

Projection of Population of Mongolia

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I. Introduction

1.1 Mongolia lies in the Central of Asia. Mongolia is a large but sparsely populated country, landlocked between the Russian Federation to the north and China to the east, west, and south. The territory covers more than 1.5 million square kilometres. With a total population of 2.34 million in 1995 Mongolia has population density of 1.3 persons per square kilometre which is one of the lowest in the world. About 58 percent of the population lives in urban areas, a quarter of it in the capital city of Ulaanbaatar.

1.2 Past trends of the demographic components :

a. Mortality : Since 1960's mortality is not declining as rapidly as was expected, there was only modest decline. For example, in term of life expectancy at birth, the population gained approximately 3.6 years years during the last 25 year period. Infant mortality rate declined by 14.9 percent. The decline in crude death rate was more significant from 12.3 to 7.3.

During the second half of the present century, Mongolia, as other least developed countries, has experienced a substantial decline in mortality. The 1940's CDR was higher than 30 per thousand. However, the fact is that during these past 20 years the pace of mortality decline has been much slower than in previous decades.

The age pattern of mortality is characterized by extremely high infant and child mortality. Mortality during the prime adult ages is relatively low for males but comparatively high for females, mainly due to maternal mortality (24 per 10000).

b. Fertility: Recent data on fertility suggest that its decline will be more rapid than was expected. In spite of the previous government's strong pronatalist policy, fertility began to fall and the sustained decline is observed by the middle of the 1970's, which intensified during the second half of the 1980's. Data from 1993 suggest that this decline will continue during the present decade, probably even more rapid than during the past quinquennium. The age pattern of fertility decline indicates that the fall occurred mainly as a result of fertility reduction among older women. For example, between 1969-74 and 1993 the TFR declined by 65.4 percent but age specific fertility declined by 86.2 percent and by 88.6 percent among women aged 40-44 and 45-49 years respectively. Between 1979 and 1993 the percentage of women of reproductive age increased from 41.7 to 48.2 percent of the total female population. These results suggest that changes in the age structure did not contribute to the decline in fertility. The singulate mean age at marriage increased from 21.6 to 23.1 years of age between these two periods. These changes may have affected the decline in fertility, but, considering that they do not represent a major shift in marriage patterns, their contribution has certainly not been of much significance. The most important intermediate variable in Mongolia's fertility decline seems to have been abortion. 32421 abortions were carried out in government health facilities in 1992 (abortion was legalized at the end of 1989). This number represents 62.9 abortion per thousand women and 511.5 per thousand births.

c. International migration: Since international migration has been negligible in Mongolia during the past three decades, this variable was not included in the analysis. Nevertheless, it seems that this situation may change in the future. The new administration has not yet issued a formal migration policy but some changes can be observed. To begin with, mainly because of the political opening up, the severe restrictions placed on travel abroad for Mongolian citizens has been relaxed. This change of attitude is reflected in the migration of a large number of the Kazakh nationality to the Republic of Kazakhstan. A decision with regard to immigration has not been taken either but, considering the geo-political situation of the country and the economic problems that it faces, it is not likely that it will adopt a policy of facilitating or stimulating immigration. However, if a policy favorable to immigration is adopted, especially from Inner Mongolia, the international migration may increase. International migration will have an impact on Mongolia's population, probably not in the next few years but certainly during the next decade. Therefore, it is not possible to risk a future estimate.

II. Methodology

2.1 Methodology for population projection:

The method used for projection in this paper is the component method. It involves separate projection of mortality, fertility, immigration and emigration. The last two components are usually combined in the form of net migration and even this combined component has been omitted by assuming that the net migration will be negligible in the future. Projections of age-sex structure are obtained directly, and total population has been obtained by combining the projections for each age-sex group.

Each component has been projected with regard to its level and age structure and separate projections are made for males and females. The level of mortality is projected in terms of life expectancy at birth, and its age structure in terms of life table survival rates. Age specific fertility level is projected based on net reproduction rates. This method yields the projected population by sex and five year age group for the end of each quinquennium of the projection period; in this case, for each five year between 1989 to 1999 and 1999 to 2019. The software computer program PEOPLE has been used.

2.2 Methodology for education projection:

The educational levels projected in terms of enrollment rates for the initial year of projection are obtained as,

$$e_x^t = E_x^t / P_x^t$$

Where:

e_x^t - enrollment rate at age 'x' at time 't'

E_x^t - number of persons of a given age enrolled at school

P_x^t - number of persons of a given age at time 't'

Hence, assumed future age-specific enrollment rates can be applied to the projected population, classified by age to obtain the future numbers of persons in the educational system by age. Thus:

$$E_x^t = e_x^t * P_x^t$$

Where:

E_x^t - projected number of persons of age 'x' in year 't' receiving education

e_x^t - assumed enrollment rate at age 'x' in year 't'

P_x^t - projected population at age 'x' in year 't'

2.3 Methodology for labor force projection:

The basic element used for obtaining projection of the future number of persons in the labor force are age-sex specific labor force participation rates, which is defined as:

$$l_{ij} = L_{ij} / P_{ij}$$

Where:

l_{ij} - labor force participation rate of persons of a given sex and age

L_{ij} - number of persons of a given sex and age in the labor force

P_{ij} - number of persons of a given sex and age

Assumed future age-sex specific labor force participation rates are applied to the projected population classified by sex and age to obtain the future labor force.

$$L_{ij}^t = l_{ij}^t * P_{ij}^t$$

Where:

L_{ij}^t - projected labor force of a given sex and age in year 't'

l_{ij}^t - assumed labor force participation rate of a given sex and age in year 't'

P_{ij}^t - projected population of a given sex and age in year 't'

III. Assumptions and Projections

3.1 Mortality:

Hypothesis 1- The level of mortality was projected by assuming that during the projection period 1989-1994 to 1994-1999 it will continue declining at the same pace as in the past two decades. The four values for life expectancy corresponding to the four quinquennium between 1969 and 1989 were incorporated in a linear equation and using this equation, life expectancy was extrapolated for the period 2014-2019.

Hypothesis 2- For the projection period 1999-2004 to 2014-19, mortality will decline at the same pace as in the past six quinquennium. Life expectancy was extrapolated up to 2014-2019 by linear equation.

Hypothesis 3- Last, assumed during the projection period 1994-1999 to 2014-2019 mortality will be decline more rapidly than past three decades. Here used modified exponential equation and also life expectancy was extrapolated up to 2014-2019.

TABLE 3.1 Mongolia: Projection of life expectancy at birth

Year	Hypothesis 1		Hypothesis 2		Hypothesis 3	
	Male	Female	Male	Female	Male	Female
1989-94	59.4	63.5	-	-	-	-
1994-99	60.0	64.3	-	-	-	-
1999-04	-	-	60.6	65.2	61.2	65.9
2004-09	-	-	61.2	66.0	62.6	67.6
2009-14	-	-	61.9	66.9	64.2	69.8
2014-19	-	-	62.5	67.7	66.3	72.5

These all procedures were applied separately to males and females. Table 3.1 and figure 3.1 show the respective data.

It is important to notice that the difference in male and female, life expectancy is expected to increase through time. This trend has been observed in most countries as mortality decline, the different between male and females mortality increase. In addition the observed life expectancy during the four past quinquenium already show this trend.

3.2. Fertility:

Hypothesis 1- Fertility was assumed to follow a logistic pattern in the future and it will continue at a level corresponding to NRR of 1 per women. The respective formula is as follows:

$$NRR(t) = K/(1+e^{a+bt}) \quad (1)$$

Where: NRR- Net reproduction rate

K- Upper asymptote

a and b- parameters of equation

t- time) in years

The upper asymptote corresponds to the historical fertility observed in the past.

The equation (1) can also be put in the form of modified exponential function, then values of the parameters of logistic curve can be found from NRR in the period 1973-1993, because in 1975 TFR in Mongolia reached historical highest level, that is 7.39. In this year NRR was 3.08.

On the basis of these assumptions the estimated parameters of equation (1) were

$$a = -3.28956$$

$$b = 0.21019$$

Now we have to find the years when the NRR will be one. From formula (1) when $NRR(t) = 1$ and $K = 3.08$ then $t = 24.47$. It means, after 24.47 years, the year will be 1999 and TFR will be 2.3 as for following equation :

$$TFR = NRR(t) * \frac{(1 + SRB)^5}{nSx} \quad (2)$$

Where: $NRR(1999) = 1$

SRB- sex ratio at birth (1.04)

nSx- survival ratio at birth of women in reproductive age (4.5831).

Hypothesis 2- Since 1999 fertility will continue to decline with same pace the last three decades. Also this decline can be described through a logistic curve, where fertility is expressed in term of net reproductive rates. By formula (1) the NRR in 2019 is equal to 0.69. Hence by formula (2) TFR in 2019 will be 1.53.

Hypothesis 3- Here fertility has been estimated by using the demographic transition theory. According to which a historical high and relatively stable level will decline to a much lower level, which is also comparatively stable. In this hypothesis fertility level of 1999 will continue to decline linearly up to 2019. NRR will be decrease by -0.05 every five years interval, and it will be equal to 0.82 in 2019. These results are presented in table 3.2

TABLE 3.2 Mongolia: Projection of TFR

Year	Projected		
	Hip1	Hip2	Hip3
1989-94	3.5496	-	-
1994-99	2.3290	-	-
1999-04	-	2.0258	2.1286
2004-09	-	1.8258	2.0041
2009-14	-	1.6896	1.9187
2014-19	-	1.5781	1.8492

3.3. a) Population projection for 1989-1999

Projection 1: In term of life expectancy at birth, it will increase from 58.5 years (1984-1999) to 60 years (1994-1999) for males and 62.4 to 64.4 for females respectively. Fertility is likely to decline from 4.8 to a value of 2.3 by the end of the projection period.

(b) Population projection 1999-2019: For this period, four population projection have been worked out using following assumptions

Projection 2: Mortality was assumed to follow the proposed linear trend of decline and fertility decline from TFR of 2.3 to 1.53 (by logistic curve) between 1999-2019. This projection will give the smallest population size.

Projection 3: Mortality projected by modified exponential trend. Life expectancy at birth will increase from 60.0 to 66.3 and 64.3 to 72.5, for males and females respectively. The assumption of fertility is same as projection 2. This projection represents the medium variant.

Projection 4: Assumption with regard to mortality are the same in projection 2. And level of fertility (TFR) will change linearly , it is 2.3 in 1999 and in 2019 it will be 1.82. This projection also represents the medium variant.

Projection 5: In this projection, the mortality and fertility value is assumed to remain unchanged from projection 3 and 4, respectively. This projection can be considered as the high variant or the projection that will result in the largest population.

IV. Findings

4.1 It is important to mention that the component that will determine the future population size and structure in Mongolia is fertility. Mortality has secondary role and even if its decline is more rapid than it is assumed, it will not effect substantially the future population. Fertility has declined very rapidly during the past decade and it is very likely that this pace of decline will continue during the 1990s. As mentioned above, the level of fertility proposed by projection 2 and 5 can be considered as a lower and upper limits within which fertility will decline. Table 4.1.1 show the total population obtained under five set of projections.

**TABLE 4.1.1 MONGOLIA: Projection of the total population
(in thousands)1989-2019**

Year	PROJ 1	PROJ 2	PROJ 3	PROJ 4	PROJ 5
1989	2044.0				
1994	2256.7				
1999	2431.0				
2004		2569.8	2572.9	2580.6	2583.7
2009		2703.0	2713.3	2735.6	2746.1
2014		2826.4	2849.6	2888.0	2912.0
2019		2925.3	2970.8	3020.1	3067.3

According to projection 3, the population of Mongolia will be almost 2.97 millions in the year 2019. Projections 2,4 and 5 give total population of 2.93, 3.02 millions and 3.07 millions respectively.

The difference between a TFR of 1.53 and 1.82 for the last quinquennium of the projection period is not large: around 142.3 thousand people. It is also important to mention that, according to these projections, the population will not reach the 3 millions figure before the quinquennium 2009-2014. Considering the fertility assumption adopted for projection 1, it is not very likely that the size of population at the turn of the century will be less than 2.5 millions.

Table 4.1.2 shows a number of indicators of the projected age and sex structure for projection 1 and 5.

TABLE 4.1.2 MONGOLIA : Projected indicators of the age and sex structure

	Projection 1		Projection 5	
	1989	1999	2009	2019
TOTAL	2044.0	2431.0	2746.1	3067.3
Males	1020.7	1215.8	1370.3	1524.7
Females	1023.3	1215.2	1375.8	1542.6
Annual growth rate	-	1.49	1.22	1.04
Under 15 (%)	41.9	34.8	25.9	23.6
15-64 (%)	54.1	61.5	70.1	71.6
65+ (%)	4.0	3.7	4.0	4.8
Females 15-49 (%)	23.5	27.4	30.3	28.3
Sex ratio	99.7	100.1	99.6	98.8
Dependency ratio	0.848	0.626	0.426	0.397
Median age	18.8	22.0	26.4	31.1

The most significant feature of this table is that the age structure of the population will experience substantial changes in the future. The main change will be increase in the proportion of the population 15 and 64, and a decline in the proportion of the young age population.

These changes obviously result in a substantial decrease of the dependency ratio and an increase of the median age of the population.

It is important to note that the rate of growth corresponding to the young population exhibit a somewhat erratic or inconsistent trend: In one quinquennia the value is negative or very low, and the next positive or very large. This is mainly the result of the progressive impact

of a fluctuating fertility and mortality rate on the age structure. This problem will be better understood by the examination of respective population pyramids.

In the figure 6.1, two population pyramids are presented. It may be noted that they are presented in absolute figure and not in the percentages. The first one correspond to the base population 1989 and the another to the expected population for year 2019 according to projection 5. The examination of these pyramid give new insights into the future age structure of the Mongolia population.

With regard to the pyramid corresponding to the 1989 population, it is mentioned that until age 35-39 does have a relatively regular shape. The age profile of the population over this age interval is quite irregular. This pattern is the result of World War II and period of political instability, crisis and conflict. The pyramid corresponding to projection 4 has a clear bell shape form. the base shows the typical constriction that result from a very rapid and substantial fertility decline when it begin to cancel the mention impetus of population growth resulting from a young age structure.

4.2 Since projection 5 was considered as the most probable future scenario only it is result are included in analysis of the labor force and the enrollment projections.

(a) Labor force projections are used to understand about the future supply of labor and how it is likely to change with time. Table 4.2.1 shows some selected indicators of the labor force for the projection period 1989-2019. In Mongolia, according to the 1989 population census, the number of persons aged 15 years and over were 1.19 millions. Out of this, approximately 67.7 percent were found to be engaged in the labor force. The population of working age representing the supply of labor force will grow very rapidly during the 1990's, it's annual growth rate will be 3.28 percent. Since the first decades of the next century this pace of growth will slow down (2.6% annual), but it will continue to be significant as compared with the overall population growth (1.2%). In 1989, the proportion of males and females who were employed were about 72.2 and 63.3 percent respectively. This proportion will increased to 78.4 and 65.7 percent respectively, in the last year of the population projection period. Also, the percentage of people outside the labor force will decrease from 32.3 percent to 28.1 percent between 1989-2019.

Obviously, labor supply does not depend on population size and age structure, but also on economic, social, cultural and so on. Population establishes the limits within which the supply of work and demand of services will vary.

TABLE 4.2.1 MONGOLIA: Projected indicators in the labor force

Variable	Projection 1		Projection 5	
	1989	1999	2009	2019
Total Labor force (15+)	804156	1115818	1477247	1686078
< 25 (%)	21.7	25.5	22.6	15.5
25-54 (%)	68.2	71.0	74.1	79.2
55+ (%)	4.1	3.5	3.3	5.3
Outside labor force	384117	470230	558911	658619
Male PR	72.2	74.6	77.0	78.4
Female PR	63.3	66.3	68.2	65.7
Median age	30.6	32.1	34.5	35.8

PR- participation rate

(b) Education projections are used to know the future number of persons who will be receiving schooling, information relating to the output of the education system, that is the numbers of persons leaving schools with different attainment levels, and also to make account of teacher and classroom requirements.

Some results of the education projection for the year 1989 to 2019 are presented table 4.2.2

TABLE 4.2.2 MONGOLIA: Projected indicators of the education

Variable	1989	1999	2019
Total schooling (000)	458.35	537.58	422.98
Schooling 8-18 (%)	80.5	79.9	80.2
Primary (%)	34.4	33.1	34.3
Secondary- I	55.6	56.3	55.4
Secondary- II	10.0	10.6	10.3
Enrollment rate	80.49	79.92	80.25
Teacher (000)	19.9	23.4	18.4
Class room (000)	13.5	15.8	14.1

Summary and Conclusions

The main result of the analysis attempted in this paper are summarized as following:

1. It is very likely that the population of Mongolia at the end of century will not be more than 2.5 millions. More uncertain, however, is the situation for the first two decades of the next century. Depending on the future pace and magnitude of fertility decline, the total population size may vary between 2.9 millions and 3.2 millions by the year 2019.
2. In spite of the rapid and significant fertility decline that the country has experienced during the last decade, the population will continue to grow at a comparatively rapid pace during the present and next decade. Only during the second decade of next century, will population growth exhibit a more moderate pace.
3. The age structure of the population shows and will continue to show, marked irregularities. These are caused by the external and internal conflicts that the country experience during the first half of the present century.
4. The age structure will experience substantial changes in the future. there will be a decline in the proportion of the young people to old and an increase in the representation of the population of working age. Nevertheless, almost all age groups will continue to experience absolute, increases and in spite of expected fertility decline, the number of births will continue to growth, although at a more moderate pace than in the past.
5. The rapid growth that middle age groups will experience in the near future will certainly put a heavy burden on the demand of some social services, especially those related to housing some health services and social security. The population changes that Mongolia is likely to experience during the first decade of the next century, the most important are those related to the expected significant growth of the working age population accompanied by a

decline in the pace of growth of younger age groups that will result in substantial changes in the future age structure.

In view of the findings of this paper some questions with regard to the future population dynamics have to be considered: Will easier access to contraceptive reduce mortality more rapidly than expected growth? What will be the impact of this more rapid decline in the economy? Will Mongolian population remain in the future a closed population? What would be the impact on the economy and on the society of significant emigration rates (or immigration)?

These questions show the necessity of giving more importance to population dynamics in policy-making and development planning and the need to undertake serious research in the area of the relationship between population and socio-economic development.

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