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Fertility Policy for India: Constant Number of Births, Replacement Level or Below Replacement Level Fertility?

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Introduction

Population projections help in the formulation of policies directed towards meeting desired goals. Such projections cannot be considered as a one time-event as new directions for policies and programs can emerge when the exercise is repeated.

In the Indian context, while it least two of the large states, namely Kerala and Tamil Nadu, have reached close to replacement level fertility, and some others are expected to follow suit soon, it is doubtful whether certain northern states, with large population will reach replacement level fertility even by the year 2001. Under these circumstances, vigorous action to reduce fertility immediately to replacement level may be an option, If this were to occur, it might have an undesired effect on the age structure of the population. Yet another option is to keep the number of births constant. The aim of this paper is to look into these alternatives for India.

Method

Given twenty five-year age specific fertility rates and five-year survival rates, $5L(x+5) / 5L(x)$ and the assumption that there is no migration, the population at time 't+5' and time 't' is related by a set of linear first-order difference equation:

$$\frac{5L(0)}{5L(5)} = \frac{5P_{15}(0) + 5P_{15}(5)}{5P_{15}(0) + 5P_{15}(5)} \frac{5F(0)}{5F(5)} + \frac{5P_{20}(0) + 5P_{20}(5)}{5P_{20}(0) + 5P_{20}(5)} \frac{5F(0)}{5F(5)} + \dots \dots \dots (1)$$

$$\frac{5L(0)}{5L(5)} = \frac{5P_{5}(0)}{5P_{5}(5)} \dots (2)$$

$$\frac{5L(75)}{5L(80)} = \frac{5P_{5}(75)}{5P_{5}(80)} \dots (3)$$

Where $5P_t(x)$ and $5P_{t+5}(x)$ are populations in the age groups (x, x+5) at time 't' and 't+5' respectively, and $1(0)$ is the radix of the life table. Using the above set of difference equations, the population by age can be projected for five years. In

the above equation, $5F_x$ refers to the fertility rate taking only female births, life table survivorship refers to females, and the female population is thus projected.

Based on the assumption of a fixed sex ratio at birth (viz. 1.06 male births per every female birth), male births can be estimated by multiplying the quantity in double parenthesis in equation (I) by 1.06. The application of male survivorship and male population in the difference equation give us the projected male population. Our approach is a female dominant projection. For every next five years of projection, a new set of age specific fertility and life table survivorship functions are applied once the trends in age specific fertility and the life table survivorship function are extraneously determined.

For the population projection based on the assumption of a constant number of births, the quantity in the double parenthesis in equation (1) is fixed for the successive five-year intervals of time. Assuming that the fertility pattern remains constant but only the level changes, the age specific fertility rates and hence the total fertility rate under constant births projection can be estimated.

The projection of the population based on replacement level fertility again assumes a fixed age pattern of fertility. Under this assumption, the inflation/deflation factor to obtain replacement level fertility is

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$$R_0 = \sum 5L_x 5F_x$$

$$x=15.5$$

Hence, replacement level age specific fertility is $5F_x/R_0$. The inflation/deflation factor changes with a change in the level of mortality.

Age structure of base population

The age distribution of the population is not yet available from 1991 census data. Given the total population in 1991, the age distribution of the 1981 census when projected with the help of appropriate estimates of fertility and mortality, should be able to provide a reasonably good estimate of the 1991 age distribution in addition to providing an estimate of the total 1991 population which matches the 1991 census estimate.

When the adjusted age distribution for 1981 as given by India[3] is taken, the total fertility rates of 4.68 for 1981-86 and 4.30 for 1986-91 seem to be the best possible estimates when judged on the basis of available information from the

Sample Registration System. Similarly, the best possible estimates of expectation of life at birth for females are 55.0 and 58.0 respectively for the years 1981-86 and 1986-91 and 56.5 and 59.1 respectively for males.

Age specific fertility rates are derived from the total fertility rate using the standard early childbearing pattern of PEOPLE[4] (Version 2.0), and survival ratios assuming the Southern Asian pattern[5] for the years 1981-86 and 1986-91. Using these values to project the 1991 population gives a total population of 844.3 million. This is quite comparable with the provisional figure of 843.9 million given by the 1991 census. The sex ratio of the projected population for 1991

Matches well with the 1991 census estimate of provisional population totals[2]. The age sex distribution of population thus obtained is given in Table1 and serves as the base population for the alternative projections made in this paper.

Tables 1: Projected age-sex distribution India, 1991 (in thousands)

| Age (Years) | Males | Females | Total |
|--------------|----------------|----------------|----------------|
| 0-4 | 58,287 | 54,166 | 112,453 |
| 5-9 | 52,451 | 48,237 | 100,688 |
| 10-14 | 46,979 | 43,642 | 90,621 |
| 15-19 | 45,171 | 41,526 | 86,697 |
| 20-24 | 40,970 | 37,478 | 78,448 |
| 25-29 | 36,376 | 33,148 | 69,524 |
| 30-34 | 31,818 | 28,810 | 60,628 |
| 35-39 | 26,601 | 24,065 | 50,666 |
| 40-44 | 21,603 | 20,217 | 41,820 |
| 45-49 | 18,225 | 17,569 | 35,794 |
| 50-54 | 15,921 | 15,540 | 31,461 |
| 55-59 | 13,653 | 13,228 | 26,881 |
| 60-64 | 10,865 | 10,451 | 21,316 |
| 65-69 | 7,981 | 7,768 | 15,749 |
| 70-74 | 5,380 | 5,353 | 10,733 |
| 75+ | 5,529 | 5,321 | 10,850 |
| Total | 437,810 | 406,519 | 844,329 |

The Three Alternative Projections

All the three projections assume that migration does not have any effect on the population size and structure. The trend in expectation of life at birth for males and females during 1991-2051 is given in Table 2.

Table 2: Assumed trend in expectation of life at birth India, 1991-2051

| Period | Males | Females |
|------------------|--------------|----------------|
| 1991-1996 | 61.3 | 60.7 |
| 1996-2001 | 63.4 | 63.4 |
| 2001-2006 | 65.1 | 65.9 |
| 2006-2011 | 66.6 | 68.4 |
| 2011-2016 | 68.1 | 70.5 |
| 2016-2021 | 69.6 | 72.2 |
| 2021-2026 | 70.6 | 73.6 |
| 2026-2031 | 71.6 | 74.8 |
| 2031-2036 | 72.5 | 76.0 |
| 2036-2041 | 73.0 | 77.0 |
| 2041-2046 | 73.0 | 77.0 |
| 2046-2051 | 73.0 | 77.0 |

Expectation of life at birth for males is assumed to increase from 61.3 years during 1991-96 to 73 years during 2046-51 and during the same period it is assumed to increase from 60.7 to 77.0 for females, A larger increase in the life expectancy of females is expected as the past trend in the developed countries and some of the developing countries has been so; the South Asian pattern of mortality is assumed to hold. Though the United Nations (1982) publication provides model life tables only up to 75 years of expectation of life at birth, PEOPLE has the provision to extrapolate beyond this age. This facility has been used in the present paper.

In the three alternative projections, only the trend in fertility is different. In the first projection, fertility is assumed to decline to replacement level around 2016 and continue to decline further to a level just below replacement level. This decline is assumed to be faster during the early period, reaching a constant level by the year 2021.

In the second projection, a sudden drop in fertility to replacement level by the year 1996 is assumed. For the year 1991-96, the of fertility is the same as in the

first projection. Thereafter, it declines slowly to keep up with changes in life expectancy to reach replacement level.

In the third projection, the fertility is determined by a policy of keeping the number of births constant. Such a policy cannot have retrospective effect and hence the fertility for the year 1991-96 is assumed to be the same as in the first projection. The number of births occurring during 1991-96 will be assumed to be maintained during the later years.

Results and Discussion

The trends in the total fertility rate from 1991-96 to 2046-2051, for the three population projections are given in Table 3.

Table 3: Trajectory of the total fertility rate under the three projections

| Year | Projection | | |
|-----------|-------------------------|----------------------------------|-----------------|
| | Slow Continuous Decline | Sudden Drop to Replacement level | Constant Births |
| 1991-1996 | 3.80 | 3.80 | 3.80 |
| 1996-2001 | 3.30 | 2.40 | 3.40 |
| 2001-2006 | 2.90 | 2.34 | 3.30 |
| 2006-2011 | 2.60 | 2.29 | 2.85 |
| 2011-2016 | 2.30 | 2.25 | 2.65 |
| 2016-2021 | 2.10 | 2.22 | 2.50 |
| 2021-2026 | 2.05 | 2.19 | 2.40 |
| 2026-2031 | 2.05 | 2.18 | 2.34 |
| 2031-2036 | 2.05 | 2.16 | 2.29 |
| 2036-2041 | 2.05 | 2.15 | 2.25 |
| 2041-2046 | 2.05 | 2.15 | 2.22 |
| 2046-2051 | 2.05 | 2.15 | 2.20 |

According to the second projection based on sudden replacement level fertility from 1996, Table 3 shows a rapid decline in total fertility between 1991-96 and 1996-2001 as one might expect. The assumption of a constant of number of births of about 128 million in every five years requires only a slow decline in total fertility.

The projection population totals from 1991 to 2051 are presented in Table 4 while Table 5 gives the percentage age distribution for selected years for three alternative projections

Table 4: Alternative population projection for India

| Year | Total Population (In millions) | | |
|------|--------------------------------|--------------|--------------|
| | Projection 1 | Projection 2 | Projection 3 |
| 1991 | 844 | 844 | 844 |
| 2001 | 1011 | 981 | 1051 |
| 2011 | 1164 | 1102 | 1185 |
| 2021 | 1296 | 1232 | 1352 |
| 2031 | 1410 | 1331 | 1506 |
| 2041 | 1504 | 1411 | 1643 |
| 2051 | 1559 | 1468 | 1749 |

Table 5: Percentage age distribution of projected population for selected years for the three projections

| Year | Age Group (Years) | Percent Population in the Age Group Under | | |
|------|-------------------|---|--------------|--------------|
| | | Projection 1 | Projection 2 | Projection 3 |
| 1991 | Under 15 | 36.0 | 36.0 | 36.0 |
| | 15-59 | 57.1 | 57.1 | 57.1 |
| | 60 and Over | 6.9 | 6.9 | 6.9 |
| 2011 | Under 15 | 28.1 | 24.0 | 29.3 |
| | 15-59 | 63.0 | 66.6 | 62.0 |
| | 60 and Over | 8.9 | 9.4 | 8.7 |
| 2031 | Under 15 | 21.5 | 21.6 | 24.1 |
| | 15-59 | 63.8 | 62.8 | 62.1 |
| | 60 and Over | 14.7 | 15.6 | 13.8 |
| 2051 | Under 15 | 18.9 | 19.7 | 21.1 |
| | 15-59 | 59.2 | 57.0 | 59.4 |
| | 60 and Over | 21.9 | 23.3 | 19.5 |

Table 6 represents the age- sex distribution under the three projected population totals for the year 2051. From the projections it is clear that population growth cannot be curtailed by keeping the population constant, as the population will exceed 1.7 billion by 2051. The other two projections are lower: the one based on achieving a sudden replacement level fertility being lower than that assuming a slow population decline to replacement level fertility, by 91 million.

Table 6: Projected population (in million) by age and sex in 2051

| Age (Years) | Projection 1 | | | Projection 2 | | | Projection 3 | | |
|-------------------|--------------|-------|--------|--------------|-------|--------|--------------|-------|--------|
| | M | F | Total | M | F | Total | M | F | Total |
| 0-4 | 49.8 | 47.4 | 97.2 | 49.8 | 47.5 | 97.3 | 63.2 | 60.2 | 123.4 |
| 5-9 | 50.0 | 47.7 | 97.7 | 49.8 | 45.5 | 97.3 | 62.3 | 59.9 | 122.6 |
| 10-14 | 50.9 | 48.6 | 99.4 | 48.6 | 46.4 | 95.0 | 62.6 | 59.6 | 122.5 |
| 15-19 | 51.7 | 49.2 | 100.9 | 47.0 | 44.7 | 91.7 | 62.4 | 59.4 | 121.8 |
| 20-24 | 51.9 | 49.3 | 101.1 | 46.6 | 44.3 | 90.9 | 62.0 | 58.9 | 120.9 |
| 25-29 | 51.4 | 48.8 | 100.2 | 48.7 | 46.3 | 95.0 | 61.5 | 58.4 | 119.9 |
| 30-34 | 50.9 | 48.4 | 99.3 | 51.3 | 48.7 | 100.0 | 60.9 | 57.9 | 118.8 |
| 35-39 | 52.2 | 49.7 | 101.9 | 50.8 | 48.3 | 99.0 | 60.1 | 57.1 | 117.2 |
| 40-44 | 53.9 | 51.3 | 105.1 | 47.5 | 45.2 | 92.7 | 59.0 | 56.1 | 115.1 |
| 45-49 | 53.9 | 51.3 | 105.2 | 43.8 | 41.7 | 85.4 | 57.6 | 54.8 | 112.3 |
| 50-54 | 54.0 | 51.6 | 105.6 | 39.8 | 38.0 | 77.8 | 55.6 | 53.1 | 108.7 |
| 55-59 | 52.7 | 50.9 | 103.6 | 52.7 | 50.9 | 103.6 | 52.7 | 50.9 | 103.6 |
| 60-64 | 48.1 | 47.7 | 95.8 | 48.1 | 47.7 | 95.8 | 48.1 | 47.7 | 95.8 |
| 65-69 | 40.0 | 41.3 | 81.3 | 40.0 | 41.3 | 81.3 | 40.0 | 41.3 | 81.3 |
| 70-74 | 30.3 | 33.9 | 64.2 | 30.3 | 33.9 | 64.2 | 30.3 | 33.9 | 64.2 |
| 75 & above | 45.1 | 55.5 | 100.5 | 45.1 | 55.5 | 100.5 | 45.1 | 55.5 | 100.5 |
| All | 786.6 | 772.5 | 1559.1 | 739.7 | 727.9 | 1467.6 | 883.7 | 865.0 | 1748.7 |
| Males/100 females | 101.8 | | | 101.6 | | | 102.2 | | |

The long-term goal of India as envisaged by the Government is to reduce the birth rate to 2.1 simultaneously achieving the lowest level of mortality[6]. The average expectation of life at birth is around 77 in Northern America, Northern Europe, Eastern Europe and Oceanic. With this level of mortality a birth rate of 2.1 can only be replacement level fertility. But our projections 1(fertility reaching

just below replacement level) yields a total population as large as 1.56 billion by the year 2051. Therefore, in order to avoid this population growth, a policy of below replacement level fertility is suggested.

From the three alternative projections, all assuming life expectancy at birth of 73 years for males and 77 years for females by 2051, it is found that the sex ratio of about 108 males per100 females in 1991 would decline to about 102 by the year 2051 (Tables 1 and 6). That is, the population would not attain female dominance as observed in developed countries even by the year 2051. According to all the three projection, fertility is assumed to vary only beyond 1996. Reaching a sudden replacement level fertility in 1996 implies a sudden drop in the number of births from 128 million to 91 million during 1996-2001(Table 7)

Table 7: Trajectory of number of births under the three projections (in millions)

| Period | Projection 1 | Projection 2 | Projection 3 |
|-----------|--------------|--------------|--------------|
| 1991-1996 | 128 | 128 | 128 |
| 1996-2001 | 124 | 91 | 128 |
| 2001-2006 | 120 | 97 | 128 |
| 2006-2011 | 117 | 103 | 128 |
| 2011-2016 | 111 | 108 | 128 |
| 2016-2021 | 107 | 107 | 128 |
| 2021-2026 | 107 | 101 | 128 |
| 2026-2031 | 107 | 101 | 128 |
| 2031-2036 | 106 | 96 | 128 |
| 2036-2041 | 104 | 99 | 128 |
| 2041-2046 | 102 | 101 | 128 |
| 2046-2051 | 101 | 101 | 128 |

The number of births then increases to reach 108 million during 2011-16 and then declines to 96 million during 2026-31 and 2031-36. The number of births once again increases to reach 101 million during 2041-46 and 2046-51. Thus, the trajectory of the number of births under a sudden fall to replacement fertility, swings up and down, and produces waves in the age distribution. The waves are clearly seen in the Projection 2 in Table 6. Such waves are not found in the case of the other two projections. Schooling, employment and the planning of other Socio-economic service facilities become difficult under such swings in birth cohorts besides exerting a stress on the economy by increasing or decreasing demand for consumer goods as the large and small cohorts age over time. But the trajectory of births under a moderate and continuous decline in fertility to one below replacement level is one of a slow and monotonic decline in birth

cohorts throughout the period 1991-2051. Therefore, changes in age distribution of the population (Table 5) are also not drastic.

Conclusion

From the foregoing analysis it is clear that trying to stabilize the population by regulating the number of births to remain constant at the level of 1991-96 will result in a very large ultimate population size. On the other hand, reducing fertility to replacement level suddenly will generate waves in the future birth trajectory, which will exert undesirable effects on the economy and social services.

Finally, therefore, it may be concluded that a moderate but steady decline in fertility to one below replacement level is necessary both to curtail the ultimate population size and to avoid waves in the age distribution of the population. Hence, the Government will have to continue to emphasize the family welfare program even after replacement level fertility has been reached in order to reduce the birth rate to below replacement level, perhaps by promoting a one-child policy.

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