

Population Prospects for Madhya Pradesh in the Twenty-first Century

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Abstract

Madhya Pradesh is passing through the classical demographic transition. Mortality has declined and fertility has also fallen with a lag and is likely to fall below the replacement level. However, population of the state will continue to increase for some time primarily due to momentum and also on account of anticipated fall in mortality. This paper presents population projection of the state up to the end of the twenty-first century. The paper suggests that state population is likely to reach a peak of about 113 million around 2070 and will then decline to about 108 million by the end of the century. The age structure of the population will also change. The state is in a position to draw good demographic dividend through the middle of the century. An alternate projection based on the assumption of accelerated and sharper fertility decline suggests that state population will peak around 105 million by 2061. Although, the population of the state will increase in future, yet the rate of growth is not likely to be large. The paper also discusses policy implications of the projected population of the state.

Introduction

Madhya Pradesh is one of the large states of India, ranking second in terms of area and fifth in terms of population size at the 2011 population census. State population nearly quintupled during the twentieth century, from 12.7 million in 1910 to 60.3 million in 2001, most of the increase occurred after 1951 (Government of India, 2013). At the 2011 population census state population was enumerated to be 72.6 million. Population growth in the state has been fairly in line with that in India with the annual rate of growth being just under or over two percent since the mid-century but the intercensal decade 2001-2011 did show a notable decline in the rate of growth. Combined with the trend in fertility and mortality, this clearly shows that the state is passing through the classical demographic transition. Recent estimates show that fertility in the state is approaching the replacement level or has perhaps reached it. The fifth round of the National Family Health Survey (NFHS-5) estimated the Total Fertility Rate (TFR) at 1.99 during 2019-21 (Government of India, 2021). The estimate from the

Sample Registration System (SRS) for 2020 (Government of India, 2022) was higher, 2.6, but given the recent trend, fall to and possibly below replacement level is expected. Clearly, we do not expect high population growth in the future and certainly no population explosion as was being talked about in the past. Yet, population will grow for some time due to the momentum of growth. Besides, mortality has been declining in the state and further decline is expected. Population growth in the future will depend on future trend in fertility, mortality, and migration. Besides, changes in demographic parameters will affect the age structure of the population over a long period. As is well recognized, the size of the population, its age structure, and the pace of change have implications for planning and administration. Population projections give an idea of the likely changes in the future and hence provide valuable inputs for policy formulation and planning.

The Technical Group on Population Projections (TGPP) constituted by the Government of India, National Commission on Population has recently prepared population projections for India and states (Government of India, 2020a). These projections go up to 2036 only and hence do not provide the long-term perspective of population growth. The United Nations Population Division also prepares population projections for its member countries but do not give state level projections (United Nations, 2022). Kulkarni (2021a) has projected population of the country and its large states up to the year 2101 based on certain assumptions on future changes in demographic parameters. This paper presents principal results for Madhya Pradesh. It is well-known that even after replacement fertility is achieved, population continues to increase due to the phenomenon of population momentum. Moreover, mortality decline is expected to continue even after attaining replacement level fertility and this would contribute to the increase in population. Further, given the experience of countries which have completed fertility transition, fertility may not remain static after reaching the replacement level but is likely to fall below the replacement level leading to population decline in the long-term. All these factors contribute to future changes in population size. A decomposition of future population changes into contributions of various factors informs policy makers (Andreev et al, 2013). Such a decomposition is presented here for Madhya Pradesh. The paper also discusses implications of future population growth for the development of the state.

Demographic Situation in Madhya Pradesh

The population projection exercise requires information on the present demographic situation - the size and the age and sex structure of the population - as the baseline, and recent trends in the parameters of the components of population change - fertility, mortality, and migration. Data from the decennial population censuses and from the official sample registration system (SRS) give estimates of various demographic parameters. Population growth in Madhya Pradesh was slow in the first half of the twentieth century, but, since 1951, population growth has been rapid, at a

pace of over two per cent per annum, until the end of the century. During the intercensal decade 2001-2011, there has been a decline in the population growth rate of the state, with the average annual growth rate falling below two per cent. Population growth in Madhya Pradesh has been slightly more rapid than that in India since 1951, but the population growth trend in India has been similar to that in India.

Table 1: Population Trends in Madhya Pradesh and India, 1901 to 2011

Year	Population (At 2011 population census)		Average annual growth rate (Per cent)	
	Madhya Pradesh	India	Madhya Pradesh	India
1901	12,679,214	238,396,327		
1911	14,249,382	252,093,390	1.17	0.56
1921	13,906,774	251,321,213	-0.24	-0.03
1931	15,326,879	278,977,238	0.97	1.04
1941	17,175,722	318,660,580	1.14	1.33
1951	18,614,931	361,088,090	0.80	1.25
1961	23,217,910	439,234,771	2.21	1.96
1971	30,016,625	548,159,652	2.55	2.20
1981	38,168,507	683,329,097	2.42	2.22
1991	48,566,242	846,421,039	2.41	2.14
2001	60,348,023	1,028,737,436	2.17	1.95
2011	72,626,809	1,210,854,977	1.85	1.63

Source: Government of India (2013).

The indicators of fertility and mortality for the state are available from SRS since 1971. The TFR in the state has declined notably while the life expectancy has increased over time (Table 2). Thus, both fertility and mortality in the state show a clear downward trend. When compared to India, TFR in the state has been higher while life expectancy has been lower than the national average. Although, Madhya Pradesh is passing through demographic transition, yet the pace of transition in the state has been slower than that in several large states of India. The male life expectancy in the state was higher than the female life expectancy during the 1970s and 1980s, but, since mid-1990s, female expectancy has overtaken male expectancy in the state, a pattern which is similar to the national pattern. The gap between the state and national life expectancy at birth was wide in the past but has narrowed recently.

As noted earlier, the SRS estimate of the TFR for the year 2020 is higher than the NFHS-5 estimate of TFR of 1.99 during the period 2019-21. A comparison of the estimates from the earlier rounds of the NFHS with the SRS estimates for the corresponding periods also shows that the NFHS estimates were lower than SRS estimates. Since the SRS estimates are based on continuous registration and half-yearly surveys and verification of events, these are preferred to examine long, or medium-term trend and one can thus infer that fertility in Madhya Pradesh has been declining and is moving towards the replacement level. It can be concluded that Madhya Pradesh is about to complete the fertility transition.

On the other hand, net inter-state migration has been very low in Madhya Pradesh in the recent decades. During 1991-2001, the net inter-state migration rate was -0.01 per 1000 for males and 0.00 for females (Government of India, 2006). During 2001-2011, the net inter-state migration rate was -0.05 per 1000 males and -0.04 per 1000 females (Government of India, 2020a).

Table 2: Indicators of fertility and mortality, Madhya Pradesh and India, 1971-2020

Period	Total fertility rate		Male life expectancy at birth		Female life expectancy at birth	
	Madhya Pradesh	India	Madhya Pradesh	India	Madhya Pradesh	India
1971-75	5.7	5.0	47.6	50.5	46.3	49.0
1976-80	5.4	4.5	49.4	52.5	48.7	52.1
1981-85	5.1	4.5	51.5	55.4	51.9	55.7
1986-90	4.8	4.0	53.7	57.7	53.0	58.1
1991-95	4.3	3.5	54.7	59.7	54.6	60.9
1996-2000	4.0	3.3	56.6	61.2	57.6	62.7
2001-05	3.8	3.0	58.9	63.1	60.5	65.6
2006-10	3.3	2.6	61.1	64.6	63.8	67.7
2011-15	2.9	2.3	63.2	66.9	66.5	70.0
2016-20	2.7	2.2	65.5	68.6	69.5	71.4

Notes: Rates up to 2000 refer to Madhya Pradesh including Chhattisgarh. The life expectancy at birth for 1971-75 refers to the period 1970-75.

Sources: Total fertility rate up to 2013 and life expectancy at birth up to 2010 (Government of India, 2014a). Total fertility rate after 2013 (Government of India, 2016; 2017; 2018; 2019; 2020; 2021; 2022). Life expectancy at birth for (Government of India, 2017a). Life expectancy at birth 2016-20 (Government of India, 2022a).

Data and Methods

The component projection method has been employed for projecting the population. This method requires baseline population size and its age and sex distribution and projected parameters of fertility, mortality, and migration. The 2011 census provides the baseline data. The age distribution has been smoothed in conventional five-year age groups following the method adopted by the Registrar General of India (Government of India, 2020a). The parameters used in the projection exercise are shown in Table 2. Since net inter-state migration for Madhya Pradesh has been found to be quite low during the last two intercensal decades, net migration was deemed negligible and no adjustment was made for it. The projected population for the state is 84.5 million for the year 2021 which is identical to the official population projection for the state (Government of India, 2020).

At the first stage, only one projection, termed as the 'Standard' projection was carried out. The projection of TFR beyond 2021 was carried out by fitting the Gompertz

curve. The lower asymptote arrived at is 1.8 by the year 2061. The male and female life expectancies at birth were projected to increase in line with the average gradient seen in different countries at the given level of mortality and are projected to increase to 81.1 years and 83.9 years respectively by the year 2101. The West Model of the Coale-Demeny Regional Model Life Tables has been adopted for projection. Madhya Pradesh has had a slightly higher (more masculine) than natural sex ratio at birth. It is assumed that this will gradually reach 106 male births to 100 female births by the year 2031. The age-pattern of fertility is projected to change to the pattern seen in the 2011-15 SRS estimates of age-specific fertility rates of Tamil Nadu. The change is assumed to be gradual and linear so that by 2031-36 the Tamil Nadu 2011-15 age pattern of fertility is likely to be achieved and the pattern is assumed to remain unchanged thereafter. No adjustment for migration has been made for the reason noted above. The United Nations software package for mortality analysis (MORTPAK) has been used in the projection exercise.

In addition to the standard projection, an alternate projection has also been carried out assuming a sharper fertility decline with the lower asymptote of 1.6 for TFR instead of 1.8 as in the standard projection. The assumption on mortality change remained the same as in the standard projection. Recent data from the SRS show that a few states in India have already achieved TFR lower than 1.6 so that the assumption for the alternate projection is not unrealistic. Moreover, in order to decompose the growth into future contributions of population momentum, mortality decline, and fertility being above or below replacement level, projections under two additional scenarios, 'momentum' and 'mortality decline-replacement level fertility', have also been carried out. In the 'momentum' scenario, TFR in 2021 was brought to a level which resulted in Net Reproduction Rate (NRR) of 1. Given the mortality at the time, the replacement level TFR worked out to 2.21. Fertility and mortality parameters were then held constant after 2021. This is labelled as Projection A and the projected population at time t is denoted by $PA(t)$. Constant mortality, obviously, is not a realistic assumption and one expects mortality to decline with the passage of time though the pace of decline becomes slower as mortality decreases. Therefore, another projection exercise was carried out for the scenario 'mortality decline-replacement level fertility' with the mortality declining as in the standard projection and fertility adjusted accordingly so as to maintain NRR at 1 after 2021. This is labelled as Projection B and the projected population at time t is denoted by $PB(t)$. The Standard projection as described above is labelled as Projection C and the projected population at time t is denoted as $PC(t)$. Growth after the initial time point T_0 , 2021 in the standard projection can be decomposed as:

$$PC(t) - P(T_0) = \{PA(t) - P(T_0)\} + \{PB(t) - PA(t)\} + \{PC(t) - PB(t)\} \quad (1)$$

Here $\{PA(t) - P(T_0)\}$ is the population growth attributed to population momentum, whereas $\{PB(t) - PA(t)\}$ is the population growth attributed to mortality decline; and $\{PC(t) - PB(t)\}$ is the population growth attributed to fertility being above or below replacement. This follows the method of Andreev et al (2013) with the change that,

since inter-state migration is assumed to be negligible in Madhya Pradesh, the migration component has been dropped. The decomposition is sequential, momentum, mortality decline, and fertility being above or below replacement, in that order.

Results

The Standard projection shows that population of Madhya Pradesh will increase after 2021 but at a gradually declining pace (Table 3). The state population is projected to cross 100 million before 2041 but after the middle of the present century, population growth will be very slow so that population of the state will peak at 113 million in the early 2070s. The population of the state will then begin to decline slowly and will decrease to just below 110 million at the end of the century.

The crude birth rate (CBR) in the state is projected to decrease throughout the present century reaching just around 10 live births per 1000 population at the end of the century as the result of the projected decline in TFR (Table 3). The crude death rate (CDR) will, however, increase in spite of a fall in mortality because the age distribution of the population will increasingly become older. The crossover is expected in the early 2070s when there will be zero population growth but this will not last long as the CDR will continue to increase so that the growth rate will turn negative.

Table 3: Projected trends in population size and vital Rates, Madhya Pradesh, 2001-2101.

Year	Standard projection				Sharper decline in fertility
	Population (million)	Crude birth rate (Per 1000 population)	Crude death rate (Per 1000 population)	Rate of natural increase (Per cent)	Population (million)
2001	60.3	30.9	10.1	2.09	60.3
2011	72.6	26.9	8.2	1.87	72.6
2021	84.5	21.6	8.0	1.36	84.5
2031	94.6	17.0	7.7	0.94	93.9
2041	102.4	15.0	8.1	0.69	100.4
2051	108.3	13.3	8.9	0.44	104.4
2061	111.7	11.9	9.7	0.21	105.4
2071	113.0	11.2	10.8	0.04	104.2
2081	112.6	10.5	11.6	-0.10	100.8
2091	110.8	10.1	12.0	-0.19	96.0
2101	108.2	9.8	12.6	-0.28	90.2

Sources: For 2001 and 2011: (Government of India, 2014a). For 2021 onwards: projections made by the author.

If it is assumed that the decline in fertility will be sharper with TFR falling to a low value of 1.6, the growth of population will naturally be less than the population growth projected by standard projection (the last column of Table 3 shows the results of this variant). The difference between the standard and the low fertility variant are conspicuous after 2040s. The peak will be lower, at 105 million, and will be achieved earlier, by 2061. At the end of the century, the difference will be nearly twenty million.

Table 4: Projected age distribution, sex ratio, and dependency ratio, Madhya Pradesh, 2001-2101.

Year	Percentage age distribution (Per cent)			Sex Ratio (Females Per 1000 males)	Dependency ratio (Per cent)	
	Below 15 years	15 -64 years	65 years and above		Based on 15-64 years @	Based on 20-64 years \$
2001	38.6	56.9	4.5	919	75.8	110.9
2011	33.5	61.6	4.9	931	62.5	95.5
2021	29.6	65.0	5.3	939	53.8	80.2
2031	26.3	67.3	6.4	948	48.7	71.6
2041	22.4	69.2	8.4	960	44.5	63.8
2051	20.3	69.2	10.5	972	44.5	60.6
2061	18.4	68.0	13.6	983	47.0	62.7
2071	17.1	65.9	17.0	995	51.9	67.2
2081	16.4	63.8	19.8	1003	56.8	72.3
2091	15.6	61.3	23.1	1001	63.1	79.3
2101	15.2	59.7	25.1	995	67.4	83.8

Remarks: @ 100* (Population of aged 0-14 and 65 years and above /Population at ages 15-64 years). \$: 100* (Population of ages 0-19 years and 65 years and above /Population at ages 20-64 years).

Sources: For 2001: (Government of India, 2006); for 2011: (Government of India, 2020); for 2021-2101: projections by the author.

The age distribution of the population will undergo major changes. The share of the young population (population below 15 years of age) will decline steadily, reaching a low of 15 per cent by the end of the century in contrast to over 38 per cent at the beginning of the century and around 33 per cent in 2011 (Table 4). The share of the old population (population aged 65 years and above) will increase steadily, and, by the end of the century, about one fourth of the population of the state will be at least 65 years old. This will be a major change over the century since this proportion was very low, less than five per cent, until 2011. The share of the working age population (population aged 15-64 years) will rise for some time due to falling share of the young population, reaching a peak of 69 percent in the 2040s, but will decrease gradually after the middle of the century because the increase in the proportion of old population will more than offset the decrease in the proportion of young population.

A direct implication of the change of share of working age population is the change in the dependency ratio which will fall just below 45 per cent in the 2040s. A low dependency ratio yields the well-known demographic dividend or the demographic opportunity conducive to economic growth (Bloom et al, 2003). Madhya Pradesh will be in a favourable situation from 2030s to 2060s with the dependency ratio remaining below 50 per cent. After 2050, the old dependency ratio will rise more rapidly than the decrease in the young dependency ratio, the overall dependency ratio will gradually increase. Conventionally, the age group 15-64 years is treated as working age group and the dependency ratio is computed accordingly. However, as the economy develops, it seems inappropriate to include those below 20 years of age as potential workers. Therefore, the last column of Table 4 also presents an alternative dependency ratio treating 20-64 years as working ages. This is naturally higher than the ratio based on ages 15-64 years, but the pattern is not different. Regardless of the age range chosen for working ages, the state will be in a position to derive demographic dividend through the middle decades of the present century.

Demographic Decomposition of Growth

The results of the decomposition exercise, in conjunction with equation (1) are presented in Table 5. Most of the population growth in the state up to 2071 will be due to population momentum which will add almost 30 million to the population of the state between 2021 and 2071. However, after 2071, population momentum will not make any additional contribution to the state population. Mortality decline will contribute to the growth of the population but the contribution of mortality decline will be low initially but will accumulate over time and will emerge as a major factor of population growth with a contribution of over 17 million. On the other hand, since fertility is projected to fall below the replacement level, some of the effect of mortality decline would be offset by the decline in fertility. This offset effect will be small initially, but after 2071, it will more than make up for the positive contribution of mortality decline to population growth.

Strictly speaking, projections are not 'forecasts' and hence it is customary to provide a set of alternate projections. The United Nations Population Division which publishes population prospects and revises them regularly (the latest revision was in 2022) gives three projections, called high fertility; medium fertility; and low fertility variants usually referred to simply as high, medium, and low variants (United Nations, 2022). In the recent revisions, the United Nations Population Division also gives probabilistic projections. In the projections made in this paper, the 'sharper fertility decline' projection shown in Table 3 may be treated as the 'low' variant, the standard projection shown in Table 3 as the 'medium' variant, and the mortality decline with replacement level fertility projection, shown in Table 5, may be treated as the 'high' variant. In all the three projections, assumptions on mortality are identical and migration has been assumed to be negligible. It is only the projected fertility decline

that varies; TFR falling to 1.6 in sharper fertility decline projection, TFR falling to 1.8 in the standard projection, and fertility at replacement level, so that TFR stays just above 2.08 in the mortality decline projection. The population of the state will peak to 105 million in the low variant and 113 million in the standard (or medium) variant. In the high variant the population of the state is projected to 131 million in 2101 will be increasing even beyond 2101 (Figure 1). While no definitive statement can be made on the actual value or the forecast of the state population, the present exercise variants suggest that the population of the state will remain roughly between 90 to 130 million after 2031.

Table 5: Projected population of Madhya Pradesh under different scenarios, 2021-2101.

Year	Population (million)		Decomposition of change since 2021 (million)				
	P(C) Standard projection	P(A) Momentum scenario	P(B) Mortality decline- replacement level fertility scenario	Total change	Due to population momentum	Due to mortality decline	Due to fertility being above/ below replacement
2001	60.3						
2011	72.6						
2021	84.5						
2031	94.6	93.7	93.9	10.1	9.2	0.3	0.7
2041	102.4	101.8	103.0	17.9	17.3	1.2	-0.6
2051	108.3	107.8	110.6	23.8	23.4	2.8	-2.3
2061	111.7	111.5	116.6	27.2	27.0	5.1	-4.9
2071	113.0	113.6	121.6	28.6	29.1	8.0	-8.6
2081	112.6	114.1	125.2	28.1	29.6	11.1	-12.6
2091	110.8	114.1	128.4	26.4	29.6	14.4	-17.6
2101	108.2	114.0	131.3	23.7	29.5	17.4	-23.1

Sources: 2001 and 2011: Table 1. 2021 onwards: projections by the author

Implications for Development and Policy

The population projections clearly show that the growth of population of Madhya Pradesh will not be large in the future. The growth rate has already slowed down and (according to the standard projection), the state is likely to reach zero-growth stage sometimes during 2070s and will subsequently enter a phase of slow population decline. There is, therefore, no longer any fear of population explosion as was the popular belief some time ago. The population of the state will not even double after 2021. The alternate projections of the population of the state will range somewhere between 90-130 by the end of the present century. The standard projection

suggests that the state population will peak at around 113 million which amounts to a growth of less than 40 per cent since 2021. This is good news for development planning. Moreover, since fertility has declined and is projected to fall below the replacement level, no specific policy measures are warranted to regulate fertility. According to NFHS-5, during 2019-21, 71.7 per cent of couples of reproductive age (15-49 years) were using some contraceptive method; 65.5 per cent were using a modern method; and 88 per cent couples with two children did not desire to have any more child (Government of India, 2021). This shows that the two-child norm has by and large been widely accepted by the people of the state. This should not be taken to mean that the ongoing programmes on fertility regulation need no longer be pursued. Creating awareness about fertility by choice, contraception, and providing contraceptive services are essential for promoting reproductive health, child health, and aiding couples to meet their reproductive goals. The programme must address the contraceptive needs of couples. So far, Madhya Pradesh has done rather well in this respect. The NFHS-5 has revealed that the unmet need for contraception is only 7.7 per cent in the state (Government of India, 2021).

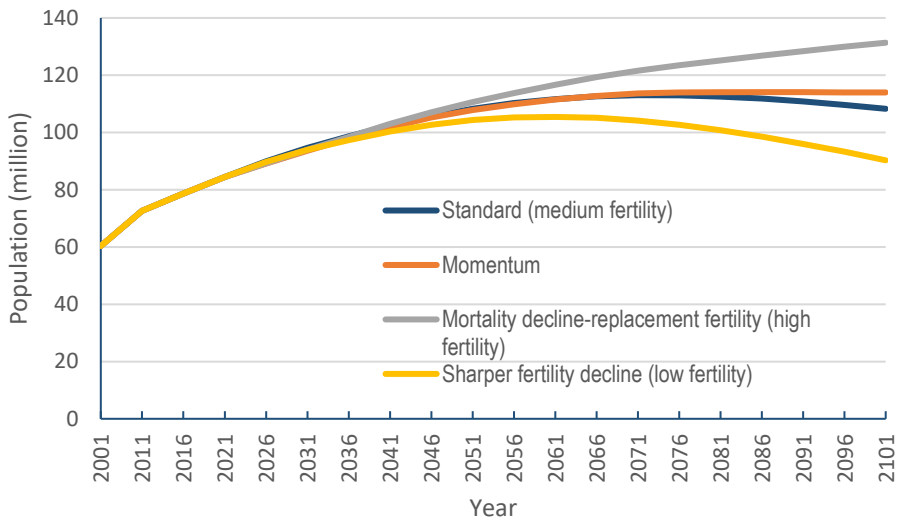


Figure 1: Projected population growth in Madhya Pradesh, 2001-2101.

Source: Author

The finding that the population would grow for some time even after attaining the replacement level fertility may cause some concern. However, achieving zero-growth immediately after reaching the replacement level fertility is not realistic. The growth momentum will make a contribution and as seen above, this factor alone would increase the population of the state by nearly 30 million. This growth cannot be prevented by policy measures unless these are more drastic than the one-child policy

introduced by China in 1979 which is abandoned now. When fertility decreases to below replacement level, concerns for low population growth, shortage of working age population, and high old-age dependency become more important as has happened in Japan and in several European countries.

The change in the age structure of the population will bring in the prospects of demographic dividend. The window of demographic opportunity will be quite wide through the 2040s and 2050s but will close after that. The state will have to make efforts to make the best use of the situation in this period. There is a need to generating adequate employment, enhance the quality of the labour force, and raise female participation in the labour force which is presently quite low. Policy measures need to be designed for these purposes.

Ageing of population is a consequence of demographic transition. Care of the old has traditionally been the responsibility of working age adults within the family. With family size shrinking, there is a need to develop some institutional support mechanism to augment the filial support to the old. Government of India has already formulated policies and launched programmes like old age pension scheme, the Maintenance and Welfare of Parents and Senior Citizens Act, health insurance and other health schemes for the old people. Since population ageing is a gradual process, programmes and schemes can be developed progressively so that, by the time the share of the old population reaches a high level, a comprehensive support system is in place.

Madhya Pradesh is lagging behind several large states of India in demographic transition. Although, the state has reached low fertility levels, the momentum of growth will continue for a longer time and will also be relatively larger than many states of the country. The share of the population of the state to the population of the country is, therefore, projected to increase, barring large scale out migration (Kulkarni, 2021a). There has not been large scale migration out of the state in the past but relatively excess growth of population in the state could exert pressure for such out-migration especially of workers. There would also be opportunities to migrate to those states in which population growth has slowed down earlier so that they are likely to face labour shortage. Between 2021 and 2061, working-age population in the state is projected to increase by about 20 million whereas many states may see a decrease working age population during this period (Kulkarni, 2021b). The inter-state migration, however, brings in issues of adjustment to the new place and access to social services including health and education. Large-scale migration also raises the possibility of political resistance to in-migrants at the place of destination.

Concluding Remarks

Madhya Pradesh has passed through decades of high population growth, but it has now entered the phase of low post-transition growth and the projections show that the state is moving towards zero-growth followed by slow decline in population

before the end of the present century. The state need not worry about population growth being out of control any longer. Instead, the state can look forward to encashing the opportunity of demographic dividend. The state also needs to take appropriate action to provide institutional support to its ever-increasing old population. Many states of the country are well ahead of Madhya Pradesh in demographic transition and will age much earlier than the state. Madhya Pradesh can learn from the experiences of these states in the introduction and implementation of programmes for the old people. The projected substantial increase in the working age population in Madhya Pradesh in the next few decades and the decrease in the working age population in some other states of the country over the same period provides opportunities for inter-state migration of working age population. However, large-scale inter-state migration is a sensitive issue that needs to be handled with finesse. Overall, the population prospects for Madhya Pradesh during the present century present a positive picture with some challenges to be addressed.

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