# Population Projections for India up to the end of the Twenty-first Century

Purushottam M. Kulkarni

Centre for the Study of Regional Development, School of Social Sciences
Jawaharlal Nehru University, New Delhi, India 110067
pmkulkarni@mail.jnu.ac.in

**Abstract** The importance of population projections for India, with a sixth of the world's population, cannot be overemphasized. This paper examines various projections and raises issues pertinent to making projections up to the end of the twenty-first century. There is a broad consensus that mortality will fall steadily and that international migration will remain negligible. While recent trends show a clear fall in fertility, views on the extent and pace of future fertility decline diverge. With evidence on the emergence of the one-child family in some sections of population, the possibility of this norm being widely accepted in the future cannot be ruled out. Though marriage remains nearly universal and there is little evidence of voluntary childlessness, globalization and social change can impact marriage preferences and fertility behavior. Population projections for India need to factor in changes in these aspects as also India's well recognized regional diversity in demographic behavior.

## Introduction

Population projections for India, which has a sixth of the world's population, undoubtedly form an important component of overall world population projections. Naturally, a number of national and international organizations and demographers project India's population. The Office of the Registrar General of India (ORGI) carries out this task normally after every census enumeration with the projections extending to 25 years (Registrar General, India, 1996; 2006); projections following the 2011 census are now due. The United Nations Population Division (UNPD) projects India's population along with those of other countries; these are generally long-term, the recent projections are up to the end of the century. The World Bank, the U.S. Bureau of Census, the Population Foundation of India and the Population Reference Bureau (PFI and PRB) have also provided projections for India. Besides, many demographers also make projections for varying periods; some of these are short-term, medium-term and some long-term. Most of the organizations and individual demographers give alternate projections and the UNPD now includes probabilistic projections as well. While some projections are for India as a whole, the ORGI and some demographers give separate projections for states, at least for large states (for example, Dyson, 2004; Registrar General of India, 2006; PFI and PRB, 2007). The projections by the ORGI have the status of 'official' projections nationally and those by the UNPD, internationally.

The U.N. Population Division (2012 revision) projected India's population for the year 2100 as 1.5 billion (the Medium Projection), with the High and Low Projections being 2.5 billion and 0.9 billion respectively (UNPD, 2013); this is a very wide range with the Low Projection being lower than the present population (Table 1 and Fig. 1). The probabilistic projections by the UNPD give 1.1 – 2.2 billion as the 80% interval, again a very wide range. The PFI and PRB projections give two alternatives A and B and the projected populations for 2101 are 2.2 billion under A and 1.9 billion under B (PFI and PRB, 2007). Most of the projections prepared over the last decade were based on the 2001 census population and age-sex distributions. Now that the results of India's 2011 census have been published, and more recent trends in fertility and mortality are available, a fresh set of projections is in order. In this context, this paper discusses issues pertinent to making projections for India up to the end of the twenty-first century. Specifically, these are: level of disaggregation, projections of mortality, fertility, sex ratio at birth, migration and urbanization.

Table 1: Population Trends in India up to 2011 and Projections up to 2101

| | Census | UNPD 2012 Revision | | | PFI/PRB | | Dyson | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Enumeration | Low | Medium | High | A | B | Low | Standard | High |
| 1901 | 238 | | | | | | | | |
| 1911 | 252 | | | | | | | | |
| 1921 | 251 | | | | | | | | |
| 1931 | 279 | | | | | | | | |
| 1941 | 319 | | | | | | | | |
| 1951 | 361 | | | | | | | | |
| 1961 | 439 | | | | | | | | |
| 1971 | 548 | | | | | | | | |
| 1981 | 683 | | | | | | | | |
| 1991 | 846 | | | | | | | | |
| 2001 | 1029 | | | | | | | | |
| 2011 | 1211 | | | | | | | | |
| 2021 | | 1321 | 1353 | 1386 | 1380 | 1371 | 1343 | 1362 | 1387 |
| 2031 | | 1391 | 1476 | 1562 | 1546 | 1523 | 1425 | 1465 | 1521 |
| 2041 | | 1419 | 1566 | 1718 | 1695 | 1651 | 1463 | 1543 | 1642 |
| 2051 | | 1399 | 1620 | 1862 | 1824 | 1751 | 1458 | 1579 | 1731 |
| 2061 | | 1339 | 1643 | 1994 | 1931 | 1822 | | | |
| 2071 | | 1249 | 1640 | 2114 | 2019 | 1864 | | | |
| 2081 | | 1138 | 1617 | 2231 | 2087 | 1881 | | | |
| 2091 | | 1019 | 1584 | 2350 | 2141 | 1876 | | | |
| 2101 | | 905 | 1547 | 2470 | 2181 | 1853 | | | |

Note: UNPD: United Nations Population Division. The UNPD projections refer to years ending with 0 rather than 1 (i.e., 2020, 2030, ..2100 rather than 2021, 2031, ….2101).

Sources: Registrar General, India (2013); UNPD (2013); PFI/PRB (2007); Dyson (2004).

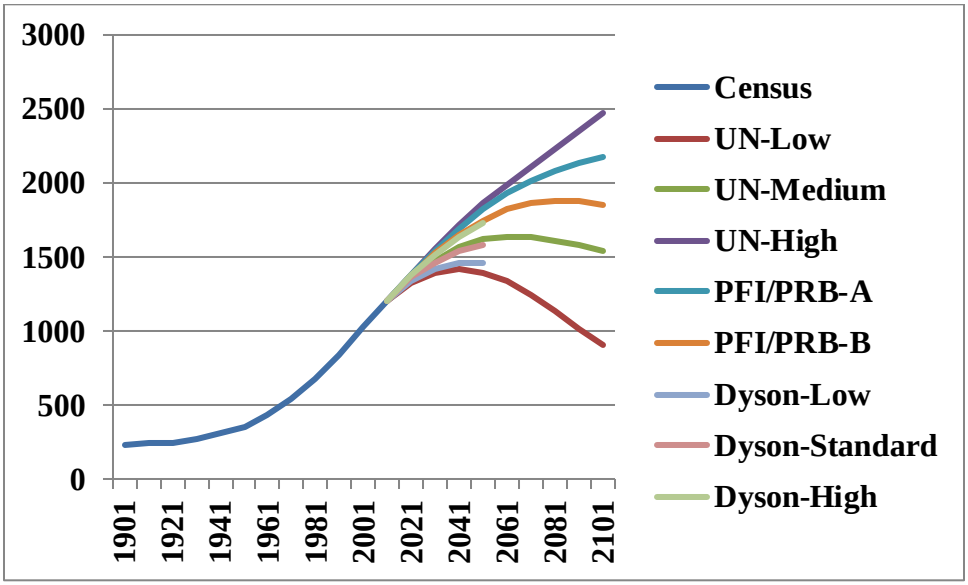


Fig.1: Population Trends for India up to 2011 and Projections by various organizations *(populations in millions)*
Source: Table 1.

**Issues in Population Projections for India**

Levels of disaggregation

For a country as large and diverse as India, disaggregated projections are in order and the ORGI does provide projections for large states; note that 10 states of India have populations exceeding 50 million (3 states have populations over 100 million and 7 between 50 and 100 million), larger than the populations of most countries of the world and 11 more have populations between 10 and 50 million. Given India's federal structure, each state requires projections for planning and administrative purposes. Moreover, as the process of demographic transition has varied spatially, both in the onset and the pace, applying techniques of sub-national projections to the national projections to obtain projections for states is not desirable and separate component projections for states, at least for large states, are called for. Fairly reliable data on fertility and mortality trends are available for large states enabling such projections. Further, projections at levels below the state, in particular, administrative districts, are demanded by Indian planners and administrators since a district is treated as a planning unit and the average district population is about two million. However, reliable data on fertility and mortality are generally not available for districts preventing application of component projection. Therefore, district shares could be projected and applied to state projections.

Disaggregation by age and sex is naturally required by planners, administrators, and demographers. There is need to have projected populations of working ages, of school ages, of

reproductive ages, and of elderly. This poses no problems in component projections since age-sex disaggregation is part of the standard projection output.

Projection of mortality

India's civil registration system does collect and publish data on births and deaths by sex, disaggregated up to the district level. Registration is compulsory by an act, yet a large number of births and deaths go unregistered. Though the level of coverage has shown distinct improvement in the last decade, the coverage is far from complete and hence the data from the civil registration are not useful to assess levels and trends in mortality or fertility. Instead, the Sample Registration System (SRS), which has been operating for over four decades, and has a continuous registration combined with half-yearly surveys with verification, has served as the principal source of information on fertility and mortality rates. Age-sex specific deaths rates are available for India and large states on an annual basis (though in some years data were not collected in a few states) allowing construction of life tables (which are also provided by the SRS). The trends show a steady fall in mortality and there is consensus among various organizations and demographers engaged in the task that the decline is expected to continue. But how long will this continue and is there a floor for deaths rates (or a ceiling for life expectancy)?

First, the recent trends show that a deviation that had arisen in India, of male life expectancy being higher than female expectancy in contrast to the general pattern of higher expectancy for females, is no longer seen (Table 2 and Fig. 2). Since the 1990s, female expectancy has been greater than male expectancy and the gap has widened over the years though it is not as much as seen in other populations with a comparable level of mortality. The huge female disadvantage in survival, that was seen earlier, has nearly disappeared and hence, in long-term projections, one could now adopt the overall pattern than a specific Indian pattern of sex differences. Second, there has been a fairly smooth increase in life expectancy.

The level of mortality does vary across states. Trends in life expectancy (both sexes combined) for some states, Kerala and Punjab representing low mortality and Uttar Pradesh and Madhya Pradesh representing relatively high mortality are shown in Fig 3. The overall trend is upward (some short-term fall seen some states is probably due to change in the method of construction of life table). Besides, the gaps seem to be narrowing somewhat pointing towards convergence in the foreseeable future. Therefore, for long term projections, it is reasonable to project a common high value for life expectancy. The UNPD projections assume a life expectancy close to 80 years (79 for males and 82 for females) and the PFI/PRB projections a value of 83 years for the end of the century. A life expectancy in the lower 80s seems realistic. The commonly used age patterns of mortality used in India are the U.N. South Asian or the Princeton (Coale-Demeny) West.

Table 2: Trends in Life Expectancy, India, Sample Registration System, 1970-2013

| Period | Male | Female | Both sexes combined | Period | Male | Female | Both sexes combined |
|---|---|---|---|---|---|---|---|
| 1970-75 | 50.5 | 49.0 | 49.7 | 1997-2001 | 61.4 | 63.3 | 62.3 |
| 1976-80 | 52.5 | 52.1 | 52.3 | 1998-2002 | 61.9 | 64.0 | 62.9 |
| 1981-85 | 55.4 | 55.7 | 55.5 | 1999-2003 | 62.3 | 64.6 | 63.4 |
| 1986-90 | 57.7 | 58.1 | 57.7 | 2000-2004 | 62.8 | 65.2 | 63.9 |
| 1987-91 | 58.1 | 58.6 | 58.3 | 2001-2005 | 63.1 | 65.6 | 64.3 |
| 1988-92 | 58.6 | 59.0 | 58.7 | 2002-2006 | 63.5 | 66.1 | 64.7 |
| 1989-93 | 59.0 | 59.7 | 59.4 | 2003-2007 | 63.7 | 66.5 | 65.0 |
| 1990-94 | 59.4 | 60.4 | 60.0 | 2004-2008 | 64.0 | 66.9 | 65.4 |
| 1991-95 | 59.8 | 60.9 | 60.5 | 2005-2009 | 64.3 | 67.2 | 65.7 |
| 1992-96 | 60.1 | 61.4 | 60.9 | 2006-2010 | 64.6 | 67.7 | 66.1 |
| 1993-97 | 60.4 | 61.8 | 61.1 | 2007-2011 | 64.9 | 68.2 | 66.5 |
| 1994-98 | 60.6 | 62.2 | 61.4 | 2008-2012 | 65.4 | 68.6 | 67.0 |
| 1995-99 | 60.8 | 62.3 | 61.5 | 2009-2013 | 65.8 | 69.3 | 67.5 |
| 1996-2000 | 61.2 | 62.7 | 61.9 | | | | |

Source: India, Registrar General (2010, 2015).

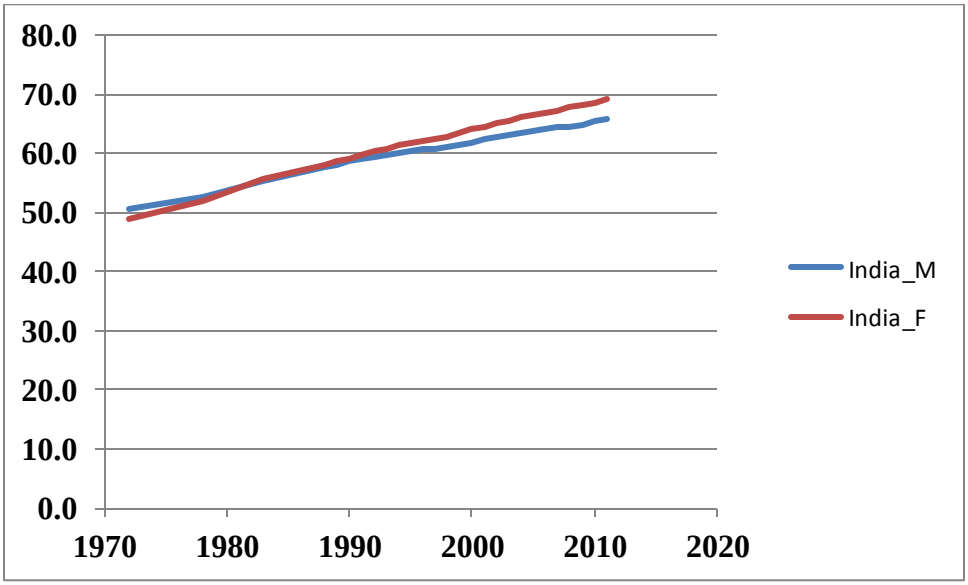


Fig. 2: Trends in Life Expectancy, India, Male and Female, Sample Registration System, 1971-2013.

Source: Table 2.

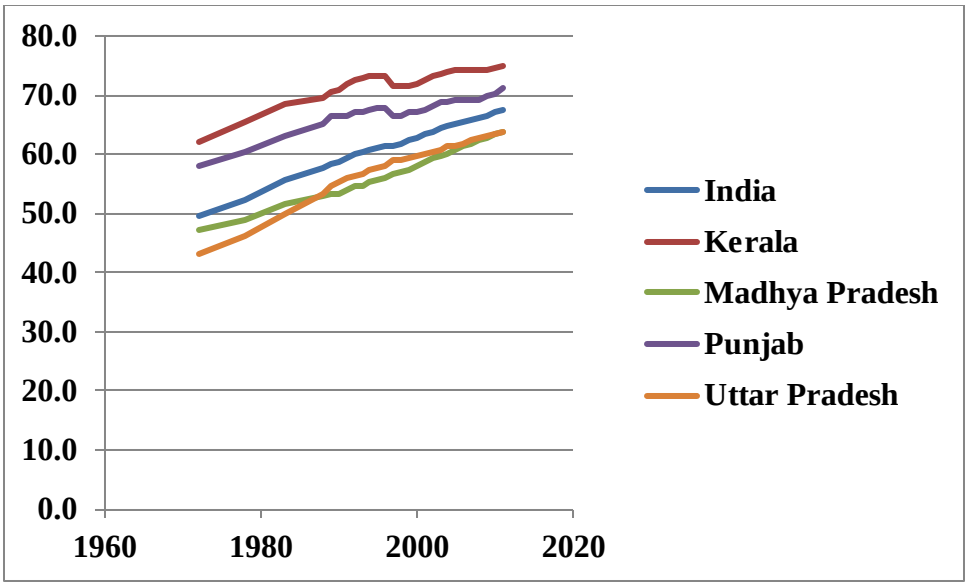


Fig.3: Trends in Life Expectancy (both sexes combined), typical large states of India, 1971-2013
Source: Based on data from Sample Registration System, Registrar General, India (2010, 2015).

Projection of fertility

The recent trends, based on the SRS estimates, show declining fertility in India especially since the 1980s (Table 3 and Fig. 4) and hence further decline in fertility is factored in the projections. However, as views on the extent and pace of further fertility decline diverge, generally alternative projections are made with different paths of fertility change. The UNPD uses a wide range in the TFR, of one point, in their alternative projections (High, Medium and Low), 1.34 to 2.34, with a medium value of 1.84 just before the end of the century with the result that the projected population for 2100 range is very wide, 2.5 and 0.9 billion (UNPD, 2013). The UNPD probabilistic projections also give a very wide range. On the other hand, the PFI/PRB projections use a narrower range for alternative values of the TFR (2.1 and 1.9) and naturally obtain projected population in a narrower range, but the projected values are large as the projected long-term TFR in these is relatively high.

The UNPD projections give too wide a range to be of much practical use and hence one needs to identify the most likely projection. Recent demographic surveys in India clearly show that the two-child norm has been widely accepted by all sections including the illiterate and the poor and that contraceptive prevalence has increased substantially (IIPS and Macro International, 2007). With rise in parental aspirations for education of children, quantity-quality trade-off comes into play lowering family size desires (Kulkarni, 2011). This suggests that fertility is expected to fall to a level of TFR close to 2 soon. In the past, it was felt that fertility will fall to low replacement level with TFR around 2.1, which incidentally matched with the goal of the population policy. The projections were generally based on TFR reaching this level and remaining at it thereafter.

However, now that the TFR in a large number of countries has fallen well below 2, the likelihood of this happening in India is strong. The TFR for urban India has touched 1.8. Besides, some states of India have already reached a TFR close to 1.8; in 2013, 10 large states accounting for nearly half of India's population had TFR below 2 (Registrar General of India, 2014). But will the TFR fall below 2 at the national level? With evidence on the emergence of the one-child family in some sections of population, the possibility of this norm being widely accepted in the future cannot be ruled out. Diffusion is expected to be rapid in the future with more channels of communication becoming available (see Bongaarts and Watkins, 1996). Further fall in fertility to levels below replacement is imminent.

Table 3: Trends in Total Fertility Rate, India, Sample Registration System, 1971-2013

| Year | Total | Rural | Urban | Year | Total | Rural | Urban |
|---|---|---|---|---|---|---|---|
| 1971 | 5.2 | 5.4 | 4.1 | 1993 | 3.5 | 3.8 | 2.8 |
| 1972 | 5.2 | 5.4 | 4.3 | 1994 | 3.5 | 3.8 | 2.7 |
| 1973 | 4.9 | 5.2 | 3.7 | 1995 | 3.5 | 3.9 | 2.6 |
| 1974 | 4.9 | 5.2 | 3.7 | 1996 | 3.4 | 3.7 | 2.4 |
| 1975 | 4.9 | 5.2 | 3.7 | 1997 | 3.3 | 3.6 | 2.4 |
| 1976 | 4.7 | 5.0 | 3.6 | 1998 | 3.2 | 3.5 | 2.4 |
| 1977 | 4.5 | 4.8 | 3.4 | 1999 | 3.2 | 3.5 | 2.3 |
| 1978 | 4.5 | 4.8 | 3.4 | 2000 | 3.2 | 3.5 | 2.3 |
| 1979 | 4.4 | 4.7 | 3.4 | 2001 | 3.1 | 3.4 | 2.3 |
| 1980 | 4.4 | 4.7 | 3.4 | 2002 | 3.0 | 3.3 | 2.2 |
| 1981 | 4.5 | 4.8 | 3.3 | 2003 | 3.0 | 3.2 | 2.2 |
| 1982 | 4.5 | 4.9 | 3.4 | 2004 | 2.9 | 3.3 | 2.1 |
| 1983 | 4.5 | 4.9 | 3.4 | 2005 | 2.9 | 3.2 | 2.1 |
| 1984 | 4.5 | 4.8 | 3.5 | 2006 | 2.8 | 3.1 | 2.0 |
| 1985 | 4.3 | 4.6 | 3.3 | 2007 | 2.7 | 3.0 | 2.0 |
| 1986 | 4.2 | 4.5 | 3.1 | 2008 | 2.6 | 2.9 | 2.0 |
| 1987 | 4.1 | 4.4 | 3.2 | 2009 | 2.6 | 2.9 | 2.0 |
| 1988 | 4.0 | 4.3 | 3.1 | 2010 | 2.5 | 2.8 | 1.9 |
| 1989 | 3.9 | 4.2 | 2.8 | 2011 | 2.4 | 2.7 | 1.9 |
| 1990 | 3.8 | 4.1 | 2.8 | 2012 | 2.4 | 2.6 | 1.8 |
| 1991 | 3.6 | 3.9 | 2.7 | 2013 | 2.3 | 2.5 | 1.8 |
| 1992 | 3.6 | 3.9 | 2.6 | | | | |

Source: Registrar General, India (2009, 2010, 2011, 2012, 2013b, 2013c, 2014).

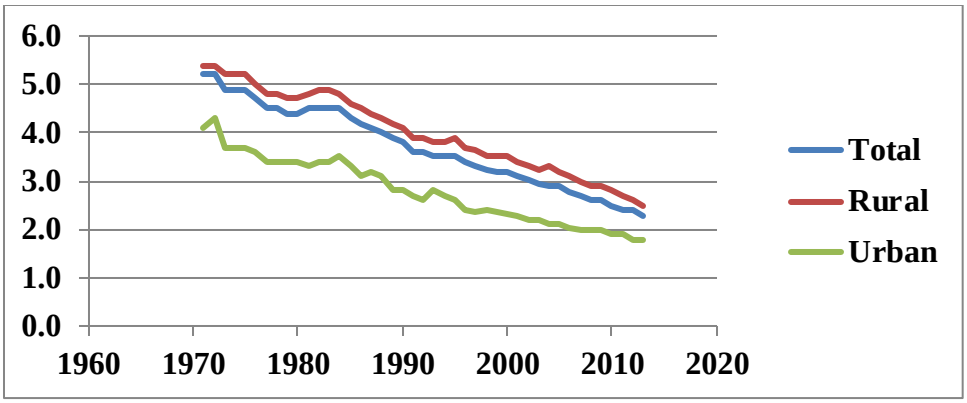


Fig. 4: Trends in Total Fertility in India, Sample Registration System, 1971-2013
Source: Table 3.

The large inter-state variations in fertility pose another problem. While decline is seen in all the regions of the country, the convergence has not been rapid. As seen from trends for some typical high and low fertility states, wide gaps persist (Fig. 5). Some states do show rapid decline moving towards the level of low fertility states, but many large states do not. Besides, for urban fertility, new gaps have emerged (Fig. 6). This makes it difficult to project national trends. If some regions continue to have higher than average fertility for a prolonged period, with mortality gaps remaining narrow, huge imbalance will emerge in population growth. This will then change the relative shares of regions and affect the national average. Extrapolations of fertility and mortality indicators at the national level will vary from the weighted aggregates of extrapolated state level indicators if the weights vary over time. In that case, the national fertility projections may have to be obtained by applying population weights, which would change over time, to the fertility projections for regions. Given that regional, especially state level, projections are strongly demanded in India, it makes sense then to make projections at least for large states separately and then arrive at national projections.

But will fertility fall much below the low replacement level, as has happened in many European countries? The recent tends show that in states that experienced transition early, Kerala and Tamil Nadu, the TFR has settled close to 1.7-1.8 (Fig. 5). On the other hand, in urban West Bengal, the TFR has reached a very low level of 1.2, labeled as 'lowest low' fertility. The European experience shows that very low fertility has been achieved in conditions of non-marriage by a fairly large section of women. Besides, there is voluntary childlessness within sexual union on a non-negligible scale. The evidence in India shows that marriage continues to be nearly universal and voluntary childlessness is negligible. If these attitudes persist, fertility may not fall to a very low level. However, globalization and social change can impact marriage preferences and fertility behavior. The likelihood of fertility falling to a very low level, well below 2 or even below 1.8 is high. This makes it difficult to arrive at a floor for the long-term fertility level.

The age pattern of fertility has changed through transition. Given the domination of sterilization in contraceptive use in India, childbearing is increasingly getting concentrated in the twenties. This is not likely to undergo a substantial change except for some upward shift due to rise in female age at marriage.

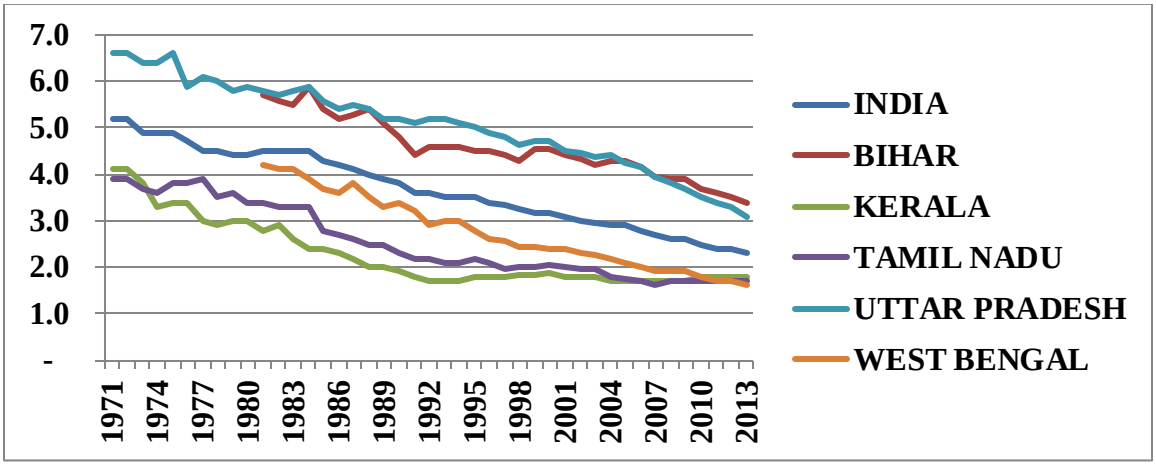


Fig. 5: Trends in Total Fertility Rate, typical large states of India, 1971-2013
Source: based on data from Sample Registration System, Registrar General, India (2009, 2010, 2011, 2012, 2013b, 2013c, 2014).

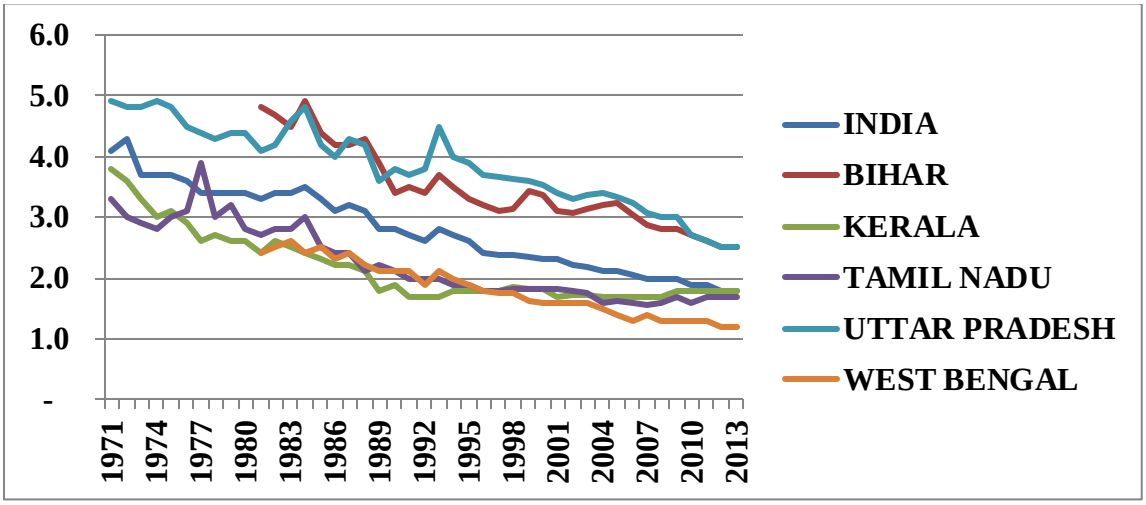


Fig. 6: Trends in Urban Total Fertility Rate, typical large states of India, 1971-2013.
Source: based on data from the Sample Registration System, Registrar General, India (2009, 2010, 2011, 2012, 2013b, 2013c, 2014).

Sex ratio at birth

The sex ratio at birth is an essential input for component projections and in most population projections it suffices to provide a normal sex ratio at birth, around 105 males per 100 females, as the input. However, since the 1990s, the sex ratio at birth has become more masculine than normal in India, crossing 113 for some time after the turn of the century and has yet to fall below 110 (Fig. 7). The reason for this deviation from the normal ratio is well known, the emergence of pre-natal sex detection followed by sex-selective abortions in some regions of the country; in some states the ratio had crossed 120. While legal measures and campaigns against sex-selection have been undertaken and the severity has reduced in regions where this practice had reached a high level, and there has been some moderation, normality is far from being restored. The trends in the sex ratio at birth are, at this time, not predictable. Though normality is expected to occur in the long-term, how long this will take is difficult to predict. The uncertainty in this will naturally impact the projections.

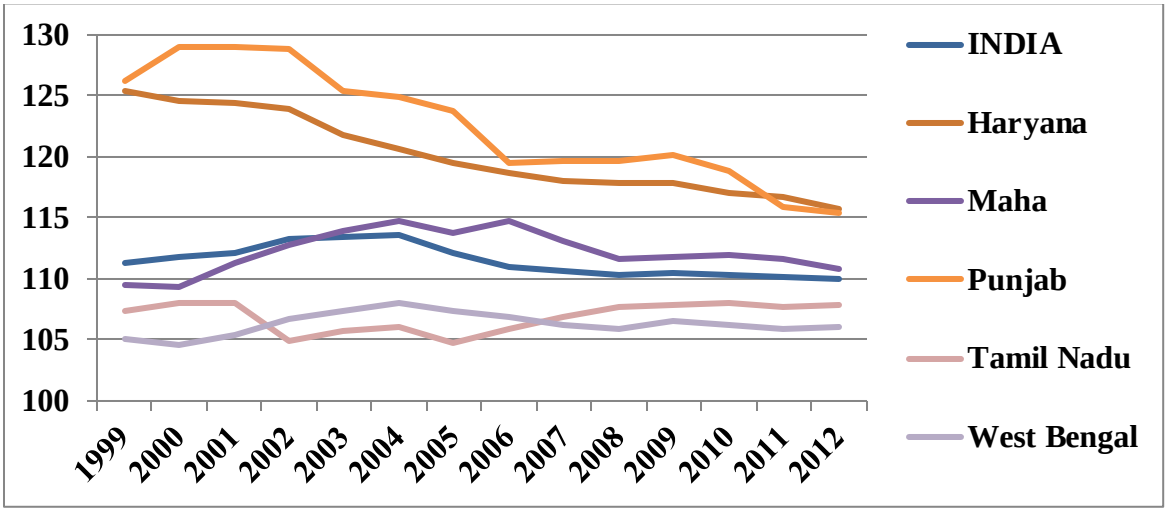


Fig. 7: Trends in Sex Ratio at Birth, typical large states of India, 1998-2013
Source: Based on data from the Sample Registration System, Registrar General, India (2009, 2010, 2011, 2012, 2103b, 2013c, 2014).

Migration and urbanization

International migration has been relatively negligible for India; this is so in both directions. While some emigration does take place, the volume is small and for India's size this hardly matters. As a result, this factor is generally ignored in national projections. There is no reason to believe that the situation will change in this respect unless major geopolitical changes occur allowing easy emigration on a large scale. However, there is substantial internal migration; though bulk of this is short distance and intra-state (including migration of women incidental to marriage), inter-state migration is not negligible and this has to be factored in while making projections for states and regions. There are some well established migration streams and some

states have been experiencing net in-migration and some net out-migration for long. However, for some states the direction of net migration has fluctuated from one inter-censal decade to another making extrapolation difficult. As long as the volume of such migration is not large, the overall impact is not conspicuous. But the next few decades are likely to be different. A result of the wide differences in fertility across states is that the growth rate will differ substantially across regions of the country. While the large states in the north-central states will continue to grow for quite some time partly due to above replacement fertility and partly on account of momentum, those in the southern regions and most of those in other parts are expected to reach near zero growth before the middle of the century. This, in turn, is bound to cause regional growth imbalance. Trial projections for three regions, the north-central region of seven states, the southern region of four states and a union territory, and the third region of the remaining areas (western, northern and eastern) show that the north-central region that includes seven large states will experience growth in excess of 60 million per decade for the next three decades whereas the other two regions will not grow much (Fig. 8, 9); these projections were made on the assumption of no migration in order to assess the impact of *differential natural increase*. After 1941, most of the growth will be in the north-central region since growth will nearly cease in the other two regions which will soon begin to experience decline. A likely consequence is of huge migration streams from the north-central region to the rest causing population redistribution, though it is not possible to predict how large this will be. Thus, inter-state migration in the future will be neither negligible nor predictable. Clearly, factoring this in the projections is essential but difficult as extrapolation of recent migration trends is not advisable.

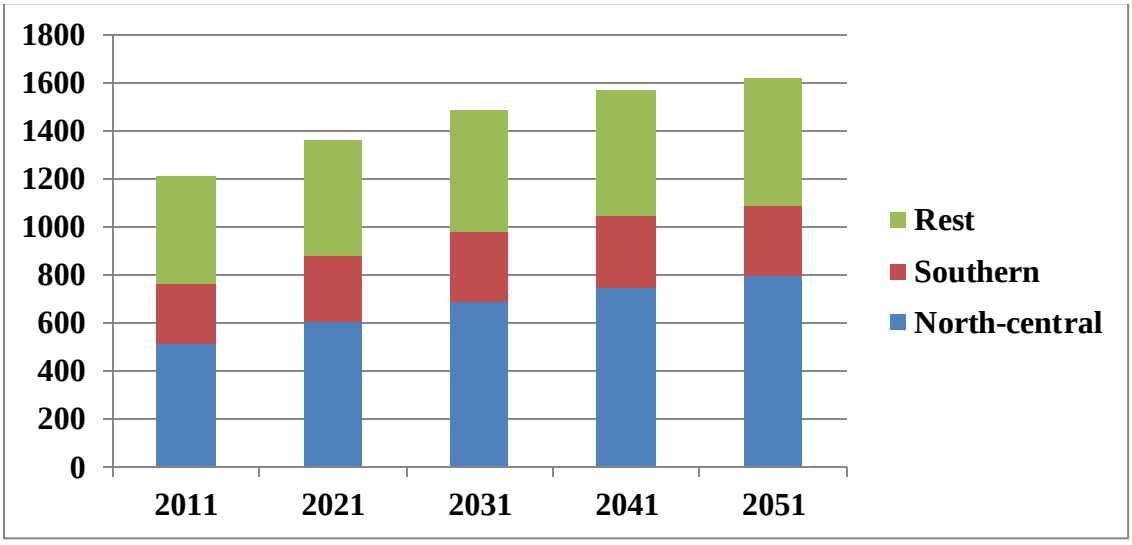


Fig.8: Projected Population (in millions) in three Regions of India, 2011-2051 (assuming no inter-regional migration)
Source: Author's computations.

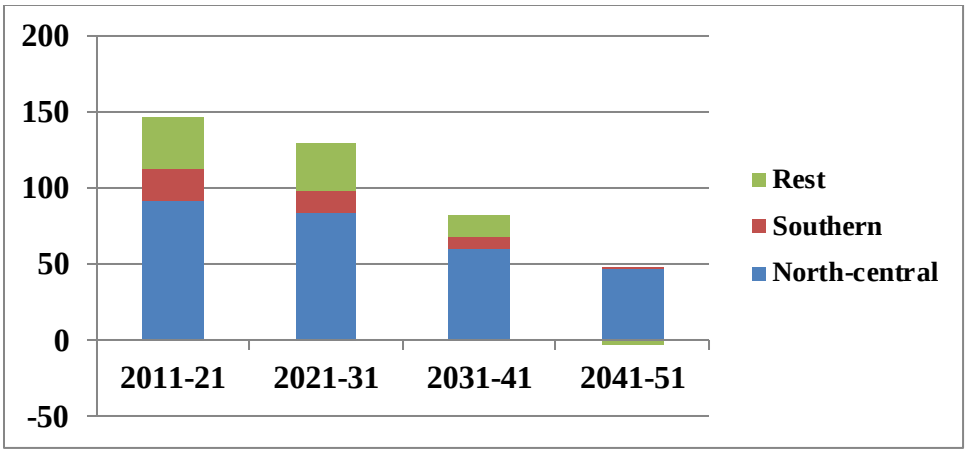


Fig. 9: Projected Decadal Population Growth (in millions) in three Regions of India, 2011-2051 (assuming no inter-regional migration).
Source: Author's computations.

In spite of India experiencing rapid economic development in the last two decades, the tempo of urbanization has been quite low (Table 4). The 2001-11 decade did show a marginal rise, but overall the level of urbanization has not been high with only about 31 percent of population residing in urban areas in 2011 (Registrar General, India, 2013a); this well below that seen in China. Besides, barring some city states, union territories and small states, nowhere has urbanization crossed 50 percent. Prospects of rapid urbanization do not appear high at the present moment. But short-term projections of urbanization can be done using standard techniques, the urban-rural growth differential being one. Planners do ask for short or medium-term projections. This is so especially for individual cities but there is greater volatility in city growth.

Table 4: Trends in Urbanization in India, 1901-2011

| Year | Percent urban | Inter-censal increase in percent urban | Urban-Rural Growth Differential (URGD) |
|---|---|---|---|
| 1901 | 10.85 | | |
| 1911 | 10.29 | -0.56 | -0.58 |
| 1921 | 11.18 | 0.89 | 0.92 |
| 1931 | 11.99 | 0.81 | 0.80 |
| 1941 | 13.86 | 1.87 | 1.66 |
| 1951 | 17.29 | 3.43 | 2.62 |
| 1961 | 17.97 | 0.68 | 0.47 |
| 1971 | 19.91 | 1.94 | 1.25 |
| 1981 | 23.34 | 3.43 | 2.04 |
| 1991 | 25.71 | 2.37 | 1.28 |
| 2001 | 27.81 | 2.10 | 1.07 |
| 2011 | 31.15 | 3.34 | 1.61 |

Source: India, Registrar General (2013a).

## Conclusions

Clearly, population projections for India pose a number of challenges. True, projection of mortality is not likely to be a major issue as the declining trend is fairly smooth and a ceiling for life expectancy close to 80 is likely to be reached. Further decline in fertility is bound to occur but given the diversity in fertility trends, the floor is likely to differ by regions. Moreover, given the very low fertility already reached in some parts, there is uncertainty in the floor; will the TFR stabilize in the range 1.6-1.8 or reach a value as low as 1.2 or 1.3? Will India experience the second demographic transition? These are difficult questions to answer but must be addressed by those engaged in long-term projections. A problem not commonly encountered in projections is that of the sex ratio at birth which has become more masculine in India than normal (China also faces this issue). The time taken for the sex ratio to return to the normal level has a bearing on projections of female population and over time of male population as well.

Regional diversity in demographic behavior is another issue quite relevant to projections for India. Over time, wide variations in levels of survival and in fertility have been observed. These have, by and large, persisted, in spite of overall improvement in survival and fall in fertility. But as mortality in some regions reaches a very low level, further declines will be difficult and convergence or at least narrowing of gaps is inevitable. How soon this happens has a bearing on projections. Gaps in fertility may persist. The projections must, therefore, take into account large regional variations, calling for projections at the state or regional level. But this is inescapable given that many states of India are large, with population exceeding fifty million, and states have their own development plans for which population projections are essential.

We thus face a number of problems in making population projections for India. This is, undoubtedly, a great challenge and an onerous task. But making projections for a country with a billion plus population, known for its proverbial diversity, cannot be expected to be a classroom exercise.

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