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# Reproductive Preference Implementation Index and Fertility Changes in India: An Analysis of NFHS Data

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## Abstract

Preferences for family size or for sex of a child reflect the values attributed to children within a given cultural setting as well as individual considerations: such preferences indicate the demand for children United Nations (1987). In traditional societies family size preferences are found to be greater than actual fertility, but in developing countries the family size preferences are lower than actual fertility; however in developed countries the two are similar Ware(1974). The need therefore exists to examine, the extent to which observed changes in fertility can be explained by the ability of individuals or couples to implement their fertility desires through informed choice of family planning methods because from the early days the family planning programme was envisaged as an integral part of a comprehensive social development programme. This programme has influenced the reproductive behaviour of the population and effected in the increase of the number of acceptors of various family planning methods. However, in spite of a long series of officially run family planning programmes during the ensuing decades, the pace of fertility decline has been relatively slow. In this study, Bongaarts variant of Easterlin's supply-demand framework is used for the analysis of fertility to estimate the level of preference implementation. This evaluation index can assist governments in designing and implementing appropriate strategies for the achievement of the set targets.

**Keywords and Phrases:** Fertility, Preference Implementation, Natural Fertility, Wanted Fertility, Fertility Regulation.

**AMS Classification: 58E35.**

# 1 Introduction

The demographers have been successful in identifying direct determinants of actual fertility Bongaarts (1978), but they have not yet been able to identify the direct determinants of reproductive preferences. Moreover, socio-economic differentials of actual fertility have long been known, but the said differentials of reproductive preferences were almost unknown until recently. Using the percentage of women wanting more children as contained in World Fertility Survey data, Brackett and others (1978) were the first to dispute the hypothesis that uneducated women had unrestricted fertility desires or desired a very much higher number of children than educated women. In subsequent studies using World Fertility Survey data, the United Nations (1981) and Lightbourne (1984) examined both the percentage of women wanting more children and mean desired family size, and reported that reproductive preferences vary little by socio-economic status. So the demographers have been engaged in debates over the relationship between population and development, as throughout the world, a shift from high to low fertility has invariably accompanied economic and social modernization. This change has largely been accomplished by reduction in time, devoted to childbearing arising from change in fertility level and change in nature of fertility from biological, to one of conscious decision of individual couples Coale (1973). Many demographers see fertility transition as a complex process that involves key roles for changes in the demand for children as well as for the diffusion of new attitudes about birth control and greater accessibility to contraception provided by various family planning programs Mason (1997), Feyisetan & Bankole (2004).

A number of analytical models have been designed to identify and measure the determinants of fertility. The Easterlin's economic framework is a model of behavioral and biological factors affecting fertility in developing countries. The model consists of three central concepts: demand for children, the potential supply of children, and the momentary and psychic costs of contraception. Though the model is simple and attractive, it could not address dynamic issues and has not succeeded in quantifying these factors in an acceptable manner Bongaarts (1993). He proposed an alternative approach to the implementation of the original model. It is a reformulation of Easterlin's framework and measures reproductive performance in terms of births. He introduced a new variable called the degree of preference implementation to quantify the roles of the costs of fertility regulation and unwanted childbearing.

# 2 Conceptual Issues behind Frame Work

The crucial role played by socio-economic development in fertility decline is by now widely recognized in the demographic literature. However, when such development takes place at a slow pace, direct intervention in the form of family planning efforts can be and often is, attempted. Thus, both socio-economic development and family planning programme efforts are expected to contribute to fertility decline. A num-

ber of studies have tried to assess the relative roles of development and programme in bringing about a fertility change. Mauldin and Berelson (1978) observed that, although programme efforts are important, programmes in countries with a better social setting are more successful. Srikantan (1977) also highlighted the importance of the socio-economic context for the success of family planning programmes. A recent analysis by Bongaarts and others (1990:303) confirms some of the earlier findings; it has been observed that declines in fertility are associated with both development and strength of programme effort, and that socio-economic development and family planning programmes operate synergistically, with one reinforcing the other.

Emerging from the model is the fact that fertility is a function of three determinants namely; supply of births (natural fertility), demand for births (wanted fertility) and degree of preference implementation. The latter in turn is dependent on cost of fertility regulation and that of unwanted child bearing. The key variables and their relationship with fertility are illustrated below:

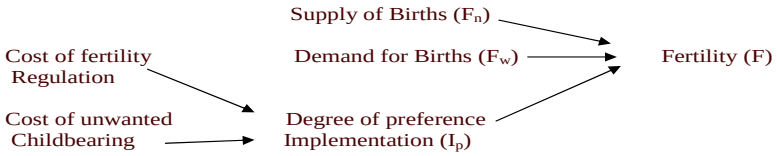


Figure 1: Key variables and interrelations in variant of supply-demand model.

Supply of births ($F_n$) is measured as natural total fertility. Natural fertility means the birth rate that would prevail in the absence of deliberate efforts by couples to limit family size. Demand for births ($F_w$) is measured as wanted total fertility. Wanted fertility is the rate of childbearing that would be achieved if all women were able to eliminate unwanted births. The third variable, the degree of preference implementation ($I_p$), is measured by an index with values ranging from 0 to 1. The level of implementation ($I_p$) is the net result of a decision making process in which the couple weigh the cost of fertility regulation and the cost of unwanted child bearing. If couples fully implement their fertility preferences, the index is equal to unity. Conversely, if the index is equal to zero, the observed fertility equals natural fertility, that is, fertility in the absence of deliberate fertility control. The value of the index determines, where actual fertility falls within the range set by wanted and natural fertility. The dependent variable, total fertility rate ($F$) gives the estimate of the number of children a woman would have by the end of her childbearing years if she were to pass through those years bearing children at the currently observed age specific rates. The model shows that the operation of these variables determines the level of fertility in a community or society. According to this variant model, as society develops, the

trend in actual fertility is a function of trends in wanted fertility, natural fertility and preference implementation.

## 3 Data and Methods

The data for the paper have been brought from the two surveys NFHS-1 and NFHS-2. The analysis makes use of Bongaart's variant of the Easterlin's supply-demand framework (Figure-1) for determinants of fertility to explain fertility changes in the states of India. The survey adopted a uniform sample design for all the states of India.

The rural samples were selected in two stages. At the first stage, the Primary Sampling Units (PSU) in which villages were selected with probability proportional to population size ( PPS). In the next stage households within each PSUs were selected at random. In the urban areas three stage procedures were adopted. First, ward (Primary Sampling Units) were selected with PPS sampling wherein census enumeration blocks (CEB) were selected at random in the next stage. However in the penultimate stage, households were selected at random from each CEB.

In this survey, residence, level of education, employment status, exposure to mass media, fertility, knowledge and use of contraception etc are used as main variables.

## 4 Estimation of Degree of Preference Implementation

According to Bongaarts (1993), the quantitative relationship between the variables and fertility can be expressed in statistical form as follows:

$$F = F_w + F_u \tag{1}$$

where $F$ is total fertility rate (births per woman), $F_w$ is wanted fertility and $F_u$ is unwanted fertility rate (which can simply be expressed as $F - F_w$). Also,

$$F_u = (F_n - F_w) \times (1 - I_p) \tag{2}$$

where $F_n$ is total natural fertility and $I_p$ is the index of preference implementation with values ranging from 0 to 1. $F_u$ is a function of the difference between supply and demand, and the degree of preference implementation. Substitution of (2) in (1) yields

$$F = F_w \times I_p + F_n \times (1 - I_p) \tag{3}$$

According to Bongaart, natural fertility can be obtained using the following relation.

$$F_n = F/C \tag{4}$$

where $C$ is an index between 0 and 1 that measures the proportional reduction in natural fertility attributable to deliberate birth control.

$$C = 1 - 1.02 \times U \tag{5}$$

where $U$ represents the proportion of married women who practice contraception. Substitution of (5) in (4) gives an estimate of $F_n$. Rearranging equation (3) gives

$$I_p = (F_n - F)/(F_n - F_w) \tag{6}$$

Equation (6) can now be used to estimate the degree of preference implementation when natural fertility, actual fertility and wanted fertility are known.

## 5 Decomposition of Fertility Trends

A decomposition of the fertility decline into the contribution of changes in proportions married and marital fertility provides a better picture of the nature of the decline. For India, Retherford and Rele (1989) estimated that, of the 1.06 point decline in TFR between the periods 1960-1964 and 1980-1984, 0.76 (about three-fourths) was due to a decline in marital fertility. Mean age at marriage for females rose in India, but less impressively than in China; this factor contributed to a decline in TFR of only 0.30 points.

The principal objective of the supply-demand framework is the identification of the causes of fertility decline. The application of this framework requires that estimates of observed, wanted and natural fertility as well as the index of preference implementation are available for two successive points in time ($t_1$ and $t_2$) and in the same population Bongaarts (1993). In the Bongaart's formulation, following variables were used.

| | Observation point | |
|---|---|---|
| | $t_1$ | $t_2$ |
| Observed Fertility | $F_1$ | $F_2$ |
| Natural Fertility | $F_{n1}$ | $F_{n2}$ |
| Wanted Fertility | $F_{n1}$ | $F_{w2}$ |
| Index of preference implementation | $I_{p1}$ | $I_{p2}$ |

The decline in fertility between $t_1$ and $t_2$ is equal to $F_1 - F_2$ and this can be expressed as a function of the mediating variables by substitution of equation (3).

$$F_1 - F_2 = [F_{w1}I_{p1} + F_{n1}(1 - I_{p1})] - [F_{w2}I_{p2} + F_{n2}(1 - I_{p2})] \tag{7}$$

Since the emphasis here is on examining changes in fertility that result from changes in determinants, this equation can be rewritten as

$$\Delta F = \Delta F_w \bar{I_p} + \Delta I_p(\bar{F_w} - \bar{F_n}) + \Delta F_n(1 - \bar{I_p}) \quad (8)$$

Where $\bar{F_w}$, $\bar{F_n}$, and $\bar{I_p}$ are the average values of $F_w$, $F_n$ and $I_p$ and $\Delta F$, $\Delta F_w$, $\Delta F_n$ and $\Delta I_p$ represent absolute changes in $F$, $F_w$, $F_n$ and $I_p$ respectively. The above formulation shows that a change in wanted or natural fertility to the observed fertility decline depends on the average level of implementation index. Similarly, the fertility effect from a given change in the index of implementation depends on the average between natural and wanted fertility $(F_n - F_w)$.

## Analysis of the Results

## 6 Levels of fertility preference implementation index

There are two levels of analysis. The first is estimating the degree of preference implementation for states of India.

Table 1: Estimates of $I_p$, $F_w$ and $F_n$ along with % change (between two periods)

| States | Year | Fn | Fw | Ip | Year | Fn | Fw | Ip | % Change (Ip) | % Change (Fw) | % Change (Fn) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | | | | | | | | | | | |
| Delhi | 1998 | 5.63 | 1.72 | 0.826 | 1992 | 6.82 | 2.2 | .822 | .49 | -21.82 | -21.00 |
| Haryana | 1998 | 6.30 | 2.10 | 0.814 | 1992 | 7.28 | 2.8 | .735 | 10.75 | -25.27 | -15.53 |
| H. P. | 1998 | 5.63 | 1.50 | 0.845 | 1992 | 6.67 | 2.0 | .793 | 6.56 | -26.47 | -18.50 |
| Punjab | 1998 | 5.32 | 1.55 | 0.825 | 1992 | 6.12 | 2.1 | .795 | 3.77 | -27.91 | -14.95 |
| Rajasthan | 1998 | 6.18 | 2.57 | 0.665 | 1992 | 5.30 | 2.8 | .663 | .301 | -7.55 | 14.35 |
| **Central** | | | | | | | | | | | |
| M. P. | 1998 | 5.85 | 2.40 | 0.737 | 1992 | 6.11 | 3.2 | .762 | -3.28 | -25.23 | -4.35 |
| U. P. | 1998 | 5.14 | 2.83 | 0.498 | 1992 | 5.94 | 3.8 | .528 | -5.68 | -25.91 | -15.58 |
| **East** | | | | | | | | | | | |
| Bihar | 1998 | 4.52 | 2.58 | 0.531 | 1992 | 5.13 | 3.2 | .581 | -8.61 | -18.87 | -13.58 |
| Orissa | 1998 | 4.16 | 1.90 | 0.753 | 1992 | 4.51 | 2.3 | .726 | 3.72 | -18.10 | -8.25 |
| West Bengal | 1998 | 4.42 | 1.78 | 0.807 | 1992 | 4.71 | 2.2 | .713 | 13.18 | -19.09 | -6.54 |
| **North-East** | | | | | | | | | | | |
| Ar. P. | 1998 | 3.79 | 1.74 | 0.619 | 1992 | 5.29 | 3.8 | .718 | -13.79 | -54.69 | -3970 |
| Assam | 1998 | 3.16 | 1.75 | 0.605 | 1992 | 4.42 | 2.5 | .457 | 32.38 | -30.56 | -39.60 |
| Manipur | 1998 | 4.13 | 2.50 | 0.669 | 1992 | 3.66 | 2.3 | .676 | -1.03 | 9.17 | 11.38 |
| Meghalay | 1998 | 5.42 | 3.83 | 0.537 | 1992 | 4.41 | 3.4 | .668 | -19.61 | 12.98 | 18.76 |
| Mizoram | 1998 | 6.91 | 2.66 | 0.946 | 1992 | 5.00 | 2.1 | .921 | 1.61 | 27.27 | 27.68 |
| Nagaland | 1998 | 5.01 | 2.98 | 0.610 | 1992 | 3.76 | 2.9 | .550 | 10.91 | 1.02 | 24.91 |
| **West** | | | | | | | | | | | |
| Goa | 1998 | 2.79 | 1.47 | 0.773 | 1992 | 3.01 | 1.6 | .785 | -1.53 | -8.13 | -7.81 |
| Gujurat | 1998 | 5.96 | 2.08 | 0.835 | 1992 | 5.83 | 2.3 | .801 | 4.24 | -10.73 | 2.30 |
| Maharasthra | 1998 | 6.68 | 1.87 | 0.865 | 1992 | 6.15 | 2.1 | .810 | 6.79 | -12.21 | 7.89 |
| **South** | | | | | | | | | | | |
| A.P. | 1998 | 5.64 | 1.88 | 0.902 | 1992 | 4.92 | 2.1 | .825 | 9.33 | -10.05 | 12.68 |
| Karnataka | 1998 | 5.02 | 1.56 | 0.835 | 1992 | 5.50 | 2.2 | .803 | 3.99 | -28.44 | -9.51 |
| Kerala | 1998 | 4.58 | 1.81 | 0.946 | 1992 | 4.49 | 1.8 | .925 | 2.27 | -0.55 | 1.88 |
| Tamil Nadu | 1998 | 4.49 | 1.71 | 0.828 | 1992 | 4.60 | 1.7 | .735 | 12.65 | -2.84 | -2.31 |

Source – Calculated from NFHS-1 and NFHS-2 data

The second level was the decomposition of fertility trends. The procedure was done to examine the contribution of degree of preference implementation to fertility decline in specific populations. The Table 1 shows that indices of preference implementation for the states, range from 0.498 in Uttar Pradesh to 0.946 in Kerala (1998).The comparison between the two surveys indicates an increase in preference implementation index for many states, except for the states Madhya Pradesh, Uttar Pradesh, Bihar, Arunachal Pradesh, Meghalaya, Nagaland, Goa and Karnataka. Assam has the highest percentage increase in Ip at 32% with Meghalaya at the bottom (-20%). Haryana, West Bengal and Tamil Nadu have growth between 10% and 15%, while the growth for the rest of the states is below 10%.

The attainment of couple's fertility preference is high in the states of India, except a few northeast states. In other words, many Indian couples have been able to implement their fertility preferences. The results typically show that most of the major states are above the transition period and majorities are approaching the end of fertility transition. This observed increase could be as a result of the programme effort by the various state governments in making contraception available, accessible and affordable as well as improved contraceptive technology.

It is also shown that wanted fertility $F_w$ fell in almost all the states except Mizoram (27% increase), Meghalaya (13% increase), Manipur (9% increase), and Nagaland (2% increase).This could be due to changes in the cost and benefits of children, which makes couples to desire smaller families. Declining infant mortality, growing individualism and desire for other goods are also important factors influencing a smaller family size. However, family welfare programmes, which are now implemented in each and every state of India also represents another factor influencing preference implementation.

## 7 Contribution of $I_p$, $F_w$ and $F_n$ to fertility decline

Table 2 shows the contribution of $I_p$, $F_w$ and $F_n$ to fertility decline for all the states and regions between the two surveys. Fertility decline for all the states between the two surveys, on an average of 0.392 births per woman. It is 0.628 in North region, 0.709 in Central region, 0.535 in East region, 0.123 in Northeast region, 0.245 in Western region and 0.348 in South region. This may be due to the fact that compared to M.P. & U.P., the states in the South and West are approaching the end of fertility transition. Regarding northeast, the reason may be more socio-cultural and limited access to fertility regulating technologies.

Contributions to fertility change by $I_p$, $F_w$, and $F_n$ for all the states are 0.077, 0.262 and 0.053 births per woman respectively. The observed decline in fertility could be because of the relative low cost and high benefits associated with fertility control, incompatibility of child bearing/ rearing with labour force participation for women, coupled with the high cost of child bearing/ rearing. The change in wanted fertility is significantly affected by development variables and hence the level of development. However, the absolute change depends on the stage of fertility transition and states

Table 2: Absolute and % Contribution in $I_p$, $F_w$ and $F_n$ in States of India

| States | F | Absolute Contribution to Fertility decline | | | Percentage Contribution to Fertility decline | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | $F_n$ | $F_w$ | $I_p$ | $F_n$ | $F_w$ | $I_p$ | |
| **North** | **.628** | **.097** | **389** | **.142** | **15.45** | **61.94** | **22.61** | **100** |
| Delhi | .624 | .211 | .395 | .018 | 33.81 | 63.30 | 2.89 | 100 |
| Haryana | 1.11 | .225 | .542 | .343 | 20.27 | 48.82 | 30.91 | 100 |
| H. P. | .837 | .199 | .409 | .229 | 23.97 | 48.86 | 27.37 | 100 |
| Punjab | .713 | .152 | .445 | .116 | 21.31 | 62.41 | 16.28 | 100 |
| Rajasthan | -.144 | -.302 | .153 | .005 | 209.72 | -106.25 | -3.47 | 100 |
| **Central** | **.709** | **.232** | **.548** | **-.071** | **32.72** | **77.29** | **-10.01** | **100** |
| M. P. | .596 | .075 | .599 | -.078 | 12.58 | 100.5 | -13.08 | 100 |
| Uttar Pradesh | .822 | .389 | .497 | -.064 | 47.32 | 60.46 | -7.78 | 100 |
| **East** | **.535** | **.147** | **.319** | **.069** | **27.48** | **59.63** | **12.89** | **100** |
| Bihar | .515 | .266 | .344 | -.095 | 51.65 | 66.79 | -18.44 | 100 |
| Orissa | .460 | .104 | .295 | .061 | 22.60 | 64.13 | 13.27 | 100 |
| West Bengal | .631 | .072 | .319 | .240 | 11.41 | 50.55 | 38.04 | 100 |
| **North-East** | **.123** | **-.016** | **.134** | **.005** | **-13.00** | **108.94** | **4.06** | **100** |
| Arunachal Pra. | 1.73 | .530 | 1.377 | -.177 | 30.63 | 79.59 | -10.22 | 100 |
| Assam | 1.219 | .563 | .398 | .258 | 46.18 | 32.65 | 21.17 | 100 |
| Manipur | -.276 | -.131 | -.135 | -.010 | 47.46 | 48.91 | 3.63 | 100 |
| Meghalay | -.837 | -.392 | -.262 | -.183 | 46.83 | 31.30 | 21.87 | 100 |
| Mizoram | -.589 | -.119 | -.526 | .056 | 20.20 | 89.30 | -9.50 | 100 |
| Nagaland | -.508 | -.546 | -.046 | .084 | 107.48 | 9.05 | -16.53 | 100 |
| **West** | **.245** | **-.03** | **.164** | **.118** | **-12.20** | **66.94** | **43.26** | **100** |
| Goa | .129 | .044 | .101 | -.016 | 34.10 | 78.29 | -12.39 | 100 |
| Gujurat | .269 | -.036 | .180 | .125 | -13.38 | 66.91 | 46.47 | 100 |
| Maharasthra | .338 | -.098 | .192 | .244 | -28.99 | 56.80 | 72.19 | 100 |
| **South** | **.348** | **.004** | **.184** | **.159** | **1.15** | **52.87** | **45.98** | **100** |
| Andhra Pr. | .336 | -.109 | .190 | .255 | -32.44 | 56.55 | 75.89 | 100 |
| Karnataka | .723 | .090 | .524 | .108 | 12.46 | 72.58 | 14.96 | 100 |
| Kerala | .041 | -.006 | .009 | .038 | -14.63 | 21.95 | 92.68 | 100 |
| Tamil Nadu | .295 | .043 | .018 | .234 | 14.57 | 6.10 | 79.33 | 100 |
| **All states** | **.392** | **.053** | **.262** | **.077** | **13.52** | **66.83** | **19.65** | **100** |

at a higher stage therefore have smaller absolute change (states of west and south regions). The study of the age pattern of fertility is important because it indicates the tempo of childbearing; the age at which women begin to reproduce, the age at which they cease childbearing, and any change in the pattern of childbearing over time.

The chances of survival of a child is strongly related to fertility: the lower the chances of survival of a child (in other words, the higher the child mortality rate), the higher is the fertility rate. However, our analysis does not show whether higher child mortality leads to higher fertility or higher fertility leads to higher child mortality. Female labour force participation, particularly a woman's participation in activities outside the home for someone else, turns out to be the second most important variable affecting fertility. The higher the proportion of women in a state who are working outside the home for someone else, the lower is the fertility of that state. However, from our study it is not known whether women have fewer children because they like to work outside the home or they work outside the home because they have fewer children.

Although, there exists substantial variation between states, the results clearly indicate the important role of wanted fertility, which on the average account for the largest proportion of the observed decline. Reduction in natural fertility and changes in preference implementation do play an important role. This implies that change in demand for children is the key factor that brings about fertility decline in India. The

variation could be as a result of the level and development of reproductive health services and facilities in various states, the level of fertility transition and socio-cultural and economic factors.

The purpose of this paper has been to study the inter-state variation in fertility in relation to certain aspects of female status (education and employment) and the survival status of children (infant/child mortality). Of these three status variables, survival status of children, particularly the child mortality rate, emerges as the single most important factor explaining inter-state variations in fertility. The chances of survival of a child is strongly related to fertility: the lower the chances of survival of a child (in other words, the higher the child mortality rate), the higher is the fertility rate. However, our analysis does not show whether higher child mortality leads to higher fertility or higher fertility leads to higher child mortality.

# 8 Conclusion

Past studies on determinants of fertility did not give quantifying relationship between factors that link fertility to its basic determinants because of absence of a conceptual framework. The Bongaart's variant of the Easterlin model allows convenient quantification of the three key determinants of fertility: the supply of births, demand for births, and the degree of preference implementation. Changes in fertility were decomposed to estimate the contribution of each of the determinants to fertility decline. The results show wide variation in the value of preference implementation especially between the states in different regions. The lag among the northeast states could be due to variation in family planning program efforts in the regions as well as socio-cultural norms. Generally, the fertility implementation index increased while wanted fertility declined over the years. This observed increase in indices of fertility preference implementation (Ip) could be because of improved program effort by the various governments in making contraception available, accessible and affordable to their populace as well as improved contraceptive technology. The observed trend in wanted fertility could be due to changes in the costs and benefits of children, which makes couples to desire smaller family sizes; declining mortality, which leads to the survival of many more children hence pressure on the family resources; growing individualism and desire for other goods and sources of satisfaction.

The decomposition procedure using data from two sets of National Family and Health Survey for the states of India indicate that on the average, changes in fertility were largely due to changes in wanted fertility. Preference implementation was found to be a less important determinant of fertility decline. This is because preference implementation index in the two periods is very high in most of the states and there is little scope for a significant increase. It is note worthy to mention that, on the average, natural fertility contributed to fertility decline, though this is negligible. In fact, within culturally homogenous populations, change in reproductive preferences spread to all sectors over a short time Knodel and others (1987), Freedman and Freedman (1992),

resulting in similar preferences across age groups.

The results of the analysis clearly show the importance of the degree of fertility preference implementation index. It tells the extent to which people have been able to implement their fertility preferences and by extension, measures the achievement of the various governments against their goals of providing family welfare services to their people. This evaluation index can assist governments in designing and implementing appropriate strategies for the achievement of the set targets.

Practical, meaningful and more effective collaboration between researchers and the respective government agencies in the design and implementation of policy programmes aim at helping the populace to achieve its fertility desires. The wide disparities in the index of preference implementation among states and over time clearly indicate that gaps exist between programme objectives and their results. It is therefore imperative that governments and researchers work together to bridge these gaps. Efforts should also be made to operationalize the relationship between the degree of preference implementation and its basic determinants namely; cost of unwanted childbearing and that of fertility regulation.

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