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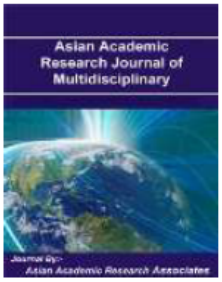

PROJECTION OF POPULATIONS BY AGE AND SEX FOR MEGHALAYA STATE FOR 2001- 2051

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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 and Meghalaya state of India in particular. The present projection is based on the Cohort component method. The projection reveals that there will be a decrease in the child population of age 0-4 and number of women in the reproductive age will increase by the year 2051.The proportion elderly age 65+ will rises to 2.6 lakh for males and 2.9 lakh for females respectively in the year 2051. Findings in this paper will help the state government in formulating the policy for identifying the thrust areas to be emphasized to improve the overall socioeconomic development.

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

1. 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.

2. 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).

Natarajan and Jayachandran (2001) also made the population projection in 2000, taking the 1996 population (934.2 million) as the base year population and assuming the life expectancy of birth as 62.9 years for male and 64.9 years for female in 2001 and projected TFR as 3.1 in 2001. They estimated that India's population would be 1012 million by 2001 and 1264 million by 2016.

Assuming to reach the fertility goals stated in the National Population Policy 2000, Srinivasan and Shastri (2001) projected that India's population will reach a size of 1330 million by the year 2026 and will continue to increase thereafter until 2046, when it reaches the peak of 1417 million. It will decline to 1416 million by the year 2051 and continuing its downward trend thereafter.

Kulkarni (2001) demonstrates the implications of the projection done by the Population foundation of India (PFI) for India and 15 major states. The PFI projection is based on the assumptions that the national TFR will fall to 2.1 in 2026 and it will not reach 1.6 by 2051. According to this projection, the size of the population is expected to reach 1345 million by 2021 and it will be around 1646 million by 2051 which is a growth of 84.5 percent since 1991 and hence is near doubling in 60 years.

According to Bhat (2004), the population of India is expected to be around 1229 million in 2015, assuming whether India attains the National Population Policy 2000 goals of reaching in replacement level of fertility by 2010 (optimistic Scenario) and if replacement level of fertility is possible to obtain by 2020 (realistic Scenario) then the expected population of India will be around 1256 million by 2015. By 2025, India's population will still be growing at a rate of one percent per annum, even though the level of fertility required for long run population stabilization would have been achieved by that time. He also estimated that by 2025, India would have begun to come out of the "demographic bonus" phase (this phase is expected to grow during 2000-2020).

In a recent projection, Dyson *et al*. (2004) estimated that the population of India is likely to be of 1.4 billion by 2026 and 1.6 billion by the year 2051. These projections are done by taking optimistic assumptions, such as the TFR will fall to around 2.1 births per woman during 2016-21, when life expectancy will be approximately 67 years for males and 70 years for females. The working age population will be approximately 1.5 times as large in 2026 as it was in 2001. If woman's participation increases, there will be an average annual addition of eight million population to the labour force annually between 2001 and 2026. If recent trends in economic growth and employment intensity continue until 2026, there will be a significant increase in the level of unemployment. Even an annual economic growth rate of eight percent up to 2026 will not avoid future increase in unemployment level.

In a recent study, Datta and Mohanty(2005) showed that in country level projection the dependency ratio is expected to decline by 2015. On social front, it is found that the absolute number of children in the primary school age will decline and so will be the requirement of new primary schools. The absolute number of children in the secondary school age will not increase much, but the requirement of secondary schools as well as secondary school teachers will be more. On health front, the requirement of health professionals such as doctors and nurses and health infrastructures, such as hospitals, health centers are likely to be more for the coming years.

3. 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 Meghalaya state in particular 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.

4. Methodology

The methodology that will be adopted in the projection is the *Cohort component method*. The method makes specific assumptions 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:

$$P_t = P_{t-1,t} + B_{t-1,t} - D_{t-1,t} + M_{t-1,t}$$

where; P_t = Population at time t, $P_{t-1,}$ = Population at time t-1,

$B_{t-1,t}$ = Births in interval from time t-1 to time t,

$D_{t-1,t}$ = Deaths in interval from time t-1 to time t,

$M_{t-1,t}$ = Net migration in the interval from time t-1 to time t.

Growth of population in an area basically depends on births, deaths and net migration of people during the period under consideration. Estimate of births and deaths is possible only when the estimates of fertility and mortality parameters of the population are available. For fertility, the parameters are age specific fertility rates (ASFR) and Total fertility rate(TFR). For mortality projections one would require life expectancy or longevity of life (e_0^0) and the corresponding Life table to give age specific survival ratios The basic task involved in population projection, therefore, is the projection of the future levels of fertility, mortality and migration rates.

Component method of population projection involves separate projection of the number of males and females in different age groups. This method takes into account separately future course of fertility, mortality and migration and is therefore considered more accurate than any mathematical method based on past trends. The ability to provide age sex break up of the projected population is an added advantage of this method.

The paper uses the SPECTRUM package of Future Group International for projection over a period of 20 years from 2001 to 2020. Spectrum has been designed to produce information that is useful for policy formulation and dialogue within a framework easy to use computer programs. The focus is given on the generation of the information useful for policy and planning process. Spectrum is an integration package. The integration is based on DEMPROJ, which is used to create the population projections that support many of the calculations in the other components – FAMPLAN, RAPID,

AIMS. RAPID is used in this present study. A number of assumptions are made for the above projection with respect to fertility, mortality and migrations which is given below.

1. Initial population with age and sex break up.
2. Past trends in mortality and assumptions about future trends in terms of survival ratios by age and sex.
3. Past trends in fertility and assumptions about future trends.
4. Past trend of migration and future assumption about is change.

5.1. Base Population

The base level population by five-year age groups and sex can be obtained from the Census 2001 which provide for each state and Union Territory, information on the population totals by sex, in two broad age groups 0-6 and 7+ in five year age group by levels of education.

As in the majority of developing countries, data by age and sex in India suffer from a number of deficiencies. For one, large numbers of people do not know their age, females
appear to be undercounted, and young children are under-represented. The age group, 5-9, appears to be is undercounted or partially omitted, as can be seen in the population pyramid for the state in Figure 1.

The various indices, which measure the accuracy of age-sex data, are the sex ratio score, the age ratio score, Whipple's index and Myers' index etc. A number of methods are available for smoothing of the data pertaining to the age-sex distribution. Due to some deficiencies in the index mention above, United Nations has suggested a joint accuracy index called the Joint Score, which is the sum of Age Ratio Scores for the two sexes and three times the Sex Ratio Score. A summary of the indices of the different smoothing procedures for Meghalaya on the basis of the Census 2001 age-sex data is given below in Table 1.

The statement depicts the value of Joint Score as 35.95 and according to UN recommendations, the quality of response to the question of age is poor and the age data collected is categorized as 'Inaccurate'.

In the light of the distortion that can arise in the collection of information in connection of ages in the census, as a consequence of people have a liking or preference for rounding neatly figures of their age, resulting in the concentration of population at terminal digits of '0' and'5' is made at the expense of population that should be properly included in adjacent ages. The method is needed to minimize or completely removed the phenomenon of age heaping or digit preference.

A common technique applied for the adjustment of age data depends on the degree of inaccuracy, so that fairly accurate statistics would be modified only slightly while less accurate data would be more radically transformed. The methodology for age smoothing is done in according the that followed by Census is described below.

If W_1, W_2, W_3,…. , W_n are respectively the n quinquennial age groups, 0-4, 5-9, 10- 14 and so on up to 75+, then,

$$S(W_2) = 0.25^* O(W_1) + 0.50^* O(W_2) + 0.25^* O(W_3)$$

where S is the smoothed population and O is the observed population

Similarly, $S(W_3) = 0.25^* O(W_2) + 0.50^* O(W_3) + 0.25^* O(W_4)$

In this way, smoothing of the all the n-2 (except the first group W_1 and last group W_n) quinquennial age groups has been carried out. For smoothing, W_1 and W_n, this formula cannot be applied since there are respectively no preceding and succeeding age groups in these two cases. So, W_1 has been smoothed as under.

$$S(W_{0\text{-}4}) = O(W_{0\text{-}14}) - (S(W_{5\text{-}9}) + S(W_{10\text{-}14}))$$

Similarly, $S(W_{75+}) = O(W_{15\text{-}75+}) - (S(W_{15\text{-}19}) + \ldots + S(W_{70\text{-}74}))$

Smoothing of age sex distribution for The state of Meghalaya, have been carried out by using the above-mentioned procedure is presented in Figure 2.

5.2. Fertility Assumptions.

NFHS provide estimates of TFR for States of the country. Gompertz model can be used in the trend analysis of for projecting the future levels of TFR in the state.

The Gompertz curve is defined as:

$$\frac{TFR-L}{U-L} = a^{b^t}$$

or alternatively,

$$L_n(-L_n(TFR-L)/(U-L))) = L_n(-L_n.a) + tL_n.b$$

where; U= Upper Limit, L = Lower Limit and a and b are constants

The past estimates of total fertility rate(TFR) are obtained from NFHS II and NFHS III. The rate is then linearly extrapolated as a consequent of which TFR of 2.1 will assume to reach in the year 2024. After obtaining the levels of TFR, Gompertz Curves were fitted for estimating future levels of fertility(Table 2).

5.3. Mortality Assumptions

Life expectancy is a measure often used to gauge the overall health of a population. As a summary measure of mortality, life expectancy represents the average number of years of life that could be expected if current death rates were to remain constant. Shifts in life expectancy are often used to describe trends in mortality. Life expectancy at birth is strongly influenced by infant and child mortality (Arriaga,1984).

Data on Life expectation for the state of Meghalaya is not available. However as the mortality figures between Assam state and Meghalaya were close, in regard to IMR, It is assume that the Life expectancy between the two states will be similar, with the latter in a slightly better position. Thus the present study utilizes the Assam figures provided by

RGI, 2006. In the present study the values of life expectancy for the periods 2001 to 2026 were obtained from the report by the Registrar General of India(2006) and the trends beyond were extrapolated, using linear-fit, at five-year intervals to 2051(Table 3.).

5.4. Assumptions on Migrations

Census provides data on net migrations and it is observe that over the years net migrations is always positive, which implies that there are more persons entering the state than those leaving the same. It has been widely observed that the propensity to migrate increases with education(Connel, etal., 1976, Banerjee,1986).This is the case with the tribal society of the state, in which only the well educated few would leave their state for working outside. Thus based on the date of Census 2001, it is assume that more educated persons are expected to migrate more than the less educated.

6. Discussion on Findings.

Results show (Figures 1 to 11) that if the assumptions for fertility, mortality and migrations follow, the state will reach replacement level of TFR by 2021 and the total population will increase by 44.86 percent by the year 2051. There will be a decrease in the child population of age 0-4 from 19.9 percent for males and 20.0 percent for females in 2001 to 6.8 percent and 7.0 percent respectively in 2051.

It is known that with the demographic transition the proportion of old age people increases, which can also be evident from the results. The proportion elderly age 65+ will rises from 2.8 for both males and females in 2001 to 9.9 for males and 11.4 for females respectively in the year 2051.

It can be seen that the proportion of women population of reproductive age 15-49 years will be raise to 41.7 percent in 2051 from its proportion of 37.5 percent in 2001.

It is estimated that the total labour force (age 20-65) will increase from 43.7 percent for males and 43.6 percent for females in 2001 to correspondingly 61.9 and 60.0 by 2051.

It is found that the total number of children for school going age(5 to 14) are going to increase form 2.63 lakh for males to 2.56 lakh for females in 2001 to 3.66 and 3.60 lakh respectively in the year 2051.

With respect to the health projection it can be seen that as per requirement set by WHO of 1 doctor for every 1000 population, about 2.3 thousands doctors was required in the state 2001 and the demand for doctors will increase to 5.1 thousands in 2051.The requirement for the number of nurses(1/500 population,WHO) will rise from 4.6 to 10.3 thousands between 2001 to 2051 and the demands for hospitals beds (3/1000 population, WHO) was 6.8 thousand in 2001 which will rise to 15.4 thousand by the year 2051.

7. Concluding remarks

The base of the age pyramid for the state of Meghalaya will decrease. There will be more women in the reproductive age in 2051. In view of the above argument there is a need to frame the policies of the state focusing more on their age structure. Focus should also be given towards full and proper coverage of maternal health services and Reproductive and Child Health services. The quality of services should be improved as the percentage of female population of reproductive age group of 15- 49 will increase. Therefore, it can be helpful in a way or another to accelerate demographic transition and achieve population stabilization. There is also a need to focus on the old age security and care factors as the proportion elderly age 65+ will rises to 2.6 lakh for males and 2.9 lakh for females respectively in the year 2051.The State Govt. should invest on primary as well as secondary education in future compared to 2001 as the requirements of schools, school teachers will be more in 2051.

On the health front, the requirements of health infrastructures and health manpower will increase. The population in absolute number is increasing and will be having a larger share of the population per capita requirement of health infrastructure. It may imply that though the health care services in the state are there but it should focus more on the vulnerable section who are deprived or less utilizing the heath care services so that the proportion of population at higher health risk can be reduced.

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Table 1. Summary of indices measuring the accuracy of data - Census 2001.

	ARSM	ARSF	SRS	JS
India	7.6	7.3	7.0	35.9
Meghalaya	10.72	11.9	4.44	35.95

Age Ratio Score for Male (ARSM), Age Ratio Score for Female (ARSF), Sex Ratio Score (SRS), Joint Score(JS).

Input Tables

Table 2: Smoothed base Population of Meghalaya, 2001 Census.

Age Group	Males	Females
0-4	230484	225286
5-9	137750	134260
10-14	125372	122048
15-19	125193	123957
20-24	98194	102826
25-29	83162	89336
30-34	76071	76547
35-39	69367	64457
40-44	57456	51017
45-49	45092	39110
50-54	33787	29311
55-59	24106	21622
60-64	18491	17344
65-69	13706	13196
70-74	9024	8842
75-79	5973	5972
80+	-3689	-3398

Table 3: Projected levels of Total Fertility Rates (TFR), life expectancy and Net migrations for Meghalaya: 2001-2051.

Year	TFR	Life Expectancy		Net Migrations	
		Male	Female	Male	Female
2001	4.7	59.6	59.6	5757	3236
2006	3.7	61.6	61.6	11514	6472
2011	3.4	63.6	63.6	17271	9708
2016	2.7	65.6	65.6	23028	12944
2021	2.1	67.1	67.1	28785	16180
2026	2.1	69	69	34542	19416
2031	2.1	70.7	70.7	40299	22652
2036	2.1	72.5	72.5	46056	25888
2041	2.1	74.2	74.2	51813	29124
2046	2.1	76.1	76.1	57570	32360
2051	2.1	78.9	78.9	63327	35596

Figure 1. Total population by age and sex for Meghalaya state: 2001 (unsmooth)

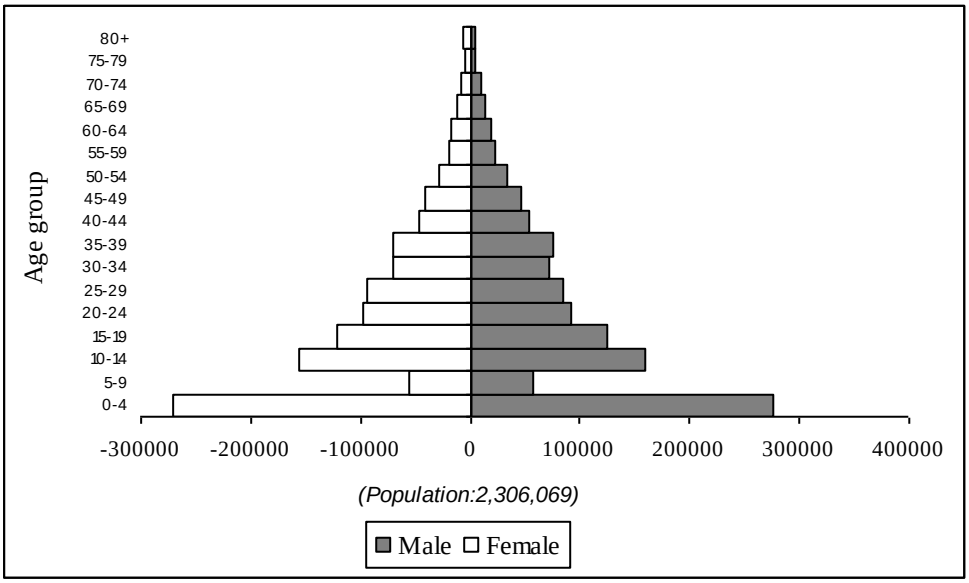

Figure 2. Total population by age and sex for Meghalaya state: 2001(smoothed)

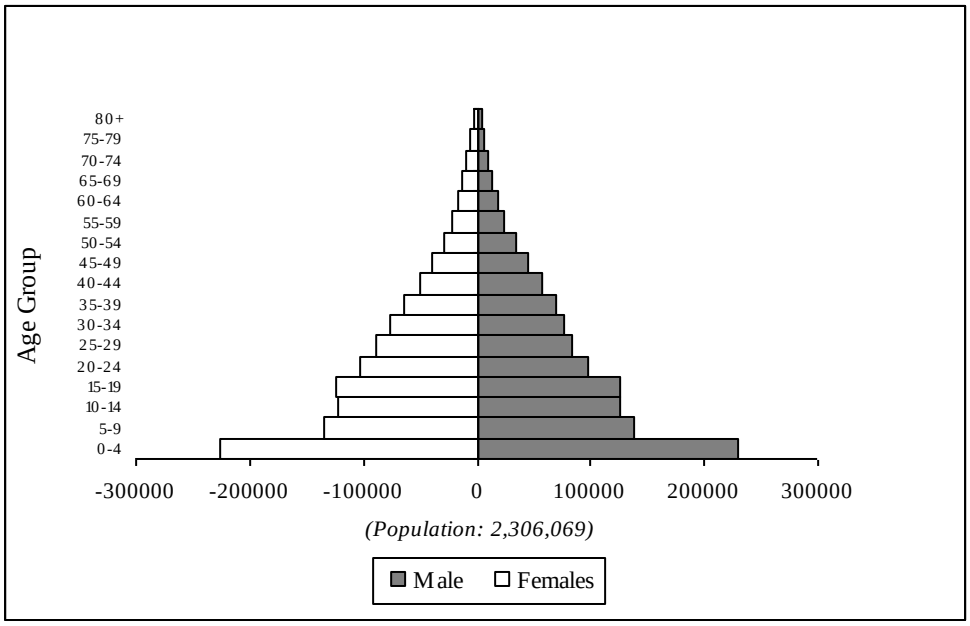

Figure 2. Projected total population by age and sex for Meghalaya state: 2006

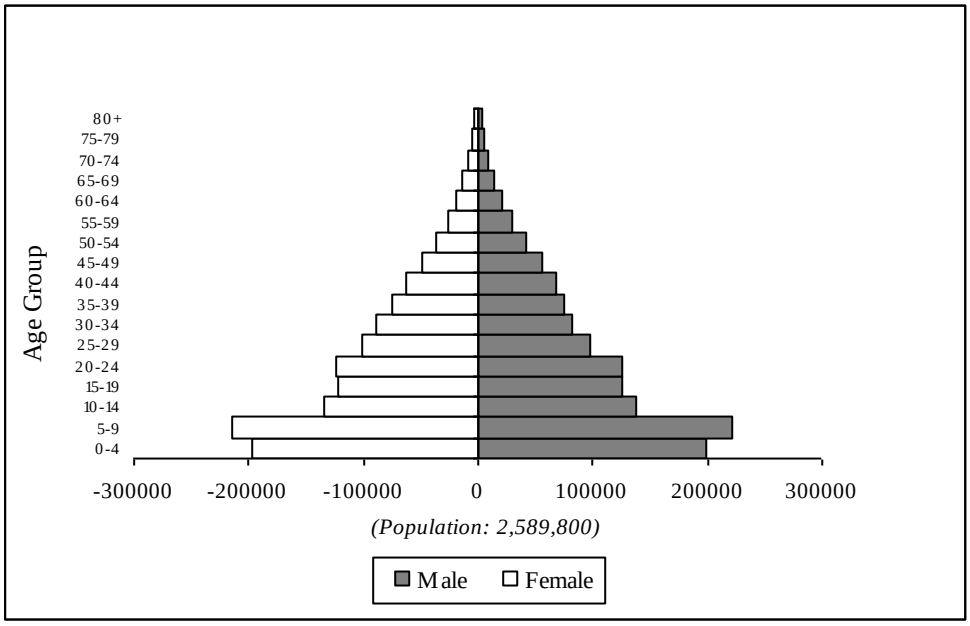

Figure 3. Projected total population by age and sex for Meghalaya state: 2011.

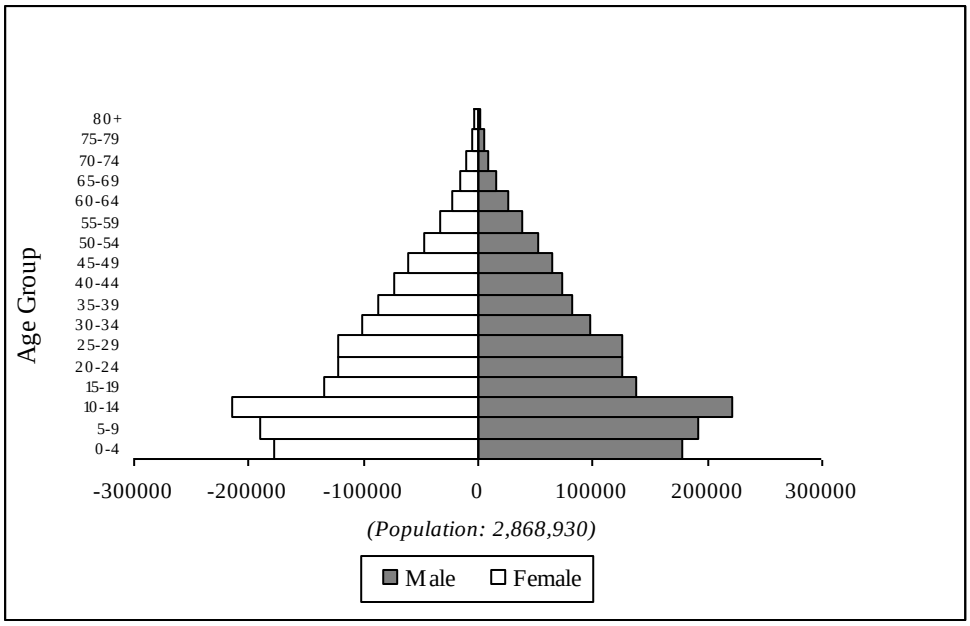

Figure 4. Projected total population by age and sex for Meghalaya state: 2016.

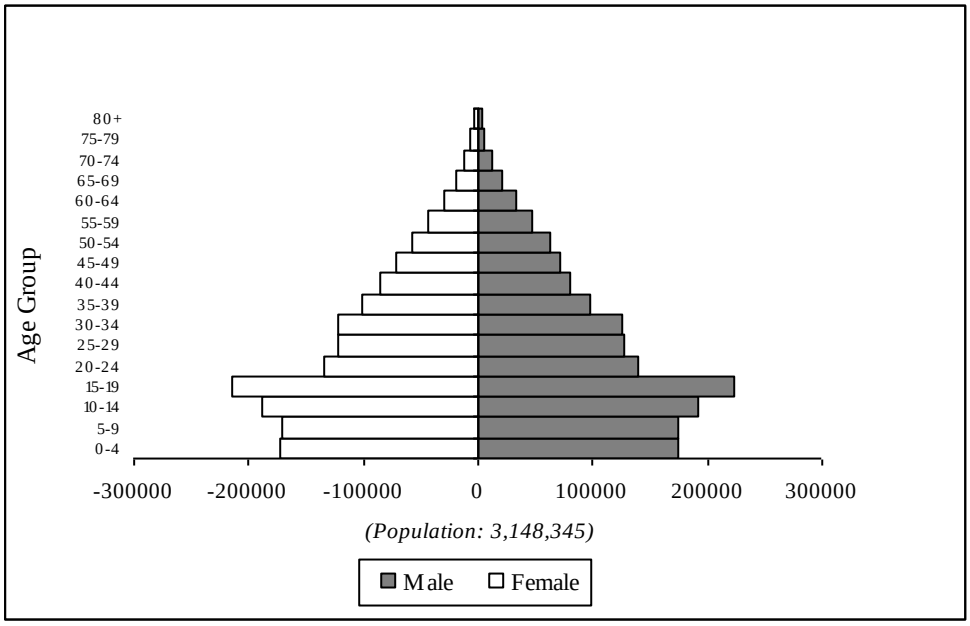

Figure 5. Projected total population by age and sex for Meghalaya state: 2021.

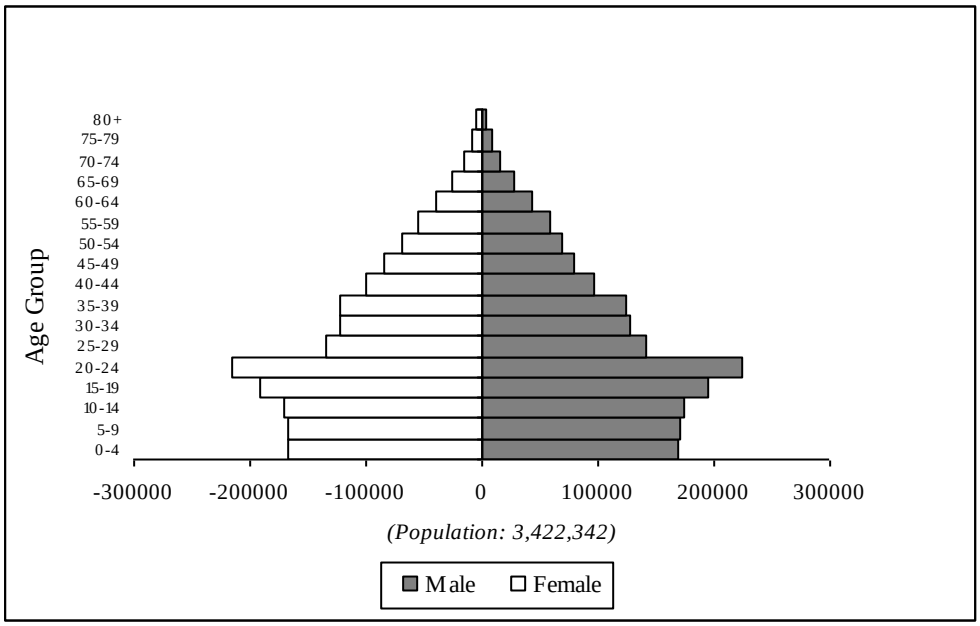

Figure 6. Projected total population by age and sex for Meghalaya state: 2026.

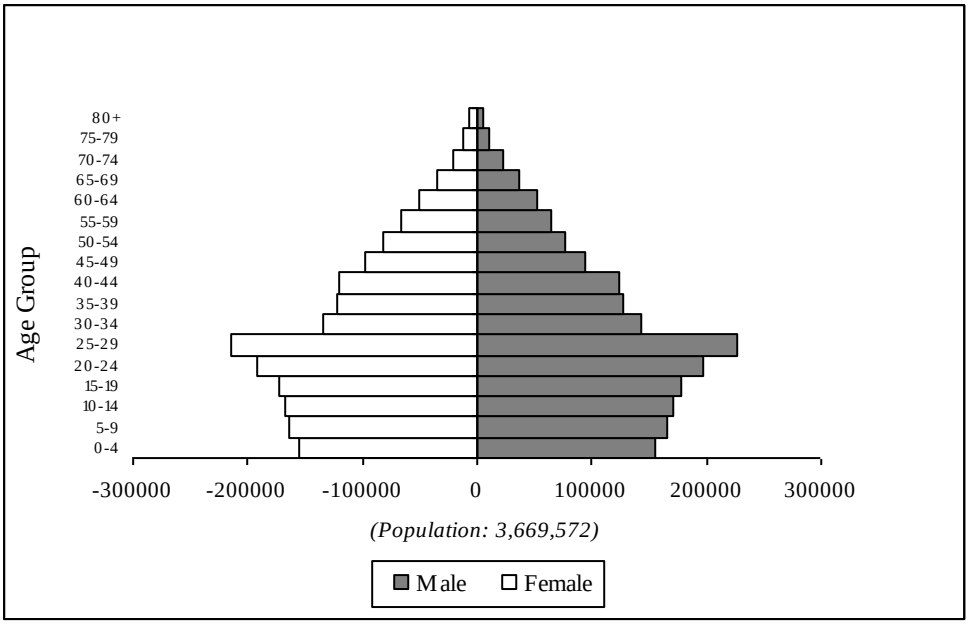

Figure 7. Projected total population by age and sex for Meghalaya state: 2031.

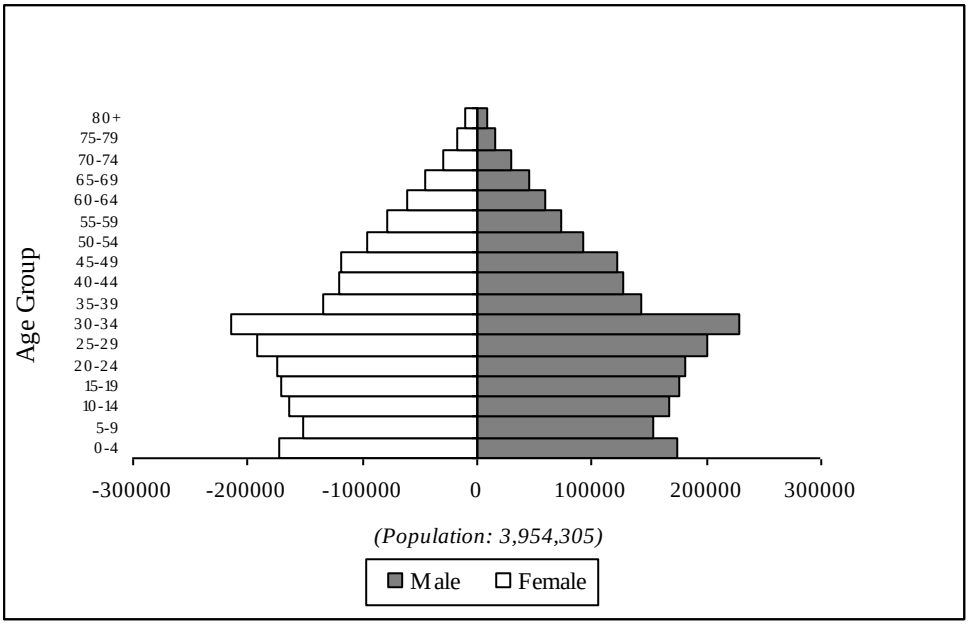

Figure 8. Projected total population by age and sex for Meghalaya state: 2036.

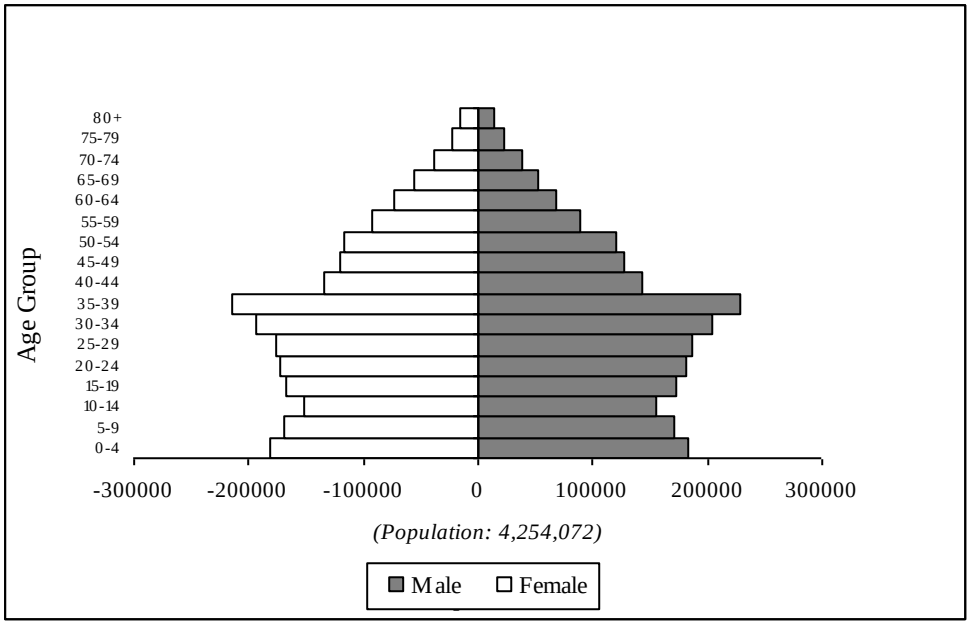

Figure 9. Projected total population by age and sex for Meghalaya state: 2041.

Figure 10. Projected total population by age and sex for Meghalaya state: 2046.

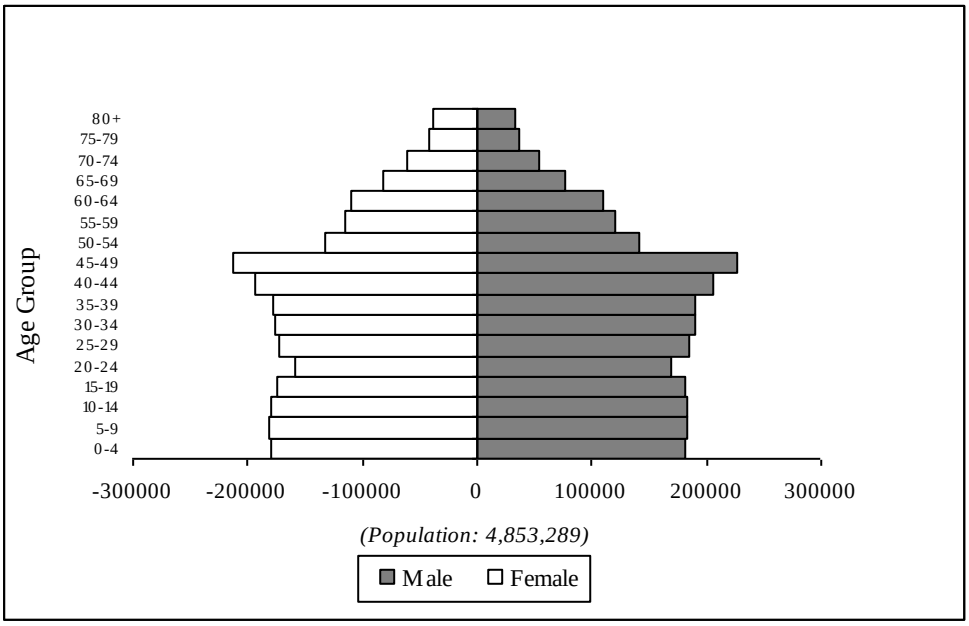

Figure 11. Projected total population by age and sex for Meghalaya state: 2051.