**A SET OF POPULATION PROJECTIONS OF INDIA AND THE LARGER STATES
BASED ON 2001 CENSUS RESULTS**

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INTRODUCTION

This note gives the underlying assumptions and results derived from a population projection exercise undertaken at the Population Foundation of India to study the ranges of population sizes and their demographic characteristics facing India and the 15 larger states based on the recently announced results of 2001 census. These 15 larger states each with more than 20 million population in 2001 and together having total 980.7 million persons constitute 96% of the country's population. What happens to these 15 larger states will determine the future demographic scenario of the country. The 2001 census has placed the population of the country as on 1 March 2001 at 1027.015 million. The data made available thus far provide for each state and Union Territory, information on the population totals by sex, in two broad age groups 0-6 and 7+ and number of literates among those 7 and above among males and females.

One of the basic data requirements to apply the component projection method (which is the universally accepted method of population projection) is information on the age distribution of the population in 5 year age groups or by single years of age at the base year of start of projection. In order to get this distribution for the base year of 2001, it has become necessary to adopt an age distribution based on the past projections or other recently available evidence. The census results available so far give distributions only in two broad ages 0 to 6 and 7 and over. It is also necessary to make assumptions on future trends in fertility and mortality at the national level and at the state levels. State level projections also call for assumptions on migration from state to state. The latest projections available so far are all are based on 1991 census data as base and we have three sets available, They are 1) by the Planning Commission's Technical Group

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on Population Projections (1996), 2) by the Population Foundation of India (2000) and 3) by Tim Dyson (2000). Assumptions and results of these projections are available in the publications cited in the Reference. The Planning Commission has requested for a preliminary set of projections based on 2001 census data y published recently for their Vision 2020 project and this exercise was undertaken to meet their needs. The assumptions underlying the projections are as follows.

II. UNDERLYING ASSUMPTIONS 1.   Assumption on the base

1. Assumption on the base year age distribution

As mentioned earlier, 2001 census results available so far provide information only on the population totals by sex in two broad age groups 0-6 and 7+. This information cannot be readily used in population projections. Hence, what we did was that we assumed that the age distribution of the population derived in the earlier projection by the Population Foundation of India (Natarajan and Jayachandran, 2000) made in 1999 based on 1991 census data will be applicable to the 2001 census data as well excepting that the totals will be according to 2001 census. The comparability of the projected data on ages 0 to 4 and 5 to 9 with the populations recorded in the age group 0 to 6 in the 2001 census was checked out. They were found to be in consistent with each other. The age distribution of the country and the 15 larger states are given in input A-Tables; A-1 for the total population, A-2 for males and A-3 for females. It has to be noted that in these tables the data for UP includes that of Uttaranchal, Bihar includes Jharkhand and MP includes Chattisgarh. Since projections of population size in the future require specific assumptions on future trends in fertility and mortality and assumptions on these are not readily available for the newly formed states of Uttaranchal, Jharkhand and Chattisgarh, projections have been made for the erstwhile composite states of UP, Bihar and MP including the newly formed states.

2. Assumptions on future trends in fertility

Assumptions on future trends in fertility are made for each of the 15 larger states on the basis of extrapolation of the past trends in the values total fertility rates (TFR). With regard to the fertility assumptions for the future, three alternative trajectories have been assumed as follows:

i) The past trends in TFR available between 1971-96 for each of the larger states were extrapolated to the future years fitting a linear trend. These linear trends were extrapolated in the future with an assumed floor value of TFR of 1.6. It was assumed that the fertility levels would not decline below 1.6 based on the current experience of lowest fertility levels achieved in developing countries. Extrapolation of India's TFR during 1971-96 into the future resulted in the replacement level of fertility, or TFR of 2.1, being realized in 2016 but as a weighted average of TFRs projected for different states, replacement level of fertility was achieved only by the year 2026, 10 years later. Hence India's TFR was always considered as the weighted average of the TFR projected for different states. The assumptions of TFR values projected in the future years based on extrapolation of past trends for each of the 15 major states and for India as a whole as a weighted average, under Alternative -1 are given in Table A-4. They are identical with those made in the earlier PFI projections.

Ii) The second set of assumptions on fertility is similar to those of the above excepting that the floor values of different states are assumed to be 1 rather than 1.6. Fertility (TFR) was allowed to go below 1.6 in view of the recent emphasis by many states in the country to reduce fertility as quickly as possible because of perceived pressures of population on physical, economic, social

and environmental resources. The assumptions on future fertility according to this alternative are given in Table A-5.

iii) In the third set of assumptions it is assumed that the fertility goals set in the various policy documents at the national and state levels, wherever they have been specified, would be realized because of the intensive efforts in this direction by the state governments and the National Commission of Population. The states of UP, Rajasthan, MP and Andhra Pradesh have already formulated state •level population policies stipulating that they will reach the TFR of 2.1 or replacement level of fertility by the years 2016, 2011, 2011 and 2006 respectively. The National Population Policy 2000 has stipulated that replacement level of fertility for India, as a whole, will be reached by 2010, However, when we take the weighted average of the fertility levels of the states, the TFR of 2.1 for the country as a whole is reached by 2012 which is not very different from the goals set in the National Population Policy. The assumptions of the fertility goals in this alternative are given in Table A-6.

3. Mortality

For projecting mortality into the future, it was assumed that in India as whole and in the states in the coming years there will be a relatively slower increase in the life expectancy partly because of the historical experience of a slow down in the life expectancy after it reaches higher levels (above 60) and partly because of the dampening effect in the life expectancy attributable to the increasing prevalence of HIV/ AIDS in the country. Tim Dyson (2000) has estimated the likely levels of life expectancy at birth for males and females for the periods 1991-95 (taken from SRS) and projected figures in the context of assumed prevalence and case fatality due to HIV/AIDS for 2011-16 and 2021-26. We felt that the mortality projections of Dyson are more likely to reflect the future trends in the country in the context of a stagnation of IMR levels during the past 10 years and increasing prevalence of HIV/AIDS in the population. The three values of life expectancy for the periods 1991-95, 2011-16 and 2021-26 were extrapolated, using linear-fit, at five-year intervals from 2001 to

2051. This was done for each of the 15 larger states and the figures for India were obtained as population-weighted average of the figures of the major states. For any given expectation of life the age patterns of mortality, indicated in the United Nations South Asia Model Life Tables were assumed for the purposes of projection. The assumptions of life expectancy at birth in the future years for males and females, thus ' computed, are given in Table A-7. These assumptions are different from the earlier PFI projections (Natarajan and Jayachandran, 2000) and give significantly lower life expectancies in the future because of increasing toll expected due to HIV/AIDS. There is, however, a need to have a re-look on the mortality assumptions in view of the changing scenario of HIV AIDS epidemic in the county.

4.   Assumptions regarding migration

We assumed, in the absence of any specific data, that there would be no large-scale interstate migration in the country in the next 50 years period. Though this is a serious assumption, we feel that such an assumption may not alter the order of magnitude of population projections in the larger states and the country as a whole.

III.   Methods used

The projections were made over a 50-year period 2001 to 2051 using the package program **"SPECTRUM"** developed by The Future's Group International, Washington and the Research Triangle Institute, Raleigh.

IV.   Results. MAJOR FINDINGS OF THE PROJECTION EXERCISE

The results in terms of future projections of population size under the three Alternatives mentioned above are given in Tables B-1 to B-4, C-1 to C-4 and D-1 to D-4 respectively. The four tables under each alternative provide for the next fifty years at five year intervals: the future size of populations in 5-year intervals from 2001 to 2051; the broad age distributions in the age groups 0 to 14, 15 to 64 and 65+; the crude birth rates and the crude death rates.

As explained earlier, Alternative 1 is a modification of the earlier projection of Population Foundation of India, taking the 2001 census results as the base, the same set of assumptions on future course of fertility levels but modifications on the mortality levels based on the extrapolation of Tim Dyson's projections on life expectancy to take cognizance of the growing menace of HtV/ AIDS in the country. Under this Alternative the population of the country is expected to grow from 1027 million in 2001 to 1409 million in 2026 (in the next 25 years) and to 1628 million by 2051. Only the states of Bihar, MP, Rajasthan and UP continue to record positive growth or increase in population until 2051 while all other states show a decline in population growth because of higher death rates compared to birth rates. This decline in growth rate happens as expected earliest by 2031 in Karnataka, Keraia and Tamil Nadu and after 2031 in other states. The continuing high growth rate of population in UP increases its share of the population in the country from 17.0% in 2001 to 27.5% in 2051. On the other hand the share of Keraia State to India's population declines from 3.1% in 2001 to 2.2% in 2051. Table B-1 provides the projected values of the population size for India and the 15 larger states from 2001 to 2051 at five-year intervals.

Because of continuing decline in fertility and increase in life expectancy (though of small magnitude) the proportion of older persons in the population will increase substantially. The percentage of population aged 65 and over is expected to rise

from 4.5 in 2001 to 7.4% in 2026 and to 14.6% by 2051. In Kerala where the fertility and mortality declines occurred earlier than other states the proportion of older persons will increase from 6.6% in 2001 to 23.7% in 2051. Thus almost every fourth individual in Kerala will be a senior citizen, aged 65 and above, by the year 2051. On the other hand in Uttar Pradesh wherein the demographic transition is occurring after a considerable time lag, the proportion of older persons, will increase from 4.4% in 2001 to 9.4% by 2051, Table B-2 provides the data on the age distributions of India and the 15 larger states in the broad age groups 0 to 14, 15 to 64 and 65 and over from 2001 to 2051.

The crude birth rate of the country steadily declines from an estimated level of 23.8 in 2001 to 17.0 in 2026 and further to 12.4 in 2051. As expected both in 2026 and 2051 the lowest birth rates are observed in Kerala and Tamil Nadu at 11.1 and 9.0 and highest birth rates are in UP at 26.3 and 18,8. See Table B-3 for the detailed figures on CBR for India and the states for different years.

With regard to crude death rates, because of changing age structure of the population with the median age rising as a consequence of continuing declines in fertility and improvements in the expectation of life, crude death rates for the country as a whole decline from 8.3 in 2001 to 7.7 in 2026 but thereafter continues to increase to a level of 9.0 by 2051. However, in the states of Kerala and Tamil Nadu because of their age distribution already older and because of rapid decline in the fertility in the past, their crude death rates continue to increase steadily from 2001 until 2051. In Kerala the CDR increases from 6.2 in 2001 to 14.5 in 2051 while in Tamil Nadu it is expected to rise from 7.6 in 2001 to 13.5 in 2051. Table B-4 gives the details.

Under Alternative 2, as stated earlier in which TFR is assumed to decline steadily on the same lines as in Alternative 1 but touching a floor value of 1 instead of 1.6 as in Alternative 1. We presume that population pressure will push the state and central government to go in for a family size of one as in China. "In this case the

population of the country will increase from 1027 million in 2001 to 1353 million in 2031 and thereafter will start to decline because of excess of deaths over births and the population will be 1295 million by 2051.tn Kerala the population increases from 31.8 million in 2001 to 33.8 in 2021 and thereafter start declining to 27.1 million by 2051. In Tamil Nadu it increases from 62.1 million in 2001 to 64.5 million by 2016 and thereafter starts declining steadily to reach 51.2 million by 2051. Thus it will be seen that the population of Kerala and Tamil Nadu in 2051 will be lower than the population in 2001. The same is the case with Andhra Pradesh. On the other hand, the states of UP, Bihar and Rajasthan continue to increase their population size continuously until 2051. The population of UP is expected to increase from 174.5 million in 2001 to 296.9 million by 2026 and to 447.9 million by 2051. In other words the share of the population of UP will increase from about 17.0% in 2001 to 34.6% of the population in 2051. Every third citizen in India will be from Uttar Pradesh in the year 2051 under this alternative. The details of the population size in different states and India as whole under this alternative from 2001 to 2051 are given in Table C-1.

Under this Aiternative because of continuing rapid declines in fertility and increase in life expectancy (though of small magnitude) the proportion of older persons in the population will increase substantially. The percentage of population aged 65 and over is expected to rise from 4.5 in 2001 to 7.8% in 2026 and to 18.4% by 2051. In Kerala where the fertility and mortality declines occurred earlier than other states the proportion of older persons will increase from 6.6% in 2001 to 31.0% in 2051. Thus almost every third individual in Kerala will be a senior citizen, aged 65 and above, by the year 2051. On the other hand in Uttar Pradesh wherein the demographic transition is occurring after a considerable time lag, the proportion of older persons, will increase from 4.4% in 2001 to 9.4% by 2051. Table C-2 provides the data on the age distributions of India and the 15 larger states in the broad age groups 0 to 14, 15 to 64 and 65 and over from 2001 to 2051.

Under this alternative the crude birth rate of the country will decline very drastically from 23.8 in 2001 to 12.7 in 2026 and to 6.3 by 2051. The birth rate in Kerala will again be the lowest at 4.3 in 2051 followed by Tamil Nadu and punjab at 4.4. Even under this fast tract declining fertility, UP will have a birth rate of 18.8 in 2051 more than 4 times the birth rate of Kerala and Tamil Nadu. Table C-3 gives the details.

Under this alternative, the crude death rate declines steadily from 8.3 in 2001 to 7.7 in 2026 but continues to rise thereafter to reach a level of 10.7 by 2051, Most of the states in the country have very high crude death rates because of a large proportion of older population and Kerala has the highest rate of 18.1 followed by Andhra Pradesh, 17.6 and Tamil Nadu, 17.0. On the other hand the BIMARU states continue to have a declining trend in their crude death rates until 2051 with figures reaching 4.9 in UP, 6.7 in RaJasthan, 7.9 in Bihar and 10.9 in MP. Thus we see the potential for further growth of population even after 2051 in these states because of persistence of high birth rate and tow death rate. Table C-4 gives the details.

Alternative 3, as explained earlier, assumes tnat the demographic goals set in the population policies for India as a whole under NPP 2000 and for the selected states for which such goals have been set in last year namely UP, Rajasthan, MP and Andhra Pradesh (which have formulated state level population policies) will be realized because of the sincere efforts of the state and central governments. Under this alternative we find the population of India will increase from 1027 million in 2001 to 1330 million in 2026 and will continue to increase thereafter until 2046 when it reaches the peak of 1417 million after which it will decline to 1416 million by 2051 continuing its downward trend thereafter. Again as in the other alternatives, in spite of rapid declines in fertility the population of states of UP, Rajasthan and Bihar will continue to increase during the 50-year period 2001 to 2051. All other states will start a decline in their population sizes because of excess of death rates over birth rates with Kerala and Tamil Nadu leading the

way from 2031 and other states following from 2031 to 2051. The details on the population size of the states and the country as a whole are given in Table D-1.

Under this Alternative, which is similar to Alternative 1 for all the states other than UP, MP, Rajasthan and Andhra Pradesh, because of continuing declines in fertility to reach a floor value of TFR of 1.6 and increase in life expectancy (though of small magnitude) the proportion of older persons in the population will increase to the same levels as In Alternative 1. For India as a whole the percentage of population aged 65 and over is expected to rise from 4.5 in 2001 to 7.8% in 2026 and to 16.8% by 2051. In the states of Uttar Pradesh, RaJasthan and Andhra Pradesh, which are assumed to realize the fertility goals set by them are assumed to be realized and thereafter the fertility decline continues to reach floor value of 1.6. Hence in these states the projections of population size, age distribution , crude birth and death rates are different from Alternative 1 ; in all other states they are identical with Alternative 1. In Uttar Pradesh wherein the demographic transition is supposed to be accelerated after 2001, the proportion of older persons, will increase from 4.4% in 2001 to 14.4% by 2051. Table D-2 provides the data on the age distributions of India and the 15 larger states in the broad age groups 0 to 14, 15 to 64 and 65 and over from 2001 to 2051.

With regard to crude birth rates, for the country as a whole there is a steady decline from 23.8 in 2001 to 14.4 in 2026 and 10.0 in 2051. Since the population policy requirements of UP and Rajasthan require that they reach a replacement level of fertility by 2016 and 2011 respectively which we assume would be realized, there is a drastic reduction in the birth rate of these states. In UP it declines from 30.8 in 2001 to 20.5 in 2016 to 107 in 2051 and in Rajasthan from 28.6 in 2001 to 18.6 in 2016 and to 10.5 by 2051. The details are furnished in Table D-3.

With regard to crude death rate, the crude death rate in the country as a whole will decline from 8.2 in 2001 to 7.7 in 2021 and increases thereafter steadily to reach a level of 10.1 in 2051. In other states there is a decline in crude death rate followed by a rise and the point of inflection is the earliest in the Southern states and latest in the states of UP, Rajasthan, MP and Bihar as in the other alternatives..

CONCLUSION

This population projection was undertaken in the context of availability of 2001 census results and the need to have a re-look at the possible future scenario on India's population. In this exercise we have attempted three alternative trajectories of fertility and one for mortality until the year 2005 for each of the 15 larger states and India as a whole. These 15 states, each with a population of 20 million or more, together constitute 96% of India's population. What happens to the population size, distribution, fertility and mortality levels of these states in the future will largely determine the future course of population in India. The assumption on mortality takes into account the real possibility of an increase in deaths or a very slow increase in the expectation of life in the coming years because of the spread of epidemic of HIV/AIDS in the country. The projections made in this regard by Tim Dyson (2000) up to the year 2026 have been extrapolated upto 2051. The three assumptions on fertility are the following :

Assumption 1 is linear extrapolation of the observed fertility trends in different states in the previous 20 years, into the future until 2051, assuming that there will no be w4tbaafcaay additional efforts on the part of the central and state governments to hasten the decline.

Assumption 2 incorporates a slight modification on Assumption 1 in that with the build up of the population pressure in all these larger states of the country there will be very severe constraints on water, land and other natural resources and the need for providing for employment for the increasing labour force. These will become major problems warranting strong governmental reaction to go in for the one child family. Severe disincentives for large families and motivating couples to have only one child as it happened in China may be introduced. In this assumption the floor value of fertility is assumed to be TFR of 1.

In the third assumption it is assumed that the fertility goals set in the National Population Policy 2000 and state policies recently annouced for UP, MP, Rajasthan and Andhra Pradesh will be realised and fertility will be brought down to the floor value of 1.6 in these states very quickly,

Out of these three assumptions, first one can be considered as the likely one and the third one the desirable one towards which policies and programmes are to be intensified. Under the first assumption the population of India will reach a size of 1628 million by 2051 while under the third assumption it will reach a size of 1416 million or 212 million less than the first one. However, even with the realisation of the fertility goals set in the National Population Policy 2000 and the state policies of the four states, a substantial increase in the population of the country by the year 2051 cannot be avoided.

REFERENCES

Dyson, T (2000): *'India's Demographic and Food Prospects State-Level Analysis', Economic and Political Weekly,* Economic and Political Weekly November 11, 2000.

Natarajan, K S and V Jayachandran (2000): *Population Growth in 21st Century - India,* in K. Srinivasan and Michat Vlassoff. (eds), "Population-Development Nexus in India - Challenges for New Millennium" Tata Mcgraw Hill Publication, New Delhi.

Registrar General, India (1996): *Census of India 1991, Population Projections for India and States 1996 - 2016,* Report of the Technical Group on Population Projections Constituted by the Planning Commission August 1996, Government of India, New Delhi.

Registrar General & Census Commisioner, India (2001): *Census of India 2001, Provisional Population Totals,* Paper 1 of 2001, Government of India, New Delhi.