

# Time Series Analysis of Statewise Total Fertility Rate

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## **ABSTRACT:**

Population is the biggest threat to our nation's growth. Stabilization of population is essential for sustainable growth with effective redistribution of available resources. Total Fertility Rate (TFR) is used mostly to measure fertility for evaluating the impact of policy interventions. A time series data for 15 states and India TFR values has been plotted under linear regression. Gap analysis has also been made. Overall, TFR is below or going below the replacement level of fertility for the states and for India too.

**Keywords:** regression, TFR, gap analysis

## **INTRODUCTION**

Population is the biggest threat to our nation's growth. Stabilization of population is essential for sustainable growth with effective redistribution of available resources. Total Fertility Rate (TFR) is used mostly to measure fertility for evaluating the impact of policy interventions. Fertility status is on transition in India (Worldometer, 2020). The national Total Fertility Rate (TFR) is 1.9 in 2023 which below the replacement level of 2.1. This situation is both for rural and urban areas in India. Rural fertility (2.1) is a little higher than urban fertility (1.5). High fertility states like Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Chhattisgarh are contributing towards population growth whereas states like Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, West Bengal showing much low fertility rates. Levels of education may be a strong determinant for TFR. In 2023, TFR is 3.3 for illiterate women and 1.8 for literate women. TFR is around 1.6 among graduates and above women. The gaps between levels of education among women is wider regardless of background.

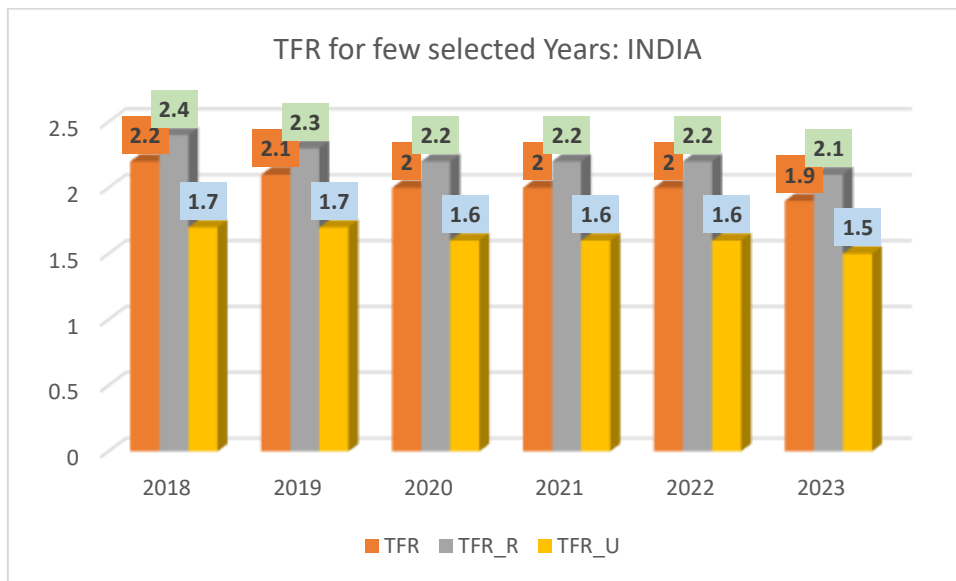
India's overall population growth will be slow concentrated in a few north-central states, while large parts of the country are already facing the prospect of stable or even population decline. The policy implications are - investments in girls' education, health, and family planning are essential to accelerate fertility decline in high-fertility states, while low fertility states must prepare for the challenges of aging populations and shifting of workforce.

NFHS has had two specific goals (1) to provide essential data on health and family welfare needed by the Ministry of Health and Family Welfare and other agencies for policy and programme purposes and (2) to provide information on important emerging health and family welfare issues. The survey provides state and national information for India on fertility, infant and child mortality, the practice of family planning, maternal and child health, reproductive health, nutrition, anaemia, utilization and quality of health and family planning services.

Total Fertility Rate (TFR) is falling across most states, with southern and western states leading in low fertility, High-fertility states include Uttar Pradesh, Madhya Pradesh, and Bihar, while Himachal Pradesh

showed a slight, rare increase recently. Rural TFR remains higher, although the gap with urban areas is narrowing, Replacement level fertility means the Total Fertility Rate is 2.1 or less. India has attained replacement level fertility as 31 states/Union territories reaching TFR of 2.1 or less in 2023.

Education is the main factor. TFR is 3.3 for illiterate women as compared with just 1.8 for literate women. TFR is around 1.6 among graduates and above. The gap is more with lower women literacy levels. The large portion of the country are already facing stabilization or decline of population growth. There may be either huge continuous investment with girls’ education – health – family planning in high-fertility states or preparation to face challenges of aging populations and workforce shifts.



TFR for Rural are higher as compared to TFR for Urban India in all the years from 2018. In this communication, an attempt has been made to regress TFR over time.

**DATA**

TFR data are collected from NFHS reports and census too. The time series data are for 1981 to 2023. The data are for 15 major Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal and for India.

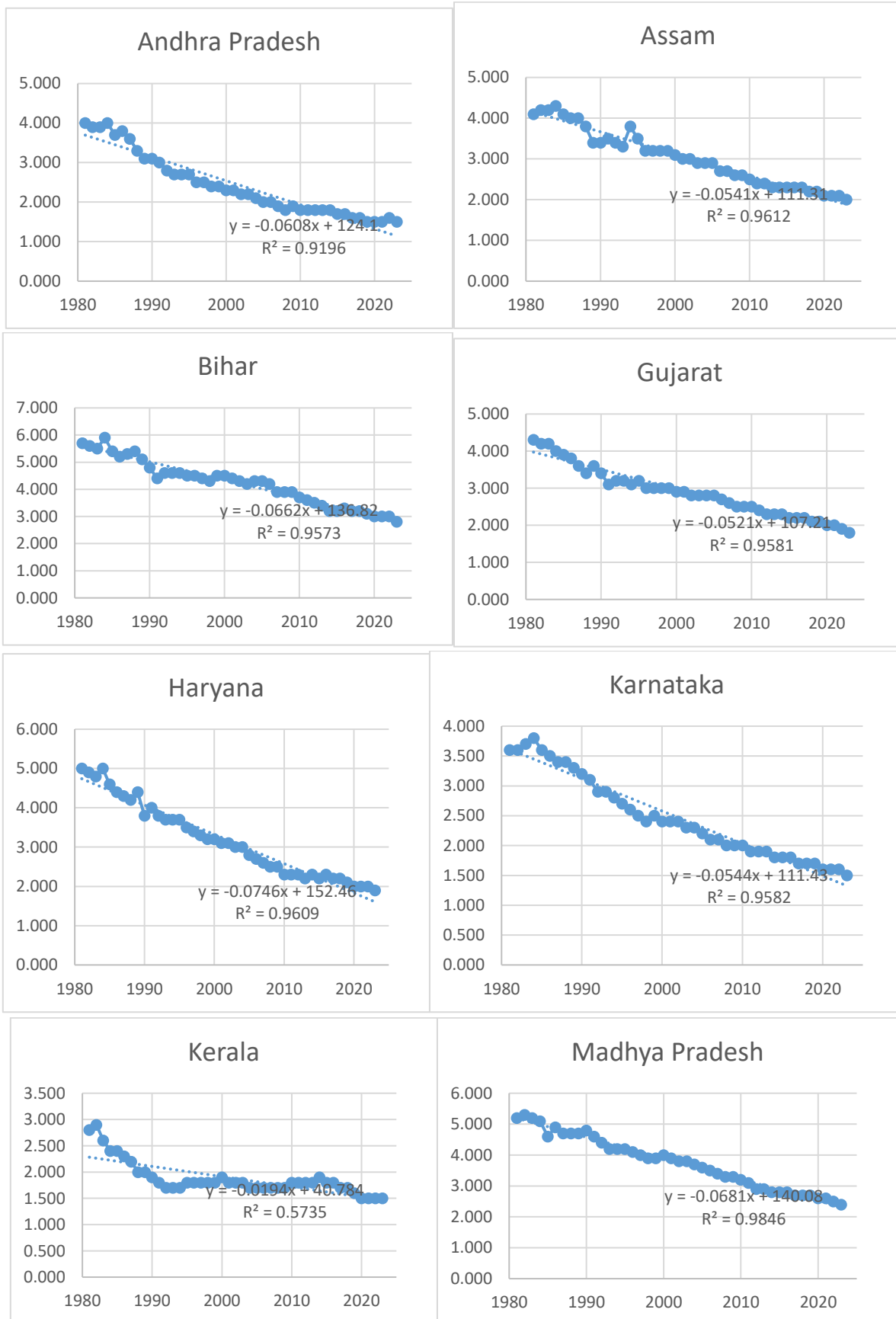
**DISCUSSION**

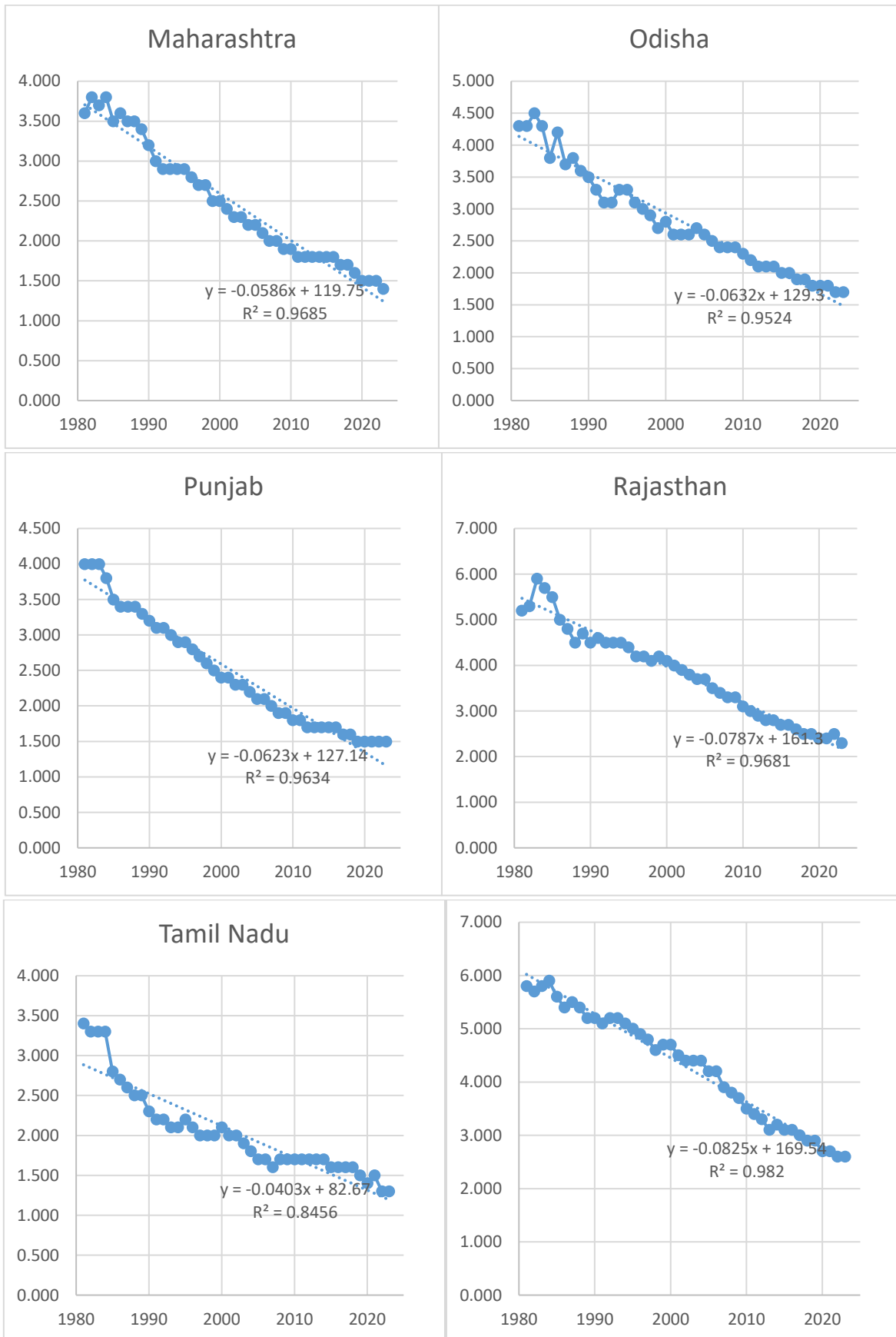
The time series data have been looked separately for each state.

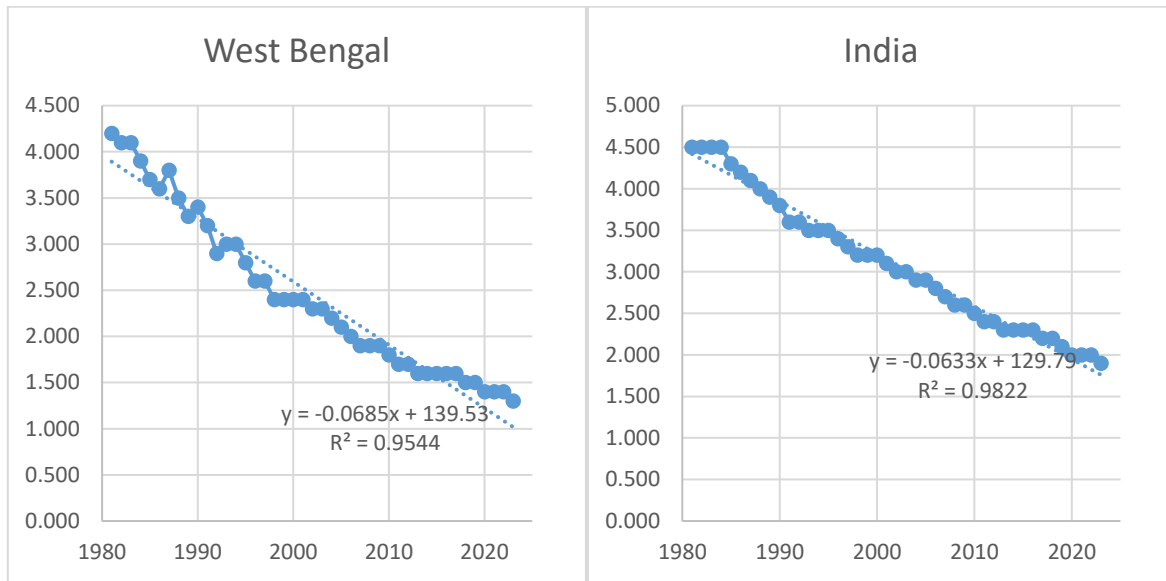
$$TFR(y) = b * time(year)(x) + a$$

b is the rate of increase/decrease per year, a is the intercept.

TFR values for each state have been plotted and linear regression with R-square has been drawn over the plotted points.







Figures (above) showing TFR plots with linear regression lines for each states and India. For each state, linear regression has been fitted over plotted TFR's. R-square has been calculated for each fitted regressions.

**Table showing a and b values of each fitted regression with R-square (R<sup>2</sup>)**

State	intercept (a)	regression coefficient (b)	R-Square
Andhra Pradesh	124.10	-0.0608	0.9196
Assam	111.31	-0.0541	0.9612
Bihar	156.82	-0.0662	0.9573
Gujarat	107.28	-0.0521	0.9581
Haryana	152.46	-0.0746	0.9609
Karnataka	111.43	-0.0544	0.9582
<b>Kerala</b>	<b>40.73</b>	<b>-0.0194</b>	<b>0.5735</b>
Madhya Pradesh	140.08	-0.0681	0.9846
Maharastra	114.75	-0.0586	0.9685
Odissa	129.30	-0.0632	0.9524
Punjab	127.14	-0.0623	0.9634
Rajasthan	161.30	-0.0787	0.9681
<b>Tamil Nadu</b>	<b>82.62</b>	<b>-0.0403</b>	<b>0.8456</b>
Uttar Pradesh	169.54	-0.0825	0.9820
West Bengal	139.53	-0.0685	0.9544
<b>India</b>	<b>129.79</b>	<b>-0.0633</b>	<b>0.9822</b>

The rate of decrease is lowest for Kerala and next for Tamil Nadu. It is highest for Uttar Pradesh, Rajasthan and Haryana. For India, rate of decrease is 0.0633 i.e. 6%.

Other way to signify the data is Gap Analysis. The gap between TFR values from 1981 and 1991 is  $G_{81/91} = [TFR(1991) - TFR(1981)]$ . Gaps are calculated for each of 15 states and India for 1991 from 1981, for 2001 from 1991, for 2011 from 2001, for 2021 from 2011 and for 2023 from 2021.

Table showing TFR for few selected years and gaps

State	1981	1991	2001	2011	2021	2023	G81/91	G91/01	G01/11	G11/21	G21/23
Andhra Pradesh	4.00	3.00	2.30	1.80	1.50	1.50	-1.00	-0.70	-0.50	-0.30	0.00
Assam	4.10	3.50	3.00	2.40	2.10	2.00	-0.60	-0.50	-0.60	-0.30	-0.10
Bihar	5.70	4.40	4.40	3.60	3.00	2.80	-1.30	0.00	-0.80	-0.60	-0.20
Gujarat	4.30	3.10	2.90	2.40	2.00	1.80	-1.20	-0.20	-0.50	-0.40	-0.20
Haryana	5.00	4.00	3.10	2.30	2.00	1.90	-1.00	-0.90	-0.80	-0.30	-0.10
Karnataka	3.60	3.10	2.40	1.90	1.60	1.50	-0.50	-0.70	-0.50	-0.30	-0.10
Kerala	2.80	1.80	1.80	1.80	1.50	1.50	-1.00	0.00	0.00	-0.30	0.00
Madhya Pradesh	5.20	4.60	3.90	3.10	2.60	2.40	-0.60	-0.70	-0.80	-0.50	-0.20
Maharashtra	3.60	3.00	2.40	1.80	1.50	1.40	-0.60	-0.60	-0.60	-0.30	-0.10
Odisha	4.30	3.30	2.60	2.20	1.80	1.70	-1.00	-0.70	-0.40	-0.40	-0.10
Punjab	4.00	3.10	2.40	1.80	1.50	1.50	-0.90	-0.70	-0.60	-0.30	0.00
Rajasthan	5.20	4.60	4.00	3.00	2.40	2.30	-0.60	-0.60	-1.00	-0.60	-0.10
Tamil Nadu	3.40	2.20	2.00	1.70	1.50	1.30	-1.20	-0.20	-0.30	-0.20	-0.20
Uttar Pradesh	5.80	5.10	4.50	3.40	2.70	2.60	-0.70	-0.60	-1.10	-0.70	-0.10
West Bengal	4.20	3.20	2.40	1.70	1.40	1.30	-1.00	-0.80	-0.70	-0.30	-0.10
India	4.50	3.60	3.10	2.40	2.00	1.90	-0.90	-0.50	-0.70	-0.40	-0.10
Average							-0.88	-0.53	-0.61	-0.39	-0.11

Note : G81/91 means Gaps in TFR of 1991 from that of 1981, etc..

It is observed that gaps are decreasing over the years for every 10 years and for all states and India. The average gaps are also decreasing in each gaps.

**REMARKS**

Overall, the data show that India’s demographic divide persists: a handful of north-central states continue

to sustain higher fertility and will contribute disproportionately to future population growth, while most southern, western and several northern states remain well below replacement level and are entering the phase of long-term population stabilization. The need to invest in universal female education and literacy is a powerful lever for population stabilization and improved health outcomes. In short, this data confirms that education is the single strongest determinant of fertility differences in India. Where education levels are high, fertility is uniformly low; where education is relatively poor, fertility remains high, sustaining population growth and slowing the demographic transition.

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