Role of Proximate Determinants of the decline to below the Replacement level Fertility in an urban society of Northeast India

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Introduction:

The fertility declines has been observed in most regions of the developing world over the last three decades. These declines in total fertility result from either a decline in marital fertility or a delay in the timing of childbearing or both. It has been shown that change in nuptiality e.g., delay of marriage leads to what Bongaarts (1999) referred to as 'tempo distortions' that exerts a downward pressure on fertility. It is thus, reasonable to expect that, when these distortions end, as they eventually must, upward pressure will be exerted in fertility.

An overwhelming majority of low fertility countries have revealed a rise in the mean age at childbearing and age at marriage are the major causes of fertility declining. All the countries in Western Europe and a majority of the countries in Northern and southern Europe exhibited a rise in the mean age at childbearing while among the countries in Eastern Europe only the Czech Republic, Hungary and Poland showed a rise in the mean age at childbearing are the important causes of fertility declining. Similar rise in the mean age at childbearing was also observed in Australia, Canada, New Zealand and the United States of America and a few Asian countries viz., Hong Kong, Japan, Singapore which was major factor to reducing fertility.

In India, a sharp declining in urban fertility reached to near or below replacement level. According to Sample Registration Sample (SRS) 1999, the urban fertility, other than Kerala and Tamil Nadu and West Bangel, the states like Himachal Pradesh, Karnataka, Assam, Andhra Pradesh and Punjab also observed near or below replacement level. Only the three large north India states of Utter Pradesh, Bihar and Rajasthan report an urban TFR of between 3.6 and 3.0. The highest change in TFR during 1987-89 and 1997-99 was observed in Punjab, 32.3 percent followed by Karnataka 28.6 percent. The total fertility rate in Assam was reported as 2.0 in 1997-99 as compared to 2.4 in 1987-89, which indicates that nearly 17 percent of fertility reduces during the period. Besides the total fertility, a high urban martial fertility is observed in Assam, which is 5.1 births, succeeded to Utter Pradesh, 5.9 births in 1999 according to SRS. It indicates that in absence of mortality nearly 5.1 births can be expected per married Assamese women during the entire span of her reproductive period. According to National Family & Health Survey (NFHS), the marriage at very young ages has been declining over time but the median age at marriage is still low at 17.4 years in 1992-93, on the other hand the age at marriage raised to 20 years in 1998-99.The large difference between marital fertility and the total fertility is mainly due to high proportion of non-married women in the urban areas. The main reason of increasing proportion of non-married women is due to high age at marriage as observed in urban areas.

As a whole, the fertility change in urban areas of Assam is about 16.7 percent in last decades ahead of Kerala and Utter-Pradesh of about 10.0 percent each. This is due to the high magnitude of the total inhibiting effects by the proximate determinants. The age at marriage, contraceptive prevalence rate, induced abortion and the lactational infecundability are four major proximate determinants in fertility reduction.

The age at marriage and the proportion of women remaining single indicate the duration of time for which they would be exposed to the risk of pregnancy and the number of women exposed to the risk of pregnancy. Age at marriage has risen due to prolonged education is the primary factor working to delay marriage. A shift, towards white-collar occupations may now be becoming important as well. Although women have continued to view marriage very positively, implying that almost all would eventually marry, attitudes may be shifted.

The use of contraception is a major determinant in reducing fertility in most of the developing countries. In India, family planning programme has officially accepted a nationwide since 1952, but the prevalence rate leads a major role for fertility declining only from last three decades. In urban Assam, the use of contraceptives did not spread widely for nearly two decades, only 53.4 percent of couple using any modern methods as reported by National Family & Health Survey, 1998-99. The maximum contraceptive practice has been observed in Himachal Pradesh, 74.3 percent while Bihar, 38.9 percent have the lowest contraceptive prevalence rate in India during the period.

Abortion is clandestine or otherwise unsafe conditions expose women to risk of mortality and morbidity (Khanna et. al. 1994). It is well recognized that there is a negative relationship exists between contraception use and the induced abortion. So from the declining trend of contraception users, it may not be a wrong assumption that the induced abortion is increasing over time. It is very hard task to collect the reliable information on induced abortion. Because induced abortion may be reported as spontaneous in order to avoid admitting morally unacceptable action. Illegal abortions of a premarital and sex-determination nature are carried out in the private sector and never enter the record. Therefore, the abortion phenomenon in India is largely disguised due to incomplete and limited data availability. India's actual abortion rate is probably about two to five times the reported rate, since only a fraction of abortion, that is, those performed in registered nursing homes and government facilities are reported (Henshew 1990). Assam having the similar problem, a large proportion of the abortion that goes unreported may have been performed with any medical supervision.

The relationship between extended durations of breastfeeding and long periods of postpartum ammenorrhoea has been well documented and post partum infertility is the path through which breastfeeding variables affect fertility (Nath et. al. 1993, Yadava and Islam 1994). In order to estimate the effect of ammenorrhoea on fertility, information on the duration of breastfeeding is essential. The breastfeeding of the long period does not protect women from conception for the entire duration but it helps to protect partly depends on the duration of exclusively breastfeeding practices of the women to their child. The duration of breastfeed practices is almost same for urban and rural areas in Assam. According to NFHS, the medium duration of breastfeeding practices for urban was 27.3 months and 29.7 months in 1992-93 and 1997-99 respectively.

Different traditional communities living in different states/areas in India are very diverse in population size, trends in fertility and mortality, rates of economic development, patterns of migration, and development approaches. Assamese people mostly leave in Assam, Northeast state of India. About 10% of the Assamese population lives in urban areas of Guwahati city.

The main objective of the study is to compare the total fertility rate in Assamese population living in an urban area of Guwahati City in Assam, India between two points of time 1991 and 1999. Bongaarts proximate determinants model with a modification is applied in two different points of time to quantify the fertility inhibiting effects of the four important proximate determinants, marriage, contraception, lactational infecundability and induced abortion. In order to study the trends in the fertility inhibiting effects of the major proximate determinants and tried to focus the variation in the proximate determinants during the period, the model was applied on the data collected from the currently married Assamese couples in Guwahati city, Assam at two points of time. It has further attempted to offer some possible explanation in the case of major contribution of the fertility-inhibiting factors over the period.

Data

The data used for the study have been taken from two surveys conducted by Department of Statistics, Gauhati University entitled "Status of Women, Fertility and their Reproductive Health in Urban Assam" under the financial assistance from Rockefeller Foundation, New York, USA, during 2000-2002 and "A Survey on Status of Women and their Reproductive Histories in Health in Urban Guwahati-1992" respectively. The survey conducted in 1999 includes 3129 eligible couples of which 1582 couples belonging to Assamese followed by 992 couples from Bengali. The remain percentage belonging to 214 couples percent of Hindi specking women and 71 couples of other community consisting of Napali, Bhajpuri and Khasi. In 1992, the survey was conducted exclusively on 1590 Assamese couples. Since the prime objective of the study is to focus the variation of the proximate determinants of fertility on Assamese population, the study includes only Assamese population from both the two surveys.

A couple was defined eligible if both the partners were alive and age of the female was in the reproductive span i.e., 15 to 49 years. Both the survey includes information on age, sex, birth, age of female at marriage, total number of children ever born and surviving, post-partum ammenorrhoea, separation, abstinence and their birth-interval, breastfeeding practices etc for all births ever life of the eligible women. But the survey conducted in 2000-2002 includes additional information regarding on abortion both induced and spontaneous with the reference of June 2000.

These records have been utilized to estimate the values of four indices namely index of marriage, contraception, lactational infecundability and induced abortion because these form the input for the application of Bongaarts model.

Methodology:

The demographic implications of proximate determinants have been studied to facilitate an understanding of their effect on fertility and population growth. It is well known that the major change in fertility is produced by changes in the factor like marriage, contraception, postpartum infecundability and abortion (Bongaarts, 1978. Bongaarts and Potter 1983). The proportion of women married, age at marriage and marriage stability determines the extent and duration of exposure to conception and childbearing. The duration and intensity of breastfeeding affect the length of the period of postpartum ammenorrhoea, which has an important in the spacing of births in the society. On the other hand, the use of contraceptive represents a deliberate attempt to space or limit child bearing. While induced abortion has been an important factor responsible for fertility decline in the society.

The detailed exposition of the proximate determinants model is given in Bongaarts (1978) and Bongaarts and potter (1983). The basic Bongaarts model is expressed as

$$TFR = C_m * C_c * C_i * C_a * TF$$

where TFR is total fertility rate, TF is the total fecundity rate; C_m, C_c, C_i and C_a are indices measuring the fertility inhibiting effect of marriage, contraception, postpartum infecundability and abortion respectively. The value of each of these four indices ranges from 0 and 1. The index takes the value 0 when the fertility inhibition of the given intermediate fertility variable is complete and equal to 1 when there is no fertility inhibition effect. These indices are estimated as:

C_m = TFR/TMR; where, TMR = Total marital fertility rate.

$C_c = 1- \alpha * u * e$.

where α is an adjustment for the couple having not using contraceptive method, Bongaarts (1978) estimated the constant as 1.08.

u = Average proportion of married women currently using contraception.

e = Use- effectiveness of contraceptive methods.

C_i = Birth interval in absence of breastfeeding/ Birth interval in presence of postpartum non-susceptible period caused due to breastfeeding.

$C_a = TFR / \{TFR + 0.4 (1+u) TA\}$.

Bongaarts (1978) established a relationship between the three cumulative fertility rates: total fertility rate (TFR), total marital rate (TM) and total natural marital fertility Rate (TN). The Basic relations between these indices and the cumulative fertility measures are:

Total Fertility Rate (TFR) = $C_m * TM$;

Total Marital Rate (TM) = $C_c * C_a * TN$;

Total Natural Marital Fertility Rate (TN) = $C_i * TF$.

Observed Reproductive Measures between two time points:

The Table 1 presents the summary of some reproductive measures of the four important proximate determinants of fertility calculated from these two surveys. It is observed that the induced abortion is usually practiced in this society. As we have mentioned earlier, the survey conducted in 1992, fails to collect the information on induced abortion so the study considered the same rate of induced abortion from National Family Health Survey, 1992-93, as because both the survey conducted approximately during the same period of time. The table indicated that the total marital fertility rate 3.04 in 1991 was declined to 2.89 per married women in 1999. On the other hand, the total fertility rate declined from 2.43 to 1.90 per women, which indicates that the fertility transition occurred from above replacement level to below the replacement level during the period in the study population. It is clear from the table that 68.9 percent of currently married women were practicing any method of family planning in 1991 but only 61.6 percent of women are using contraception method in 1999. It can be stated that in spite of more prevalence rate of contraception in 1991, the use of effectiveness of method is more in 1999. It is seen that most of the contraceptive users preferred condom (36 percent) followed by other method including traditional, withdrawal etc (25 percent) in 1991. On the other hand, other methods including traditional, withdrawal claims the highest prevalence rate (51 percent) followed by sterilization 22.3 percent in 1999. It is notable that the proportion of sterilized women increased marginally by 0.7 percent whereas the proportion raised to 25.7 percent of practices for other methods during 1991-99.

Table 1: Estimates of selected Reproductive measures over two points of time

Reproductive measure	1991	1999
Total marital fertility rate	3.04	2.89
Total fertility rate (observed)	2.43	1.91
Proportion of contraceptive user	68.9	61.6
Contraceptive use-effectiveness	0.9365	0.9398
Total Induced Abortion Rate	0.1240	0.2735
Duration of Lactational Infecundity	7.8	11.3

The relationship between extended durations of breastfeeding and long periods of postpartum ammenorrhoea has been well documented and post partum infertility is the path through which breastfeeding variables affect fertility. It is also indicated that the duration of lactational infecundity increases with time, nearly 3.5 months extends during the time. It may be one of the causes of declining trend of fertility in the study population in 1999. Another cause may be due to induced abortion. The extent to which women resort to abortion has a direct effect on fertility levels independent of other proximate determinants because abortion ends pregnancy. The abortion rate increased over time period, in 1991 where the rate was 0.12 but rose to 0.27 in 1999 in the study population. This rise in abortion rate may be due to declining in contraception prevalence rate. The total abortion rate increased 0.15 over this period. It may be due to the reason that with the higher education and availability of well-equipped medical facilities intend a person for safe abortion rather than contraception use, as there is a possibility of failure or side effect in using the contraceptive methods.

Modified Bongaarts Model:

The model describes by Bongaarts (1978) and Bongaarts and Potter (1983) shows the relationship between the indices of marred women, contraception users, abortion, lactational infecundity and the total fecundity rate with the total fertility rate. Reinis (1992) is skeptic of the indices proposed by Bongaarts and Potter in their adequacy in measuring the impact of the proximate determinants of fertility (Reinis, 1992, 1994 and Bongaarts, 1994). Even with the original components of Bongaarts model, Casterline et. al (1984) arrive at a mean TF of 14.5 for 29 countries in the region of South America, Asia and Africa using World Fertility Survey data. On basics of NFHS, 1992-93, the TF ranges from 9.5 in Bihar state to 15.2 in Kerala state in India and India, as a whole, is estimated as 11.8 (Vasaria 1999). On the other hand, the constants proposed by Bongaarts largely based on historical population in Western Europe, for defining the indices of the four proximate determinants are not appropriate for this population. So the study tried to estimate the constants involved in the fertility model. The index of marriage C_m is the ratio between the total fertility rate and the total marital fertility rate and hence no constant is involved in computation of C_m. If, however, the constants assumed in the computation of C_c, C_a, and C_i are not appropriate then it would likely to be affected the value of total fecundity rate, which further effects on estimated fertility.

The constants assumed in the computation of C_c can be considered appropriate due to reason that the constants involved in C_c is $Cc = 1 - \alpha * u * e$, where α is a constant, which implies an adjustment for the couple having not using contraceptive method. Bongaarts estimated the constants as 1.08. In estimating the same constants using nonlinear estimation method Krishnamoorthy et. al (2003) also found $\alpha = 1.06$.

The index of abortion, C_a is expressed as $C_a = \frac{TFR}{TFR + \hat{a}\,(1+u)\,\mathrm{TA}}$, where TA represents the total fecundity rate and the constant $\hat{a}$ is expressed as the number of birth averted by induced abortion. In estimating the constant using nonlinear regression method, Krishnamoorthy et. al (2003) found that the value $\hat{a}$ is 0.36 whereas Bongaarts assume $\hat{a}$ =0.4. Though there is not significant difference between Bongaarts estimates and the nonlinear estimate in the study for estimating the indices of contraception and abortion respectively we consider $\alpha = 1.08$ and $\hat{a}$ =0.4.

The relationship between breastfeeding (B) and the postpartum ammenorrhoea (PPA) follows different distribution in the two different points of time. In 1991, the exponential model as described by Bongaarts and Potter (1983) is a good fit, while in 1999, the exponential model fails to estimate the relationship between PPA and breastfeeding. In reviewing the literature for identifying the nature of the relationship between breastfeeding practices and PPA, we found that different scholars observed different distribution of PPA and breastfeeding practices.

Bongaarts and Potter (1983) while studying the fertility inhibiting effect of breastfeeding, observed the logistic type relationship between the duration of breastfeeding and ammenorrhoea. They suggested the use of an exponential model as an indirect technique to derive lactational infecundability from the duration of breastfeeding data in a situation when

direct observations on PPA variables were not available. The exponential model Bongaarts and potter (1983) based on 41 developed and developing countries, suggested as estimated PPA = 1.753 exp {0.1396 ∗ B - 0.001872 ∗ B^2}; B = Median duration of breastfeeding practices, $R^2 = 0.96$. In a study in Santiago, Chile, Perez et al., (1971) obtained the correlation between breastfeeding (B) and postpartum ammenorrhoea (PPA) as 0.74 with line of regression, estimated PPA = 1.5 + 0.6 ∗ B. Van Ginneken (1974) in a study in International Postpartum Survey found 0.3 as the degree of correlation between B and PPA with line of regression P = 2.7 + 0.3 ∗ B. Jain et. al, (1979) in another study in Taiwan found a moderate degree of correlation between the two as 0.43 with estimated PPA = 4.4 + 0.4 ∗ B as line of regression. Yadava and Islam (1994) re-estimated the values of the parameter by the least square method using the data set from eight developing countries and expressed the equations as, estimated PPA = 3.186 exp {0.0973 x B – 0.00158 x B^2} and suggested that the model which has congruence with the prevailing norm of breastfeeding and PPA in developing countries. The model of Bongaarts and other scholar of double exponential model suggested a continuous increase in post partum ammenorrhoea with an increase in the duration of breastfeeding. But no population will have a lactational infecundable period on an average more than 12-14 months and this infecundable period cannot increase after a certain level. In view of two types of models for estimating PPA, we consider bimodal model patterns of PPA for 1999 by grouping the breastfeeding practices into two parts:
1) Duration of breastfeeding <= 18 months and 2) Duration of breastfeeding > 18 months

It is found that exponential model gives a good fit for 1992 data whereas quadratic model is fitted for 2000-02 data. The fitted model, which express the relationship between breastfeeding and PPA for both the time as:

$$\text{Estimated PPA (1991)} = 1.753 * \exp\{0.1396 * B - 0.001872 * B^2\};$$

$$\text{Estimated PPA (1999)} = \exp\{2.4445 + 0.0353 * B\};\ \text{for } B \le 18 \text{ months.}$$

$$= 59.9358 - 0.2554 * B - 0.0046 * B^2;\ \text{for } B > 18 \text{ months.}$$

Then the relationship between breastfeeding and postpartum ammenorrhoea for the all the women can be express as

$$\text{Estimated PPA (1999)} = \pi * \exp\{2.5 + 0.0345 * B\} + (1-\pi) * [5.2475 + 0.0905 * B - 0.0011 * B^2]$$

B = median duration of breastfeeding and
π = Proportion of women having breastfeeding of either group.

It is observed that 42.9 percent of women having their breastfeeding practices less than or equal to 18 months with the median duration 12 months and remaining 57.1 percent of women having their breastfeeding practices greater than 18 months with the median duration 26 months in 1999. But the median duration of breastfeeding practices was 13 months by the women in 1991. Sahu (1998) used bimodal distribution in describing PPA pattern of another group of Indian married weman.

Further while deriving the index C_i, Bongaarts assumed empirically (largely based on historical population in Western Europe) that in the absence of breastfeeding, the minimum duration of PPA is 1.5 months and waiting time for conception as 7.5 months. In India, the waiting time for conception is longer than 7.5 months due to some biological and social factors. Potter et al. (1965) has reported 10.7 months of waiting time for conception in the India. Recently, Singh et al. (1993) has reported, based on the survey data on maternity history of women in rural areas of eastern Utter-Pradesh, that the waiting time for conception is 13.2 months. In such situation, where actual waiting time is longer than what Bongaarts reported, the model will underestimate the index C_i, which will over estimates the fertility inhibiting effect of lactational infecundability.

Theoretically, a woman would bear maximum of 15 children on average with 25 years (300 months) of their reproductive span. The actual reproductive span for a woman is 35 years i.e. 15 to 49, but due to delay marriage after few years of menarche and the onset of permanent infecundity usually occurs a few years before menopause. The study considers the reproductive span is 25 years (300 months) for both the periods. Using two sets of data, it is found that the minimum PPA for both the points of time are 1 month and the average waiting time for conception are 9.43 months and 12.58 months for 1991 and 1999 respectively. Considering the gestational period and the pregnancy wastage are same as Bongaarts reported i.e. 9 months and 2 months respectively. The total fecundity rate, which can be defined as the average number of live births expected among women who during their entire reproductive period remain married, do not use any contraception method, do not have any induced abortion and do not breastfeed their children is found to be $\frac{300}{21.43}$ = 14.0 months in 1991 [21.43 months = Minimum duration of PPA (1month) + Waiting time of conception (9.43 months) + Gestation period (9 months) + Pregnancy wastage (2 months)] and $\frac{300}{24.58}$ = 12.2 months in 1999 [24.58 months = Minimum duration of PPA (1month) + Waiting time of conception (12.58 months) + Gestation period (9 months) + Pregnancy wastage (2 months)] rather than 15.3 months as suggested by Bongaarts for most of the population.

The index of abortion is the ratio of observed total fertility to the estimated total fertility without induced abortion, which can be written as $C_a = TFR / \{TFR + b * TA\}$; where, b = 0.4 (1+u) and u is the proportion of women using contraception among those who have had an induced abortion.

The denominator depends on the number of births averted per induced abortion (b) and total abortions rate (TA), the number of abortions a woman would experience if she were subject to prevailing age-specific abortion rates throughout her lifetime. The total fertility rate and the total abortion rate can be directly estimated from the population data. Since the collection of reliable information on birth averted per induced abortion is very hard, Bongaarts (1982) established a relationship between the birth averted per induced abortion and contraception prevalence rate by b = 0.4 * (1+ u). The constant involved in finding b is 0.4, which implies that in the absence of contraceptive users, an induced abortion averts about 0.4 births, while about 0.8 births are averted when moderately effective contraception is practiced. The proportion of all married women who uses contraception is taken as an approximation to

u. Since b depends on the effectiveness of contraception uses and direct estimation of effective contraception used by the couple are almost never available, we substitute u by u $*$ e, where e is the contraceptive use-effectiveness and is calculated by Σ [$u_i * e_i$ / Σu_i]. Then b can be estimated as b' = 0.4 (1 + u $*$ e).

Using the modified relation with the number of births averted per abortion (b) and the contraception prevalence rate, the index of abortion can be estimated as C_a = TFR / {TFR + 0.4 (1+ u * e) * TA};

Role of Proximate Determinants of fertility:

Table 2 shows the estimated values of the four indices of proximate determinants. The lower the index, the greater is its fertility reducing impact. In fact, the index C_m represents the proportion by which TFR is smaller than TM as a result of marriage pattern. It is clear from the Table that the value of C_m is a declining trend, which reflecting the increase in proportion of non-married i.e., in the age at marriage over the period 1991 to 1999. The proportion of married women in 1991 was 0.7993, which reduced to 0.6689 in 1999 in the study population. In the light of the basic relations between the indices and the cumulative fertility measures, the reason of the difference between TM and TFR is mainly due to C_m, i.e. 0.53 births per women or 21 percent fertility averted due to the increase of 16 percent of non-married women during the period. The index C_c gives the proportion by which TM is smaller than TN with the use and effectiveness of contraception. The study reveals the declining trend of contraceptive prevalence rate is the main cause of increasing the value of C_c from 0.3031 to 0.3748 i.e. 24 percent. On the other hand, the value of C_i states that, how much TN is smaller than TF due to the effect of lactational infecundability. The fertility reducing effect of lactational infecundability increases over time helped to trim down the value of index from 0.7579 to 0.7047. The value C_a represents the index of abortion, which is inversely related with total abortion rate. If total abortion rate is tends to 0, the index approaches to 1. The value of C_a pointed out that the average number of induced abortion per woman at the end of the reproduction period, if the induced abortion rate remaining at the prevailing level for woman in each age group in nearly zero. The study found that due to the lactational infecundability the total natural fertility rate reduces to 10.6 in 1991 from the total fecundity rate 14 whereas in 1999 the rate reduces from 12.2 to 8.6. On the other hand, the total marital fertility rate reduces to 3.11 in 1991 and 2.95 in 1999 is only due to inhibiting contribution of contraception and abortion from total natural fertility rate.

It is clear from the Table 2 that induced abortion per woman increases about 6 percent over the two points of time at the end of their reproduction period. The reproductive span of a couple starts with menarche or marriage whichever is late and continues till the onset of menopause or secondary sterility whichever is earlier. Theoretically, a woman would bear maximum of 15 children on average with 25 years (300 months) of their reproductive span and the length of this span is constants in almost all the population. However, the number of children that a woman will ultimately have during this period depends on the age at which she begins childbearing and that she bears subsequent children. It is seen in the study population that the waiting time of conception increased over time and it reached to 12.6 months in 1999 from only 9.4 months in 1991, which results the total fecundity rate declined from 14 births to

12.2 births over two different time period i.e. in absence of breastfeeding and contraceptive practices, a woman can produced 12.2 births in 1999 instead of 14 births in 1991.

Table 2: Estimates of four important proximate determinants and the cumulative fertility rates

Model Indices	1991	1999
Index of Married woman (C_m)	0.7993	0.6689
Index of Non-use of Contraception (C_c)	0.3031	0.3748
Index of Infecundability (C_i)	0.7579	0.7047
Index of Abortion (C_a)	0.9675	0.9157
Overall inhibiting effect of the combined indices Cm * Ci * Cc * Ca	0.1776	0.1618
Total fecundity rate (TF)	14.0	12.2
Total fertility rate	2.45	1.94
Total marital fertility rate	3.11	2.95
Total natural fertility rate	10.6	8.6

Magnitude of the total inhibiting effects accounted for by each proximate fertility determinants:

The Table 3 exhibits the magnitude of the total inhibiting effect being accounted by each proximate fertility determinant at two points of time. The differences between the total fecundity (TF) and the estimated TFR are attributed as the result of the inhibiting effect of each determinant. The total inhibiting effect is prorated by the proportion of the logarithm of each index to the sum of logarithm of all indices (Wang et. al., 1987).

The fertility inhibiting effect of marriage is obtained as:

$$[TF-TFR \text{ (estimated)}] \times \log C_m / (\log C_m + \log C_c + \log C_a + \log C_i).$$

The fertility inhibiting effect of contraception is obtained as:

$$[TF-TFR \text{ (estimated)}] \times \log C_c / (\log C_m + \log C_c + \log C_a + \log C_i).$$

The fertility inhibiting effect of lactational infecundability is obtained as:

$$[TF-TFR \text{ (estimated)}] \times \log C_i / (\log C_m + \log C_c + \log C_a + \log C_i).$$

The fertility inhibiting effect of abortion is obtained as:

$$[TF-TFR \text{ (estimated)}] \times \log C_a / (\log C_m + \log C_c + \log C_a + \log C_i).$$

As is apparent from the Table 3, contraceptive practice is the major fertility inhibiting intermediate variable for both the periods. It has led to reduction in fertility by 7.96 births or 69.16 percent in 1991 while 5.51 birth or 53.86 percent in 1999. It is well documented that the contribution of the other proximate determinants is high, on fertility reduction when a little use of contraceptive practice are observed in the society.

Table 3: Magnitude of the total inhibiting effects accounted for by each proximate fertility determinants:

Proximate Determinants	Fertility inhibiting effects			
	Birth per Women		Percent	
	1991	1999	1991	1999
Marriage C_m	1.49	2.26	12.95	21.99
Contraception C_c	7.96	5.51	69.16	53.86
Lactational infecundity C_i	1.85	1.97	16.07	19.26
Induced Abortion C_a	0.21	0.50	1.83	4.89
Total: TF-TFR (estimated)	11.51	10.23	100.00	100.00

Among the proximate determinants marriage has the next major contributor of fertility reduction in 1999, while lactational infecundability played a vital role in reduction the fertility in 1991. The fertility inhibits due to marriage in 1991 was 1.49 births or 12.95 percent raised to 2.26 births or 21.99 percent in 1999. On the other hand, lactational infecundability caused due to the breastfeeding practice reduced the fertility of 1.85 births or 16.07 percent in 1991 and 1.97 births or 19.26 percent in 1999. The abortion rate, which is another important factor for fertility reduction, responsible for 0.5 births or 4.9 percent in 1999 against only 0.21 births or 1.83 percent in 1991 of fertility reduction. The total fertility inhibiting due to the effect of the four proximate determinants was 11.51 births in 1991 declined to 10.23 births in 1999.

Decomposition of change in TFR during the period 1991-99:

The contribution made by each of the proximate determinants of fertility to an observed change in fertility between two points of time can be quantified by using the decomposition equation:

$$TFR(99)/TFR(91) = C_m(99)/C_m(91) + C_i(99)/C_i(91) + C_a(99)/C_a(91) + C_c(99)/C_c(91) + TF(99)/TF(91).$$

$$P_f = P_m + P_i + P_a + P_c + P_r + I$$

Where, $P_f = [TFR(99)/TFR(91)] - 1$
= Proportional change in TFR between 1991 and 1999.

$P_m = [C_m(99)/C_m(91)] - 1$
= Proportional change in TFR between 1991 and 1999 due to change in marriage.

$P_c = [C_c(99)/C_c(91)] - 1$

= Proportional change in TFR between 1991 and 1999 due to change in contraception.

P_i = $[C_i (99)/C_i (91)] - 1$
= Proportional change in TFR between 1991 and 1999 due to change in postpartum infecundability.

P_a = $[C_a (99)/C_a (91)] - 1$
= Proportional change in TFR between 1991 and 1999 due to change in induced abortion.

P_r = $[TF (99)/TF (91)] - 1$
= Proportional change in TFR between 1991 and 1999 due to change in total fecundity rate.

The interaction factor I can be easily obtained by subtracting the sum of $P_{m,}$ $P_{i,}$ $P_{a,}$ P_c and P_r form P_f.

The decomposition equation simply yields the proportional change in TFR between two points of times, which equals the sum of the proportional change of the proximate determinants, and an interaction term. The absolute change in TFR can be estimated by reusing the decomposition equation as [TFR (99) - TFR (91)] x TFR (91) i.e.

$$[TFR (99) - TFR (91)] = TFR (91) \times [P_m + P_i + P_a + P_c + P_r + I].$$

Table 4: Decomposition of change in TFR between 1991 and 1999:

Factor responsible for fertility change	Percent of change in TFR	Distribution of percentage of change in TFR	Direction and magnitude of change in TFR
Proportion of Women marriage (P_m)	-16.31	79.25	-0.41
Contraception Practices (P_c)	23.66	-114.97	0.60
Duration of post-partum infecundability (P_i)	- 7.02	34.11	-0.18
Induced abortion (P_a)	- 5.35	26.00	-0.13
Other Proximate determinants (P_r)	-12.86	62.49	-0.33
Interaction (I)	- 2.70	13.12	-0.07
Total	-20.58	100.00	-0.52

The result of the decomposition of the components of the device in TFR indicates that 21 percent decline in TFR during 1999 due to the proximate determinants in the study population between two points of time. The decline in TFR can be decomposed into a 16.31 percent decline due to decrease in proportion of married women, a 7.02 percent decline due to an increase in the duration of postpartum infecundability caused due to breastfeeding and a 5.35 percent of decline due to increase in induced abortion in the study population. The contraceptive practice contributes a 23.66 percent increase in TFR due to the decrease in the prevalence rate. The remaining proximate determinants contribute a 12.86 percent decline in TFR while the interaction factor affects a 2.7 percent to the decease in TFR. It is clear from these results that major contribution of fertility reduction in the study population is the change in marriage patterns specially delay in marriage. This finding confirms that changes in age at marriage can have a substantial influence on fertility in the study population.

Trend of age at Marriage and first birth between 1991-1999:

Increases in ages at marriage and at first birth were an important component of fertility reduction in most Asian countries and late age at marriage was a factor in the relatively low pre transition fertility of European population. Many ambiguities are associated in linking with the timing of marriage and the onset of childbearing in most African societies (Van de Walle 1993). According to SRS (1999), in Assam the age at marriage of women less than legal age i.e. 18 years is only 2.9 percent while 68 percent of women got married above 21 years. "Marriage is generally considered the best indicator of exposure to the risk of childbearing" (Bledsoe and Cohen 1993). The delay of marriage is closely associated with shorter duration of reproductive span. The reproduction before marriage is not acceptable in this society. Thus the decline in the proportion of married women may be due to increase in the mean age at marriage.

Table 5: Mean age at marriage of women in Guwahati during two points of time 1991 and 1999.

Age at the time of survey	Mean age at Marriage		Direction and magnitude of change in age at marriage
	1991	1999	
15-19	15.81	16.29	+ 0.48
20-24	18.03	18.65	+ 0.62
25-29	20.71	21.42	+ 0.71
30-34	21.66	22.27	+ 0.66
35-39	20.98	21.94	+ 0.96
40-44	21.29	21.16	- 0.13
45-49	20.29	19.91	- 0.38

Note: Change in age at marriage: Mean age at marriage (99) - Mean age at marriage (91).

It is clear from the table that age at marriage is increasing over the points of time, 1991 and 1999. The trend across cohorts suggests substantial increase in age at first birth from the younger to older cohorts. The change in the age group 35-39 is large, which indicated that 0.96 years increases in age at marriage during the two point of time in the study population. But after 39 years, the age at marriage showed a positive change. This should be an error such as misreporting of the woman's age, underreporting of first birth, and misreporting of the data of birth of first child. These types of errors are usually more pronounced among older women in developing country.

The impact of an increase in the median age at marriage on fertility will depend in part on the extent to which the increase is accompanied by a corresponding increase in the median age at first birth. Clearly, an increase of age at first birth mainly depends on the age at marriage and the first birth interval. When successive cohorts delay childbearing, TFR is temporarily depressed, as has happened in the study population and a number of other developed courtiers since the mid 1970s (Bongaarts and Feeny 1998, Bongaarts 1998, cited in Bongaarts 1982).

Age-specific Marital Fertility Rate:

Analysis of marital fertility provides insight into the pattern of reproductive behaviour of those exposed to childbearing and enables us to identify whether there was any changes in this behaviour accompanying the change in age at marriage. In the society, where the fertility out of marriage is not accepted, marital fertility rate can increase more understanding about the fertility trend than the total fertility rate. Table 6 represents the marital fertility rate for two points of time.

Table 6: Age-specific Marital Fertility Rate by the age of women at the time of survey during 1991 and 1999:

Age at the time of survey	Age-Specific Marital fertility rate		
	1991	1999	Direction and magnitude of change
15-19	0.284	0.1296	-0.154
20-24	0.163	0.1791	+0.016
25-29	0.119	0.1348	+0.016
30-34	0.034	0.0949	+0.061
35+	0.009	0.0382	+0.029
Total (15-49)	0.609	0.577	-0.032

Note: Change in ASMFR: ASMFR (99) - ASMFR (91).

The Table 6 showed that the marital fertility in the younger age group is more in 1991 as compared to 1999. The difference between the patterns of age-specific fertility rate between two points of time is that in the former trend nearly 57 percent of total marital fertility occurred within 30 years of age of women where only 44 percent of fertility took place within the same age group in the later period. Overall change in age-specific marital fertility was observed 0.032 or 0.16 births per married women during the period in the study population.

Discussion:

The present paper indicates the role of the proximate determinants in reducing fertility to below replacement in an urban society of Northeast India. Bongaarts' model remains one of the most widely used tools for analyzing fertility and fertility change. Bongaarts proximate determinants model is applied to estimate the fertility inhibiting effect of the four important proximate determinants, marriage, contraception, lactational infecundability and induced abortion. The trend in total fertility rate examined by using period measure is however based on the reproductive performance of a hypothetical cohort of women who experienced over their lifetime the age-specific fertility rates observed in a particular population at a particular time.

The present analysis shows that the fertility transition occurred in the study population during the period 1991 and 1999. In the year 1999, the fertility is estimated as 1.89 children per women while in the previous time point (1991), it was 2.49 children per women. Among the four proximate determinants marriage has an important contribution of fertility inhibiting in the survey population, which is the unique factor to bring down the total fertility rate during the period. It is observed that along with total fertility rate marital fertility also declines but not the same proportion. The marital fertility, which was 3.04 in 1991 reduced to 2.89 in 1999. The result indicated that the total fertility rate is declining more rapidly than the total marital fertility rate, which may be due to the faster change proportion of married women caused due to delay the age at marriage. The study found that the declining in total marital fertility rate is only due to reducing in the adolescent fertility (15-19 years of age). As compared to 1991, the total adolescent fertility reduces to 0.6 births per married women. This decline in fertility may be due to the effect of delay age at marriage as well as increasing of age at childbearing. With regard to the age pattern of fertility, highest fertility is generally found in 25-29 age groups, but in 1991 the highest fertility is observed in adolescent age group, while in the year 1999 the major of fertility occurred in 20-29 years of age group in this study population. On the other hand, age at childbearing also played a significant role of inhibiting fertility. It is found in the study population that the waiting time has risen nearly 5 months i.e. from 9.43 to 12.58 months during the point of time. This high age at marriage and age at childbearing together have a major impact on reducing 16.3 percent of fertility in the study population.

The postpartum ammenorrhoea associated with prolonged breastfeeding is another factor for the fertility deduction. As indicated in the study, the lactational infecundity inhibited the fertility to 1.97 births in 1999 against 1.85 births in 1991. There is nearly 33.77 percent positive change in lactational infecundability i.e. indicates the increasing trend in the lactational infecundability. The nature of breastfeeding practice, which is described by bimodal confirms that the postpartum ammenorrhoea 11.3 months in1999. The postpartum ammenorrhoea based on the breastfeeding practices in this society in 1991 was found 7.8 months, which is less than 10.9 months for Assam as a whole based on NFHS, 1990-91 (Visaria 1999).

The practice of contraception plays a key role in fertility reduction. The substantial change in fertility limitation in developing countries that has transpired over nearly a quarter of a century can be viewed in the trend data on contraceptive practice. More than 61 percent of currently married women depend on contraception for their fertility regulation in the study population in 1999, but in 1991 the contraceptive prevalence rate was 68.9 percent. On the other hand, the contraceptive use-effectiveness in 1991 was 0.9365 rose to 0.9398 in 1999, which confirms that the effectively of the contraceptive practices has been increased over this period.

The relationship between the abortion rate and the contraceptive prevalence rate follows dual in nature in the early and middle phases of fertility transition. Sometimes the relation follows negative and sometimes it follows positive. In Kazakhstan, Kyrgyz Republic, Turkey and Uzbekistan, abortion incidence declined as prevalence of modern contraceptive use rose. On the other hand, in Republic of Korea, Singapore, and the United States of America, level of abortion and contraceptive use rose simultaneously. However, after fertility level gets stabilized, the relationship showed as the contraceptive use continued to increase and abortion rates fall. The proposed modification in the relationship between induced abortion and the contraception helps to provide better information on index of induced abortion. The new relationship gives 0.66 births averted per induce abortion in 1991 while 0.63 births averted in 1999 indicates more or less the averted per induced abortion is same for both the points of time. But the total abortion rate varies greatly between the time in 1991, the abortion rate of 12 percent rose to 27 percent in 1999 in the study population. The inclining trend in abortion may be due to the improvement of medical facilities and the impact of higher education among the women present in the study population.

In studying the fertility rate in other Asian countries such as in Nepal, Pakistan (North west Frontier Province) and China, many scholars have reported the large discrepancy in observed and model estimated fertility rates (Thapa, 1987; Saattar, 1984; Wan et al; 1987). This discrepancy may be due to the total fecundity rate other than the proximate determinants. Bongaarts has empirically shown that the TF value ranges between 13 and 17 births per women with an average near 15 and has suggested that values outside this range are very likely due to some errors in data or estimation procedures. While in India as a whole, the total fecundity rate was estimated to be 11.8 births and 13.5 births (Visaria, 1999) for Assam. In the urban population the total fecundity rate is found different for two point of time, in 1991, it was found to 14 where in 1999 it reduced to 12.4, which is slightly higher than all Assam but lower than India, as a whole. The total fecundity rate is mainly depends on the reproductive span of a woman and the waiting time of first conception taking other factors constant. The variation of total fecundity rate is only due to the increase from 9.4 months in 1991 to 12.4 months in waiting time during the period 1999.

The empirical data demonstrates that the early fertility transition took place in this urban society of India before the entry of 21 century. The couples in this society are having, on average, fewer births than are necessary for generations to replace themselves. The past studies reveal that once the fertility transition begins, further declines follow almost invariably (Coale and Watkins 1986, Kirk, 1996, Knodel and Vande Walle 1979, Bongaarts and Watkins 1996). The rate of fertility transition occurred may not be in the same rate in all population, rather it depends on the factor responsible for the fertility transition. The study exhibits that increasing of age at marriage and age of childbearing are two important factors of fertility reduction but when these factors stopped rising, the present downward distortion would disappear and the

TFR could be expected to rise. In the United States, for example, the upward trend in the mean age at childbearing ceased in the 1990 and that accounted for the recent rise in the TFR.

It is true that, government policy may significantly affect the trends in fertility in some cases, while in others economic and social changes may be equally important. In Asian countries, the role of Government as a determinant of fertility was particularly important. The policy decision at the national level has been a major factor in bringing about fertility decline, in contrast to developed countries likes Europe, where individual couples acted primarily in their own interest. The concept that individuals should take into account the needs of society at large in their decision-making is deeply embedded in this culture and population pressure is universally recognized as a social problem.

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