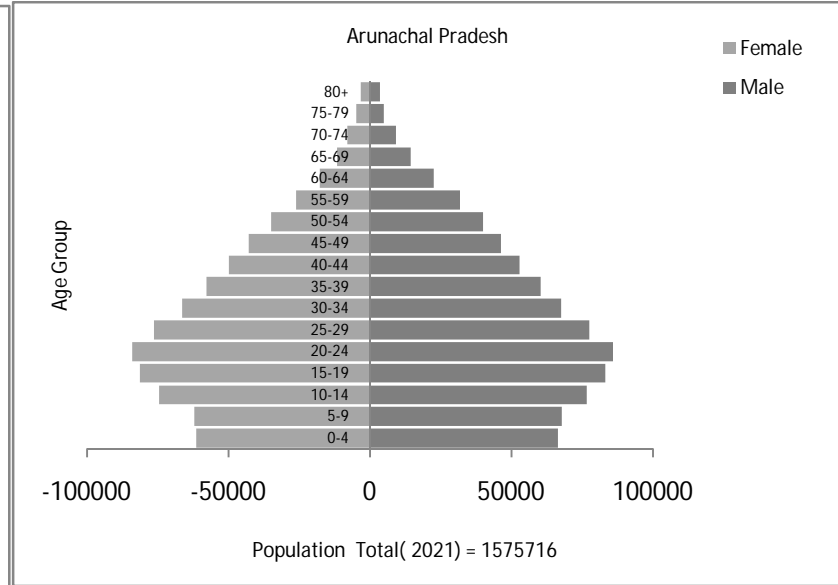
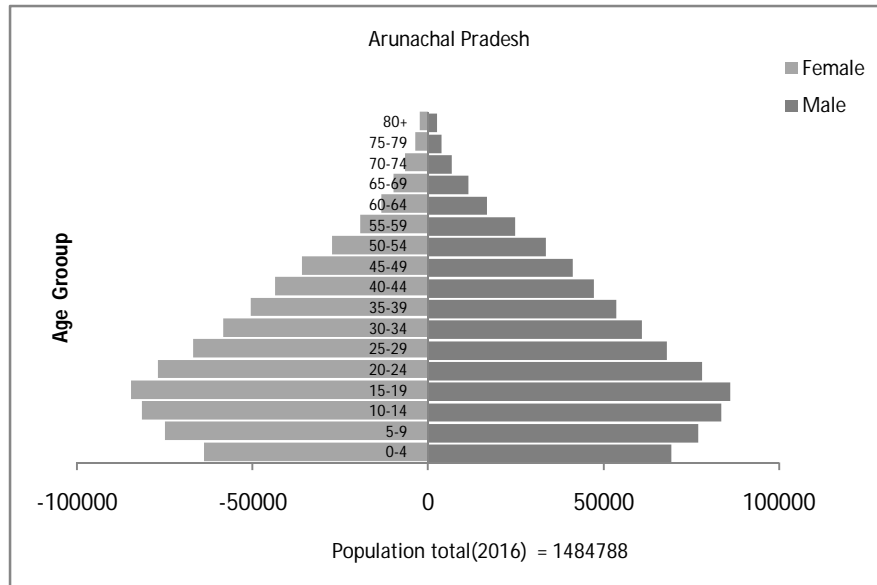
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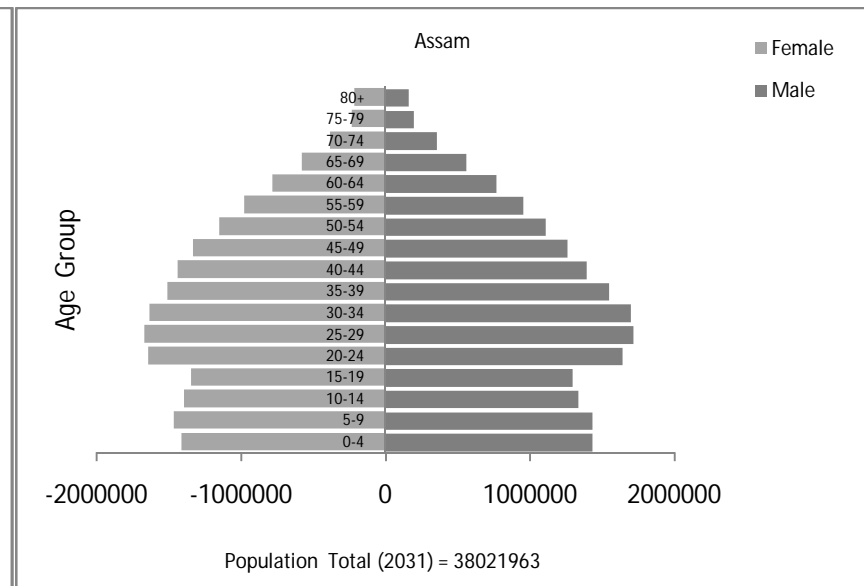
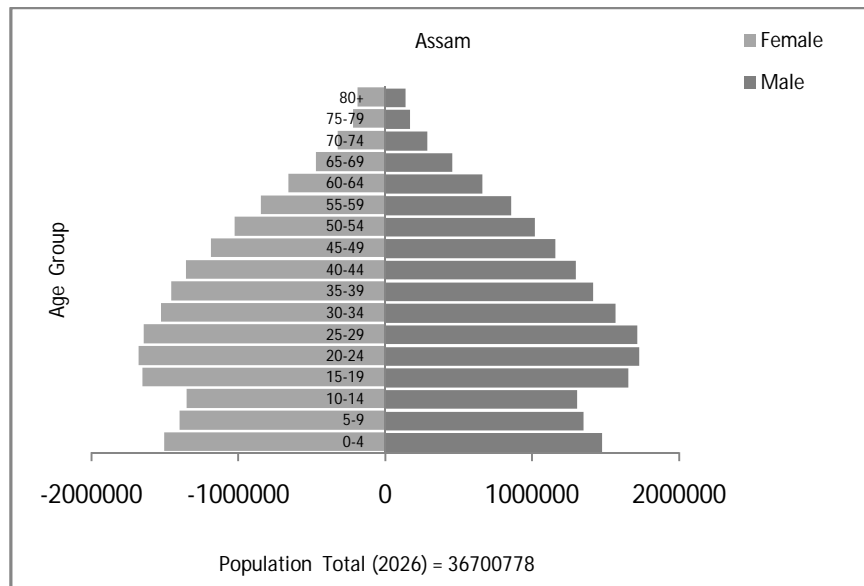
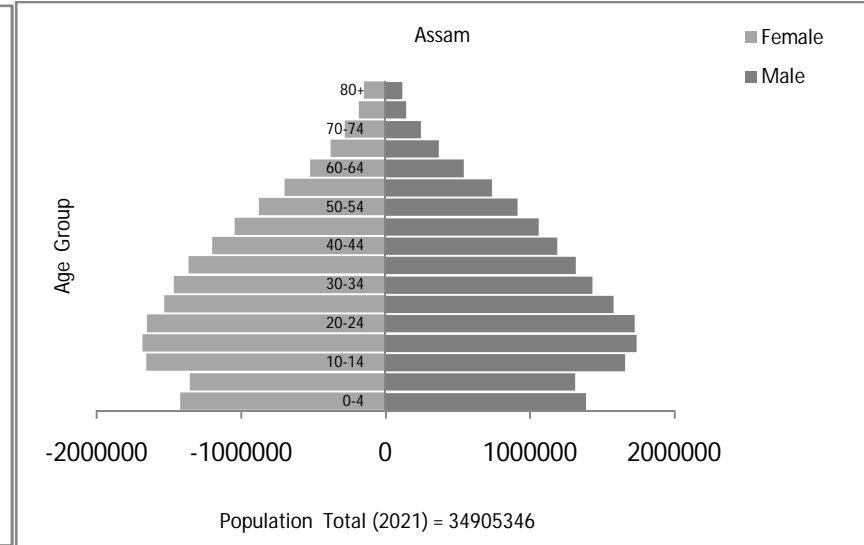
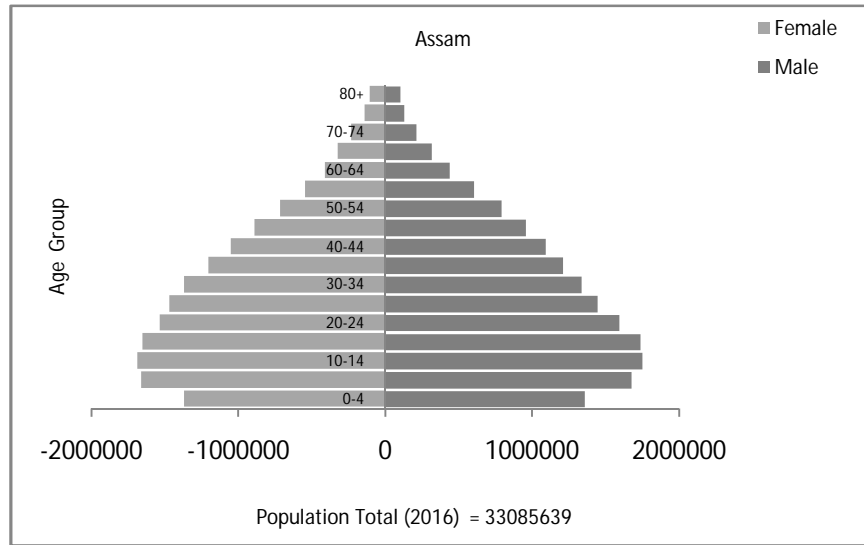
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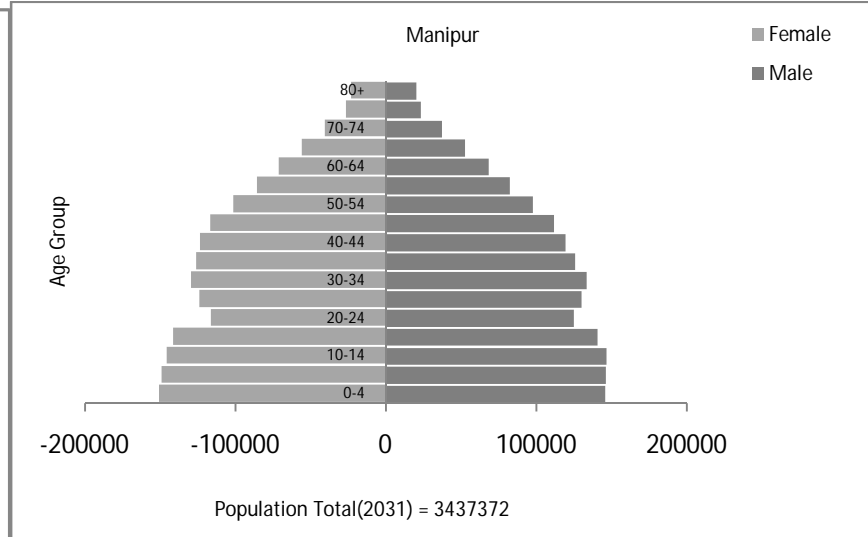
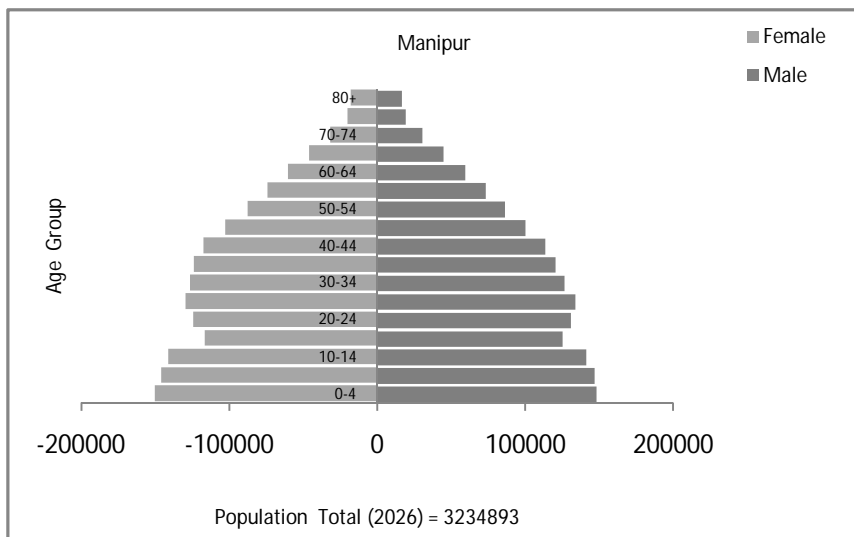
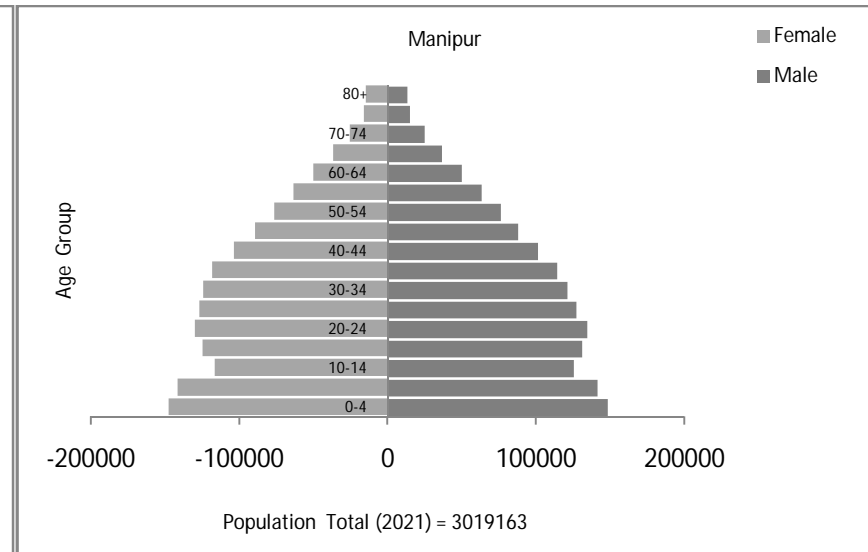
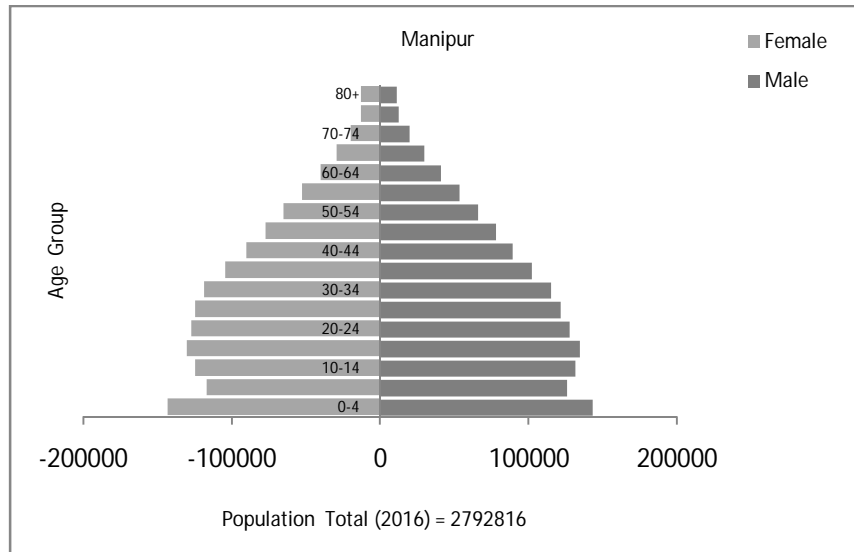
**Table 1: Projected Levels of Life expectancy at birth , Total Fertility Rates and Sex ratio: 2011-2031.**

Year	Total Fertility Rate	Sex ratio (F/M)*1000	Life expectancy at birth	
			Male	Female
<b>Arunachal Pradesh</b>				
2011	2.6	920	63.6	65.4
2016	2.1	940	65	65
2021	1.9	960	67.3	66
2026	1.7	980	67.5	67.5
2031	1.5	1001	68.2	69.5
<b>Assam</b>				
2011	2.3	954	60.4	62.1
2016	2.2	963	60.75	62.5
2021	2.1	973	61.1	62.9
2026	2.0	983	62	64
2031	1.9	993	63.5	65.6
<b>Manipur</b>				
2011	2.7	987	70	72.2
2016	2.6	1001	70.2	73
2021	2.53	1016	70.5	73.9
2026	2.49	1031	71	74.2
2031	2.46	1044	71.6	74.9
<b>Meghalaya</b>				
2011	3.4	986	58	61.9
2016	3.0	988	58.3	62
2021	2.5	994	58.5	62.3
2026	2.2	999	58.2	63.4
2031	1.9	1004	57.8	62.5
<b>Mizoram</b>				
2011	2.6	975	68.9	72.6
2016	2.3	990	70	73
2021	2.1	1015	71	74
2026	2.0	1050	72	76
2031	1.9	1085	73.5	77
<b>Sikkim</b>				
2011	1.55	889	64.4	69.7
2016	1.2	903	65	70
2021	1.0	915	65.1	70.5
2026	0.8	927	65	72
2031	0.7	942	64.9	72.8
<b>Tripura</b>				
2011	1.9	961	68.1	70.8
2016	1.7	965	69	72
2021	1.6	972	69.5	73.3
2026	1.48	980	68	75
2031	1.38	987	68.7	75.9

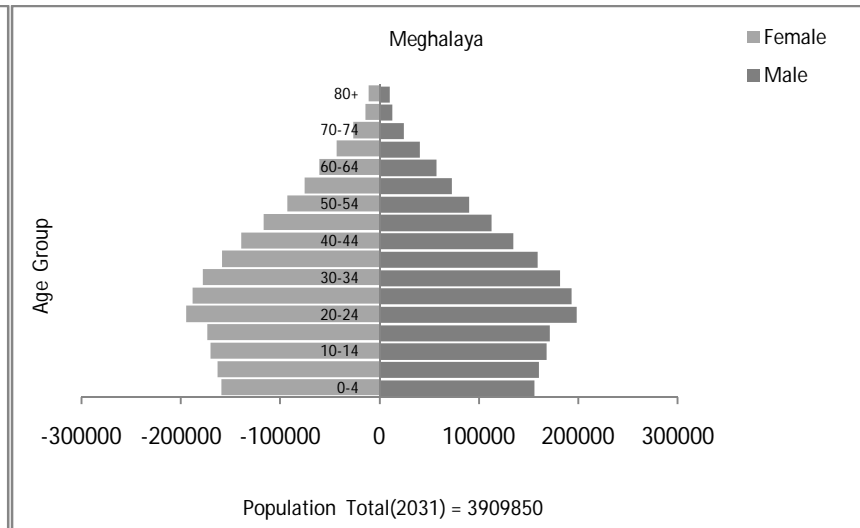
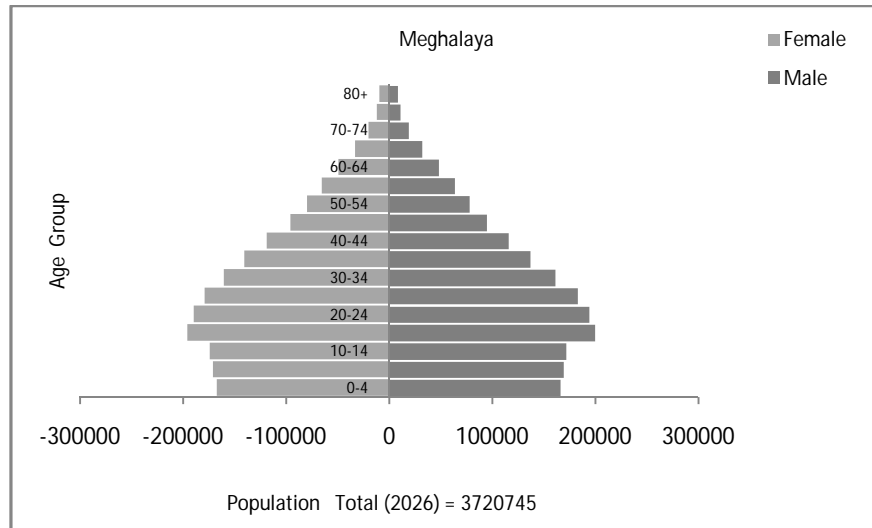
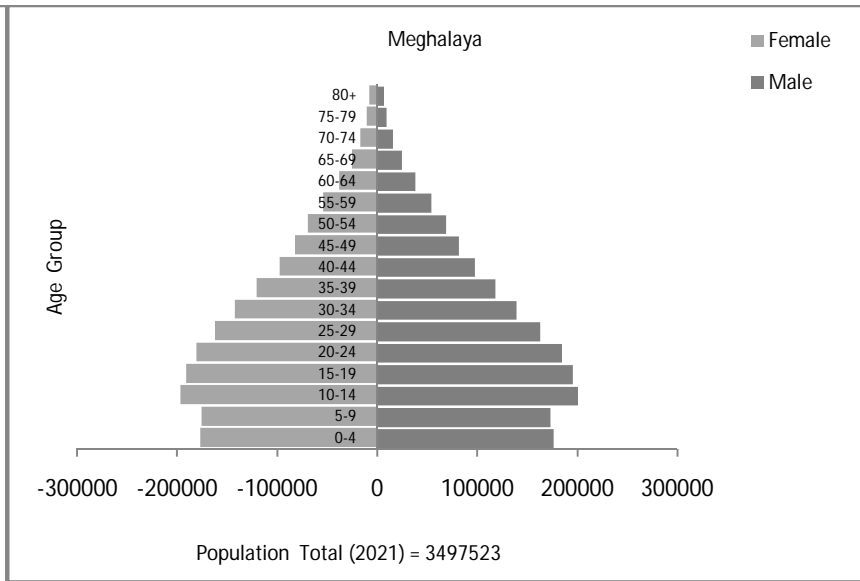
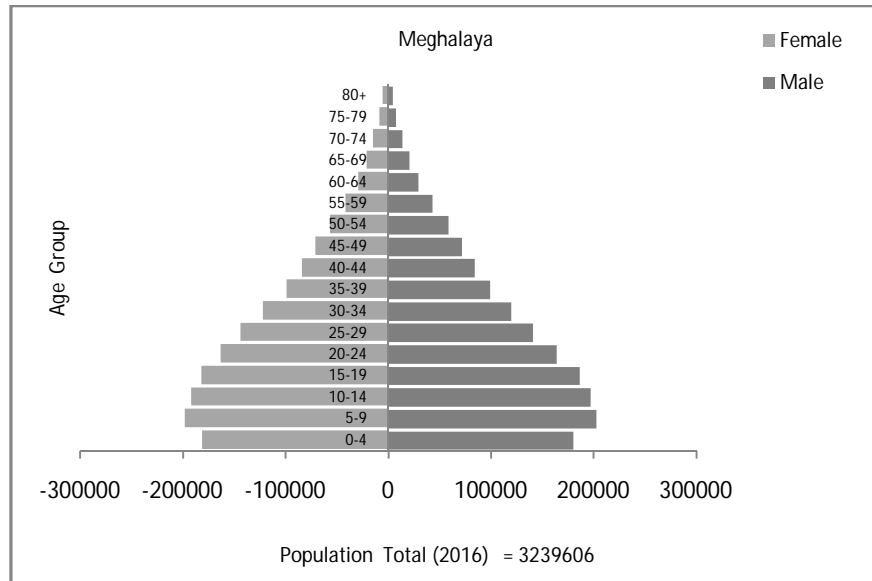
### POPULATION PYRAMIDS

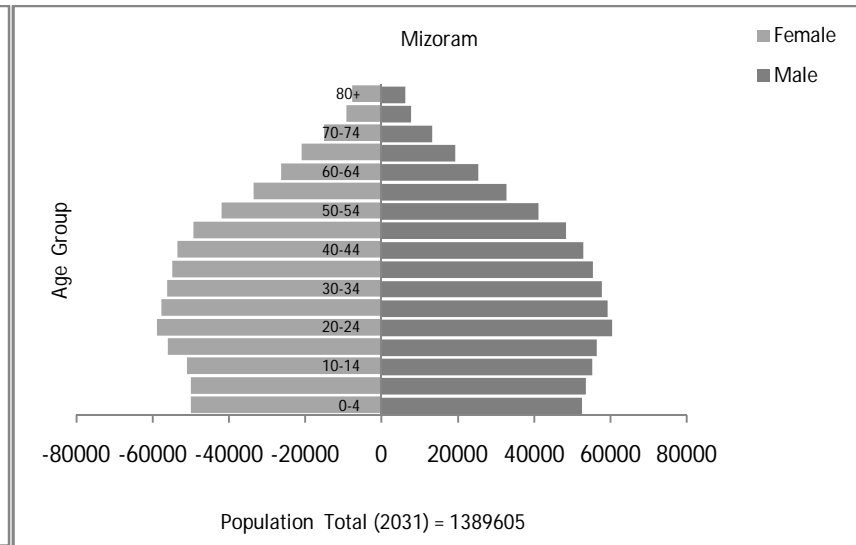
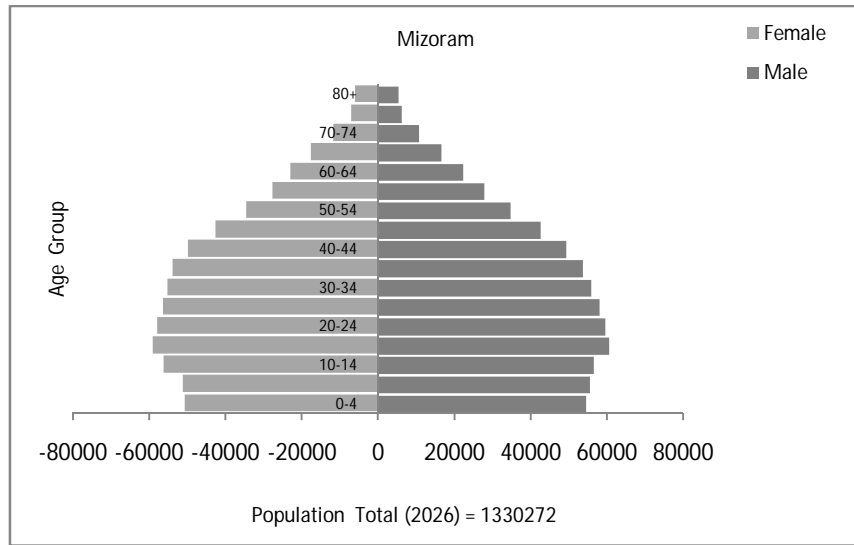
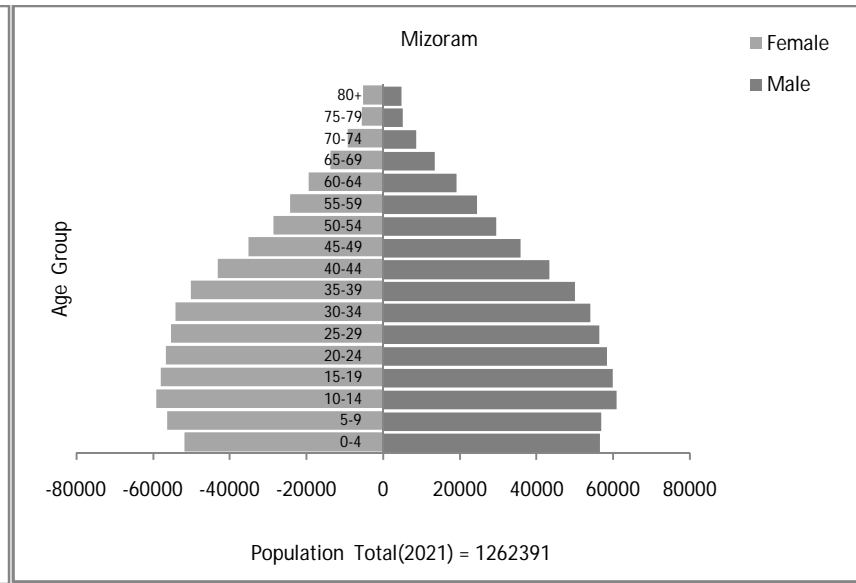
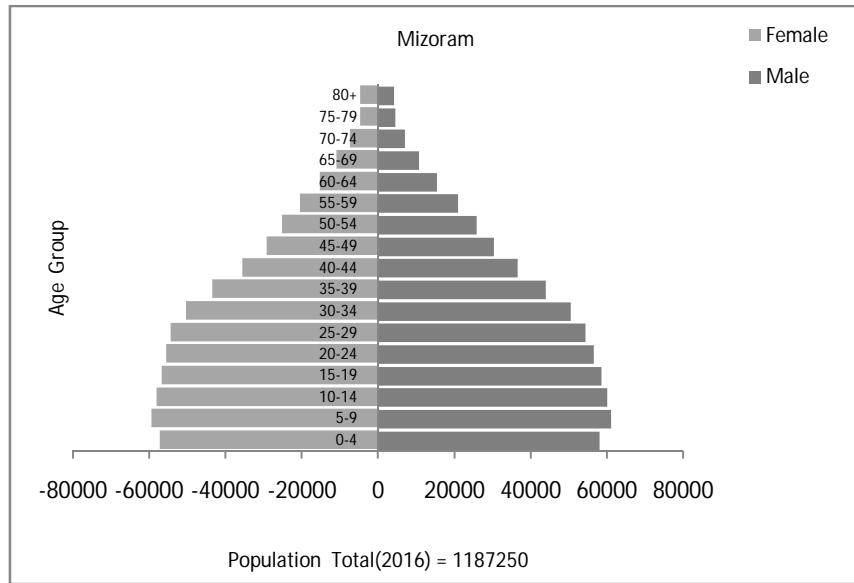


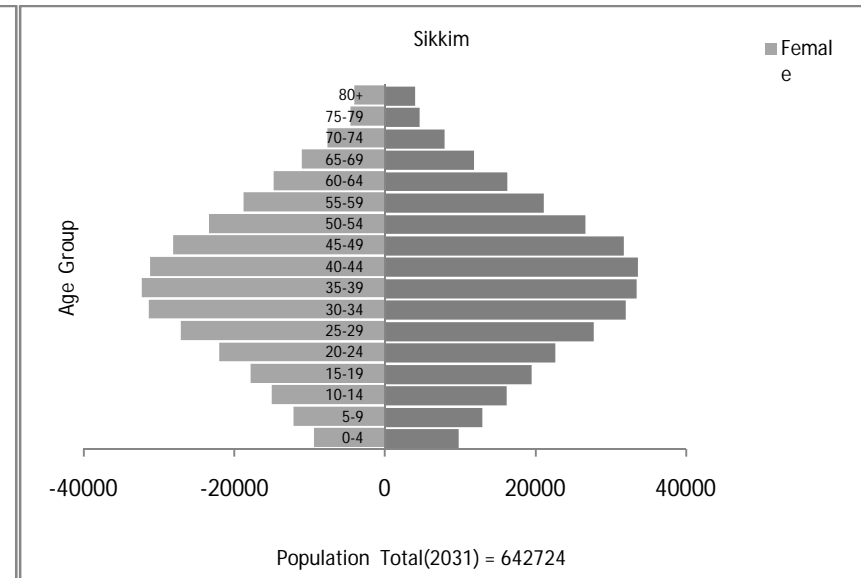
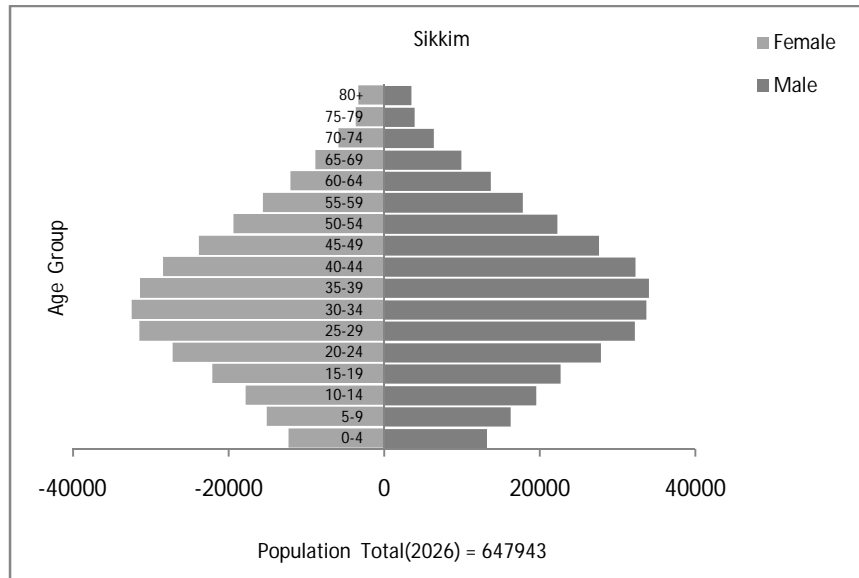
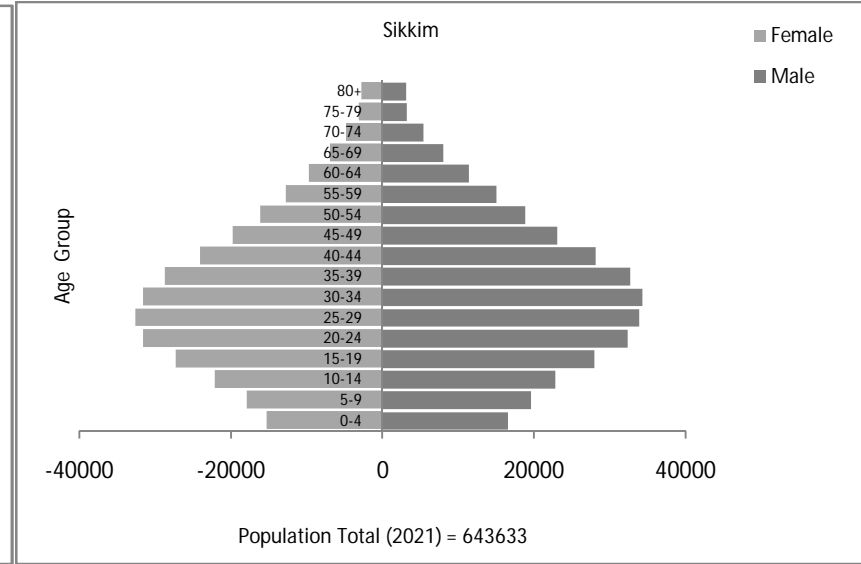
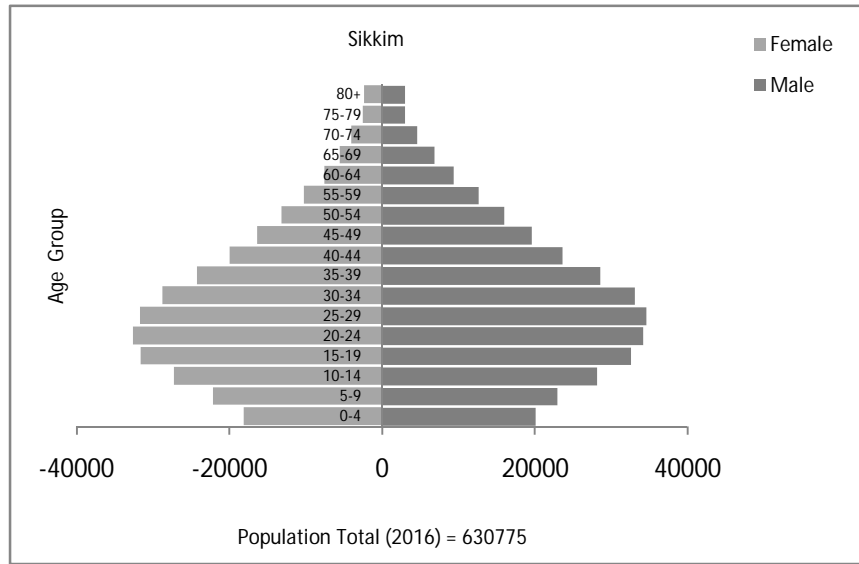


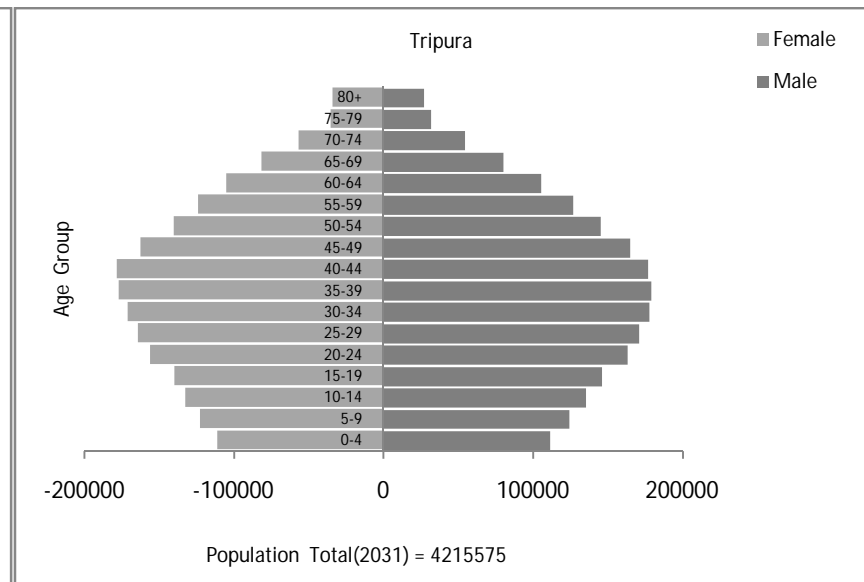
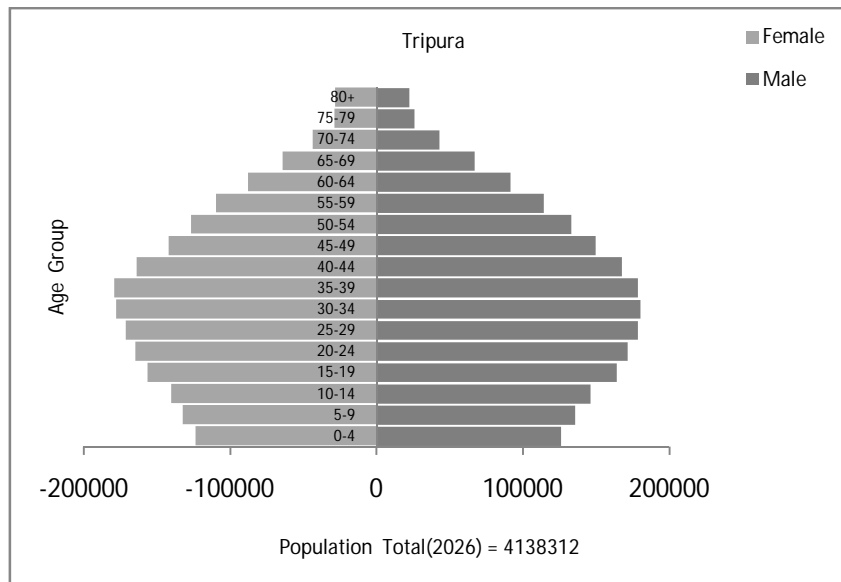
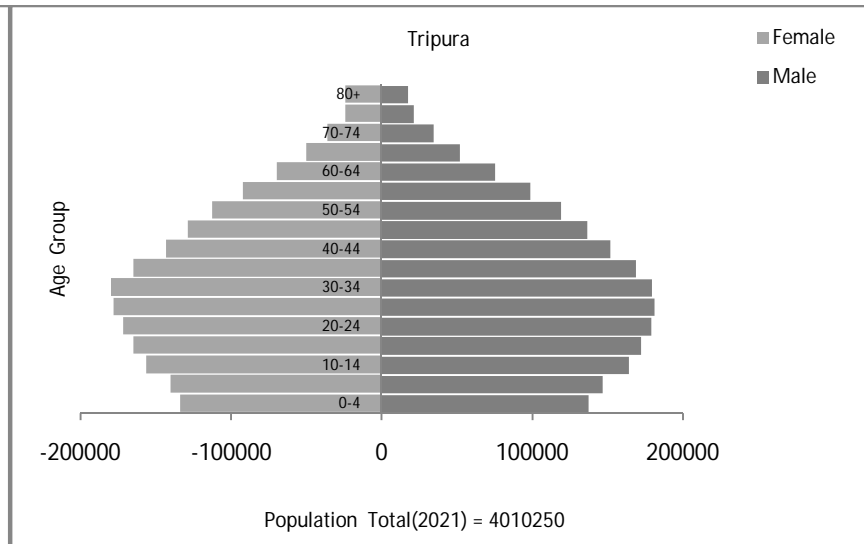
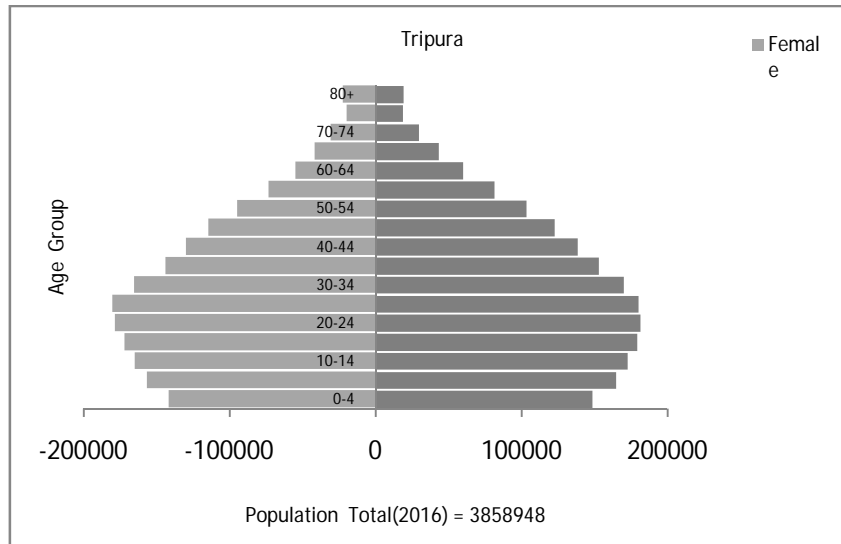


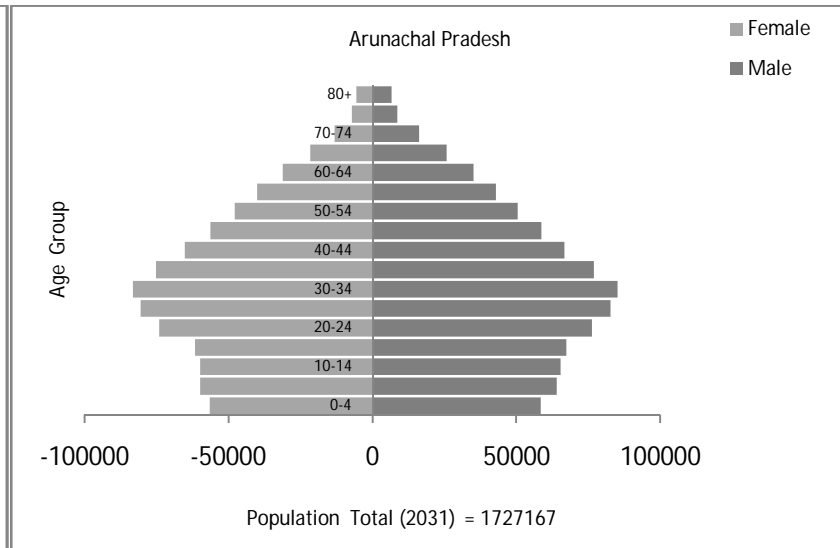
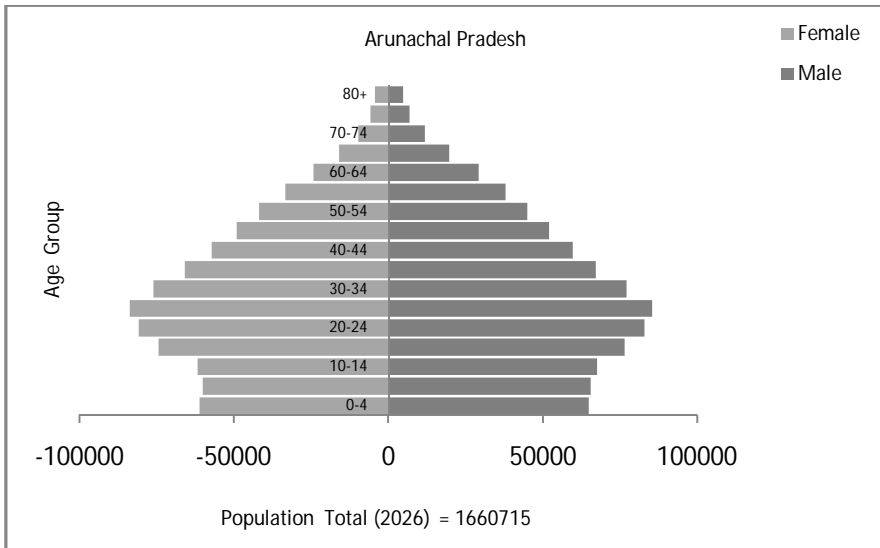
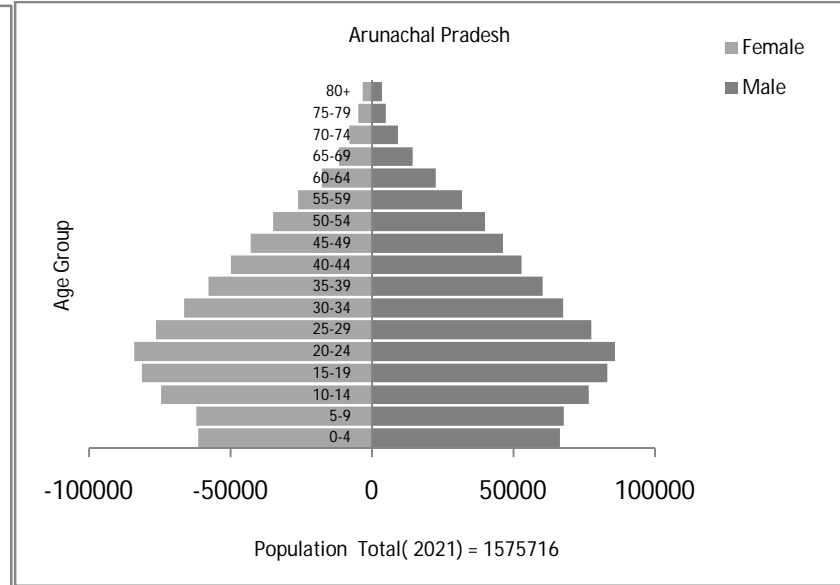
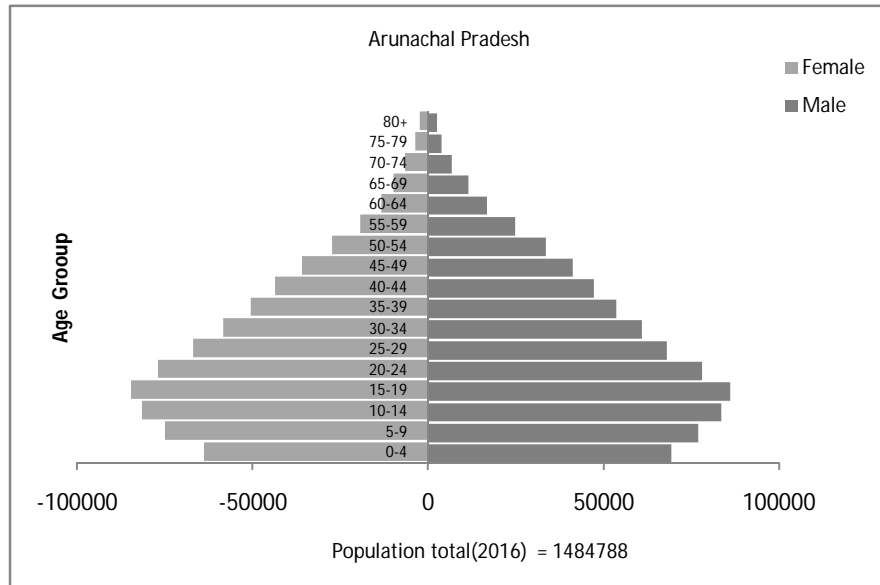


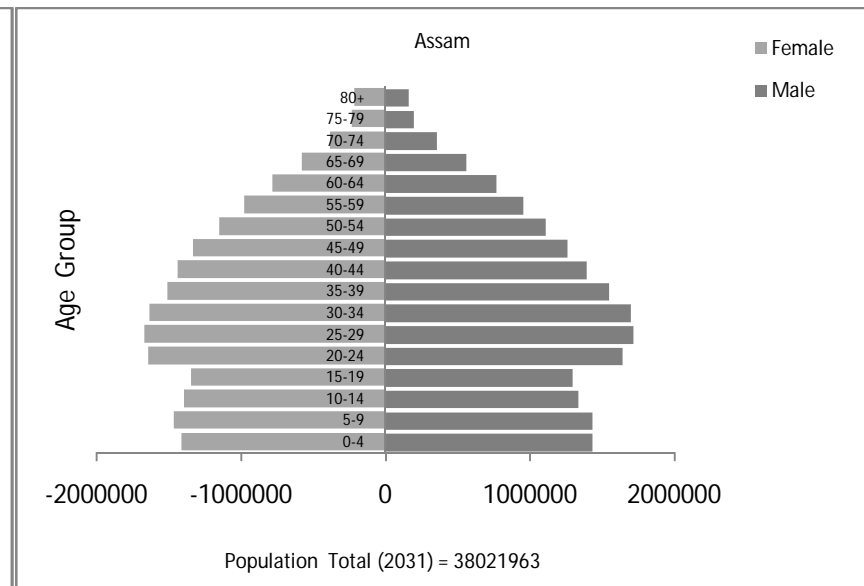
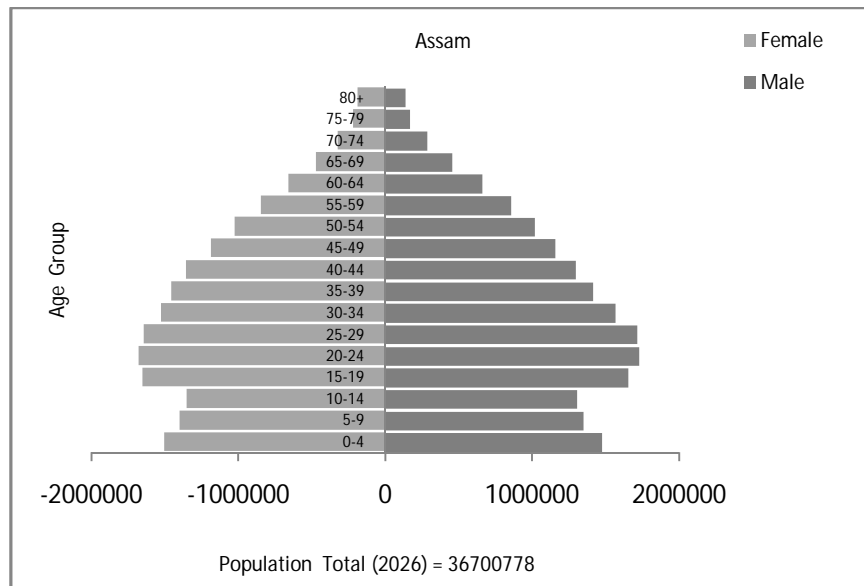
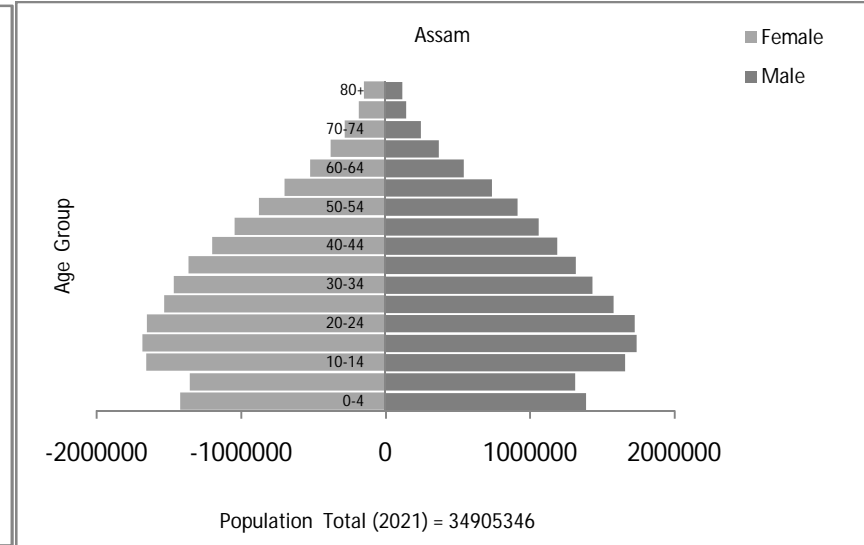
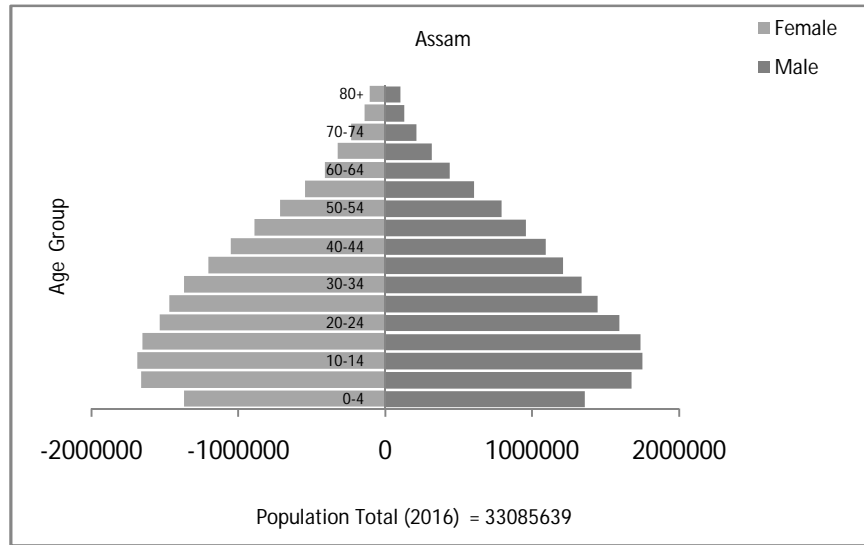


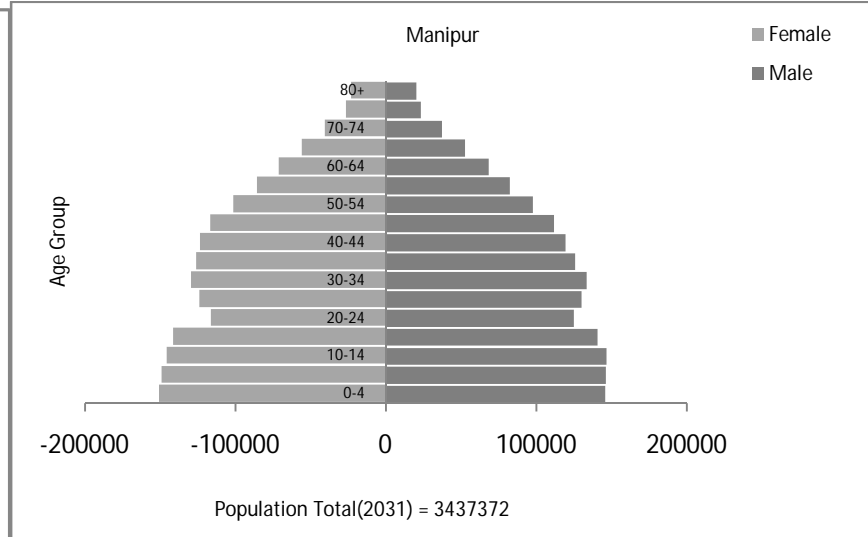
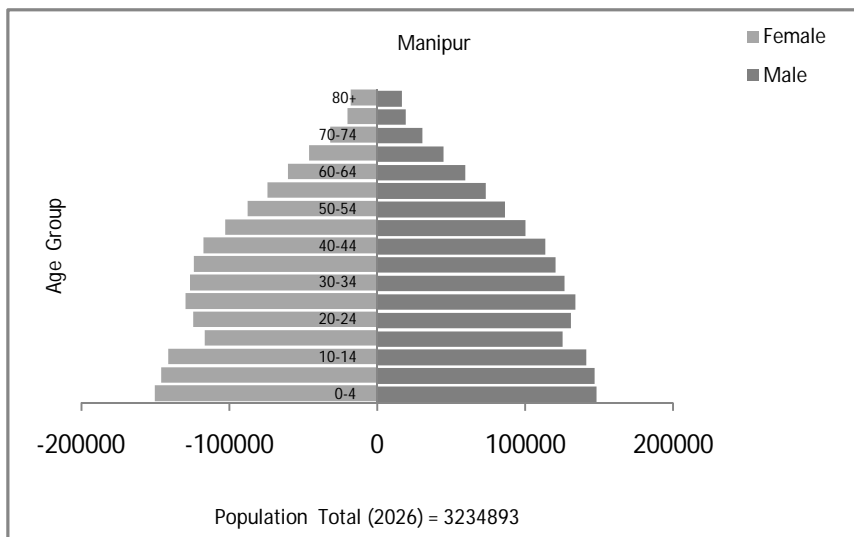
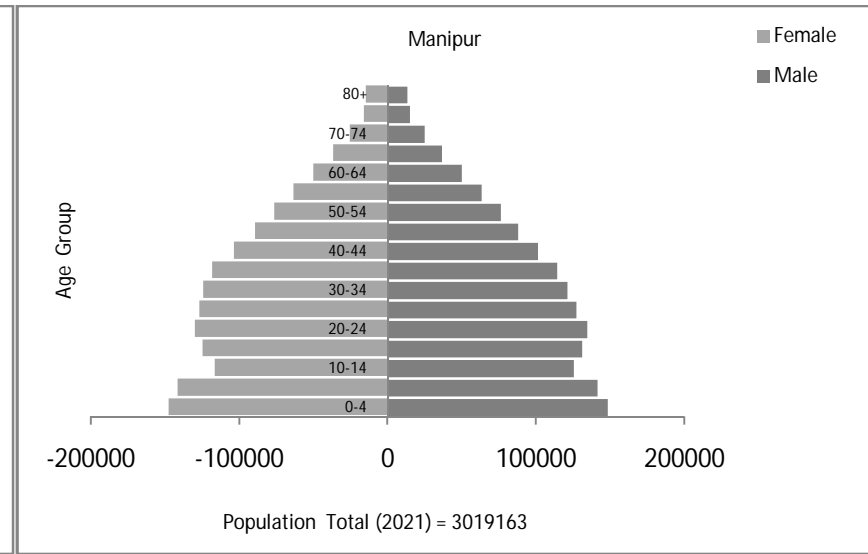
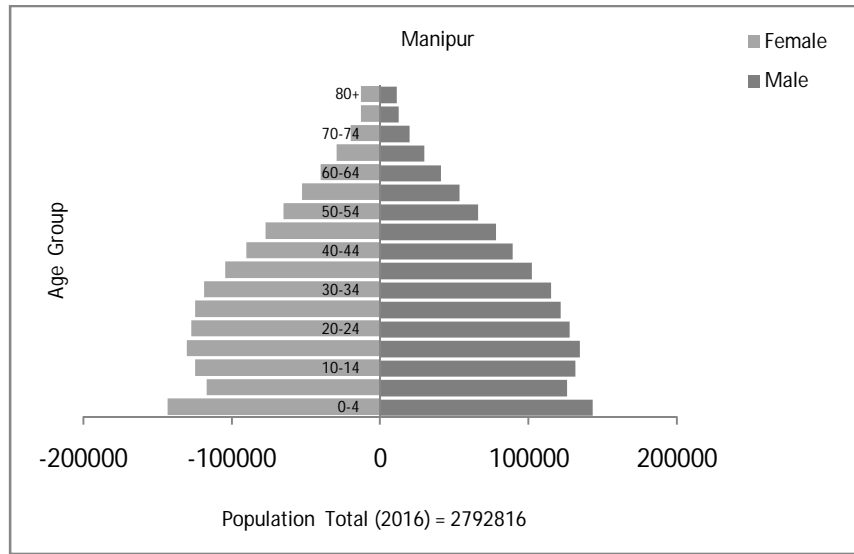


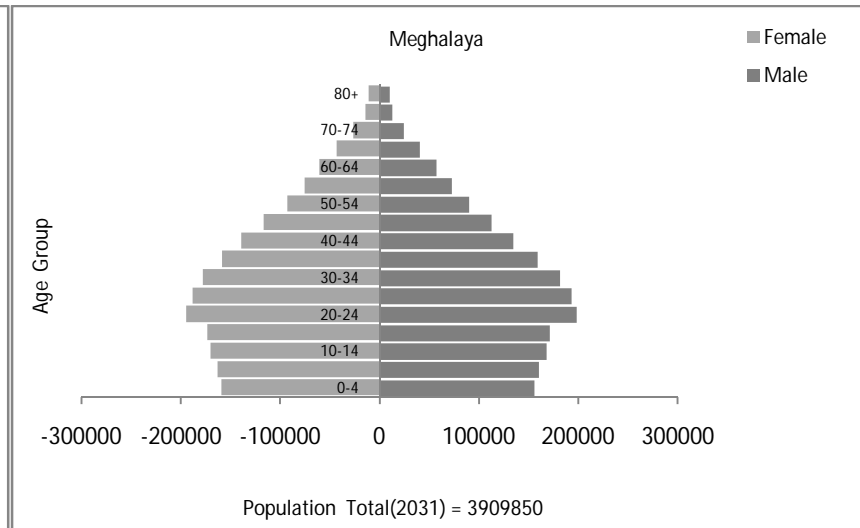
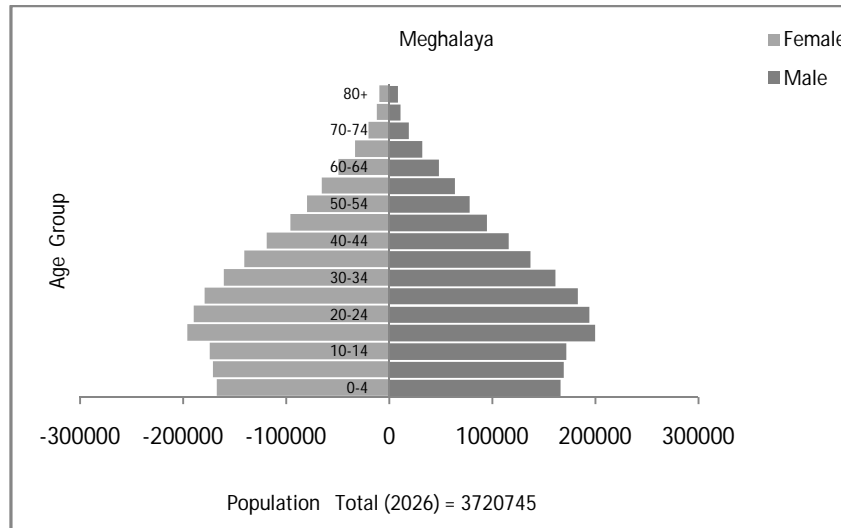
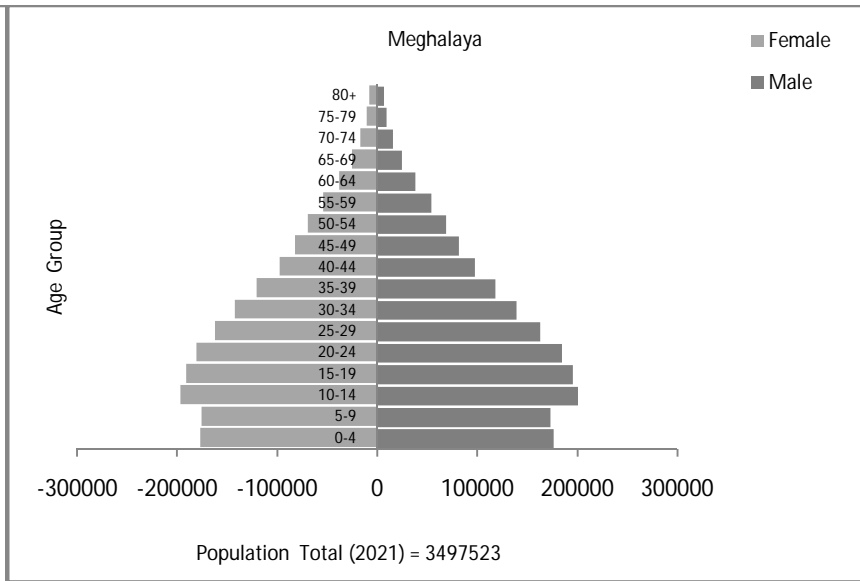
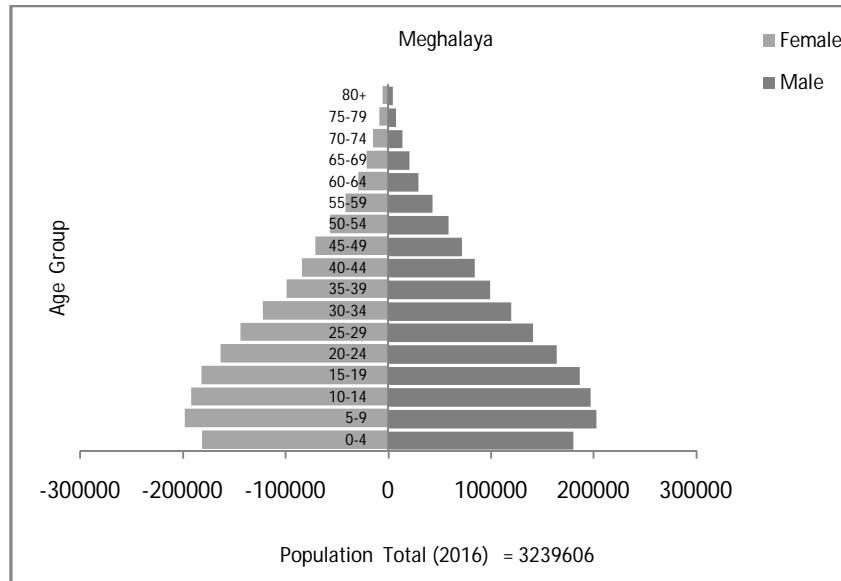




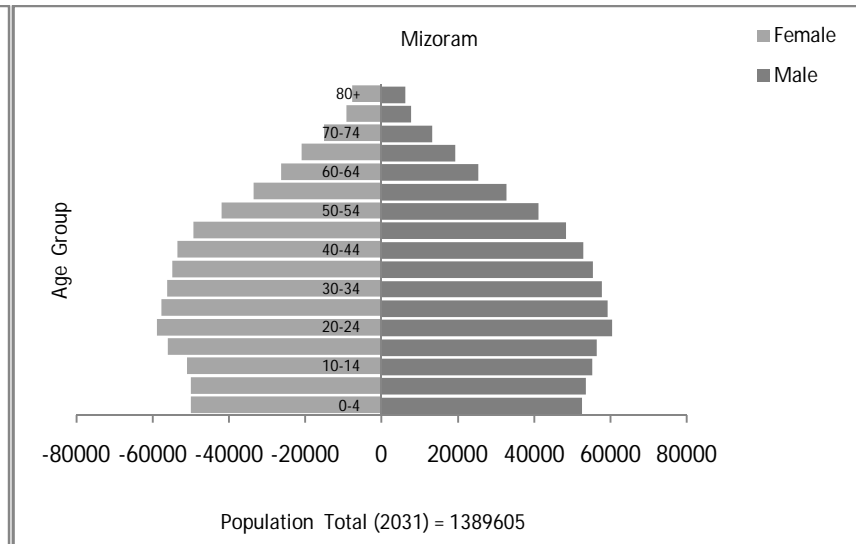
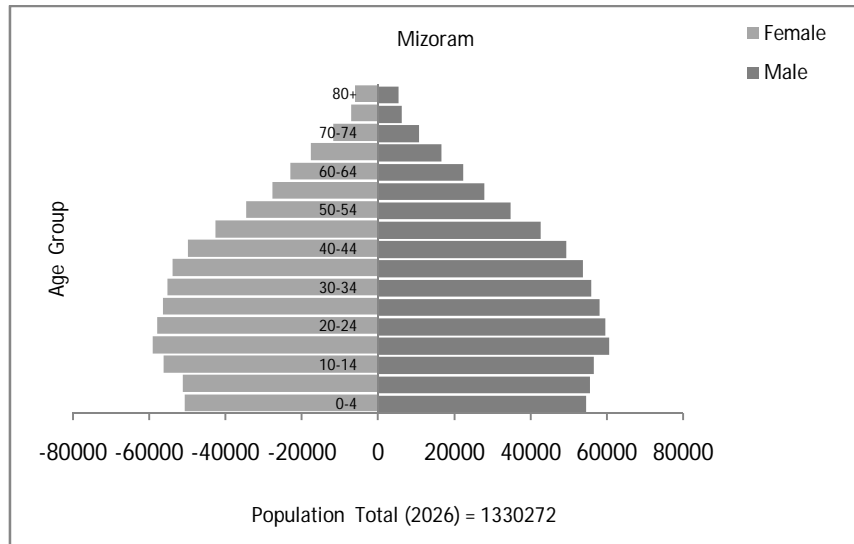
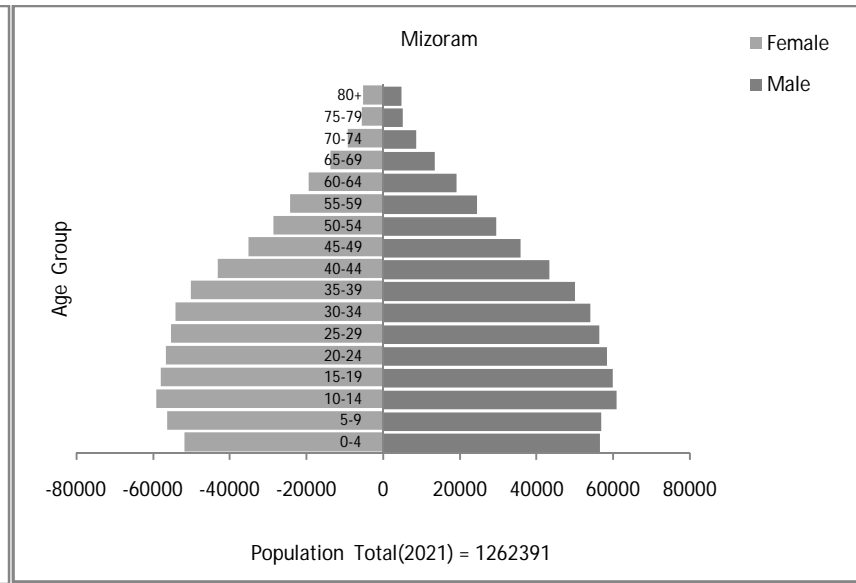
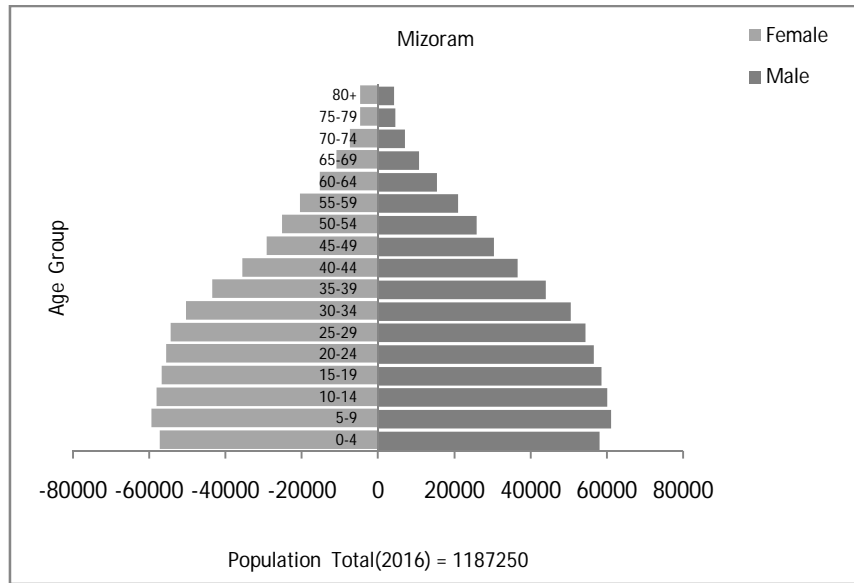


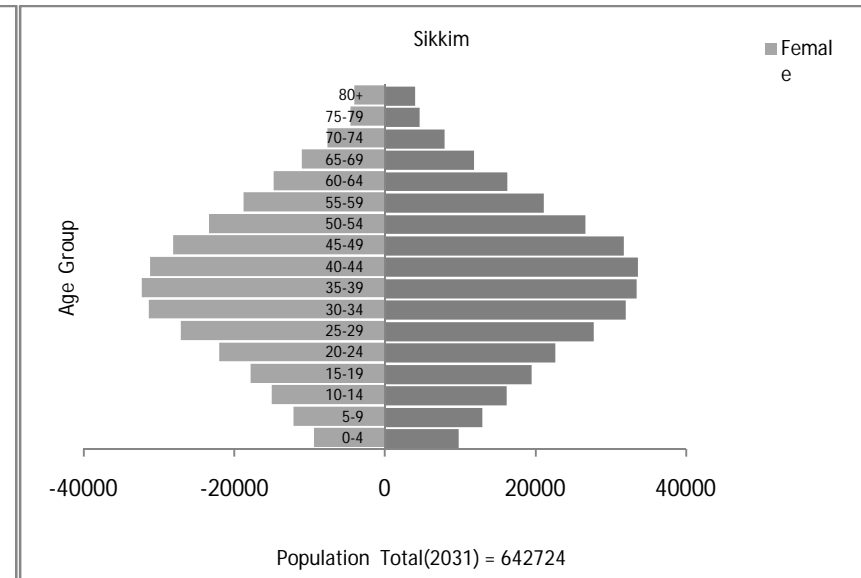
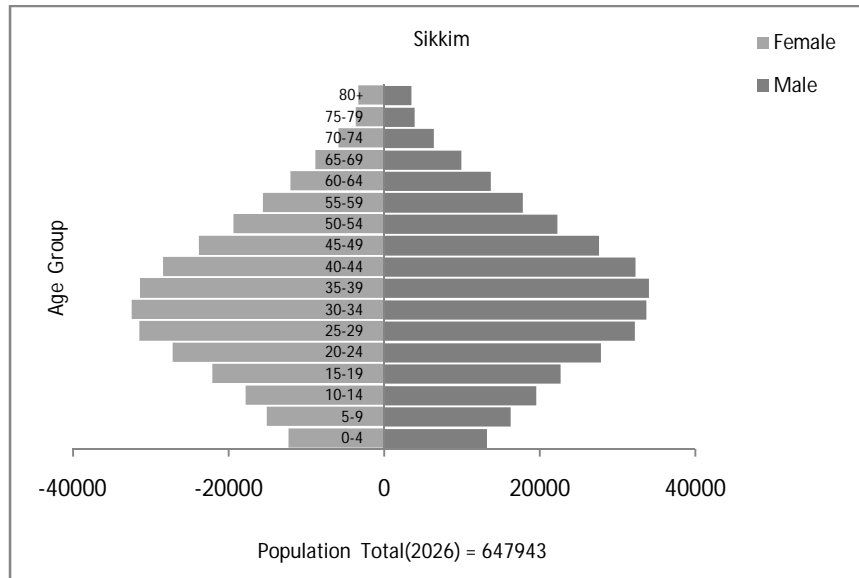
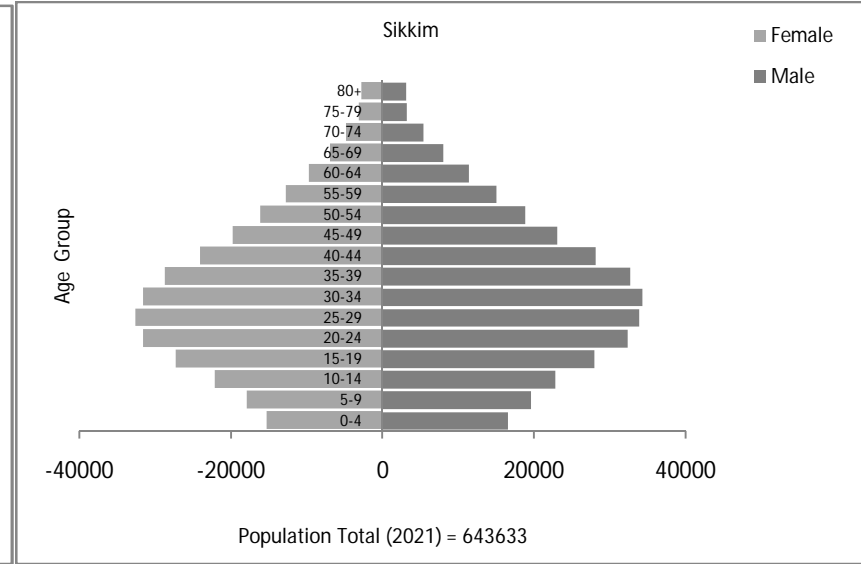
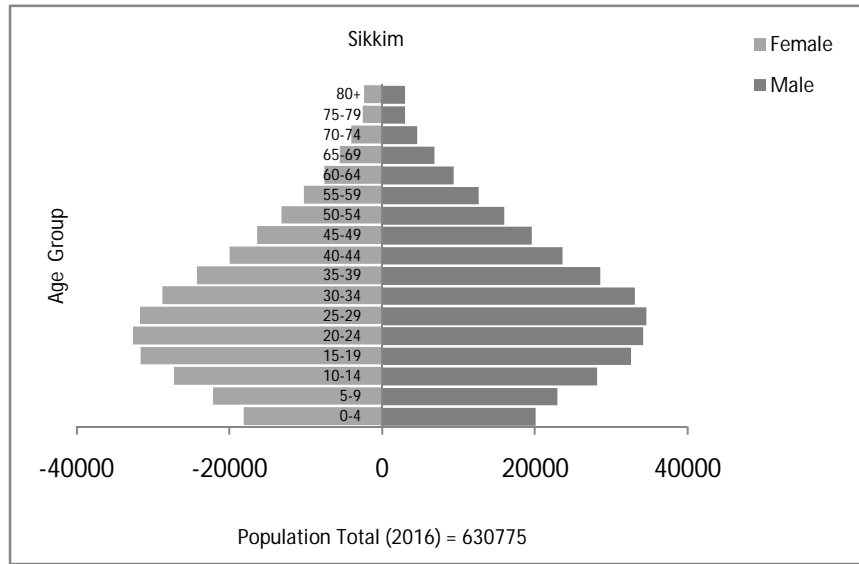


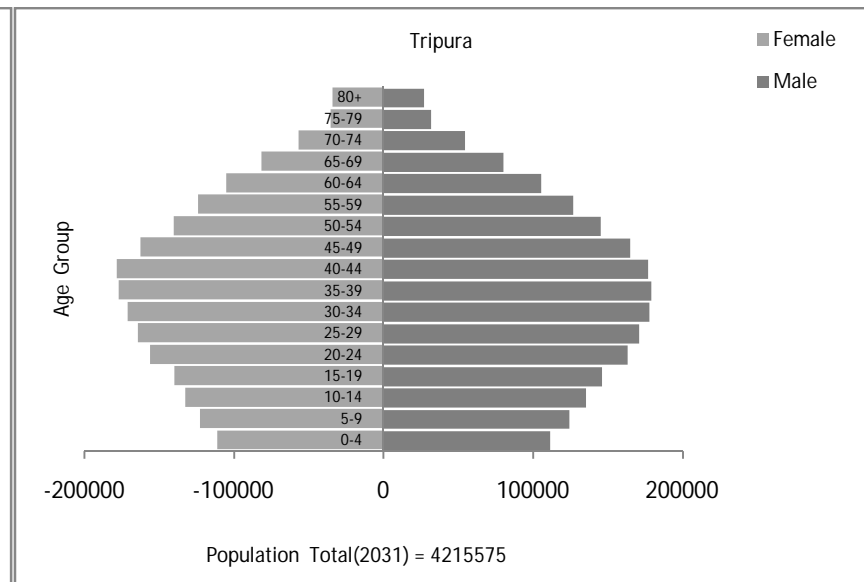
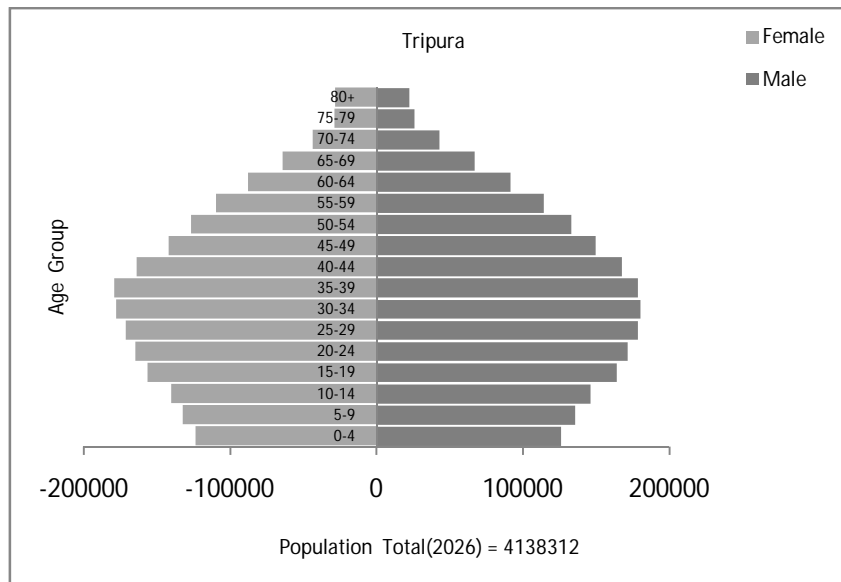
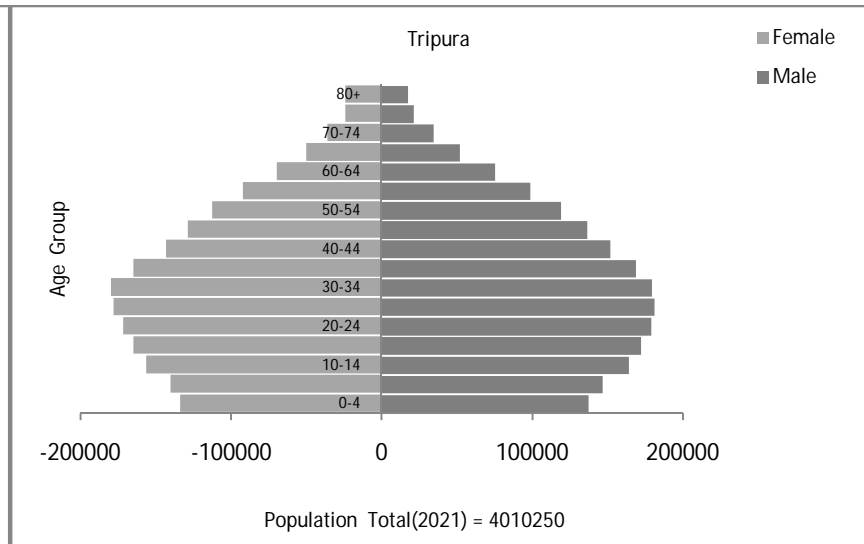
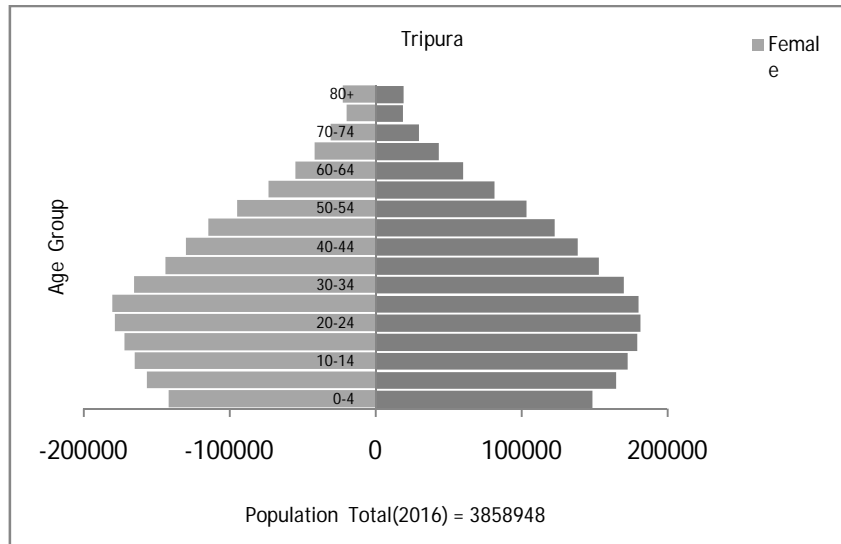












**Table 2: Population and its growth in North East states of India 2011-2031.**

Years	Population			5 year Growth Rate(%)		
	Urban	Rural	Total	Urban	Rural	Total
<b>Arunachal Pradesh</b>						
2011	317053	1065165	1382218	-	-	-
2016	344653	1140136	1484788	8.7	7.0	7.4
2021	368657	1207059	1575716	7.0	5.9	6.1
2026	389491	1271225	1660715	5.7	5.3	5.4
2031	404114	1323053	1727167	3.8	4.1	4.0
<b>Assam</b>						
2011	4394737	26792015	31186752	-	-	-
2016	4651306	28434333	33085639	5.8	6.1	6.1
2021	4857496	30047851	34905346	4.4	5.7	5.5
2026	5017820	31682958	36700778	3.	5.4	5.1
2031	5084640	32937322	38021963	1.3	4.0	3.6
<b>Manipur</b>						
2011	832029	1731358	2563387	-	-	-
2016	905674	1887142	2792816	8.9	9.0	9.0
2021	974993	2044170	3019163	7.7	8.3	8.1
2026	1038184	2196710	3234893	6.5	7.5	7.1
2031	1095635	2341737	3437372	5.5	6.6	6.3
<b>Meghalaya</b>						
2011	594447	2366658	2961105	-	-	-
2016	657727	2581879	3239606	10.6	9.1	9.4
2021	711793	2785730	3497523	8.2	7.9	8.0
2026	751964	2968781	3720745	5.6	6.6	6.4
2031	779190	3130659	3909850	3.6	5.5	5.1
<b>Mizoram</b>						
2011	571418	525155	1096573	-	-	-
2016	620774	566476	1187250	8.6	7.9	8.3
2021	660382	602008	1262391	6.4	6.3	6.3
2026	693792	636480	1330272	5.1	5.7	5.4
2031	720246	669359	1389605	3.8	5.2	4.5
<b>Sikkim</b>						
2011	153389	456012	609401	-	-	-
2016	159826	470949	630775	4.2	3.3	3.5
2021	163472	480160	643633	2.3	2.0	2.0
2026	164504	483439	647943	0.63	0.68	0.67
2031	162871	479853	642724	-0.99	-0.74	-0.81
<b>Tripura</b>						
2011	960872	2711429	3672301	-	-	-
2016	1002700	2856249	3858948	4.4	5.3	5.1
2021	1025674	2984576	4010250	2.3	4.5	3.9
2026	1045821	3092490	4138312	2.0	3.6	3.2
2031	1050237	3165338	4215575	0.42	2.4	1.9