

K. B. Pathak* and M. P. Guru*

Trends in the Tempo of Reproduction Process in India and Some Selected States

Introduction

THESE are two distinct aspects of the study of fertility. The first is, how frequently a woman gives birth or what are the timings of child birth, and second is what is the chance of her proceeding to the next parity in future. These two are respectively called tempo and quantum of fertility. While both these aspects of fertility can easily be ascertained for a cohort of women with completed fertility on the basis of their maternity histories, their ascertainment from the incomplete maternity histories of other women will be biased due to the truncation of their reproductive life. Moreover, such assessments do refer to the past reproductive behaviour of the women with staggering distance from the point of observation. They also fail to reveal the recency of the reproductive behaviour. To overcome the inherent difficulties in studying the tempo of reproduction of the women in a given period of time from the observed data on maternity history, we have constructed a synthetic cohort of women to bear children according to the given schedule of age-specific fertility rates (ASFRs). By treating an ASFR as risk of birth at the corresponding age, we have calculated several measures of tempo of fertility. In this paper, following Krishnamoorthy (1979) but ignoring mortality, the parity distribution of women at the end of their reproductive life has been generated for India and four major states, namely, Uttar Pradesh, Maharashtra, Tamil Nadu and Kerala, circa 1972 and 1988. These states form a continuum in fertility transition achieved. While over the period of 1972-1988 the total fertility rate for India (rural) declined to a level of 4.3 from a level of 5.9, it fell from 7.3 to 5.6 in rural U.P., from 5.2 to 3.9 in rural Maharashtra, from 4.5 to 2.7 in rural Tamil Nadu and from 4.7 to 2.0 in rural Kerala. The estimates of ASFRs are obtained from the Sample Registration Scheme and the All India Fertility Survey of 1972. In Section 2, we discuss the details of the methodology.

Methodology

Let us assume that,

(a) the women do not die before the end of reproduction,

- (b) the probability that a woman gives birth in the age interval x and $x + dx$ is $f(x) dx$ irrespective of what changes occur during the period $(0, x)$, where $f(x)$ is the age-specific fertility rate at age x or birth density at age x ,

$$\begin{aligned} f(x) &> 0 && \text{for } \alpha < x < \beta \\ &= 0, && \text{otherwise} \end{aligned}$$

α and β are the starting and last age of child-bearing respectively.

Under the above assumptions, birth of a child can be treated as a Poisson process and hence,

$$P_x(0) = e^{-\int_0^x f(t) dt} \quad (1)$$

where $P_x(0)$ denotes the probability that the woman will remain childless till age x , starting from age zero.

Since probability of giving births below age α is zero, we can safely write,

$$P_x(0) = e^{-\int_0^x f(t) dt} = e^{-\sum_{15}^{x-5} f(a)} \quad (2)$$

where $\alpha = 15$ and $f(a)$ denotes the age-specific fertility rate for the age group a to $a + 5$.

Following the logic developed by Pathak (1970) and Krishnamoorthy (1979) one can easily ascertain that,

$$P_x(r) = \frac{\{A(x)\}^r}{r!} e^{-A(x)} \quad (3)$$

where $A(x) = \int_{\alpha}^x f(t) dt$ and $P_x(r)$ denotes the probability of having exactly r births by age x .

Thus, the probability of having exactly r births by the end of reproductive span can be calculated as,

$$P(r) = \frac{1}{r} \int_{\alpha}^{\beta} \{A(x)\}^r e^{-A(x)} dx \quad (4)$$

Similarly, from equation (1) we can get the expression for the probability that a woman will remain childless throughout her reproductive life as,

$$P(0) = e^{-\sum_{15}^{45} f(a)} \quad (5)$$

Now we know that,

$$P(r+) = P\{(r-1) +\} - P(r-1) \quad (6)$$

where $P(r+)$ denotes the probability of having at least r children at the end of reproductive span.

Since $P(0+) = 1$ and $P(1+) = 1 - P(0)$, equation (6) can easily be obtained for all values of r .

Moreover, the progression from at least zero parity to at least one parity is nothing but the proportion of women becoming mother, that is, having at least one child.

Thus, $a(0) = P(1+)$ and higher order PPRs can be calculated as,

$$a(r) = \frac{P\{(r+1) +\}}{P(r+)} \quad (7)$$

Further, the mean age at first birth (MAWFB) to the women can be ascertained as,

$$\begin{aligned} MAWFB &= \frac{\int_0^{\beta} x f(x) e^{-A(x)} dx}{\int_0^{\beta} f(x) e^{-A(x)} dx} \\ &= \frac{\alpha - \beta e^{-TFR} + \int_0^{\beta} e^{-A(x)} dx}{1 - e^{-TFR}} \\ &= \frac{\alpha - \beta e^{-TFR}}{1 - e^{-TFR}} + \frac{\int_0^{\beta} e^{-A(x)} dx}{1 - e^{-TFR}} \\ &= \frac{\alpha - \beta e^{-TFR}}{M} + \frac{1}{M} \sum_{15}^{40} e^{-CFR(x+2.5)} \end{aligned} \quad (8)$$

where $\beta = 45$ years and age-specific fertility rates are available for *quinquennial* age-groups.

Also, the mean age of the women at the birth of last child (MAWLB) is given by,

$$MAWLB = \frac{\int_0^{\beta} x f(x) e^{-\bar{A}(x)} dx}{\int_0^{\beta} f(x) e^{-\bar{A}(x)} dx} \quad \text{where } \bar{A}(x) = TFR - A(x).$$

After solving the numerator and denominator terms, we obtain,

$$\begin{aligned}
 MAWL B &= \frac{\{\beta - \alpha e^{-TFR}\} - e^{-TFR} \int_{\alpha}^{\beta} e^{A(x)} dx}{e^{-TFR} \int_{\alpha}^{\beta} f(x) e^{A(x)} dx} \\
 &= \frac{1}{M} \left\{ \beta - \alpha e^{-TFR} \right\} - \left\{ \frac{\int_{\alpha}^{\beta} f(x) e^{A(x)} dx}{\int_{\alpha}^{\beta} e^{A(x)} dx} \right\}^{-1} \\
 &= \frac{1}{M} \left\{ (\beta - \alpha e^{-TFR}) - e^{-TFR} \sum_{15}^{40} e^{CFR(x+2.5)} \right\} \quad (9)
 \end{aligned}$$

where $CFR(x+2.5) = 5 \sum_{15}^{x-5} 5fa + K(5fx)$

for all $x = 20, 25, \dots, 40$

and $CFR(x+2.5) = K(5fx)$ for $x = 15$.

The K multipliers can be ascertained using Brass multipliers for calculating P/F ratios (see Brass, 1968).

If we do not want to use multipliers, then we can solve the integral,

$$\int_{\alpha}^{\beta} e^{-A(x)} dx \quad \text{as well as} \quad \int_{\alpha}^{\beta} e^{A(x)} dx$$

using approximation discussed below.

Let $f(\bar{x})$ be the fertility at the average age x of the mothers then,

$$\begin{aligned}
 \int_{\alpha}^{\beta} e^{-A(x)} dx &= \frac{1}{f(\bar{x})} \int_{\alpha}^{\beta} f(x) e^{-A(x)} dx \\
 &= \frac{1}{f(\bar{x})} \{1 - e^{-TFR}\}
 \end{aligned}$$

Similarly,

$$\int_{\alpha}^{\beta} e^{A(x)} dx = \frac{1}{f(\bar{x})} \int_{\alpha}^{\beta} f(x) e^{A(x)} dx$$

$$= \frac{1}{f(x)} \{ e^{TFR} - 1 \} \quad (11)$$

Substituting these values we get,

$$MAWFB = \frac{\alpha - \beta e^{-TFR}}{1 - e^{-TFR}} + \frac{1}{f(x)} \quad (12)$$

$$MAWLB = \frac{\beta - \alpha e^{-TFR}}{M} - \frac{1}{f(x)} \quad (13)$$

Proceeding in the same way, one can get expressions for the variance of these waiting times from the start of the reproductive life.

Taking difference the MAWFB and MAWLB, the average effective reproductive span (ASR) has been ascertained. Again, the mean closed birth interval (MCBI) is derived by using the relation,

$$MCBI = \frac{ARS}{TFR - 1} \quad (14)$$

Obviously the completed average family size of a woman of the synthetic cohort is the same as the total fertility rate. After having obtained the mean closed birth interval, the average level of fecundability X can easily be ascertained by using the approximate relationship,

$$\lambda = \frac{1}{MCBI} + h \quad (15)$$

where h is the total of post partum amenorrhea following a live birth and gestation period for the live birth pregnancy. This formula assumes the absence of abortion in the reproductive process and hence should be treated as only crude. Changes in A , over time can indicate change in the spacing pattern if h is taken as constant. In the absence of detailed and reliable knowledge of the lactational amenorrhea, it is better to assume h to be constant and estimate X as indicated above. In our calculation here h is assumed to be equal to 1.50 years. Undoubtedly the estimate of A will be biased towards lower side because in reality not all the pregnancies end in live birth. If we denote V' as the fecundability of the woman before the first live birth, then by assuming no change in it by age before the first birth, we can easily show that asymptotically,

$$\lambda^{(1)} = \frac{1}{MAWFB - \text{Average age at Marriage}} \quad (16)$$

Findings

Applying the procedure discussed earlier, we have derived the proportion of women with no child, and those with at least four children among women of completed fertility, their completed family size (x), the mean ages of women at their first birth, last birth, their average effective reproductive span after achieving motherhood, their average fecundability to bear child after the first birth and the average closed birth intervals for four states, namely, Uttar

Pradesh, Maharashtra, Tamilnadu and Kerala, taking rural and urban areas separately, circa 1972 and 1988. The age-specific fertility rates for 1972 come from the All India Fertility Survey of 1972 and ASFRs for 1988 are taken from the Sample Registration Scheme of the Registrar General of India. It will be pertinent to note that the estimates so obtained here are not affected by the bias of under-reporting or over-reporting of the ASFRs due to the reference error. These estimates are presented in Table 1. •

TABLE 1 : SOME SALIENT ASPECTS OF REPRODUCTIVE PROCESS FOR A SYNTHETIC COHORT OF WOMEN IN FOUR SELECTED STATES AND INDIA (RURAL AND URBAN), CIRCA 1972 AND 1988.

| Statistics | Uttar Pradesh | | Maharashtra | | Tamilnadu | | Kerala | | India | |
|---------------|---------------|-------|-------------|-------|-----------|-------|--------|-------|-------|-------|
| | 1972 | 1988 | 1972 | 1988 | 1972 | 1988 | 1971 | 1988 | 1972 | 1988 |
| (Rural Areas) | | | | | | | | | | |
| P(0) | 0.001 | 0.004 | 0.005 | 0.021 | 0.011 | 0.068 | 0.009 | 0.134 | 0.003 | 0.014 |
| P(4+) | 0.944 | 0.828 | 0.766 | 0.543 | 0.666 | 0.282 | 0.697 | 0.145 | 0.848 | 0.623 |
| TFR(X) | 7.27 | 5.60 | 5.20 | 3.88 | 4.54 | 2.68 | 4.73 | 2.01 | 5.91 | 4.29 |
| MAWFB | 19.90 | 21.00 | 20.90 | 20.70 | 22.00 | 22.20 | 22.90 | 23.80 | 20.50 | 21.30 |
| MAWLB | 40.00 | 37.90 | 36.40 | 31.40 | 35.20 | 30.10 | 36.60 | 29.50 | 38.00 | 34.70 |
| XMCBI | 3.3 | 3.8 | 3.7 | 3.7 | 3.7 | 4.7 | 3.7 | 5.6 | 3.6 | 4.1 |
| ARS | 20.5 | 16.9 | 15.5 | 10.7 | 13.2 | 7.9 | 13.7 | 5.7 | 17.5 | 13.4 |
| λ | .556 | .435 | .455 | .455 | .455 | .313 | .453 | .244 | .476 | .385 |
| Statistics | Uttar Pradesh | | Maharashtra | | Tamilnadu | | Kerala | | India | |
| | 1972 | 1988 | 1972 | 1988 | 1972 | 1988 | 1972 | 1988 | 1972 | 1988 |
| (Urban Areas) | | | | | | | | | | |
| P(0) | 0.003 | 0.014 | 0.014 | 0.059 | 0.025 | 0.118 | 0.015 | 0.127 | 0.009 | 0.050 |
| P(4+) | 0.827 | 0.613 | 0.623 | 0.315 | 0.503 | 0.168 | 0.610 | 0.155 | 0.700 | 0.353 |
| TFR(X) | 5.71 | 4.24 | 4.29 | 2.83 | 3.88 | 2.14 | 4.23 | 2.06 | 4.75 | 3.00 |
| MAWFB | 21.30 | 22.00 | 22.40 | 22.20 | 22.70 | 22.50 | 22.80 | 23.20 | 21.70 | 22.60 |
| MAWLB | 38.10 | 35.60 | 34.60 | 30.10 | 33.50 | 28.00 | 35.60 | 28.70 | 35.70 | 31.60 |
| MCBI | 3.6 | 4.0 | 3.7 | 4.3 | 3.8 | 4.8 | 4.0 | 5.2 | 3.7 | 4.5 |
| ARS | 16.8 | 13.0 | 12.2 | 7.9 | 10.8 | 5.5 | 12.8 | 5.5 | 14.0 | 9.0 |
| λ | .476 | .400 | .455 | .357 | .444 | .303 | .400 | .270 | .455 | .333 |

Note: $P(x)$ = Probability that a woman will have x births at the end of her reproductive life.
MAWFB = Mean age of women at the birth of first child.
MAWLB = Mean age of women at the birth of last child.
ARS = Average reproductive span.
MCBI = Mean closed birth interval.
 λ = Fecundability.

Family Size

It is clearly evident that by 1988, Kerala (rural as well as urban) has achieved the replacement level of fertility. The total fertility rate of the women is halved from the level of 4.73 (Rural Kerala) and the level of 4.23 (urban Kerala) in a span of just 16 years (1972-1988). Circa 1972, levels of fertility in urban areas were almost same in Kerala and Maharashtra but decline in the total fertility in urban Kerala was more than that in Maharashtra (urban) during 1972-88. In Maharashtra (urban), total fertility is still as high as 2.83 in 1988. Though Tamilnadu had lower TFR (3.88) than Kerala (urban) in 1972, its TFR reduced to 2.14 in 1988 as against 2.06 for Kerala, Tamilnadu had the TFR of 4.54 in 1972 as against 4.73 for Kerala in rural areas. Though TFR of Tamilnadu (rural) was 2.68 in 1988, Tamilnadu seems to be close to Kerala in completing the fertility transition, first in urban areas and successively in rural areas. On the other hand, Maharashtra (urban) has been able to achieve reduction in the TFR from a level of 4.29 (slightly more than 4.23 of Kerala (urban) in 1972 to a level of 2.83 (much higher than 2.06 of Kerala (urban) and 2.14 of Tamilnadu (urban)) in 1988. Though Maharashtra Urban is losing the gap towards achieving the replacement level of fertility, Maharashtra (rural) is still having higher fertility compared to both Kerala and Tamilnadu. The TFR for Maharashtra (rural) declined from a level of 5.20 in 1972 to 3.88 in 1988 recording a total decline of 1.32 birth per women as against a decline of 2.72 births in Kerala and 1.86 births in Tamilnadu in a period of 16 years. Uttar Pradesh (both rural and urban) stands quite high on the scale of fertility. Even in 1988, its TFR for rural areas was 5.60, higher than the level of Maharashtra (rural) in 1972. Even in the urban areas of U.R, the TFR in 1988 (4.24) was almost same as observed in Tamilnadu (urban) and Kerala (urban) in 1972. Thus, U.P. (urban) is lagging behind by more than 16 years from Kerala and Tamilnadu in regard to fertility transition.

Higher Order Births

The proportion of childless women (either due to late marriages or non-marriages) has increased both in rural and urban areas of the four states over the period of 1972-1988. Except in the case of Kerala, in all the three states childlessness [$P(0)$] is higher among the women in urban areas than in the rural areas. In case of Kerala (rural) there was a drastic decline in the proportion from 0.0087 to 0.1341 over the period of 1972-1988. For Tamilnadu (rural) the proportion increased from 1 per cent to about 7 per cent and for Maharashtra (rural) from 0.5 per cent to 2 per cent. For U.P. (rural) it was only a marginal gain and childlessness was almost zero. Circa 1988, urban areas of Kerala, Tamilnadu and Maharashtra had proportion of childlessness of about 13 per cent, 12 per cent and 6 per cent respectively as against 1.4 per cent of U.P. (urban). At all India level while it is 1.4 per cent in rural areas, it is about 5 per cent in urban areas (year 1988). These figures clearly evidence the increase in age at marriage of the females and shifting of the start of reproduction beyond the age of 15 years in the states of Kerala, Tamilnadu and also in Maharashtra (urban).

Looking at proportion of women having four children or more in their whole reproductive life, it is observed that the proportion circa 1972 was 70 per cent, 67 per cent, 77 per cent

and 94 per cent respectively in the rural areas of Kerala, Tamilnadu, Maharashtra and U.P. as against 85 per cent of rural India. These proportions reduced to quite low of 14 per cent in Kerala, 28 per cent in Tamilnadu, 54 per cent in Maharashtra and 83 per cent in U.P. in the year 1988. The same proportions were 61,50,62 and 83 respectively for urban women of Kerala, Tamilnadu, Maharashtra and U.P. in 1972 which reduced to 15,17,31 and 61 in 1988. In urban areas of Kerala, therefore there seems to be adoption of stoppage rule at 3 itself by almost all women. The same is true for urban women in Tamilnadu. This percentage is still quite high for U.P. (urban). Even at all India level the percentage of women with 4+ births in urban areas seems to be 35. Thus in the case urban areas in Tamilnadu and Kerala, not only there is an increase in childlessness but also there is a decline in higher order births especially beyond three. In case of Kerala, the drop is even in case of rural areas, Tamilnadu is at the second place to approach the same level as in case of urban areas may be in a couple of years. Even in this regard the urban areas in U.P. are about 16 years behind Kerala, but the rural women of U.P. lag far behind the rural women of Kerala or even Maharashtra (all India average women), by more than 20 years or so.

Family Building Process

Circa 1972, the mean age at first birth for the states of Kerala as well as Tamilnadu (urban) was beyond 22 years. In 1988, in case of Kerala it was beyond 23 years while in case of Tamilnadu (rural) it was about 22 years. In Maharashtra (rural) MAWFB was close to 21 years as against 22 years in urban areas in the year 1972. In urban areas of U.P. the MAWFB was close to that of Tamilnadu (urban) and Maharashtra (urban) in the year 1988. However in rural areas of U.P., the MAWFB was only 21 years in 1988. Clearly the reproduction starts much earlier in rural areas of U.P. Though the differences in the MAWFB's of different states is upto 3 years, a marked difference is found in respect of the mean age of the women at the last birth. For example, in case of rural Kerala it was as high as 36.6 years in 1972 as against 36.4 years in Maharashtra, 35.2 years in Tamilnadu and 40.4 years in U.P. In 1988, it was 29.5 years in case of Kerala (rural), 31.4 in Maharashtra (R), 30.1 in case of Tamilnadu (rural). In case of U.P. this remains still at the level of almost 38 years. Thus women in Kerala, Maharashtra and Tamilnadu stopped child-bearing almost five years earlier than they did in 1972. In U.P., it came down by almost two years decline circa 1988. After first birth, on average a woman in rural areas of Kerala spent 5.7 years in the active reproductive life as against her counterparts in Tamilnadu (7.9), Maharashtra (10.7) and U.P. (16.9) in the year 1988. These figures also indicate use of terminal methods of family planning in the urban areas of U.P. and in both rural and urban areas of Kerala, Tamilnadu and Maharashtra. Except in case of Kerala, where women in both rural and urban areas spent almost 6 years in the active reproductive life, the women in the urban areas of all other states had almost 3 years less reproductive life than the rural women. In case of U.P. the difference has been almost 4 years.

Spacing Between Births

Looking at the spacing between births, both in rural and urban areas, the closed birth intervals increased. In case of rural women of Kerala, the increase was from 3.7 years in

1972 to 5.6 years in 1988 and in case of urban areas, it increased from 4 years to 5.2 years. Thus, the use of spacing methods became popular in the 1980's in rural Kerala as well as in urban areas. In case of both rural and urban areas of U.P., there has been only marginal increase in the closed birth interval. In case of Tamilnadu, increase has been estimated at almost 1 year for both rural and urban women over the period of 1972-1988. Maharashtra has been singled out on this count. In Maharashtra, the mean closed birth intervals of the rural women remained longest (3.7 years) but the same changed from 3.7 in 1972 to 4.3 years in 1988 for urban women. Thus, in Maharashtra (rural) women have mostly reduced their reproductive span after first birth by using terminal methods and not using spacing methods. Moreover, in case of urban areas of Maharashtra, some women started using spacing methods. The estimates of fecundability for all the four states indirectly confirms the above observations based on the measure of tempo.

Using the approximate relationship given by equation 11, it is possible to estimate average fecundability of women implied by the age-specific fertility rate of 1972 and 1988 in the four selected states of India as well as India as a whole and taking rural and urban areas separately. Maharashtra is the only state where fecundability is found almost same in the case of rural women both in 1972 and 1988. We assume that $h = 1.50$ years in all the states. In the case of rural women of U.P., change is from level of 0.56 in 1972 to 0.44 in 1988. On the other hand, in case of rural Kerala and Tamilnadu the levels were 0.453 and 0.455 respectively but they reduced to 0.244 and 0.313 respectively. While in case of Tamilnadu, the rural women use contraception, the drastic reduction in case of Kerala women may be both because of contraception and increase in person years lived by rural Kerala women in spinsterhood.

In case of urban women, the level fecundability declined more in Kerala (from 0.400 to 0.270) followed by Tamilnadu (from 0.444 to 0.303), Maharashtra (0.455 to 0.357), U.P. (0.476 to 0.400). Change in fecundability in all the states except in case of Kerala may be attributed to use of contraception for spacing purposes within the age group 20 to 35 years.

Parity Progression Ratios

Transition in fertility may be better explained through the study of period specific parity progression ratios (see Ram and Pathak, 1989). Table 2 gives the parity progression ratios implied by the ASFRs for rural and urban areas of the four selected states of India as well as India as a whole. It is quite clear in the case of rural areas in Kerala that PPR corresponding to parity 4 and 5 came down to the level of about 37 per cent and 32 per cent in 1988 from respective levels of 74 and 66 per cent respectively in 1972. In case of Tamilnadu (rural), these possibilities reduced to 0.48 and 0.41 in 1988 from the respective values of 0.72 and 0.64. But in case of Maharashtra (rural) the same are still as high as 0.64 and 0.56 in 1988 while for U.P. (rural) they are 0.82 and 0.75 respectively. Looking at these values in urban areas we find that circa 1988, these PPRs were respectively 0.38 and 0.32 for Kerala as against 0.39 and 0.33 for Tamilnadu, 0.50 and 0.43 for Maharashtra and 0.68 and 0.60 for Uttar Pradesh. At each parity, the trends are maintained and it becomes clear that women in U.P., whether in rural or urban areas, continue bearing child with higher progression

proportion than in the states of Kerala, Tamilnadu and Maharashtra. Tamilnadu seems poised for quick transition of fertility than Maharashtra. At each parity, the women are choosing to stop comparatively more in Kerala and Tamilnadu than in case of Maharashtra and Uttar Pradesh. Even at all India level circa 1988, 45 per cent women in the rural areas who have given birth to 8 children are proceeding towards bearing ninth child. This figure is also high in urban areas of all India (0.32).

The study of parity progression ratios as implied by the ASFRs of the current population circa 1988, clearly indicates lack of motivation to the older and high parity women to stop reproduction and accept the terminal methods. However, there are negligible percentages of women with higher parities in Kerala and Tamilnadu as against those in Maharashtra and U.P. Therefore, those parity progression ratios should always be read with the parity distribution of the women at different ages, say, 30, 35 and 40 years.

TABLE 2 : PARITY PROGRESSION RATIOS (PPRs) FOR THE WOMEN OF SYNTHETIC COHORT IN INDIA AND SELECTED STATES. CERCA 1972 AND 1988

| States | Year | Area | a(0) | a(1) | a(2) | a(3) | a(4) | a(5) | a(6) | a(7) | a(8) |
|---------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Uttar Pradesh | 1972 | Rural | .9995 | .9962 | .9854 | .9625 | .9260 | .8767 | .8253 | .7705 | .7173 |
| | | Urban | .9969 | .9820 | .9471 | .8925 | .8261 | .7569 | .6909 | .6310 | .5779 |
| | 1988 | Rural | .9965 | .9800 | .9425 | .8851 | .8166 | .7463 | .6799 | .6201 | .5673 |
| | | Urban | .9857 | .9383 | .8804 | .7704 | .6830 | .6070 | .5418 | .4871 | .4412 |
| Maharashtra | 1972 | Rural | .9947 | .9720 | .9245 | .8575 | .7825 | .7090 | .6414 | .5827 | .5814 |
| | | Urban | .9864 | .9404 | .8648 | .7759 | .6896 | .6130 | .5476 | .4923 | .4462 |
| | 1988 | Rural | .9794 | .9183 | .8273 | .7299 | .6409 | .5650 | .5019 | .4498 | .4064 |
| | | Urban | .9411 | .8227 | .6949 | .5856 | .4991 | .4317 | .3788 | .3366 | .3024 |
| Tamilnadu | 1972 | Rural | .9894 | .9513 | .8837 | .8005 | .7165 | .6401 | .5738 | .5178 | .4694 |
| | | Urban | .9749 | .9631 | .8068 | .7060 | .6164 | .5413 | .4797 | .4291 | .3873 |
| | 1988 | Rural | .9317 | .8033 | .6713 | .5620 | .4771 | .4112 | .3606 | .3201 | .2874 |
| | | Urban | .8819 | .7139 | .5720 | .4672 | .3909 | .3344 | .2913 | .2576 | .2307 |
| Kerala | 1972 | Rural | .9913 | .9587 | .8967 | .8180 | .7362 | .6603 | .5935 | .5361 | .4871 |
| | | Urban | .9855 | .9378 | .8592 | .7688 | .6826 | .6067 | .5403 | .4857 | .4398 |
| | 1988 | Rural | .8659 | .6888 | .5462 | .4436 | .3700 | .3159 | .2749 | .2425 | .2174 |
| | | Urban | .8732 | .7001 | .5577 | .4541 | .3793 | .3241 | .2821 | .2494 | .2233 |
| India | 1972 | Rural | .9975 | .9850 | .9543 | .9043 | .8416 | .7745 | .7014 | .6495 | .5959 |
| | | Urban | .9914 | .9589 | .8930 | .8198 | .7383 | .6624 | .5955 | .5381 | .4890 |
| | 1988 | Rural | .9864 | .9408 | .8647 | .7758 | .6894 | .6128 | .5474 | .4924 | .4461 |
| | | Urban | .9502 | .8429 | .7203 | .6117 | .5237 | .4543 | .3994 | .3553 | .3193 |

Summary

An attempt has been made in this paper to estimate measures of quantum and tempo of fertility and changes therein in the recent past in four selected states of India and the country as a whole (separately for rural and urban areas). The estimates are based on a synthetic cohort of women who bear children according to the current schedule of fertility and do not experience mortality. Specifically, we have improved upon the procedure developed by Krishnamoorthy (1979) to generate parity distribution of women at the end of their reproductive life and also such other parameters as the starting age of reproduction (MAWFB), the age at which child-bearing stops (MAWLB), the average closed birth interval (MCBI) and fecundability (A.).

The results indicate that by the year 1988 Kerala has already completed fertility transition in both rural and urban areas, followed closely by Tamilnadu. Though Maharashtra has been able to achieve substantial decline in fertility, it is still having higher fertility compared to Kerala and Tamilnadu. On the other hand, Uttar Pradesh has a long way to go in achieving replacement level of fertility.

Over the years, an increase in the proportion of childless women has been observed in all the states, probably as a result of late marriages and non-marriages. In general, the instances of childlessness are higher among the women living in urban areas. However, in the state of Uttar Pradesh, marriages and reproduction seems to be universal even in the year 1988. In all the selected states, the proportion of women having four children or more has declined drastically during 1972-88, more so in the two southern states of Kerala and Tamilnadu. Women living in urban areas of these two states (Kerala and Tamilnadu) seem to have limited their family size to only three children.

It is also observed that child-bearing in India starts at an early age, mostly in rural areas, and continues till the age of, say, 35 years. Among the states, there has been a marked variation in respect of the age at which reproduction stops.

In general, the states have experienced a marked increase in the length of closed birth interval in both rural as well as urban areas, indicating widespread use of spacing methods of family planning by the year 1988. Estimates of fecundability (X) indirectly confirms these observations.

Though there has been a substantial decline over the years in the proportion of women going for higher parities, say parity 5 and parity 6, the proportion of women going for such higher parities is still high in the state of Uttar Pradesh.

References

- Brass, W., 1968, The Techniques of Demographic Analysis. In : W. Brass *et al.* (eds.), *Demography of Tropical Africa*.
- Krishnamoorthy, S., 1979, Family formation and the life cycle. *Demography*, **16** (1): 121-130.
- Pathak, K. B., 1970, On the Mechanism of Selection of Fecundability. *Artha Vijnana*, **13** (3): 346-352.
- Pathak, K. B. and F. Ram, 1989, An Application of Life-Table Approach in the Analysis of Fertility in India. In : S. N. Singh, M. K. Premi, P. S. Bhatia and Ashish Bosc (eds.), *Population Transition in India*, Vol 1. B.R. Publishing House, Delhi, India, pp. 341 -352.