# THE PROXIMATE DETERMINANTS OF FERTILITY: EVIDENCE FROM THE 1993 KENYA DEMOGRAPHIC AND HEALTH SURVEY

**BY**

*MUTETEI KAVALI*

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**Dr. Kimani**

# DEDICATION

To my dear spouse Mueni and my two children Vincent and Fiona, who paid the price of staying many days without me during my studies.

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ABSTRACT

The main objective of this study was to determine the fertility levels and differentials of various sub-groups in Kenya and to explain these differentials using the intermediate fertility variables. The sub-groups considered in the study were the regions, place of residence, and levels of education. The intermediate fertility variables that were studied were postpartum infecundability, non-marriage and contraception.

The study used the Bongaarts' model to estimate the indices for each intermediate fertility variable and also to estimate the resulting total fertility rates for each sub-group. These fertility rates were compared with those obtained from the Gomperrtz relational model which was chosen as an independent method of estimating fertility. The Bongaarts'-Kirmeyer regression equation of predicting fertility rate given the contraceptive prevalence rate was also used to predict fertility by the regions. The data used in this study was the Kenya demographic and health survey conducted in 1993.

The study found out that there was a general trend of decline in fertility among the regions, place of residence and by the levels of education between the period 1989 and 1993. The study also showed that at the national level as well as among five of the seven regions, the index of postpartum infecundability was the lowest followed by that of non-marriage, then contraception. This implies that the most important fertility inhibiting variable was lactation, followed by non-marriage, then contraception. This agreed closely with Wamalwas' findings of 1991 using the 1989 Kenya demographic and health survey.

According to this study, lactation reduced total fecundity by 39.3 percent while non-marriage and contraception reduced the total fecundity by 34 percent and 29.2 percent respectively. According to Wamalwa , these percentages were 36, 26 and 18 respectively. Thus there has been a general increase in the effect of these intermediate fertility variables in reducing fertility between these two

periods which, a fact that is supported by the general decline in fertility mentioned above. The study also points out that contraception reduces fertility most among women in Nairobi, Central province and those with secondary and higher level of education. Non-marriage had the greatest fertility reducing effect among women in urban areas.

The other important finding of this study was that contraception was shown to have taken a leading role in reducing fertility during the period 1989 to 1993. This is attributed to the highest percent difference in the fertility reducing effect due to contraception of 11.2 percent compared to that of 8.0 percent due to non-marriage and 3.3 percent due to breastfeeding or lactation. It was shown that there was positive linear relationship between contraceptive prevalence rate and the level of fertility among the sub-groups. This relationship was used to show how future demand for contraceptives could be projected.

From these findings we were able to recommend that family planning programmes should be intensified in those regions with high fertility like western, Nyanza and Rift valley. Universal education especially for girls was also recommended since there existed direct relationship between the level of education and the use of contraceptives.

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## INTRODUCTION

### 1.1 BACKGROUND

Most studies of the causes of fertility trends and differentials have sought to measure the impact of socio-economic factors on fertility. These factors include income, education, and place of residence among others that have been readily available and easily manipulated to influence fertility. Unfortunately, the results of these studies have been far from being conclusive. Not infrequently, relationships have been found to differ not only in magnitude but even in direction in different settings and at different times ( Rodriguez and Cleland 1987). Therefore to improve understanding of the causes of fertility variation, it has been necessary to analyse the mechanisms through which these socio-economic variables influence fertility. In response to this need, studies are being undertaken on the proximate determinants of fertility.

The proximate determinants of fertility are the biological and behavioural factors through which social, economic and environmental variables affect fertility; the principal characteristic of a proximate determinant being its direct influence on fertility. To explain fertility differentials among populations as well as the trends in fertility over time, we need to look at variations in one or more of the proximate determinants. Bongaarts et al (1984) enumerated nine proximate determinants of fertility. Among them, the four most important ones are; Marriage patterns, Postpartum infecundability, Contraceptive use, and Induced abortion.

These four determinants of fertility represent factors that directly affect fertility and do vary across different cultures. The percentage of women married determines the number of women exposed to the risk of becoming pregnant. The greater the number of women exposed the higher the resulting fertility. On the other hand, contraception delays or limits the number of children being born which clearly affects a society's fertility level.

The practice of breastfeeding and sexual abstinence after the birth of a child reduces a woman's exposure to becoming pregnant. Breastfeeding of long duration and on demand delays the return of a woman's normal pattern of ovulation. This in return affects the fertility of a woman. Induced abortion includes any practice that deliberately interrupts the normal course of gestation and therefore affects a society's level of fertility.

Other proximate determinants such as the level of natural sterility and the rate of spontaneous abortion tend to be fairly constant across populations, and hence do not contribute much toward explaining fertility differences between populations or over time within the same population.

During the periods 1984-1988 and 1989-1993, fertility dropped by about 20 percent, this being the most dramatic decline in fertility ever recorded in Kenya and one of the most dramatic recorded elsewhere. Table 1 gives the total fertility rates among women aged 15-49 by the provinces. Fertility decline varied considerably among provinces. A comparison of the 1977-1978 KFS data with the 1993 KDHS data in table 1 shows declines in all provinces. Major fertility declines were recorded in Nairobi, Rift Valley and Central Provinces. For example fertility in Central Province fell from an average of 8.6 to 3.9 children per woman over 15 years. KDHS results show that as fertility decline, the differentials among provinces increased. In 1977-1978, women in Rift Valley Province had an average of 2.7 more live births than their counterparts in Nairobi (8.8 and 6.1); this difference between provinces with the highest and the lowest fertility had increased to 3.5 births by 1989 and to 3.0 births by 1993 (8.1 and 6.4 in Western Province Vs 4.6 and 3.4 in Nairobi).

Fertility differentials by education and place of residence have also been studied. Table 2 below gives the observed total fertility rate by education and place of residence, according to survey and the percentage decline in fertility in the period 1977-1993. From the table, it can be seen that there has been a dramatic decline in fertility of more than 30 percent in the period 1977-1993 except for the women with no education whose percentage decline is 26.0. The highest decline in fertility has been recorded among women living in the urban areas, a decline of 43 percent within the period 1977-1993.

Comparing data from the 1977-1978 Kenya fertility Survey (KFS), the 1984, 1989 and 1993 Kenya demographic and health survey (KDHS) by the regions, it can be seen that the TFR declined from a high 8.1 children per woman in 1977-1978 to 7.7 in 1984, 6.7 in 1989 and further down to 5.4 in 1993. This gives a total decrease of 33 percent.

**Table 1.1 Total fertility rates among women aged 15-49, by Province, according to survey: and percentage decrease by Province, Kenya, 1977-1993.**

| PROVINCE | 1977-1978 KFS | 1984 KCPS | 1989 KDHS | 1993 KDHS | % DECREASE 1977-93 |
|---|---|---|---|---|---|
| Total | 8.1 | 7.7 | 6.7 | 5.4 | 33.3 |
| Western | 8.2 | 6.3 | 8.1 | 6.4 | 21.9 |
| Nyanza | 8.0 | 8.2 | 7.1 | 5.8 | 27.5 |
| Rift Valley | 8.8 | 8.6 | 7.0 | 5.7 | 35.2 |
| Central | 8.6 | 7.8 | 6.0 | 3.9 | 54.7 |
| Nairobi | 6.1 | 5.6 | 4.6 | 3.4 | 44.3 |
| Eastern | 8.2 | 8.0 | 7.0 | 5.9 | 28.0 |
| Coast | 7.2 | 6.7 | 5.5 | 5.3 | 26.4 |

Source: (1) Central Bureau of Statistics (CBS), First Report, KCPS 1984, Nairobi, 1984.
(2) NCPD and Institute for Research Development, DHS, 1989 and 1993, Nairobi Kenya.
(3) CBS, First Report, KFS 1977-1978, Nairobi, Kenya, 1980.

**Table 1.2 Observed total fertility rate by Education and place of residence, according to survey and percentage decrease.**

| Subgroup | 1977-1978 KFS | 1989 KDHS | 1993 KDHS | % DECLINE 1977-1993 |
|---|---|---|---|---|
| Kenya | 8.15 | 6.62 | 5.40 | 33.7 |
| Urban | 6.07 | 4.71 | 3.44 | 43.3 |
| Rural | 8.36 | 6.98 | 5.80 | 30.6 |
| No Education | 8.15 | 7.23 | 6.03 | 26.0 |
| 1-4 years | 8.97 | 7.65 | 6.18 | 31.1 |
| 5-7 years | 7.91 | 7.15 | 5.02 | 36.5 |
| 8+ years | 6.95 | 4.95 | 4.03 | 42.0 |

Source:(1) Population dynamics of Kenya pg. 106-9

(2) Demographic and Health Survey, Kenya, 1993.

The above mentioned fertility differentials and trends as well as the decline over the period 1977-1993 may be well explained by looking at the variations which may have taken place on the proximate determinants of fertility. Results from the 1977-1978 KFS data indicated that postpartum infecundability was the most important fertility-inhibiting variable at the national level. Marriage pattern followed in significance, with contraception having a relatively minor effect during this earlier period. The national research council (NRC, 1993) analysed the proximate determinants of fertility using the 1989 KDHS data. At the national level, they found out that the most important inhibiting index was postpartum infecundability, followed by contraception and then the marriage pattern. Tables 1.3 and 1.4 below give the three most important proximate determinants by subgroups for the period 1977-1978 and 1989 respectively.

**Table 1.3 Proximate Determinant by Subgroup, 1977-1978 and the observed total fertility rate.**

| Subgroup | Observed TFR | Index of Marriage, CM | Index of Contraceptive Cc | Index of Postpartum infecundability, Ci |
|---|---|---|---|---|
| National | 8.15 | 0.91 | 0.95 | 0.64 |
| Urban | 6.07 | 0.84 | 0.89 | 0.69 |
| Rural | 8.36 | 0.92 | 0.96 | 0.64 |
| No Education | 8.15 | 0.96 | 0.97 | 0.61 |
| 1-4 years | 8.97 | 0.93 | 0.95 | 0.64 |
| 5-7 years | 7.91 | 0.90 | 0.93 | 0.69 |
| 8+ years | 6.95 | 0.83 | 0.83 | 0.70 |

Source: Population Dynamics of Kenya pg. 106-7

**Table 1.4 Proximate Determinants by Subgroup, 1989 and the observed total fertility rate.**

| Subgroup | Observed TFR | Index of Marriage, Cm | Index of Contraception, Cc. | Index of Postpartum Infecundability |
|---|---|---|---|---|
| National | 6.62 | 0.86 | 0.76 | 0.66 |
| Urban | 4.71 | 0.82 | 0.71 | 0.70 |
| Rural | 6.98 | 0.81 | 0.77 | 0.66 |
| No Education | 6.98 | 0.87 | 0.71 | 0.70 |
| 1-4 years | 7.65 | 0.94 | 0.77 | 0.65 |
| 5-7 years | 7.15 | 0.88 | 0.74 | 0.69 |
| 8+ years | 4.95 | 0.82 | 0.65 | 0.71 |

Source: (1) Population Dynamics of Kenya, pg. 108-9

Wamalwa (1991) also analysed the proximate determinants of fertility using the 1989 KDHS data. He found out that the most important fertility-inhibiting factor was postpartum infecundability. However, his second most important fertility inhibiting factor was still marriage patterns (as was the case in 1977-1978), while contraception played the least role in reducing fertility.

## 1.2 Statement of the Problem

From the studies undertaken using the 1989 KDHS DATA on the proximate determinants of fertility, it is evident that there is a consistency as well as a contradiction between Wamalwa's findings and those from the National Research Council. Wamalwa (1991) and the NRC (1993) found out that the most important proximate determinant was postpartum infecundability. However, Wamalwa (op.cit) found out that the second most important fertility inhibiting factor was marriage patterns, while the NRC (1991) showed that this factor had been overtaken by contraception. Thus the second most important factor inhibiting fertility was different although the data source was the same. With this contradiction in place and the fact that the role played by each proximate determinant changes with time, this study aims at determining the role played by each of the three intermediate fertility variables using the most recent data, the 1993 Kenya Demographic and Health Survey. Contraceptive prevalence has increased sharply in most developing countries in the recent past. For example in Kenya, the prevalence rate has increased from 6% in 1977-1978 to 14% in 1984, then to 27% in 1989 and to 33% by 1993. The total fertility rate has also been going down from 8.1 in 1977-1978, 7.7 in 1984, 6.7 in 1989 and down to 5.4 in 1993. Due to this strong linear relationship between the prevalence rate among married women and the TFR, contraception is widely being said to be the major cause of fertility decline in many developing countries. In some cases, the observed TFR does not match the predicted value from the prevalence rate. The basic question therefore is what is the situation by regions in Kenya? Does the observed TFR match the prevalence rates? These two questions along with the fore- mentioned contradiction are mainly the issues of concern, which need to be investigated in this study.

## 1.3 General Objective

The general objective of this study is to determine and account for the fertility levels of various sub-groups in Kenya by applying the Bongaarts' model on the 1993 KDHS data.

### 1.3.1 Specific Objectives

(i) To estimate fertility levels by regions, education and place of residence using Bongaarts' model (model estimate of TFR).

(ii) To estimate fertility by regions, education and place of residence using the Gompertz relational model and compare it with (i) above.

(iii) To determine the contribution of each of the three fertility inhibiting factors on fertility by the subgroups.

(iv) To determine the predicted TFR using the Bongaarts'-Kirmeyer regression equation.

(v) To determine regions with excess fertility (those with higher observed TFR than the predicted one).

(vi) To project fertility and hence demand for future contraceptives.

## 1.4 Justification of the Study

The study is aimed at undertaking an analysis of the proximate determinants of fertility and will enable us to determine the most recent causes of fertility differences in Kenya. From this study, it may be possible to estimate how much each or all of the proximate determinants may be modified to obtain a given reduction in fertility. This may enable projections into future fertility declines, which is of great interest and importance to the planners and policy makers.

The study is going to give an evaluation of the achievement of family planning programme in reducing fertility in various regions of the country. It will also help to project future demand for contraception, which is a major policy idea.

The study is also expected to open up new areas of research for interested future researchers.

## 1.5 Scope and Limitations of the Study

This study uses data from the 1993 Kenya Demographic and Health Survey. The analysis has been limited to the data collected from 7540 women aged 15-49 years. The survey covered all areas of Kenya except all the districts in North -Eastern province and four other northern districts - Samburu, Turkana in Rift-valley and Isiolo and Marsabit in Eastern province - all of which contain less than 4% of the country's population. The 1993 KDHS is limited to data on abortion. This is mainly because abortion is not legalised and therefore obtaining data on it is very difficult. This study therefore does not estimate the index of abortion. The data is also insufficient for any reasonable district analysis to be done and hence the analysis is largely going to be done by the provinces.

Methodology limitations include the errors in measurement of the proximate determinants, and those arising in the specification of the model. The figure of TF to be used in the analysis will only be an approximation since TF is a function of the other three proximate determinants not explicitly included in the model (i.e. natural fecundity, intra-uterine mortality and permanent sterility).

# CHAPTER TWO:

# LITERATURE REVIEW AND THEORETICAL FRAMEWORK

## 2.1 LITERATURE REVIEW

Investigations into the proximate determinants of fertility go all the way back to the mid 1950s. Davis (1956) constructed the first detailed mathematical models of the reproductive process. Following this pioneering work, other researchers did further investigations during the 1960's most notably Potter (1963), Sheps (1964) and Tietoze (1964).

Since Davis and Blake's (1956) seminar paper on the proximate determinants of fertility, many such frameworks have been proposed. Davis and Blake recognised the fact that fertility differences among populations and trends in fertility over time can always be traced to variations in one or more of the proximate determinants. Starting from the premise that reproduction involves three necessary steps of intercourse, conception and completion of gestation, they identified a set of 11 proximate determinants that they called "intermediate fertility variables".

Davis and Blake framework of 1956 with 11 intermediate variables has been divided into the following three categories:-

I. Factors affecting exposure to intercourse

  1. Age of entry into sexual unions

2. Permanent celibacy: proportion of women never entering sexual unions.

3. Amount of reproductive period spent after or between unions.

4. Voluntary abstinence.

5. Involuntary abstinence (from illness, impotence, unavoidable but temporary separations).

6. Coital frequency (excluding periods of abstinence).

II. Factors affecting exposure to conception.

7. Fecundity or infecundity as affected by involuntary causes.

8. Use or non-use of contraception

   a) By mechanical and chemical means.

   b) By other means.

9. Fecundity or infecundity, as affected by voluntary causes (sterilisation, sub-incision, medical treatment, etc.).

III. Factors affecting gestation and successful parturition.

10. Foetal mortality from involuntary causes

11. Foetal mortality from voluntary causes.

Bongaarts (1978) then improved on the Davis and Blake model and came up with his model which contains a set of eight intermediate variables: proportion married, contraception usage and effectiveness, prevalence of induced abortion, duration of postpartum infecundability, frequency of intercourse (fecundability), spontaneous intrauterine mortality, prevalence of permanent sterility and duration of the fertile differences. He further showed that among these four, lactation plays the most important role in tropical Africa. Bongaarts' model can be used to estimate how much one or a combination of several of the intermediate fertility variables has to be modified to obtain a given reduction in fertility.

Most of the other earlier efforts focused on the construction of increasingly more realistic but sometimes highly complex models for the relationship between fertility and the proximate determinants of fertility. This development has continued into the 1980s and relatively simple yet quite realistic fertility models now exist. The construction of these models and their validation has been made possible by the greatly increased availability of empirical measures of the proximate variables in many populations. The resulting improvement in the understanding of the fertility effect of the proximate determinants has led to a more frequent inclusion of the proximate factors in studies of socio-economic and environmental determinants of fertility (for example Bongaarts 1980, Laesthaeghe 1982, Shah and Page 1982).

Gaslonde (1982) developed the sexual activity table (SAT) which can be included in the survey to gain information on the exposure status of each woman for each month preceding the survey over the period of interest, usually 12 months. Each woman can then be classified into one of the following exposure state for each month covered by SAT: pregnant, absence of sexual relations, sexual relations using effective contraception, sexual relations using inefficient contraception, sexual relations using no contraception. From the data obtained from SAT, the reducing effect of the absence of sexual relations, $r_{ASR}$, the reducing effect of contraceptive practice, $r_{CP}$, and the reducing effect of foetal mortality, be estimated using simple relationships and a model set to associate the theoretical fertility rate, P, (which is defined as the rate that would have been achieved had all the women had sexual relations regularly without using any means of deliberate fertility control) and which is similar in concept to Bongaarts' TNM (total natural marital fertility rate), with observed fertility rate, f. The immediate advantage of this approach is that it eliminates the problems associated with using marital status alone to define women exposed to sexual intercourse, since the SAT obtains information directly on exposure status. However, the strongest drawback is the fact that in many societies such intimate questions touching on the sexual behaviour would be totally unacceptable.

Potter, Kobrin and Langsten (1979) distinguished three main classes of contraceptive acceptance strategy: fixed duration T" ( for women counselled to accept T months after childbirth), "Postamenorrhoeic" ( for those counselled to accept directly after the first postpartum menses), and "mixed T" (for those counselled to accept T months after childbirth or after menses , whichever comes first). Any two strategies may be compared by means of probability model simulating the first passage time from childbirth to the next pregnancy of two cohorts of mothers identical in their fecundity and in the effectiveness and continuation with which contraception is practised, but contrasting in their acceptance regimes. Relative efficiency is measured by mean intervals to the next conception. The class of mixed T has only recently come under theoretical study. The efficiency of the mixed T rule at least equals and usually exceeds that of corresponding fixed duration rule.

Sheps (1964) concerned herself with models for the number and timings of a sequence of births to women living in a sexual union, for what she called "couple fertility" patterns. According to her, reproductive performance of human populations' results from births to couples marrying or cohabiting at different ages, of different innate fecundity, different rates of foetal loss and different practices of family planning, breastfeeding etc. Her study of couple reproduction is in part an effort to evaluate the effects of such variables on natality rates. Although utilising information from other approaches to natality, students of reproductive patterns of couples have had to devise new methods of analysing data and to assess critically the possible role of these methods in systematising and illuminating the study of this major component of population change.

Hobcraft and Little (1984) developed a new method for assessing the contribution of the proximate determinants to fertility differentials. According to them, Davis and Blake's framework has proved hard to operationalize, mainly because of the absence of suitable data on the intermediate fertility variables. They also said that Gaslonde's sexual-activity table's main flaw was the failure to take account of post-partum infecundity and particularly the effects of lactation. Hobcraft and Little (opcit) then came up with an approach which is a natural extension of Gaslonde's sexual activity table meant for analysis of fertility exposure.

## 2.2 APPLICATION OF THE VARIOUS MODELS

### (a) World regions in general

Using the above approaches, some findings have been obtained throughout the world. Studies have been carried out to try and explain the differences in fertility levels among population. Potter and Bongaarts (1983) observed that variations in the fertility of individual women are caused by variations in the proximate determinants. They also found out that breast-feeding was the principal determinant of amenorrhea. Without lactation, the average amenorrhea interval is short, usually 1.5-2.0 months, but with increasing duration of breastfeeding, the duration of amenorrhea rises, although not at the same rate. An additional month of breastfeeding increases amenorrhea on average by less than one month.

From fitting a number of curves to summarise this relationship between breastfeeding and amenorrhea, the best fit was provided by:

$$A = 1.73 \exp. (0.1396B - 0.001872B^2) \qquad (11)$$

Where

A = mean or median duration of postpartum amenorrhea in months.

B = mean or median duration of breastfeeding in months.

Amenorrhea is affected not only by the duration of breastfeeding, but also and perhaps most importantly by the type and intensity of breastfeeding. Thus it has been demonstrated that women giving their infants only breast milk have a much lower probability of resuming menstruation than women who supplement the diets of their infants with fluids by bottle or with solid food.

In the United States of America and other modern societies, one expects to find differences in the desired number of children born because the desired family size varies among women and contraception is available to help achieve these objectives. Some women have fewer or more than the desired number of births for non-voluntary reasons such as the premature onset of sterility or contraceptive failure. However, much of the desired family size is achieved due to reasonable women education as well as availability of contraceptives.

Bongaarts' and Kirmeyer (1982) observed that on average prevalence increases with age until a maximum in age 30-34 and declines slightly to other older ages and as noted in previous studies, the patterns of different populations are similar in shape. The only significant difference appears to be relatively prevalence among younger women in France and United States. This may be attributed to greater inclination to use contraception for spacing purposes. They discussed the occurrence of excess fertility in Kenya, Yemen, Syria, Jordan and Zimbabwe in 1987 and hinted that in some instances the explanation lies in the relatively low fertility inhibiting effects of other proximate determinants such as breastfeeding and marriage given the stage of development implied by the contraceptive prevalence. Bongaart's demonstrated that differences in fertility among and between populations are mainly a function of four intermediate variables; proportion married among females, contraception use and effectiveness, prevalence of induced abortions and duration of post-partum infecundability. Data on the natural fertility factors (the remaining three variables) is available but not used in this analysis for they are considered to be less important according to Bongaart's. Fecundity for example can be estimated either directly from data on last closed or open interval or indirectly through Mosley's model and is sterility. Primary sterility was found to be very insignificant as a fertility inhibiting variable among Kenyan women; about 97 percent of all women interviewed had at least one pregnancy (central bureau of statistics, 1980). Mosley's recent analysis found higher secondary sterility cases than would be expected in a healthy population (Mosley, 1982).

Singh, Casterline and Cleland (1985) observed that the fertility reducing impact of marriage and contraception is nearly always greater among women living in towns and small cities than for rural women and greater still for those living in major urban centres. The expectation is that the fertility reducing effect of marriage and contraception will increase with education but that the opposite relationship will hold for postpartum infecundability. For contraception and infecundability, this expectation is fulfilled with a few exceptions- due to unreliable estimates based on small number of women. Thus effect of contraception increases monotonically with ascending levels of education while that of lactational infecundability decreases.

In all the three world regions the effect of nuptiality is stronger among women with between 4-6 years of schooling than among those with between 1-3 years. For the period in the 1970s, the major cause of high fertility in Kenya was due to the fast decline in breastfeeding and the slow compensating movements in contraception and nuptiality.

Goldsheider and Mosher (1988), carried out a study on religious affiliations and contraceptive usage and found out that higher rates of sterilisation was among Protestants than Catholics, Jews and those of no religion. Among the current users, pill ranks highest for Protestants, Catholics and women of no religion. Ranking next among the Protestants and the Catholics was the condom followed by diaphragm and intra-uterine device with the rhythm method being the least used. The pill was by far the leading method among never-married Protestants and catholic women since a larger proportion of Catholics than Protestants are never married.

**(b) Latin America and Asian Countries.**

Curtis and Diamond (1995) in their study on the components of high fertility for observed contraceptive use in North East Brazil observed that among the many frameworks ( Bongaart's 1978, Gaslonde 1982, Hobcraft and Little 1984) that had been proposed since that of Davies and Blake(1956), Bongaarts' framework (1978) was the most widely used. His framework relates the TFR with the relative levels of breastfeeding, marriages, contraceptive use and induced abortion. These four factors help explain the causes of fertility differences between societies for they represent those factors that directly affect fertility and vary across different cultures. Others such as sterility and spontaneous abortions are in general fairly constant among populations and hence do not contribute to fertility differentials.

Hobcraft and Cleland (1985) analysed the world fertility survey and found out that there was considerable fertility differences existing between socio-economic groups in the Dominican Republic. The effect of education on fertility working through the four major proximate determinants of fertility was as follows: 0 to 2 years of schooling had a TFR of 7.19, 3 to 5 years of schooling had a TFR of 5.87, while 6+ years of schooling had a TFR of 3.06. Urban residents had a TFR of 3.65 while their rural counterparts had a TFR of 7.34.

Nortman (1980) noted that one third of married women of reproductive age were currently contracepting and contraceptive prevalence varied widely among countries; it was less than 10 percent in a number of developing countries and it reached nearly 80 percent in some developed countries. Contraceptive use increased during the decade 1965 to 1975, but the rise was so small in Pakistan such that fertility was still close to natural.

**(c) Sub-Saharan Africa.**

The principal proximate determinants of the levels and differentials of fertility in sub-Saharan Africa are lactation amenorrhea due to breastfeeding, decreased exposure to conception due to postpartum sexual abstinence, and pathological, involuntary infertility due to diseases such as gonorrhoea (Frank, 1983).

These three proximate determinants depend on behaviours that are susceptive to modern influences in Africa namely education and urbanisation. Thus educated urban women, although they tend to marry later, generally abstain sexually for shorter periods after delivery and tend to replace breastfeeding earlier or altogether with alternative milk or solid foods.

According to the Nigeria fertility survey (1983), it was confirmed that fertility was higher among women with primary education compared to women with less or no education, and among women with an urban residence (Federal republic of Nigeria, 1983). It has been noted that broad extension of education for women in rural areas could bring about these effects at national level, but some erosion of abstinence and breastfeeding duration can be expected to occur even in the absence of substantial increases in women's education.

Bongaarts' (1979) showed that in tropical Africa, the large majority of women are not at risk of conceiving for prolonged periods after they have given birth due to postpartum infecundability which results from the practice of breastfeeding and postpartum abstinence from sexual relations. While the prevalence and duration of lactation is not very different from that of traditional societies in other parts of the developing world, postpartum abstinence is practised widely and for longer duration than is usually found in areas outside sub-Saharan Africa. Kamuzora and Komba (1988) applied the Bongaarts' model on data from Kibaha district, Tanzania and found out that the combined effect of non-marriage and infecundability reduced biological potential fertility (total fecundity rate) to 7.8. This compared well with the reported total fertility rate and complete family size of 7.3 and 7.2 respectively- these latter actual figures included the effect of contraception and abortion that might have been existing in the society however minimal.

Other studies include Gaisies (1984) study in which he examined the fertility reducing impact of the intermediate fertility variables in Ghana. He discovered that fertility levels among various sub-groups are reflected in the intermediate variables. For example, the fertility differentials among the residential and educational groups were found to be inversely related to variations in the combined effect of postpartum amenorrhea and postpartum abstinence and positively related to variations in the proportions currently married. He also found out those women no longer breastfeeding were far less likely to be amenorrheoic than those who were still breastfeeding.

**(d) Kenya.**

As mentioned earlier, many studies have been done on fertility in Kenya, with only a few of them touching on the proximate determinants of fertility. Among the earliest are those done by Mosley in 1977 and 1982. Mosley (1977) examined the interactions of contraception and breastfeeding and found out that although prolonged lactation has an important fertility reducing effect, it is less adequate as a birth spacing method than the modern contraceptives. This is first due to the fact that the effectiveness of lactation during amenorrhea in preventing pregnancy is lower than that of oral contraceptives and intra-uterine device. Secondly, the protection against the risk of conception provided by lactation is shorter than that of oral contraceptives and the intra-uterine device. The use of modern contraceptives through prolonging birth spacing naturally facilitates and support longer breastfeeding.

Mosley (1980) used the 1978 Kenya fertility survey (KFS) and found out that the highest levels of fertility were observed among the Kalenjin and Kisii, while the Mijikenda had the lowest fertility because they had the longest birth intervals and breastfeeding periods. Anker and Knowles (1980) when they found out that different tribes had different cultural norms or patterns of marriage which affect fertility had also mentioned this effect of ethnicity.

Ferry and Page (1984) used the 1978 KFS data and found out that there existed a strong impression of the dominating role still played by lactation amenorrhea, followed by marriage patterns.

Contraceptives, especially non-reversible forms, had only a limited impact on a few sub-groups. There was a clear indication of a two- stage fertility transition, with declines in lactation and abstinence not yet been compensated by contraceptive use except among the highest socio-economic groups and among some of the oldest women.

Kalule-Sabiti (1984) applied Bongaarts' proximate determinants of fertility model to group data from the 1978 KFS data and found out that fertility inhibiting effect of both non-marriage and contraception increased with education and metropolitan environment. However such variations were less apparent in other subgroups based on religious affiliation, ethnic group and region of residence (except Nairobi which has a marked lower index of non-marriage and a high index of contraception). The low fertility inhibiting effect rises from 6% to 30% among women with no education and those with and those with 9 or more years of schooling respectively and from 9% to 12% for rural and metropolitan women respectively. Elsewhere, the reduction effect accounted for by contraception is lowest among Muslims, Mijikenda, Luo, Luhya, Kisii, Kalenjin, Coast, Rift valley and Western categories.

The reduction effect of breastfeeding is highest among women with little or no education and among rural population. Kalule-Sabiti also found out that the number of women in each age group who have not used contraception in the open interval but who nevertheless have had no birth in the last 5 years, suggests relatively higher secondary sterility or unreported abortions among the metropolitan, Mijikenda, Muslim and Coast populations than among other subgroups. In the model, it is assumed that in the absence of lactation and contraception there is an average birth interval of about 20 months of which about 7 months represent the interval of exposure(i.e. the menstrual interval) so that potential fertility of populations would vary within a narrow range of 13.5 to 17.5 births per woman with an average of 15.3. Postpartum abstinence can be ignored as an appreciable factor in Kenya. The mean duration of abstinence for the majority of women is 6 months. The length of postpartum amenorrhea increases slightly with age but decreases drastically with education and rural-urban residence (central bureau of statistics, 1980).

According to the Kenya contraceptive and prevalence survey (KCPS), 1984, there is no significant difference in fertility between Catholics and Protestants. There is however a big difference in fertility between Christians and the Moslems. Catholics have the highest total fertility rate of 6.5 while Moslems have the lowest total fertility rate of 5.7. Among ethnic groups, the Luo have the highest TFR of 7.5 while the Meru have the lowest TFR of 4.1. Nairobi had the lowest TFR of 4.5 while the highest was 8.1 of western province.

Child spacing achieved primarily by prolonged lactation remains the major restraint on fertility levels in most of the subgroups, particularly in Eastern province, among the women with no education, Protestants and among the Meru. According to Wamalwa, the use of contraceptives is still very limited in Kenya, with the exception of central province where about 30% of the married women use at least a modern method of contraception. Women in central province practise contraception most, those with secondary education and higher, Protestants and Kikuyu. Women in Western province practise it least, women with no education, the Moslems and Luo. Non-marriage is least common in Western province, among women with no education, Protestants and Luo. Women in rural areas have a higher index of non-contraception and a lower index of lactation infecundability compared to their urban counterparts.

In conclusion therefore, it can be said that although there exists a number of alternative models of proximate determinants of fertility, the most widely applied and most versatile is the Bongaarts' model of 1978. This is the model that has been applied in this study.

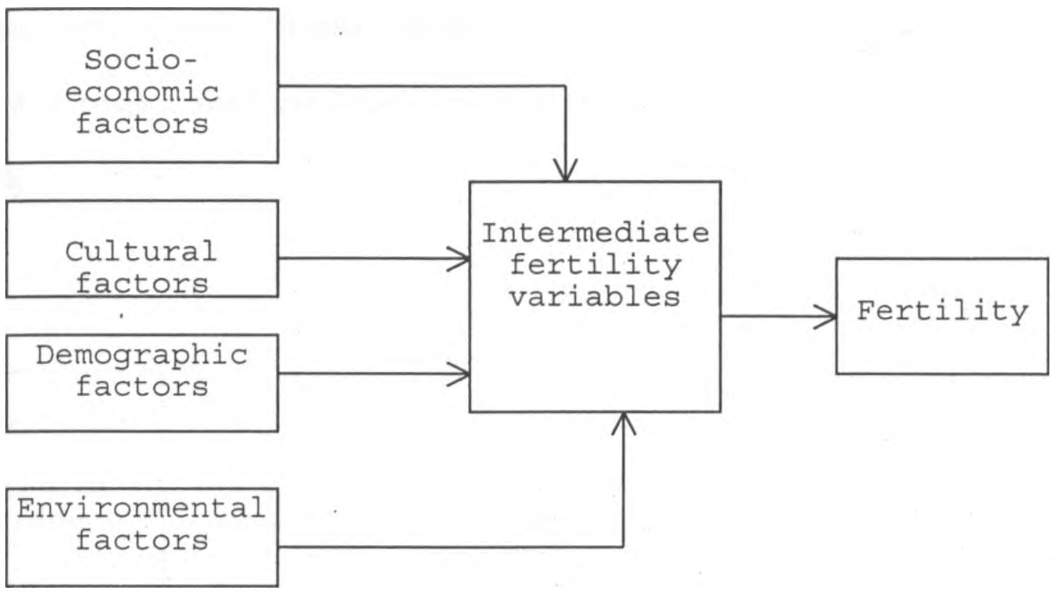
## 2.3 Conceptual Framework:

As pointed out earlier in the previous chapter, the focus of the study is on the recent changes on proximate determinants of fertility. Therefore the framework to be developed for the study will attempt to conceptualise the relationship between the proximate determinants and fertility. Fertility is therefore going to be treated as the primary dependent variable, while the proximate determinants will be part of the independent variables. In this regard therefore, the framework to be used will be the Bongaarts' (1978) framework for the analysis of fertility.

In the framework, the proximate determinant factors through which the socio-economic, cultural, demographic and environmental factors operate to influence fertility are going to be specified.

Figure 1 below then summarises the basic components of the framework, as it will be discussed in the following chapter. The framework depicts the operations of the socio-economic, cultural, environmental and demographic factors affecting fertility through the intermediate fertility variables. The empirical evidence supporting the relationships between the concepts has been given in the literature review.

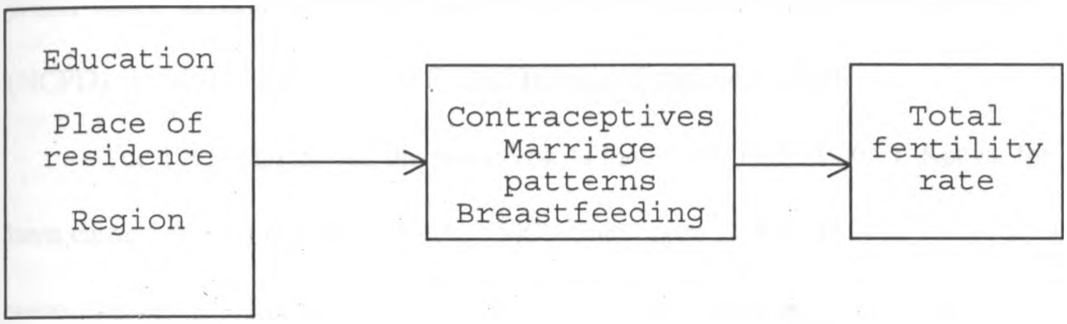
**Figure 1. The Bongaarts' Framework.**




Source: J. Bongaarts (1978).

**2.4 Operational framework.**

From our conceptual framework above, it has been conceptualised that socio-economic, cultural, environmental and demographic factors are likely to affect fertility levels. These are high order concepts that cannot be subjected to empirical investigation. Thus the framework needs to be operationalised. The operational framework used in this study has three selected variables namely education, place of residence and region or province. It is important to note that there are other variables such as ethnicity, religion, occupation, income etc that have been left out in this operational framework. It has been assumed in this study that the effect of these factors is to some large extent reflected in other three included in the study. For example it has assumed that the level of education plays a major role in determining the occupation and hence the income of a given household. Ethnicity has been assumed to be reflected in the regional boundaries. It will also be worth noting that the operationalisation of a theory involves assumptions and can never be perfect. It always involves some degree of uncertainty. The figure 2 below then gives the operational framework that has been used in this study.




**2.5 Operational hypotheses**

From the above operational framework, the following operational hypotheses may be formulated.

1.Education has a significant effect on the level of fertility.

2.The place of residence has a significant effect on the level of fertility.

3.Different regions or provinces are likely to have different fertility levels.

We further wish to hypothesize that contraception is the most important fertility inhibiting factor in the recent past, and that its use is dependent on socio-economic, demographic, cultural and environmental factors.

# CHAPTER THREE:

# METHODS OF DATA COLLECTION AND ANALYSIS

## 3.1 Sources of data

The data used in the study was drawn from the Kenya demographic and Health Survey 1993, which was a national survey carried out by the National Council of Population and Development (NCPD), in collaboration with the Central Bureau of statistics (CBS).

The 1993 KDHS was the second of its kind to be carried out in Kenya; the first one having been carried out in 1989. In the study, 7540 women aged 15-49 years and 2336 men aged 20-54 years were interviewed. The study was designed to provide information on levels and trends of fertility, infant and child mortality, family planning knowledge and use, maternal and child health, and knowledge of AIDS. In addition, the male survey obtained data on men's knowledge and attitudes towards family planning and awareness of AIDS.

The fieldwork started in mid February 1993 and ended in mid august 1993 and all districts of Kenya were covered except for seven northern districts that together contain less than four percent (4%) of the country's population. The survey utilised a two stage, stratified sample consisting of 536 sample units (clusters). The same areas covered in 1989 were targeted in the 1993 KDHS in order to maintain comparability with the previous survey. From this data reliable estimates of certain variables can be made for some districts. However, for a majority of the districts, no reliable estimates could be produced for planning purposes. This could only be possible if sample sizes were expanded to unmanageable sizes.

Due to over sampling in some districts, the KDHS sample is not self-weighting at the national level. Sample weights were used to compensate for the unequal probability of selection between strata, and weighted figures were used.

### 3.2 Methods of Data Analysis:

The study methods used for analysis are the Bongaarts model of proximate determinants of fertility. Using this model, the various indices were estimated for each region, by education and by place of residence.

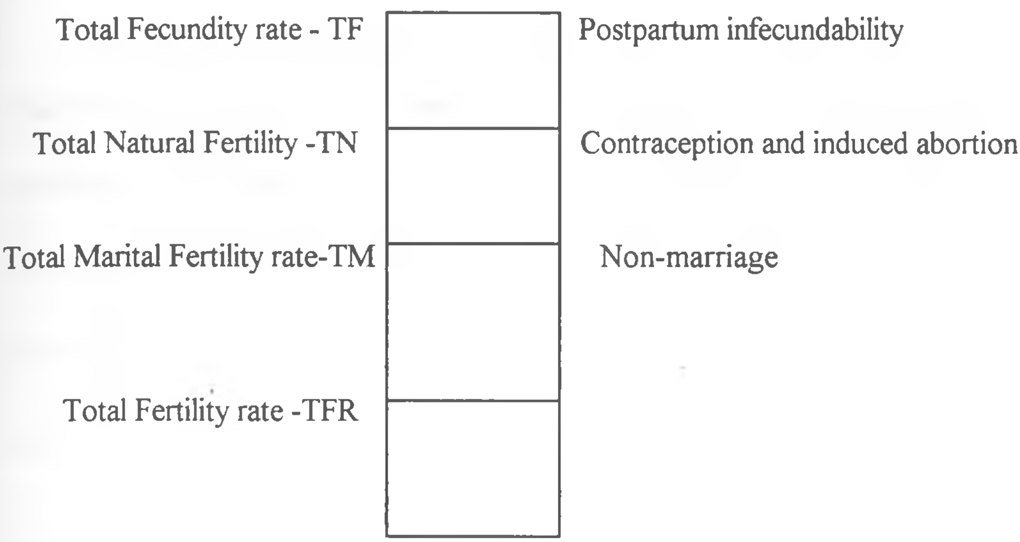
Another model used in data analysis was the Bongaarts- Kirmeyer model. They estimated regression models for the relationships between contraceptive prevalence and the total marital fertility rate and between prevalence and the total natural marital fertility rate, both of which have been used in the analysis. For consistency purposes, we have also used their model for the relationship between contraceptive use and TFR. Finally, the Gompertz relational model has been used to obtain observed TFR's for comparison with the model estimates of fertility.

### 3.3 Bongaarts' Model:

#### Description of the method:

This is a more comprehensive model, which focuses on the four principal proximate determinants of fertility. These four principal intermediate fertility variables are considered inhibitors of fertility, because fertility is lower than its maximum value as a result of delayed marriage (and marital disruption), the use of contraception and abortion, and postpartum infecundability induced by breastfeeding (or abstinence). As mentioned earlier, the effect of abortion will not be analysed in this study due to the unreliability of the data on the same. Therefore in the figure below, four different types of fertility levels are identified from which the impact of the intermediate fertility variables can be derived. With the inhibiting effects of all intermediate fertility variables present, a population's actual level of fertility is observed, measured by the total fertility rate, TFR. If the fertility inhibiting effect of non-marriage is removed, fertility will increase to a level TM, the total marital fertility rate. If the practice of contraception and abortion is also removed, fertility will rise further to a level TN, the total natural marital fertility rate. Removing in addition the practice of lactation and postpartum abstinence further increases fertility to the total fecundity rate, TF. While the fertility rates TFR, TM and TN vary widely among populations, the total fecundity rate is rather stable. In an earlier study, an estimate of 15.3 was derived for the average total fecundity rate, with a standard deviation of approximately five percent. This estimate should be acceptable in many populations, but adjustments are required in special circumstances- for example, if there is a high prevalence of diseases causing sterility or if prolonged spousal separations are common.

**Figure 3: Relationship between the fertility inhibiting effects of intermediate fertility variables and various measures of fertility.**




The fertility effects of three most important fertility variables to be analysed in this study - proportion married, contraception and postpartum infecundability are measured in the model by three indices. The indices can only take values between 0 and 1. When there is no fertility - inhibiting effect of a given intermediate variable, the corresponding index equals one (1); if the fertility inhibition is complete, the index equals zero.

Definition of the indices:

$C_m$ = index of proportion married (equals 1 if all women of reproductive age (15-49) are married and in 0 in the absence of marriage).

$C_c$ = index of contraception (equals 1 in the absence of contraception and 0 if all fecund women use 100 percent effective contraception).

$C_i$ = index of contraception (equals 1 in the absence of lactation and postpartum abstinence and 0 if the duration of infecundability is infinite).

Each index (or set of indices) by definition equals the ratio of the fertility levels in the presence and in the absence of the inhibition caused by the corresponding intermediate fertility variable(s).

$C_m = TFR/TM \Rightarrow TFR = (C_m \times TM)$ ........................................................(1)

$C_c = TM/TN \Rightarrow TM = Cc \times TN$ ........................................................ (2)

$C_i = TN/TF \Rightarrow TN = C_i \times TF$ ........................................................ (3)

$\Rightarrow TFR = C_m \times C_c \times TN = Cm \times C_c \times C_i \times TF$ ................................. (4)

Note: In equation (4), the index of abortion $C_a$ has been left out since it is not to be analysed in this study.

Equation (4) summarises the relationship between the total fertility rate and the intermediate fertility variables.

From equations (1), (2) and (3), the indices $C_m$, $C_c$, and $C_i$ can be calculated if the measures TFR, TM, TN and TF are available (which is rarely the case). In most populations, the indices are estimated directly using the following formulas.

The index of marriage, $C_m$, measuring the effect of the marriage pattern of a population on its fertility is given by

$$C_m = \frac{TFR}{TM} = \frac{\sum f(a)}{\sum f(a)/m(a)} \qquad \text{.......................................................................5(a)}$$

Where: -

m (a) equals the proportion currently married among females, by age.

f (a) is a schedule of age specific fertility rates.

Alternatively, $C_m$ is the average of the age specific proportions of married women, m (a). Now since the impact of marriage on fertility also depends on the age distribution of married women, these age-specific proportions of married women are weighted by the corresponding age-specific marital fertility rates, g(a)

i.e. g(a) = f(a)/m(a) and hence

$$C_m = \frac{\sum f(a)}{\sum g(a)} \quad \text{.......................................................} 5(b)$$

The index of contraception, $C_i$ incorporates both prevalence of contraceptive use and its effectiveness. It is given by

$$C_c = 1 - 1.08 \times e \times u \quad \text{.......................................................} 6(a)$$

Where u is the prevalence of current contraceptive use among married women (average of age-specific use rates), e is the average use-effectiveness by age and method.

In the absence of age-specific use rates, the proportion of all married women of reproductive age that currently uses contraception - a variable for which data are more widely available - can be employed as an estimate for u.

The average use effectiveness is calculated as the weighted average of the method-specific use-effectiveness levels with the weights equal to the proportions of women using the corresponding method.

Use-effective levels are also likely to differ between populations for methods for which there is room for user-error, for example pill or condom, since higher levels of user-failure might be expected in populations where little education is available on how to use a method correctly.

To relate the index of non-contraception to the total fertility rate, equation (2) is substituted into equation (1), yielding.

$$TFR = C_m \times C_c \times TN \quad \text{......} 6(b)$$

This equation calculates the total fertility rate from the natural marital fertility rate by taking into account fertility reducing impact of contraception and non-marriage measured by the indexes Cm and $C_c$

The final index, the index of postpartum infecundability, $C_i$, measures the effect of the duration of postpartum infecundability as determined by the breastfeeding patterns prevalent in a particular society on fertility.

Lactation has an inhibitory effect on ovulation and thus increases the birth interval and reduces natural fertility. Quantitative estimation of the fertility reducing effect of lactation infecundability is most easily accomplished by comparing average birth interval lengths in the presence and absence of lactation.

Without lactation, a typical average birth interval can be estimated to be 20 months, made up of 1.5 months of non-lactation infecundity, an average of 7.5 months waiting time to conception, 2 month added by intrauterine mortality and 9 months gestation period. With lactation, it equals the average total duration of infecundable period plus 18.5 months (7.5 + 2 + 9). The ratio of the average birth intervals without and with lactation is the one called the index of lactation infecundability, $C_i$.

$C_i = 20/(18.5+i)$ ....................................................................7(a)

Where i months is the mean duration of postpartum infecundability from birth to the first postpartum ovulation (menses).

As seen éarlier in equation (3), the relationship between lactation and the total natural fertility rate, TN, is

$TN = C_i \times TF$

Now from equation (7a), if there's no lactation, $C_i = 1$ and TN = TF, because i= 1.5 months.

To relate the index of lactation infecundability to the total fertility rate we substitute equation (3) into equation 6(b) and obtain

$TFR = C_m \times C_c \times C_i \times TF$ ...............................................................7(b)

Which resembles equation (4) and summarises the entire model for the relationship between the three intermediate fertility variables and fertility.

In order to apply this model, the following data is required.

a) total female population of married women in each five-year age group (irrespective of marital status).

b) the total female population of married women in each five year age group.

c) the total births in the last year by five-year age groups of married mothers.

d) the total number of married women using each modern contraceptive method.

e) the total number of women who are currently breastfeeding.

### 3.4 Bongaarts - Kirmeyer Model:

Bongaarts' - Kirmeyer model is a regression model of the relationship between the total fertility rate (TFR) and the contraceptive prevalence rate. There are other more recent models based on recent data, but the parameters of Bongaarts - Kirmeyer regression model are almost identical to those in the more recent models so that the predicted TFR does not vary much according to the model used.

The Bongaarts - Kirmeyer model was used to estimate the relationships between contraceptive prevalence and the total marital fertility rate (TM) and between prevalence and the total natural marital fertility rate (TN) apart from the total fertility rate (TFR).

The models to be used are:-

(a) $TFR = 7.3 - 0.064 \times u$ ..........8

(b) Total marital fertility rate

$TM = 9.5 - 0.048 \times u$ ..........9

(c) Total natural marital fertility rate

$TN = 15.3 - 0.137 \times u$ ..........10

Where u is the percentage of currently married women practising contraception.

The data required in this model is;

(a) The percent number of women currently using contraception

(b) The projected total fertility rates, TFR



EAST AFRICANA COLLECTION

### 3.5 Gompertz relational model.

There have been advances in methods of estimating demographic parameters in populations with limited data. Demographically, it is recommended that the fertility measures obtained from models should be upgraded whenever there is such improvements on the current models in use. Some of these lately developed models include the Coale-trussell P/F ratio method and the Gompertz relational model.

The Coale-Trussell P/F ratio method seeks to adjust the level of the observed age specific fertility rates, while the Gompertz relational model was designed for the evaluation and adjustment of fertility estimates obtained from retrospective reports for birth histories or features of birth histories (Brass, 1981). The Coale-Trussell method uses three parameters while the Gompertz relational model uses two parameters to determine the shape of age specific fertility rates. This latter method therefore uses as few parameters as possible, thus improving the accuracy of the representation by empirical transformation of the age scale.

Another important property of the Gompertz relational model is the fact that the mathematical function was chosen so that the model could be expressed linearly in terms of the unknown parameters. This property greatly simplifies the comparison of models with observations, which is required for exploratory analysis. Osiemo(1986) analysed the fertility levels and differentials using both models and found out that the P/F ratio method based on Coale-Trussell model gave higher estimates of fertility than those based on the Gompertz relational model. Thus the latter model once again gives a more refined estimate, a property that further supports the choice of the Gompertz relational model for this study.

### 3.5.1 Theoretical background of the model

The principle used in the derivation of the model was to start with a mathematical function representing fertility rates by age with as few parameters as possible (Brass, 1981). The representation of fertility by age of a woman by the Gompertz function has been improved by Brass and his students, Booth and Zaba, from the traditional Brass P/F ratio by transforming it into relational Gompertz model.

The suggestion that a Gompertz relational system would be useful in fertility analysis was made by Brass (1974) who elaborated the idea further with an indication of the main application (1977). The basic work, which provided the empirical scale transformation, and examined the goodness of fit to observations and estimation problems, was done by Booth (1977).

Zaba (1981) made an important advance by providing the method for separating the examination of fertility pattern from the estimation level.

Most of the studies on fertility estimates in Kenya have been based on the traditional Brass P/F ratio. However, Gompertz relational model was used by Osiemo (1986) and Omurundo (1989).

The Gompertz function is defined by:

$$Y = A^{B^X}$$

Where, A and B are positive constants. X is the independent variable and Y is the dependent variable. The Gompertz function can be linearly transformed by applying logarithms twice on each side. i. e.,

$$\log Y = B^x \log A$$

$$\Rightarrow \quad \log(\log Y) = X \log B + \log(\log A)$$

The Gompertz relational model for fertility proposed by Brass can be written as:

$$F(x)\ F^{B^{x - x_0}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where A and B are between 0 and 1, F a positive number and $x_0$ an arbitrary origin.

When transformed (i.e. relational model), it becomes ,

$$F(x) = Te^{-e^{-(\alpha + \beta Y_s(x))}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$\Rightarrow$ $-\ln(-\ln(F(x)/T)) = \alpha + \beta\ Y_s(x)$ ............................................................(4) Where T = Total fertility rate.

F(x) = Cumulated fertility up to age x.

We can also write in terms of reported average parities as:

$$P(i) = T\ e^{-e^{-(\alpha + \beta Y_s(i))}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

$\Rightarrow \ln(-\ln(P(i)/T)) = \alpha + \beta Y_s(i)$ ...........................................................................(6)

Where P(i) is the reported average parity of the $i^{th}$ age group. The parameters $\alpha$ and $\beta$ can be determined if $Y_s(x)$, $Y_s(i)$, F(x), F, and P(i) are known from the relations in (4) and (6).

However, in most cases with retrospective data from developing countries like Kenya, it is difficult to determine T (TFR) accurately. This is because estimates from the series of F(x) values are often quite different from those based on a series of P(i) values and both series are seldom reliable at the older ages due to biases in reporting births in the past 12 months and children ever born by older women.

The problem of estimating T directly was avoided by a method proposed by Zaba (1981) by postulating a relationship between the ratios of successive F(x) values and successive P(i) values and the parameters $\alpha$ and $\beta$ needed to define a suitable model fertility schedule. Thus, Zaba postulated that:

If Z(x) is defined as

$\Rightarrow Z(x) = -\ln [ -\ln \; F(x) / F(x+5)]$ ....................................................................(7)

$Z(x) = -\ln\{-\ln[T \exp.(-\exp.(\alpha + \beta Y_s(x))) / T \exp.(-\exp.-(\alpha+\beta Y_s(x+5)))$ ..............(8) which can be written as

$Z(x) = \alpha - \phi_x(\beta)$ ....................................................................(9)

Where $\phi_x(\beta) = \ln [ \exp.(-\beta Y_s(x)) - \exp.(-\beta Y_s(x+5))]$ ..........................................(10)

After applying Taylor's expansion and rearrangement, expression (8) becomes:

$Z(x) - [\phi_{x'}(1) - \phi_x(1)] = \alpha + \beta\phi_{x'}(x)$ ....................................................................(11)

Which is of the form , Y = A + Bx , which is linear.

This implies that,

$Z(x) - e(x) = \alpha + \beta\, g(x) - c(\beta - 1)^2/2$ ....................................................................(12)

Where, $e(x) = \phi_{x'}(1) - \phi_x(1)$ and $g(x) = -\phi_{x'}(1)$

$c$ = constant = values of $\phi_{x''}(1)$ in the range $15 < x < 35$.

Similarly, the above relationship can be extended directly to the average parity.

$Z(i) = -\ln [ P(i) / P(i+1)]$ ....................................................................(13)

which implies,

$Z(i) = -\ln\{-\ln[T \exp.-\exp.-(\alpha + \beta Y_s(i)) / T \exp.-\exp.-(\alpha + \beta Y_s(i+1))]\}$

$\Rightarrow Z(i) = \alpha - \phi_i(\beta)$

Where, $\phi_i(\beta) = \ln [\exp. (-\beta Y_s(i)) - \exp.(-\beta Y_s(i+1))]$

Which after applying Taylor's expansion becomes,

$Z(i) - e(i) = \alpha + \beta g(i) - c(\beta-1) / 2$ ..............................................................(14).

Where, $e(i) = \phi_{i'}(1) - \phi i(1)$ and $g(i) = - \phi_{i'}(i)$

c = constant = values of $\phi_{i''}(1)$ in the range 15-19 to 35-39

Therefore, TFR,(T) can now be estimated by using current preliminary fertility schedule from information on births in the past year as:

$$T(x) = \frac{F(x)}{\exp.[-\exp.(-(\alpha+\beta\, Y_s(x)))]} \quad \text{.....................................................(15)}$$

Where, F(x) is the cumulated fertility schedule calculated from f(i)'s.

Or by using reported average parity, P(i) as:

$$T(i) = \frac{P(i)}{\exp.[-\exp.(-(\alpha+\beta Y_s(i)))]} \quad \text{.....................................................(16)}$$

# CHAPTER FOUR:

# THE PROXIMATE DETERMINANTS OF FERTILITY AND FERTILITY ESTIMATES

## 4.1 Introduction

This chapter mainly deals with the estimation of the three proximate determinants of fertility, their effects on fertility and also the estimation of the total fertility rates from the indices. A comparison between the fertility rates obtained from the indices will be conducted against those obtained using the Gompertz relational model for the various sub-groups: regions, level of education and place of residence.

The latter part of this chapter examines the total fertility rate, validating the prediction power and then projecting fertility and future demand for contraceptives.

## 4.2 Background characteristics of the female respondents

**Table 4.1 Percentage distribution of women, births in the last year, the proportion married and contracepting by regions**

| Region | female population(FPOP) | births in the last year (BL12) | Proportion married m(a) | Proportion contracepting u(m) |
|---|---|---|---|---|
| Nairobi | 4.86737 | 3.50877 | 0.53 | 0.3869209 |
| Central | 14.25729 | 9.5347 | 0.56 | 0.4046511 |
| | 14.46949 | 13.27231 | 0.60 | 0.2043996 |
| Eastern | 13.84615 | 15.40808 | 0.62 | 0.2998084 |
| Nyanza | 16.76392 | 18.84058 | 0.63 | 0.1906645 |
| Rift Valley | 23.26259 | 26.46834 | 0.61 | 0.2103762 |
| Western | 12.53315 | 12.9672 | 0.65 | 0.2021164 |
| National | 1.0000 | 1.0000 | 0.6078 | 0.3227 |

The distribution of the women by the regions indicate that 23% of the DHS sample was from Rift Valley and only 4.9% were from Nairobi. The proportion contracepting was highest in Central and the least in Nyanza. The proportion married was highest in Western and least in Nairobi. Table 4.1 gives a summary of the characteristics by regions.

**Table 4.2 Percentage female population, births in the last year as well as proportion married and contracepting by level of education**

| Education | FPOP | BL12 | m(a) | U(m) |
|---|---|---|---|---|
| No education | 17.20 | 16.65 | 0.7856 | 0.1796 |
| Incomplete Primary | 40.44 | 41.37 | 0.5785 | 0.1968 |
| Complete Primary | 18.57 | 21.52 | 0.6271 | 0.3014 |
| Secondary + | 23.79 | 20.46 | 0.5206 | 0.3673 |

Table 4.2 above shows that about 40% of the women interviewed had incomplete primary education while only 17% had never attended school. The proportion contracepting increased with increase in the level of education with those with secondary and higher education practising contraception more. The proportion contracepting was highest among women in the urban areas and least among their counterparts in the rural areas as summarised in Table 4.3 below.

**Table 4.3 Percentage female population, births in the last year, proportion married and contracepting by the residence.**

| Residence | FPOP | BL12 | m(a) | U(m) |
|---|---|---|---|---|
| Urban | 15.40 | 10.51 | 0.5228 | 0.4218 |
| Rural | 84.60 | 89.49 | 0.6233 | 0.3076 |

## 4.3 Estimation of the indices by various sub-groups

The main proximate determinants that have been estimated are the index of contraception ($C_c$), index of marriage ($C_m$) and the index of post-partum infecundibility ($C_i$). The index of abortion ($C_a$) is not estimated in this study because its data is not easily available since abortion is an illegal practice in Kenya.

### 4.3.1 Estimation of the Index of Post-partum infecundibility ($C_i$)

To compute the index of ($C_i$), the duration of breast-feeding needs to be first estimated. Breast-feeding is a natural contraceptive whose mechanism is hormonal. Prolonged breast-feeding lengthens the birth intervals due to its relationship with lactation amenorrhea, since for a great majority of the women the ovaries are inactive for most of the period of lactation.

There are two methods of estimating the duration of breast-feeding. One is direct and the other is indirect. In the direct method breast-feeding duration is obtained by dividing the total number of months women breast-feed in that sub-group by the total number of women in that sub-group. However studies have shown that the direct method cannot yield accurate results since the data used has errors in most cases. These errors include those caused by mis-reporting of the duration of breast-feeding by the women interviewed. In this case some may under-report while others may over-report their duration of breast-feeding. There also exists truncation error in this direct method of estimation. This happens because during the time of interview, some respondents are still breast-feeding and hence although the duration they have breast-fed so far is known, how much longer they will breast-feed is not exactly known.

Finally, incompleteness of data is also a common source of error in the data collection.

Due to these unforeseen errors and problems, we found it necessary to use an indirect method to estimate the duration of breast-feeding. A simple estimation procedure was chosen, the prevalence incidence method, which gives us the desired mean duration of breast-feeding.

To obtain the mean duration of breast-feeding using the prevalence incidence method and hence the index $C_i$, the computational procedure will be given using the national level data.

**Step 1 To compute the incidence (I)**

I = 1/36(all births 0-35 months before the survey +1/2 of births occurring 36 months prior to the survey).

This gives the approximate number of births per month.

**Step 2 Computation of the prevalence (P)**

P = Number of children currently breast-feeding irrespective of age.

**Step 3 Computation of the mean duration of breast-feeding**

Mean duration of breast-feeding = Observed prevalence (P) /Average number of births per month (P).

$$B = P/I$$

**Table 4.4 Births occurring 0-35 months, exactly 36 months before the survey and number currently breast-feeding by age group of the mothers**

| Age-group | Births 0-35 months before survey | Births exactly 36 months before survey | No currently breast-feeding |
|---|---|---|---|
| 1 | 312 | 2 | 211 |
| 2 | 1056 | 20 | 612 |
| 3 | 891 | 31 | 508 |
| 4 | 681 | 31 | 391 |
| 5 | 346 | 12 | 215 |
| 6 | 158 | 15 | 106 |
| 7 | 52 | 1 | 25 |
| Total | 3496 | 112 | 2074 |

Source: Computed from 1993 KDHS data.

From table 4.4 above the values of P, I and B have been calculated for the national level case as shown below.

$I = 1/36\ [3496 + ½\,(112)] = 98.67$

$P = 2074$

$B = P/I = 2074/98.67 = 21.02$

The above procedure was used and the prevalence, incidence and hence the mean duration of breast-feeding were computed for all sub-groups considered in the study. This has been summarised in the table 4.5 below.

**Table 4.5 The prevalence, incidence and the mean duration of breast-feeding for all the sub-groups.**

| Sub-group | Prevalence (P) | Incidence (I) | Mean duration of breast-feeding (B) |
|---|---|---|---|
| National | 2074 | 98.67 | 21.02 |
| Nairobi | 66 | 3.63 | 18.21 |
| Central | 204 | 10.68 | 19.11 |
| Coast | 263 | 12.68 | 20.74 |
| Eastern | 339 | 14.03 | 24.17 |
| Nyanza | 360 | 18.18 | 19.80 |
| Rift Valley | 536 | 25.04 | 21.40 |
| Western | 306 | 14.36 | 21.31 |
| Urban | 215 | 11.51 | 18.67 |
| Rural | 1859 | 87.15 | 21.33 |
| No education | 385 | 16.86 | 22.83 |
| Incomplete Primary | 840 | 40.83 | 20.57 |
| Complete Primary | 429 | 20.3 | 21.11 |
| Secondary + | 420 | 20.65 | 20.34 |

Computed from the 1993 KDHS data

Once the mean duration of breast-feeding has been estimated, then Ci is computed as follows.

$C_i = 20/(18.5+i)$

where the $i = 1.753e^{0.1396B-0.001872B2}$ and B is the mean duration of breast-feeding.

For the national level case, the value of i was obtained to be 14.42 after substituting the value of B = 21.02 into the equation for i.

Therefore:

$C_i = 20/(18.5+14.42) = 20/32.92 = 0.6075$

Using the same procedure as above, the index of post-partum infecundibilty was obtained for all sub-groups. Table 4.6 below gives the $C_i$ values for all the sub-groups.

**Table 4.6 The Mean Duration of Breastfeeding and the Index of post-partum infecundability $C_i$**

| Sub Group | Mean Duration of Brestfeeding (B) | Index of Infecundability (Ci) |
|---|---|---|
| National | 21.02 | 0.6075 |
| Nairobi | 18.21 | 0.6564 |
| Central | 19.11 | 0.6400 |
| Coast | 20.74 | 0.6122 |
| Eastern | 24.17 | 0.5612 |
| Nyanza | 19.80 | 0.6279 |
| Rift valley | 21.40 | 0.6013 |
| Western | 21.31 | 0.6030 |
| Urban | 18.67 | 0.6479 |
| Rural | 21.33 | 0.5765 |
| No Education | 22.83 | 0.5797 |
| Incomplete primary | 20.57 | 0.6148 |
| Complete primary | 21.11 | 0.6061 |
| Secondary + | 20.34 | 0.6188 |

### 4.3.2 Estimation of the Index of Non-marriage ($C_m$)

The index of Non-marriage $C_m$ is given by:

$$C_m = \sum f(a) / (\sum f(a)/\sum m(a)) = \sum f(a)/\sum g(a)$$

Where:

$\Sigma$ is sum of

f(a) is the age specific fertility rates obtained by dividing births in the last year by female population in that particular age-group.

m(a) is the proportion married in a given age group obtained by dividing the married women by the total female population in that age-group.

The ratio f(a)/m(a) is the age specific marital fertility rate denoted by g(a).

For the age-group 15-19, g(a) is estimated as:

$$g(15\text{-}19) = 0.75 \times g(20\text{-}24)$$

The reason for this is because the direct estimate of g(15-19) is unreliable especially where the value of m(15-19) is very low as in most populations.

Hence the index of Non-marriage $C_m$ is obtained by dividing the sum of all the age-specific fertility rates $\Sigma f(a)$ by the sum of age-specific marital fertility rates $\Sigma g(a)$. Table 4.7 below gives a summary of the required data for a national level case. The value of $C_m$ is then obtained as in the working below.

**Table 4.7 The female population, (FPOP), number married, proportion married, m(a), births in the last year, BL12, age specific fertility rates, f(a), and age specific marital rates g(a) for all the women.**

| Age group | FPOP | Number married | m(a) | BL12 | f(a) | f(a)/m(a) = g(a) |
|---|---|---|---|---|---|---|
| 1 | 1788 | 261 | 0.1460 | 167 | 0.0934 | 0.3165 |
| 2 | 1605 | 917 | 0.5713 | 387 | 0.2411 | 0.4220 |
| 3 | 1199 | 978 | 0.8157 | 319 | 0.2661 | 0.3262 |
| 4 | 1112 | 932 | 0.8381 | 246 | 0.2212 | 0.2639 |
| 5 | 743 | 611 | 0.8223 | 121 | 0.1629 | 0.1981 |
| 6 | 653 | 530 | 0.8116 | 55 | 0.0842 | 0.1037 |
| 7 | 440 | 354 | 0.8045 | 18 | 0.0409 | 0.0508 |
| Total | 7540 | 4583 | | 1313 | 1.1098 | 1.6812 |

Source: Computed from the 1993 KDHS data

$Cm = \sum f(a) / \sum g(a) = 1.1098/1.6812 = 0.6601$

The above procedure was repeated for all sub-groups and the index of Non-marriage $C_m$ was estimated. This has been summarised in the table 4.9 for all various sub-groups.

### 4.3.3 To estimate the index of contraception (Cc)

To estimate the index of contraception Cc, the proportion of women using a specific method, denoted U(m) is obtained by dividing total married women users of a specific method by the total number of married women. The average use effectiveness denoted **e** is estimated as the weighted average of the method specific use-effectiveness levels, e (m), with the weight equal to the proportion of women using a given method u (m)

$U = \Sigma u(m)$

$e = \Sigma u(m) e(m) / \Sigma u(m)$

where Σ is the sum of

From the table 4.8 below which gives the national level data on contraception, the values of U and e have been computed. The index of $C_c$ is given by:

$C_c = 1\text{-}1.08 \times U \times e$

$= 1\text{-}1.08 \times (0.3227)(0.8366439)$

$= 0.7084$

**Table 4.8 Estimation of the Index of contraception**

| Method | u(m) | e (m) | e(m) u(m) |
|---|---|---|---|
| Pill | 0.0860 | 0.9 | 0.0774 |
| IUD | 0.0393 | 0.95 | 0.037335 |
| Sterilisation | 0.0569 | 1.0 | 0.0569 |
| Others | 0.1405 | 0.7 | 0.09835 |
| | U = 0.3227 | | Σu(m)e(m) =0.269985 |

Note: The estimates of the contraception effectiveness used are the standard method specific values adapted from data from the Philippines which are used in the calculation for the average effectiveness levels in developing countries. The estimation of $C_c$ for all the other subgroups is done in a similar manner. Table 4.9 below gives all the indices for all the sub-groups.

**Table 4.9 A summary of the three proximate determinants of fertility.**

| Region / sub-group | Index of Non-marriage (Cm) | Index of Post-partum infecundibility (Ci) | Index of contraception (Cc) |
|---|---|---|---|
| National | 0.6601 | 0.6075 | 0.7084 |
| Nairobi | 0.6058 | 0.6564 | 0.5797 |
| Central | 0.6130 | 0.6400 | 0.4714 |
| Coast | 0.6348 | 0.6122 | 0.7680 |
| Eastern | 0.6300 | 0.5612 | 0.6437 |
| Nyanza | 0.7100 | 0.6279 | 0.7861 |
| Rift Valley | 0.6721 | 0.6013 | 0.7629 |
| Western | 0.7198 | 0.6030 | 0.7819 |
| Urban | 0.5496 | 0.6479 | 0.6079 |
| Rural | 0.6789 | 0.5765 | 0.7238 |
| No education | 0.7830 | 0.5797 | 0.8233 |
| Primary Incomplete | 0.7115 | 0.6148 | 0.7564 |
| Primary Complete | 0.6674 | 0.6061 | 0.6661 |
| Secondary + | 0.5494 | 0.6188 | 0.5290 |

## 4.4 Estimation of the Model TFR from the Indices

The Bongaarts' Model (1978;1982) expresses the impact of the four main intermediate fertility variables in terms of the extent to which they inhibit overall fertility.

$$TFR = TF \times C_m \times C_a \times C_c \times C_i$$

where TF is the total fecundity.

In this study, the Bongaarts' model has been applied and three major proximate determinants, which have been estimated, are used.

$$TFR = TF \times C_m \times C_c \times C_i$$

$C_a$, the index of abortion is not estimated due to lack of reliable data (abortion is an illegal exercise in Kenya and its data is not easily available).

TF which is the total potential fertility (total fecundity), is the level of total fertility expected if all women were married throughout the reproductive age range, if there was no contraceptive use and if the post-partum period was not extended by lactation and abstinence. It ranges from 13 to 17. A TF of 15.3 is used as the average for a given population. This is an estimate that has been chosen for populations in the developing countries.

Therefore, $TFR = 15.3 \times C_m \times C_i \times C_c$

For the national level case,

$$TFR = 15.3 \times 0.6601 \times 0.6075 \times 0.7084$$

$$= 4.35$$

A summary of all the three indices and the resulting TFR is given in table 4.10 below for all the sub-groups.

Table 4.10 The indices $C_i$, $C_m$, $C_c$ and the model TFR

| Region/sub-group | Index of Non-marriage (Cm) | Index of Post-partum infecundibility (Ci) | Index of contraception (Cc) | Bongaart's model TFR |
|---|---|---|---|---|
| National | 0.6601 | 0.6075 | 0.7084 | 4.35 |
| Nairobi | 0.6058 | 0.6564 | 0.5797 | 3.53 |
| Central | 0.6130 | 0.6400 | 0.4714 | 2.83 |
| Coast | 0.6348 | 0.6122 | 0.7680 | 4.57 |
| Eastern | 0.6300 | 0.5612 | 0.6437 | 3.48 |
| Nyanza | 0.7100 | 0.6279 | 0.7861 | 5.36 |
| Rift Valley | 0.6721 | 0.6013 | 0.7629 | 4.72 |
| Western | 0.7198 | 0.6030 | 0.7819 | 5.19 |
| Urban | 0.5496 | 0.6479 | 0.6079 | 3.31 |
| Rural | 0.6789 | 0.5765 | 0.7238 | 4.33 |
| No education | 0.7830 | 0.5797 | 0.8233 | 5.72 |
| Primary Incomplete | 0.7115 | 0.6148 | 0.7564 | 5.06 |
| Primary Complete | 0.6674 | 0.6061 | 0.6661 | 4.12 |
| Secondary + | 0.5494 | 0.6188 | 0.5290 | 2.75 |

Note: The model TFR obtained does not take into consideration the effect of abortion. It should clearly be noted that although abortion data is not available, its effect on the fertility of the women in the various sub-groups is not to be ignored. In fact there has been growing evidence in some developing countries in which abortion index $C_a$ has been estimated and found to have a large effect on fertility in some settings and small effect in others. For instance, in the work done by Heidi and Kenneth

(1996) on induced abortion in developing world, the estimate for abortion index between the period 1988-1989 was 1.011, but this decreased to 0.748 during the period 1993. This clearly indicates that there has been increasing effects of abortion (induced) on fertility in the recent past, a factor that cannot go unmentioned in this analysis.

### 4.5 Estimating the total fertility rates using the Gompertz Relational Model

The Gompertz relational model was chosen as an independent method of estimating the TFR. This TFR generated from this model was then compared to that obtained from Bongaarts' model.

The Gompertz relational model fits the data into a smooth curve thus providing a more refined estimate of fertility. The total fertility rates could be obtained using the reported average Parity P(i), or the current fertility schedule F(x), i.e. using information of children born during the last 12 months before the survey (CBL12). The TFR obtained from the P (i)'s refers to 'Lifetime fertility' while that obtained by fitting the model to F (x) values refers to 'current fertility'. The TFR obtained from retrospective data, F (x)'s give lower values than those on reported average parities P (i)'s. In this study, the TFR based on retrospective data is more appropriate since this is taking into consideration the improvement of age at marriage which is greatly influenced by education. It also takes into account the improvement of the usage of modern contraceptives as well as life expectancy that have led to fertility decline. Another reason for using the TFR based on the cumulative fertility F (x) is the fact that the TFR's being generated are to be compared to those from the Bongaarts' model, which are based on the births in the last 12 months.

Below is the computational Procedure of obtaining TFR using current Preliminary fertility schedules and data from the national level.

**Step 1: Calculation of fertility schedule f (i) given by:**

$$f(i) = CBL\ 12\ (i) / FPOP\ (I)$$

where

CBL12 (i) is children born in the last 12 months by women in the $i^{th}$ age group

FPOP (I) is the female population in the $i^{th}$ age group

Example:

$$f(1) = 167/1788 = 0.093400$$

**Step 2: Computation of the cumulated fertility schedule, F(x).**

Cumulated fertility, F(x), is obtained by multiplying each f(i) values by 5 and cumulating up to the last age group, that is

$$F_{15\text{-}19} = 5 \text{ x } f_{15\text{-}19}$$

$$F_{20\text{-}24} = 5 \text{ x } f_{15\text{-}19} \text{ etc.}$$

Example:

$F_{15\text{-}19} = 5 \times 0.0934 = 0.467002$ (see table 4.11 for complete results).

**Step 3: Ratio of F(x) / F(x+5)**

Example: $F_{15\text{-}19} / F_{20\text{-}24} = 0.0467002 / 1.672609 = 0.279206$. (see table 4.11 for complete results).

Step 4: $Z(x) = -\ln[-\ln(F(x)/F(x+5))]$

Example: $Z_{15\text{-}19} = -\ln[-\ln(0.279206)] = -0.243578$

**Step 5: $Z(x) - e(x) = Y_i$ .......(see table 4.12)**

**Step 6: Computation of Y^(x)**

$$Y\hat{}(x) = \alpha + \beta Y_s(x)$$

where Z(x)-e(x)'s are taken as y values and g(x)'s are taken as x values. $Y_s(x)$ is taken from the annex. $\alpha$ and $\beta$ were calculated using the least squares method up to age group 35-39 .

For the national level case $\alpha = -0.116577$ and $\beta = 1.007214$

Therefore $Y\hat{}(x) = -0.116577 + 1.007214 Y_s(x) = -0.893340$

**Step 7: Computation of F^(x)**

$F\hat{}(x) = \exp.-((\exp.-Y\hat{}(x))$

Example: $F\hat{}_{(15\text{-}19)} = \exp.-((\exp.-(-0.893340)) = 0.086876$

**Step 8: Computation of TFR**

$$TFR = F(x) / F\hat{}(x)$$

$$= F(x) / \{\exp.-\exp.[-\alpha + \beta Y_s(x)]\}$$

Example: $TFR_{15\text{-}19} = 0.467002 / 0.86876 = 5.38.$

**Table 4.11: Computed values F(i), F(x), and F(x) / F(x+5).**

| Age group | FPOP | CBL12 | F(i) | F(x) | F(x)/F(x+5) |
|---|---|---|---|---|---|
| 15-19 | 1788 | 167 | 0.0934 | 0.4670 | 0.2792 |
| 20-24 | 1605 | 387 | 0.2411 | 1.6726 | 0.5570 |
| 25-29 | 1199 | 319 | 0.2661 | 3.0029 | 0.7308 |
| 30-34 | 1112 | 246 | 0.2212 | 4.1090 | 0.8346 |
| 35-39 | 743 | 121 | 0.1629 | 4.9232 | 0.9212 |
| 40-44 | 653 | 55 | 0.0842 | 5.3444 | 0.9631 |
| 45-49 | 440 | 18 | 0.0409 | 5.5489 | - |

Source: Computed from the 1993 KDHS

**Table 4.12: Computed values of Z(x), Z(x)-e(x), α and β**

| age group | Z(x) | e(x) | g(x) | Z(x) - e(x) |
|---|---|---|---|---|
| 15-19 | -0.2436 | 1.3364 | -0.4501 | -1.5800 |
| 20-24 | 0.5358 | 1.4184 | -0.7430 | -0.8828 |
| 25-29 | 1.1596 | 1.2978 | -0.0382 | -0.1382 |
| 30-34 | 1.7104 | 0.9670 | 0.8356 | 0.7434 |
| 35-39 | 2.5000 | 0.4509 | 2.1649 | 2.0492 |
| 40-44 | 3.2819 | 0.0462 | 4.4564 | 3.2357 |
| 45-49 | - | - | - | - |

$\alpha = -0.1166$ $\beta = 1.0072$

**Table 4.13: Computed values of ^Y(x), ^F(x) and TFR.**

| Age group | $Y_s(x)$ | Y^(x) | F^(x) | TFR |
|---|---|---|---|---|
| 15-19 | -0.7712 | -0.8934 | 0.0869 | 5.38 |
| 20-24 | -0.0410 | -0.1579 | 0.3100 | 8.39 |
| 25-29 | 0.6294 | 0.5174 | 0.5510 | 5.45 |
| 30-34 | 1.8878 | 1.2881 | 0.4550 | 5.43 |
| 34-39 | 2.4736 | 2.3749 | 0.9112 | 5.40 |
| 40-44 | 4.4984 | 4.4142 | 0.9880 | 5.41 |
| 45-49 | 9.3416 | 9.2924 | 0.9991 | 5.55 |

Mean total fertility rate is 5.43

The same procedures were repeated for all the sub-groups and the total fertility rates were obtained.

**Table 4.14 Total fertility rates obtained using the Bongaarts' model versus those obtained from Gompertz Relational Model**

| Sub-group | TFR from Gompertz Relational Model | TFR from Bongaarts' Model |
|---|---|---|
| National | 5.43 | 4.35 |
| Nairobi | 4.52 | 3.53 |
| Central | 3.65 | 2.83 |
| Coast | 5.06 | 4.57 |
| Eastern | 6.12 | 3.48 |
| Nyanza | 6.11 | 5.36 |
| Rift Valley | 6.23 | 4.72 |
| Western | 5.77 | 5.19 |
| Urban | 3.24 | 3.31 |
| Rural | 5.85 | 4.33 |
| No education | 5.71 | 5.72 |
| Primary Incomplete | 5.93 | 5.60 |
| Primary Complete | 5.67 | 4.12 |
| Secondary + | 3.85 | 2.75 |

Source: Computed from the 1993 KDHS

## 4.6 Comparing the TFR'S estimated from Bongaart's model with those estimated from the Gompertz relational model.

The table above gives a summary of the total fertility rates obtained using the Gompertz relational model and the Bongaarts' model. The difference between the two fertility rates range from 0.01 among women with no education, to 2.64 for women from eastern province. The mean difference however is 0.989 births per woman. It can however be deduced that apart from a few cases of women from eastern, rift valley, rural areas and among those with primary complete education, the fertility rates are not very different. For eastern province, the Bongaarts' TFR is 3.48, far much lower than the Gompertz TFR. This may be due to its low index of contraception and index of post-partum infecundability of 0.6437 and 0.5612 respectively. The observed level of contraception at the time of the survey may not have had its full effect on fertility due to lag effects. Another reason for this low fertility rate could be reporting errors by the respondents during the time of survey. Therefore although this same province had the lowest level of $C_i$ of 0.6160 in 1989, the drop from 0.6160 to 0.5612 of about 9 percent may not have actually occurred. Similarly a drop from 0.80796 to 0.6437 in the index of lactation, $C_c$, which is equivalent to an increase of 20.3% in the use of contraception may also not have occurred.

On the other hand, the Gompertz relational model may not be able to reflect sufficiently on changes that affect the proximate determinants of fertility. For example, the Gompertz model uses data on the births in the last 12 months while $C_c$ is determined by the current users of contraception during the time of the survey. It should be noted that births in the last year is affected by the level of usage prior to the survey and not by the number of users during the survey. This may be summarised as the by effects in which the current use of contraceptives only determines future fertility and not current fertility. The low value of $C_i$ of 0.5612 is due to a long duration of breast-feeding of 24.17 for eastern province, which is the longest duration among all the regions. This was also the case in 1989 (Wamalwa, 1991). However, although there is some consistency, we cannot rule out errors in reporting of the data used to estimate the mean duration of breast-feeding as well as the proportion contracepting in this province.

The other difference in the other values of TFR for the other various sub-groups may be attributed to the methodology differences. The use of a TFR of 15.3 is only an agreed on standard which may not be true for all the sub-groups. The effects of other proximate determinants e.g. index of abortion, $C_a$ and index of sterility cannot be ignored. In fact there is evidence that the secondary and primary sterility is on the decrease which may in turn lead to an increase in fertility which cannot be explained by the two models being used. Abortion is also playing a crucial role in reducing fertility in the recent past and this too has not been taken into account when the model TFR was estimated. Where the total fecundity has been under-estimated, this has the effect of lowering the total fertility rate. Thus the TFR's estimated from Bongaarts' model are generally lower than those estimated from Gompertz relational model. This may have been as a result of under-estimating the total fecundity rate.

### 4.7 Estimating the role of each proximate determinant in reducing fertility

In this section, the attempt is to uncover the mechanisms that are at play in producing current overall levels of fertility and to assess the relative role of each of the intermediate variables to overall fertility levels. A further attempt is also made to examine the combined effect of these variables on fertility in Kenya.

In section 4.3, the Bongaarts' Model was chosen to estimate the indices of the three proximate determinants of fertility. The model expresses the impact of each of the three intermediate variables of fertility in terms of the extent to which it inhibits overall fertility. These indices take the values 0-1 and the greater the fertility-inhibiting effect of a given variable, the lower the value. Thus the indices take the value of 1 when the determinant has no effect on fertility and the value 0 when the determinant eliminates all fertility, a situation which is not at all practical.

**Table 4.15 The Indices of Non-marriage, Lactation and Contraception at the National level**

| $C_m$ | $C_i$ | $C_c$ | TFR (Bongaarts') |
|---|---|---|---|
| 0.6601 | 0.6075 | 0.7084 | 4.35 |

From Table 4.15, it can be deduced that the index of lactation is the lowest, while that of contraception is the highest. The implication here is that fertility reducing effect of lactation is greater than that of the other two and that fertility-inhibiting effect of contraception is the lowest. This was the same finding by Wamalwa (1991). According to him, the index of lactation was 0.6356, that of non-marriage was 0.7353 and that of contraception was 0.8216. Thus the index of lactation had the greatest fertility inhibiting effect, followed by non-marriage then contraception.

**Table 4.16 The Indices of Non-marriage, Lactation and Contraception among women by the 7 provinces**

| Region | $C_m$ | $C_i$ | $C_c$ | TFR (1993) | TFR (1989) |
|---|---|---|---|---|---|
| Nairobi | 0.6058 | 0.6564 | 0.5797 | 3.53 | 4.51 |
| Central | 0.6130 | 0.6400 | 0.4714 | 2.83 | 5.97 |
| Coast | 0.6348 | 0.6122 | 0.7680 | 4.57 | 5.64 |
| Eastern | 0.6300 | 0.5612 | 0.6437 | 3.48 | 6.42 |
| Nyanza | 0.7100 | 0.6279 | 0.7861 | 5.36 | 7.08 |
| Rift Valley | 0.6721 | 0.6013 | 0.7629 | 4.72 | 6.66 |
| Western | 0.7198 | 0.6030 | 0.7819 | 5.19 | 8.10 |

Source: (1) Computed from KDHS 1993

(2) Wamalwa 1991

From Table 4.16, it can be deduced that non-marriage has the greatest inhibiting effect in Nairobi province and least impact of fertility in Western province. Lactation on the other hand has the greater impact on fertility in Eastern province and the least impact in Nairobi. Central province has the lowest index of contraception while Western has the highest. Thus reducing effect on contraception on fertility is greater in Central province and least in Western province. Nairobi, Central and Eastern provinces can be said to be regions of low fertility (less than 4.0) while coast and Rift valley provinces may be said to be regions of moderate fertility (between 4.0 and 5.0). Nyanza and Western provinces with very high TFR are regions of high fertility (more than 5.0). Central province has the lowest total fertility rate while Nyanza province has the highest.

The scenario above seems to have slightly changed between the period 1989 to 1993. Eastern province seems to have switched positions with Coast province which is now a region of moderate fertility while the former is a region of low fertility. This may be attributed to the long breast-feeding periods and increased use of contraceptives in eastern province than in the Coast province. Western and Nyanza provinces are still regions of high fertility. We can further deduce from the table that the three proximate determinants of fertility have played a great role in reducing fertility in all the regions of Kenya. The greatest reduction was achieved in central province (approximately 3 births) and least in Nairobi province (1 birth). On average, these fertility inhibiting variables reduced fertility during the periods 1989 and 1993 by about 2 births among the regions of Kenya.

As a result of these variations on effect at the regional level, we can say that the only index that has maintained the same position at the regional level is that of non-marriage. It is the second most important fertility inhibiting variable. Contraception and lactation are seen to switch positions with the latter being the most important fertility-inhibiting variable in five of the seven regions and the former in only two regions.

When we contrast this picture with that at the national level, we find that lactation has the greatest influence on fertility in these five regions namely Eastern, Coast, Rift valley, Western and Nyanza. In these regions also non-marriage comes second in importance in influencing fertility, with contraception being the least important. This agrees strongly with the general picture at the national level. However Nairobi and Central regions have a different pattern altogether. Contraception is the most important variable influencing fertility followed by non-marriage then lactation. This may be due to high levels of education in these regions as well as urbanisation that both favour the use of contraceptives as well as delayed marriages.

**Table 4.17 The Indices of Non-marriage, Lactation and Contraception among women by levels of education**

| Education Level | $C_m$ | $C_i$ | $C_c$ | TFR |
|---|---|---|---|---|
| No education | 0.7830 | 0.5797 | 0.8233 | 5.72 |
| Primary Incomplete | 0.7115 | 0.6148 | 0.7594 | 5.06 |
| Primary Complete | 0.6674 | 0.6061 | 0.6661 | 4.12 |
| Secondary + | 0.5494 | 0.6188 | 0.5290 | 2.75 |

From Table 4.17 it is clear that the Index of Non-marriage decreases with increases in education such that the inhibiting effect of non-marriage is highest among women with secondary and higher education and lowest among those with no education. The effect of lactation on reducing fertility is vice versa; greatest among women with no education and lowest among women with secondary and higher level of education. For contraception, the index is lowest among women with secondary and higher education and highest among those with no education. Thus the inhibiting effect of contraception is highest among the highly educated and lowest among those with little or no education. The TFR computed from these indices varies inversely with the level of education such that the higher the level of education the lower the level of fertility.

**Table 4.18 The Indices of Non-marriage, Lactation and Contraception among women in the rural and urban areas**

| Residence | $C_m$ | $C_i$ | $C_c$ | TFR |
|---|---|---|---|---|
| Urban | 0.5496 | 0.6479 | 0.6079 | 3.31 |
| Rural | 0.6789 | 0.5765 | 0.7238 | 4.33 |

From Table 4.18, it is evident that women residing in the urban areas have a lower index of non-marriage and contraception than their counterparts in the rural areas. This implies that the index of non-marriage and contraception has a greater impact on reducing fertility among women in the urban areas than those living in the rural areas. The women in the rural areas however have the lowest index of lactation than those in the urban areas. Thus fertility reducing effect of lactation is greatest among women in the rural areas than those in the urban areas. These fertility-inhibiting factors have a greater impact on fertility among the women in the urban areas than those in the rural areas.

## 4.8 The impact of Proximate Determinants of fertility on fertility using the percentage reduction in fertility

To be able to estimate the percent reduction in fertility as a result of the inhibiting effect of the proximate determinants, we first use the Bongaarts' model to estimate the total natural marital fertility (TN), the total marital fertility (TM) and the total fertility rate (TFR).

The total natural marital fertility (TN) is given by TF $\times$ $C_i$. This measures the effect of lactation on fertility, which is given by the difference between C (Total fecundity) and TN where C is 15.3. The percentage reduction in fertility due to lactation is then given by:

$$(C- TN) /C \times 100$$

The values of C, TN, (C-TN) and the percentage reduction in fertility are given in Table 4.19 below.

**Table 4.19 The values of C, TN and C-TN and the percent reduction of fertility due to lactation by regions**

| Region | C | TN = C X C | C-TN | percent Reduction in Fertility |
|---|---|---|---|---|
| Nairobi | 15.3 | 10.0 | 5.3 | 34.6 |
| Central | 15.3 | 9.79 | 5.51 | 36.0 |
| Coast | 15.3 | 9.37 | 5.93 | 38.8 |
| Eastern | 15.3 | 8.59 | 6.71 | 43.9 |
| Nyanza | 15.3 | 9.61 | 5.69 | 37.2 |
| Rift Valley | 15.3 | 9.20 | 6.10 | 39.9 |
| Western | 15.3 | 9.23 | 6.07 | 39.7 |
| National | 15.3 | 9.29 | 6.01 | 39.3 |

The effect of lactation on fertility can be established by obtaining the difference between the total fecundity rate and the natural fertility rate. The bigger the difference, the greater the reduction in fertility and hence the greater the impact of lactation on fertility. Therefore from Table 4.19, lactation has the greatest impact on fertility in Eastern province where the percent reduction in fertility is 43.9 and least in Nairobi where reduction was 34.6 percent.

**Table 4.20 The values of C, TN C-TN and the percent reduction in fertility among women by levels of education**

| Education Level | C | $TN = C \times C_i$ | C-TN | percent Reduction in Fertility |
|---|---|---|---|---|
| No Education | 15.3 | 8.87 | 6.43 | 42.0 |
| Primary Incomplete | 15.3 | 9.41 | 5.89 | 38.5 |
| Primary Complete | 15.3 | 9.27 | 6.03 | 39.4 |
| Secondary + | 15.3 | 9.47 | 5.83 | 38.1 |

From Table 4.20 it is indicative that the higher the level of education, the lower the percent reduction in fertility due to lactation. Thus the impact of lactation on fertility reduces as the level of education among women increases. However, it should be noted that the difference in percent reduction of fertility due to lactation among primary incomplete and primary complete slightly varies from this trend. Women with primary complete education seem to lactate longer than those with primary incomplete.

There also exists a notable difference in the impact of lactation on fertility among women residing in urban areas and those residing in rural areas. Table 4.21 below indicates that the greatest percent reduction in fertility is among women in the rural areas than those in the urban areas which in turn implies a greater impact of lactation on fertility among these women than their counterparts in the urban areas.

**Table 4.21 The values of C, TN, C-TN and the percent reduction in fertility among women in rural and urban areas.**

| Residence | C | TN = C × Ci | C-TN | percent Reduction in fertility |
|---|---|---|---|---|
| Urban | 15.3 | 9.91 | 5.39 | 35.2 |
| Rural | 15.3 | 8.82 | 6.48 | 42.4 |

The percentage reduction in fertility due to Lactation at the national level is 39.3.

The total marital fertility (TM) is given by $C_c \times TN$. This in turn measures the effect of contraception on fertility (abortion being assumed to be negligible in Kenya). The percentage reduction in fertility due to contraception is given by

$$(TN-TM) / TN \times 100$$

**Table 4.22 Values of TN, TM, TN - TM and the percent Reduction in fertility due to contraception by provinces**

| Region | TN | TM | TN - TM | percent Reduction in fertility |
|---|---|---|---|---|
| Nairobi | 10.0 | 5.82 | 4.22 | 42.0 |
| Central | 9.79 | 4.62 | 5.18 | 52.9 |
| Coast | 9.37 | 7.19 | 2.17 | 23.2 |
| Eastern | 8.59 | 5.53 | 3.06 | 35.6 |
| Nyanza | 9.61 | 7.55 | 2.05 | 21.4 |
| Rift Valley | 9.20 | 7.02 | 2.18 | 23.7 |
| Western | 9.23 | 7.21 | 2.01 | 21.8 |
| National | 9.29 | 6.58 | 2.71 | 29.2 |

From Table 4.22 it is evident that the impact of contraception on fertility is greatest in Central Province and the least in Western Province. This is because the difference in TN - TM is greatest in Central Province and smallest in Western. This in turn gives rise to a percent reduction in fertility of 52.9 and 21.8 respectively.

**Table 4.23 TN, TM, TN - TM values and the percent reduction of fertility among women by levels of education and place of residence.**

| Education | TN | TM | TN - TM | Percent reduction in fertility |
|---|---|---|---|---|
| No education | 8.87 | 7.30 | 1.57 | 17.7 |
| Primary incomplete | 9.41 | 7.12 | 2.29 | 24.3 |
| Primary complete | 9.27 | 6.18 | 3.09 | 33.3 |
| Secondary + | 9.47 | 5.01 | 4.46 | 47.1 |
| Urban | 9.91 | 6.03 | 3.88 | 39.2 |
| Rural | 8.82 | 6.38 | 2.44 | 27.7 |

Table 4.23 reflects that the difference between TN and TM increases with the level in education. The impact of contraception on fertility therefore increases with the increase in the level of education. This phenomenon is seen to happen very consistently. There is a distinct difference in the impact of contraception among women residing in rural and urban areas. The greatest impact of contraception on fertility is marked among the women in the urban areas and least among their counterparts in the rural areas.

The percentage reduction in fertility due to contraception at the national level is 29.2. The total fertility rate (TFR) is given by $C_m \times TM$, where $C_m$ is the index of Non-marriage. The difference between TM and TFR is the impact of Non-marriage on fertility patterns. The percentage reduction on fertility due to Non-marriage is given by (TM - TFR) / TM $\times$ 100

**Table 4.24 TM, TFR, TM - TFR Values and the % Reduction in fertility among women by regions**

| Region | TM | TFR | TM - TFR | % Reduction in fertility |
|---|---|---|---|---|
| Nairobi | 5.82 | 3.53 | 2.29 | 39.3 |
| Central | 4.62 | 2.83 | 1.79 | 38.7 |
| Coast | 7.19 | 4.57 | 2.62 | 36.4 |
| Eastern | 5.53 | 3.48 | 2.05 | 37.1 |
| Nyanza | 7.55 | 5.36 | 2.19 | 29.0 |
| Rift Valley | 7.02 | 4.72 | 2.30 | 32.8 |
| Western | 7.21 | 5.19 | 2.02 | 28.0 |
| National | 6.58 | 4.34 | 2.24 | 34.0 |

From table 4.24 above, Nairobi province has the greatest percent reduction in fertility due to non-marriage and the smallest percent reduction is found in western province. Thus the impact of non-marriage is greatest in Nairobi and least among women in western province. As for women with different levels of education, the impact of non-marriage is greatest among those with secondary and higher level of education and least among those with no education. In fact the impact of non-marriage on fertility increases with the increase in the level of education.

**Table 4.25 TM, TFR, TM - TFR Values and the % Reduction in fertility among women by education levels and place of residence.**

| Education/Residence | TM | TFR | TM - TFR | % Reduction in fertility |
|---|---|---|---|---|
| No Education | 7.30 | 5.72 | 1.58 | 21.6 |
| Primary Incomplete | 7.12 | 5.06 | 2.06 | 28.9 |
| Primary Complete | 6.18 | 4.12 | 2.06 | 33.3 |
| Secondary + | 5.01 | 2.75 | 2.26 | 45.1 |
| Urban | 6.03 | 3.31 | 2.72 | 45.1 |
| Rural | 6.38 | 4.33 | 2.05 | 32.1 |

As with women in different residential areas, it can be said from table 4.25 below that the impact of non-marriage is greatest among those in urban areas and smallest among those in the rural areas. At the national level, the percentage reduction in fertility due to non-marriage is 34.

From the above analysis, it can be deduced that the greatest fertility inhibiting factor is post-partum infecundability which reduces the total fecundity at the national level by 39.3 percent followed by the reducing effect of non-marriage (34.0 percent). The least fertility-inhibiting factor at the national level is contraception, whose overall percentage reduction in fertility is 29.2 percent. This agrees with Wamalwa's findings (1991) that contraception was the least fertility inhibiting variable with a percent reduction of 18 while non-marriage was the second important variable with a percent reduction in fertility of 26 and lactation being the most important of the three with a percent reduction in fertility of 36. However, a keen look at contribution of each proximate determinant between the period 1989-1993 reveals a different situation altogether.

**Table 4.26 The percent reduction in fertility by $C_i$, $C_c$ and $C_m$ among women by region between the period 1989-1993**

| REGION | LACTATION | | | CONTRACEPTION | | | NON-MARRIAGE | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1989 | 1993 | Difference | 1989 | 1993 | Difference | 1989 | 1993 | Difference |
| National | 36 | 39.3 | 3.3 | 18 | 29.2 | 11.2 | 26 | 34 | 8.0 |
| Nairobi | 38 | 34.6 | -3.4 | 28 | 34.6 | 14.0 | 34 | 39.3 | 5.3 |
| Central | 34 | 36.0 | 2.0 | 29 | 52.9 | 23.9 | 16 | 38.7 | 22.7 |
| Coast | 34 | 38.8 | 4.8 | 14 | 23.2 | 9.2 | 35 | 36.4 | 1.4 |
| Eastern | 39 | 43.9 | 4.9 | 19 | 35.6 | 16.6 | 15 | 37.1 | 22.1 |
| Nyanza | 36 | 37.2 | 1.2 | 10 | 21.4 | 11.4 | 19 | 29.0 | 10.0 |
| Rift Valley | 36 | 39.9 | 3.9 | 17 | 23.7 | 6.7 | 17 | 32.8 | 15.8 |
| Western | 37 | 39.7 | 2.7 | 10 | 21.8 | 11.8 | 7 | 28 | 21.0 |

Source: 1) Compiled from KDHS Data 1993

2) Wamalwa, 1991

From Table 4.26 above it can be noted that during this period, lactation had the greatest impact in reducing fertility among women in Eastern Province (there was a difference in fertility reduction effect of 4.9%) and it was least among those in Nairobi (a drop in reduction effect of 3.4%). At the national level there was an increase in fertility reducing effect of 3.3 percent due to lactation. For contraception, Central Province had increased its fertility reducing effect by 23.9 percent, this being reflected in its larger proportion contracepting than in the other provinces. Rift valley on the other hand had the least increase in fertility reducing effect due to contraception. At the national level there was marked increase in fertility reducing effect of contraception by 11.2 percent. In the case of non-marriage, the greatest increase in fertility reducing effect was in Central province and least in Coast province. At the national level, the fertility reduction effect due to non-marriage went up by 8.0%.

Therefore considering the three proximate determinants during this period, it can be said that contraception had the greatest fertility inhibiting effect of 11.2 percent, followed by non-marriage with 8.0 percent and then lactation with 3.3 percent. Thus fertility inhibiting effect of contraception has been greater than that of the other two proximate determinants in the few years preceding the 1993 KDHS survey, a fact that agrees with other findings related to the transition to lower fertility in Kenya (Cross R., Walter Obungu and Paul Kizito, 1991; National Research Council , 1993).

## 4.9 Estimation of the predicted TFR using the Bongaarts'-Kirmeyer model

The Bongaarts'-Kirmeyer Model is a regression model of the relationship between the Total Fertility Rate (TFR) and the Contraceptive Prevalence Rate. In this study, the Bongaarts'-Kirmeyer Model is used to estimate the predicted TFR using the Contraceptive Prevalence levels. In section 4.8 above it has been determined that contraceptive prevalence had taken a leading role in reducing fertility in the last few years preceeding the 1993 survey. Thus there seems to be a strong linear relationship between the prevalence rate among married women and the TFR. Due to this reason, an attempt has been made to find out if the observed TFR in various regions of the country matches the contraceptive prevalence rates.

The predicted TFR is given by:

$$TFR = 7.3 - 0.064 \times U$$

Where U is the percentage of currently married women practising contraception.

In our case, the observed TFR used is that obtained using the Gompertz relational model which had been chosen as an independent method of estimating fertility.

**Table 4.27 The observed TFR, contraceptive prevalence rate and predicted TFR among women by regions.**

| Region | Percent contraceptive Prevalence | Predicted TFR | Gompertz TFR(Observed TFR) | Difference |
|---|---|---|---|---|
| Nairobi | 45.42 | 4.39 | 4.52 | 0.13 |
| Central | 56.99 | 3.65 | 3.65 | 0.00 |
| Coast | 25.80 | 5.65 | 5.06 | 0.59 |
| Eastern | 38.98 | 4.81 | 6.12 | 1.31 |
| Nyanza | 23.82 | 5.78 | 6.11 | 0.33 |
| Rift Valley | 27.00 | 5.57 | 6.23 | 0.66 |
| Western | 24.71 | 5.72 | 5.77 | 0.05 |
| National | 32.27 | 5.23 | 5.43 | 0.20 |

From Table 4.27, the only region with excess fertility is Eastern province. Thus the level of contraceptive use achieved in Eastern province in 1993 had not had the anticipated impact on fertility by the time of the survey, a situation we referred to as lag effect. The observed TFR in Eastern province is actually consistent with a contraceptive prevalence rate of 18.4 percent rather than 38.98 percent. The other regions have basically no excess fertility, while at the national level, the difference between the predicted TFR and the observed one is very small (0.20 births per woman). Thus it can be said that the observed TFR is matching the contraceptive prevalence rate in the other regions.

From the above findings, it can therefore be said that by setting a given contraceptive prevalence level, the desired Total Fertility Rate (TFR) can be obtained. The regions with high fertility in Kenya are the same regions with very low levels of contraceptive prevalence rates. Therefore by raising the levels of contraceptive prevalence, the TFR in these regions can be reduced to a desired level.

## 4.10 Projecting fertility and future demand for contraceptives.

In section 4.9, it has successfully been shown that the observed fertility does actually match the percentage levels of contraceptive prevalence. This implies that the effect of the other two proximate determinants estimated in this study is not expected to bring about large effects on TFR in the various regions of the country. Therefore contraceptive prevalence can be assumed to be the factor which is going to determine the way the TFR goes in the future. Using this fact and by setting the desired future levels of fertility, then the corresponding levels of contraceptive prevalence can be estimated and vice versa. Thus the demand for future contraceptives can be projected as well as the future fertility if the contraceptive prevalence level is known. The table below gives the projected total fertility rates obtained from the last population census of 1989 in Kenya.

**Table 4.28 Projected Total Fertility Rate and the rate of fertility decline at the national level.**

| Rate of fertility decline | Period and the projected TFR | | | |
|---|---|---|---|---|
| | 1990-1995 | 1995-2000 | 2000-2005 | 2005-2010 |
| SLOW (0.1 births per annum) | 5.5 | 5.0 | 4.5 | 4.0 |
| MEDIUM (0.15 per annum) | 5.5 | 4.75 | 4.0 | 3.25 |
| FAST (0.2 births per annum) | 5.5 | 4.5 | 3.5 | 2.5 |

Source: Kenya Population Census 1989, Analytical Report Volume VII- Population projections, April 1996

From Table 4.28 the Projected future fertility at the National level has been given depending on the rate of fertility decline. Bongaarts'-Kirmeyer equation for the predicted total fertility rate is given by :

$$TFR = 7.3 - 0.064 \times U$$

Where U is the percentage of the currently married women using contraception.

From this equation, the level of contraceptive prevalence can be determined by residual once the TFR has been set. Thus the future demand for contraceptives can be projected using the projected TFR.

Now if we choose a rate of fertility decline of 0.15 births per annum, then for the four periods 1990-1995, 1995-2000, 2000-2005 and 2005-2010, the corresponding projected fertility rates from the table above are 5.5, 4.75, 4.0 and 3.25 respectively.

But TFR = $7.3 - 0.064 \times U$. Putting TFR = 5.5, then the predicted contraceptive prevalence rate is estimated to be

$$U = (5.5 - 7.3) / -0.064 = 28.12\%$$

for the period 1990 to 1995.

For the other three periods, the desired contraceptive prevalence rate U is 39.84 percent, 51.56 percent, and 63.28 percent. Hence by choosing any desired rate of fertility decline and the projected TFR at various periods, the demand for future contraceptives can be estimated.

# CHAPTER FIVE:

# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.1 Introduction:

The main aim of this study was to determine the fertility level and differentials by various subgroups in Kenya and to explain these differentials using the proximate determinants of fertility. The study also sought to find out the contribution of each of the intermediate fertility variables in inhibiting fertility. The data used in the study was the 1993 Kenya Demographic and Health Survey. The three main proximate determinants estimated in this study are the index of postpartum infecundability, $C_i$, the index of non-marriage, $C_m$, and the index of contraception, $C_c$. The study also sought to use the contraceptive prevalence rate to estimate the predicted total fertility rate, TFR, and then compare it with the observed fertility to determine any regions of excess fertility. An attempt has also been made to project fertility and demand for future contraceptives.

The data used in the study was drawn from the Kenya demographic and health survey 1993. This was the second DHS to be carried out in Kenya, the first having been carried out in 1989. In the survey 7540 women aged between 15-49 years were interviewed. The survey was designed to provide information on levels and trends of fertility, infant and child health, and knowledge of AIDS. This survey targeted the same areas covered in 1989 in order to maintain comparability with the previous survey.

Three models were used in data analyses. The Bongaarts (1978) model was used to estimate the total fertility which was compared to that obtained using the Gompertz relational model, chosen as an independent method of estimating fertility. Lastly, the Bongaarts-Kirmeyer regression equation was used to predict TFR and also to project future demand for contraceptives.

## 5.2 Summary of the findings.

In section 4.3, the three main proximate determinants of fertility have been estimated using the Bongaarts (1978) model. This was followed by estimating the total fertility rates, TFR, using the Bongaarts model and finally using the Gompertz relational model by the regions, education levels and place of residence. A comparison of the TFR's from the two models was then done thus achieving the first, second and third objectives of the study.

From the table 4.9, it was shown that the value of the three intermediate fertility variables vary by the regions, thereby giving rise to different levels of fertility. The values of the indices by the other subgroups of residence and education also vary widely bringing about differences in fertility among women in these subgroups. It can be said therefore that the differences in levels of fertility are to be attributed to the combined effect of these proximate determinants.

Table 4.14 also gives the fertility rates obtained from the Bongaarts' model and the Gompertz relational model. The difference between these fertility rates range from 0.01 to 2.64 births per woman. These differences are highest among women in Eastern province, those with primary complete education and those from the rural areas. The lowest differences are found among women in urban areas and those with no education. The differences in the other categories are quite small, which may be attributed to the usefulness of the proximate determinants in estimating fertility. These large variations were attributed to various factors that include the following;

(a) Errors in the intermediate fertility variable estimates;

(b) The total fecundity average of 15.3 used for all subgroups that may not hold for all the subgroups;

(c) Assumption that the effect of induced abortion is negligible which is not the case since it has been found to have significant effect on fertility in many developing countries;

Generally, the fertility rates obtained from the Gompertz relational model are higher than those obtained from the Bongaarts' model..

As shown in table 4.9, lactation has the greatest fertility inhibiting effect followed by non-marriage while contraception had the least effect. Lactation was found to have the greatest fertility inhibiting effect in five regions namely Eastern, Rift valley, Western, Nyanza and Coast. However it had the least effect in Nairobi and Central. Non-marriage had the second greatest fertility inhibiting effect in all the regions, while contraception was the least fertility inhibiting variable except for Central and Nairobi where it was the leading fertility inhibiting variable.

The fertility inhibiting effect of lactation decreased with the increase in the level of education. Thus the index of lactation was lowest among women with no education and highest among those with secondary and higher level of education. The index of non-marriage decreased with the increase in education, and so did the index of contraception. Thus the fertility inhibiting effect of these two variables increased with the increase in the level of education. The inhibiting effect of lactation was highest among women residing in the rural areas, while that of non-marriage and contraception was highest among those with the highest level of education. The index of non-marriage was lowest among women with secondary and higher level of education, that of lactation among those in Eastern province, while that of contraception was lowest among the women in Central province.

From table 4.26, it was noted that there has been an increase in the fertility reducing effect of all the three intermediate fertility variables during the period 1989 to 1993. At the national level, lactation has a percent improvement of 3.3, non-marriage 8.0 percent and contraception 11.2 percent. We can therefore say that during this period, contraception and non-marriage mainly contributed in achieving the declines in fertility, with lactation playing an almost constant role. This finding is actually very similar to other findings like that of Cross, Obungu and Kizito(1991) that contraception has recently been the main cause of fertility decline in many developing countries.

In section 4.9, the only region that was found to have excess fertility was Eastern province which had a difference of more than one birth between the predicted and the observed fertility. The other regions had very small differences between the predicted and the observed fertility of less than one birth. We can therefore say that the observed fertility matches the predicted fertility within the regions which further suggests that the contraceptive prevalence rate of a certain region does determine the fertility in that region.

In section 4.10, the future fertility was projected using fertility decline rates on a given population. Since fertility is expected to match the contraceptive prevalence rates then this rate was also determined by residue method. Thus the demand for future contraceptives may be estimated in this manner.

## 5.3 CONCLUSIONS:

The three main proximate determinants of fertility have been estimated in this study and the resulting total fertility rates obtained using the Bongaarts' model for all the subgroups considered in this study. At the national level, the TFR obtained was 4.35, which means an average of about four births per woman compared to about six births in 1989. This suggests a decline in fertility during the period 1989 to 1993. At the regional level, Central had the lowest fertility rate of 2.83 compared to 4.5 of Nairobi in 1989. Nyanza had the highest fertility of 5.36 while western had 8.10 as the highest in 1989. From these figures, it can be concluded that there has been a decline in fertility during this period. We also note that Central took over from Nairobi as the region with the lowest fertility while Nyanza took over from Western during this period. We can finally conclude that there was a drop in fertility of between one birth and three births across the regions.

Women in the urban areas had a fertility rate of 3.31, while their counterparts in the rural areas had a fertility rate of 4.33. In 1989, these rates were 4.99 and 6.66 respectively indicating a drop in fertility of more than one birth for women in the urban areas and more than two births for those in the rural areas. There were also very striking differences in fertility for women with different levels of education. Women with no education had a fertility rate of 5.72 while those with secondary and higher level of education had a fertility rate of 2.75 births per woman. The corresponding figures were 7.23 and 4.95 respectively in 1989. We therefore conclude that there was also a decline in fertility among these two subgroups during this period.

Among the three proximate determinants of fertility estimated in this study, we can conclude that postpartum infecundability was the most important fertility inhibiting variable at the national level and among all the sub-groups except in Nairobi and Central regions, and in the urban areas as well as among women with secondary and higher level of education. Non-marriage was the second most important variable at the national level and among all the sub-groups except in the urban areas where it took the leading role in reducing fertility. Contraception was the most important fertility inhibiting variable in Nairobi and Central regions, among the women with secondary and higher level of education and the least important at the national level and the other sub-groups.

There was a general increase in the fertility reduction effect of all the three proximate determinants during the period prior to the 1993 survey at the national level and across the regions from the previous section. We can conclude that contraception and non-marriage mainly contributed towards achieving the declines in fertility between the period 1989 to 1993.

The prediction of fertility using contraceptive prevalence rate indicated that Eastern province was the only region with excess fertility of more than one birth. The other regions did not have excess fertility. We can therefore conclude that observed fertility matches with the contraceptive prevalence rates in these regions. We can also conclude that using this fact, projections for future demand on contraceptives can be made for any region once the desired future fertility has been determined.

## 5.4 POLICY RECOMMENDATIONS:

From the findings of this study, the following recommendations can be drawn;

(i) The women with low fertility are those in Nairobi, Central, urban areas and those with secondary and higher level of education. This is largely due to effective use of contraceptives and also non-marriage. We therefore recommend that the use of effective contraceptives be made available in the other subgroups with high fertility like Western, Nyanza and Rift valley.

(ii) Since reducing fertility in most populations is an effort towards improving the standards of living in that population, we recommend that family planning programmes aimed at increasing the use of effective contraception be intensified throughout the country with emphasis in Nyanza, Western, Rift-valley and Eastern.

(iii) This study has also shown that there is a positive relationship between the level of education and use of contraceptives. This in turn has the ultimate result of lowering fertility. We therefore recommend that the government provide universal education for all and especially for the girls even if it is for free.

(iv) Non-marriage seems to be increasing among women with secondary and higher level of education and those residing in the urban areas. We recommend that the important role played by marriage in our society should be re-enforced to the youth in schools and in churches by the respective leaders. At the same time the importance of breastfeeding in reducing fertility should be brought to the light of the many youths that do not otherwise know of this fact.

## 5.7 RECOMMENDATIONS FOR FURTHER RESEARCH:

From this study, the following suggestions for further research have been made;

(i) It has been pointed out in this study that induced abortion is increasing in many developing countries. We suggest that studies be done that includes the effect of induced abortion in reducing fertility.

(ii) Eastern province was found to be the region with excess fertility. A study to find out the causes of the excess fertility in this region is useful.

(iii) Population projection studies to be done at regional and district levels so as to enable other projections to be made like that of future contraceptives.

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## APPENDIX A: COMPUTATION OF THE TOTAL FERTILITY RATES USING THE BONGAARTS' MODEL

**NAIROBI**

**1. computation of index of post-partum infecundability, $C_i$**

| age group | children born 0-35 months prior to survey | children exactly 36 months | no. of women currently breastfeeding |
|---|---|---|---|
| 1 | 9 | 1 | 5 |
| 2 | 53 | _ | 28 |
| 3 | 39 | _ | 18 |
| 4 | 19 | _ | 9 |
| 5 | 6 | _ | 4 |
| 6 | 3 | _ | 1 |
| 7 | 1 | _ | 1 |
| Total | 130 | 1 | 66 |

$C_i$ = 20/18.5+i
where i = $1.753e^{0.1396-0.001872B2}$

B = mean duration of breastfeeding.

B = P/I

I = births 0-35 months +1/2(aged 36 months)/36

=130+1/2(1)/36 =3.25

B = 66/3.25 =18.21

$i = 11.97$

hence $C_i = 20/18.5$

**2. Computation of index of non-marriage, $C_m$**

| age group | female population (FPOP) | married women | proportion married, m(a) | births in the last 12 months (BL12) | age specific fertility rates, f(a) | age specific marital fertility rates, g(a) |
|---|---|---|---|---|---|---|
| 1 | 58 | 14 | 0.2414 | 7 | 0.1207 | 0.2090 |
| 2 | 126 | 61 | 0.4841 | 17 | 0.1349 | 0.2787 |
| 3 | 78 | 52 | 0.6667 | 13 | 0.1667 | 0.2500 |
| 4 | 46 | 29 | 0.6304 | 6 | 0.1304 | 0.2069 |
| 5 | 25 | 17 | 0.6800 | 2 | 0.0800 | 0.1176 |
| 6 | 20 | 13 | 0.6500 | – | 0.0000 | 0.0000 |
| 7 | 14 | 10 | 0.7143 | 1 | 0.0714 | 0.1000 |
| Total | 367 | 196 | 4.0669 | 46 | 0.7041 | 1.1622 |

$C_m$ = sum f(a)/sum g(a) = .7041/1.1622 =0.6058

**3. Computation of the index of contraception, $C_c$**

| method | no. married women using method | married proportion contracepting, U(m) | use effectiveness, e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 40 | 0.2041 | 0.90000 | 0.1837 |
| IUD | 19 | 0.0969 | 0.9500 | 0.0921 |
| Female sterilisation | 4 | 0.0205 | 1.0000 | 0.0205 |
| Others | 26 | 0.1327 | 0.7000 | 0.0929 |
| Total | 89 | 0.4542 | | 0.3892 |

$C_c$=1-1.08(U)(E)

E = sum U(m)e(m)/sum U(m) =0.3892/0.4542 = 0.8569)

$C_c$ = 1-1.08(0.4542)0.8569 = 0.5797

## CENTRAL

### 1. Computation of the index of infecundability, $C_i$

| age group | children born 0-36 months prior to survey | children exactly 36 months | no. Of women currently breastfeeding |
|---|---|---|---|
| 1 | 30 | _ | 22 |
| 2 | 120 | 2 | 61 |
| 3 | 105 | 3 | 53 |
| 4 | 80 | _ | 43 |
| 5 | 29 | 1 | 17 |
| 6 | 16 | 2 | 7 |
| 7 | 3 | _ | 1 |
| Total | 383 | 8 | 204 |

$C_i = 20/18.5 + i$ where $i = 1.753e^{0.1396B - 0.001872B2}$

B= P/I =(383+1/2(8))/36 =204/10.68 =19.11

I =12.75

$C_i = 20/18.5 + 12.75 = 0.6400$

### 2. Computation of the index of non-marriage, $C_m$

| age group | fpop | married women | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 238 | 13 | 0.0546 | 17 | 0.0714 | 0.2296 |
| 2 | 219 | 98 | 0.4475 | 30 | 0.1370 | 0.3061 |
| 3 | 168 | 128 | 0.7619 | 32 | 0.1905 | 0.2500 |
| 4 | 168 | 135 | 0.8036 | 32 | 0.1905 | 0.2370 |
| 5 | 92 | 77 | 0.8370 | 11 | 0.1196 | 0.1428 |
| 6 | 110 | 84 | 0.7636 | 3 | 0.0273 | 0.0357 |
| 7 | 80 | 65 | 0.8125 | – | – | – |
| Total | 1075 | 600 | | 125 | 0.7363 | 1.2012 |

$C_m$ = sum f(a)/sum g(a)

= 0.7363/1.2012 =0.6130

**3. Computation of the index of contraception, $C_c$**

| method | no. of married women using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 108 | 0.1800 | 0.9000 | 0.1695 |
| IUD | 63 | 0.1050 | 0.9500 | 0.0998 |
| Sterilisation | 53 | 0.0883 | 1.0000 | 0.0883 |
| Others | 113 | 0.1883 | 0.7000 | 0.1318 |
| Total | 337 | 0.5699 | | 0.4894 |

$C_c$ = 1- 1.08(U)(E)

E = 0.8588

$C_c$ =0.4714

**COAST**

1. **Computation of the index of infecundability, $C_i$**

| age group | children born 0-35 months prior to the survey | children exactly 36 months | no. of women currently breastfeeding |
|---|---|---|---|
| 1 | 42 | _ | 27 |
| 2 | 138 | — | 74 |
| 3 | 110 | 4 | 63 |
| 4 | 84 | 12 | 46 |
| 5 | 58 | — | 40 |
| 6 | 9 | 1 | 8 |
| 7 | 7 | — | 5 |
| Total | 448 | 17 | 263 |

$C_i = 20/18.5+I$

$i = 14.17$

$C_i = 20/18.5+14.17 = 0.6122$

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 278 | 52 | 0.1871 | 21 | 0.0755 | 0.3112 |
| 2 | 222 | 135 | 0.6081 | 56 | 0.2523 | 0.4149 |
| 3 | 177 | 142 | 0.8023 | 40 | 0.2260 | 0.2817 |
| 4 | 164 | 133 | 0.8110 | 29 | 0.1768 | 0.2180 |
| 5 | 131 | 103 | 0.7863 | 22 | 0.1679 | 0.2135 |
| 6 | 64 | 44 | 0.6875 | 5 | 0.0781 | 0.1136 |
| 7 | 55 | 42 | 0.7636 | 3 | 0.0545 | 0.0714 |
| Total | 1091 | 651 | | 174 | 1.0311 | 1.6243 |

$C_m = \Sigma f(a)/\Sigma g(a)$

$= 1.0311/1.6243 = 0.6348$

**3. Computation of the index of contraception, $C_c$**

| method | married women using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 52 | 0.0799 | 0.9000 | 0.0719 |
| IUD | 20 | 0.0307 | 0.9500 | 0.0292 |
| Sterilisation | 23 | 0.0353 | 1.0000 | 0.0353 |
| Others | 73 | 0.1121 | 0.7000 | 0.0785 |
| Total | 168 | 0.2580 | | 0.2149 |

$C_c = 1\text{-}1.08(U)(E)$

$E = 0.8328$ $C_c = 0.7680$

**EASTERN**

**1. Computation of the index of infecundability, $C_i$**

| age group | children 0-35 months prior to the survey | children exactly 36 months | no. of women currently breastfeeding |
|---|---|---|---|
| 1 | 41 | — | 29 |
| 2 | 147 | 2 | 110 |
| 3 | 109 | 3 | 72 |
| 4 | 102 | 6 | 67 |
| 5 | 54 | 3 | 33 |
| 6 | 33 | 4 | 23 |
| 7 | 10 | – | 5 |
| Total | 496 | 18 | 339 |

Ci =20/18.5+I

i = 17.14

Ci = 20/18.5+17.14 = 0.5612

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 221` | 23 | 0.1041 | 23 | 0.1041 | 0.4145 |
| 2 | 214 | 114 | 0.5327 | 63 | 0.2944 | 0.5527 |
| 3 | 162 | 133 | 0.8210 | 43 | 0.2654 | 0.3233 |
| 4 | 160 | 140 | 0.8750 | 37 | 0.2313 | 0.2643 |
| 5 | 105 | 88 | 0.8381 | 19 | 0.1810 | 0.2160 |
| 6 | 125 | 101 | 0.8080 | 14 | 0.1120 | 0.1386 |
| 7 | 57 | 50 | 0.8772 | 3 | 0.0526 | 0.0600 |
| Total | 1044 | 649 | | 202 | 1.2408 | 1.9694 |

Cm = sum f(a)/sum g(a) =1.2408/1.9694 = 0.6300

**3. Computation of the index of contraception, Cc**

| method | married women using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 85 | 0.1310 | 0.9000 | 0.1179 |
| IUD | 38 | 0.0586 | 0.9500 | 0.0556 |
| Sterilisation | 35 | 0.0539 | 1.0000 | 0.0539 |
| Others | 95 | 0.1464 | 0.7000 | 0.1025 |
| Total | 253 | 0.3898 | | 0.3299 |

$C_c$ =1-1.08(U)(E)

E = 0.8462 $C_c$ =0.6437

## NYANZA

### 1. Computation of the index of infecundability, $C_i$

| age group | children 0-36 months prior to survey | children exactly 36 months | no. of women currently breastfeeding |
|---|---|---|---|
| 1 | 72 | — | 46 |
| 2 | 193 | 5 | |
| 3 | 175 | 7 | 107 |
| 4 | 123 | 3 | 99 |
| 5 | 47 | 3 | 66 |
| 6 | 26 | 2 | 24 |
| 7 | 8 | 1 | 16 |
| Total | 644 | 21 | 360 |

$C_i = 20/18.5+i$ ; $i = 13.35 \Rightarrow C_i = 20/18.5+13.35 = 0.6279$

### 2. Computation of the index of non-marriage, $C_m$

| age group | fpop | married fpop | m(a) | BE12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 318 | 64 | 0.2013 | 36 | 0.1132 | 0.3132 |
| 2 | 258 | 170 | 0.6589 | 71 | 0.2752 | 0.4177 |
| 3 | 181 | 157 | 0.8674 | 69 | 0.3812 | 0.4395 |
| 4 | 199 | 175 | 0.8794 | 42 | 0.2111 | 0.2401 |
| 5 | 110 | 84 | 0.7636 | 16 | 0.1455 | 0.1905 |
| 6 | 119 | 95 | 0.7983 | 11 | 0.0924 | 0.1157 |
| 7 | 79 | 57 | 0.7215 | 2 | 0.0253 | 0.0351 |
| Total | 1264 | 802 | | 247 | 1.2439 | 1.7518 |

$C_m$ = sum f(a)/sum g(a) = 1.2439/1.7518

= 0.7100

**3.Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 32 | 0.0399 | 0.9000 | 0.0359 |
| IUD | 9 | 0.0112 | 0.9500 | 0.0106 |
| Sterilisation | 55 | 0.0686 | 1.0000 | 0.0686 |
| Others | 95 | 0.1185 | 0.7000 | 0.0830 |
| Total | 191 | 0.2382 | | 0.1981 |

$C_c = 1-1.08\,(U)(E)$ ; $E = 0.8317 \Rightarrow C_c = 0.7861$

**RIFT-VALLEY**

**1. Computation of the index of infecundability, $C_i$**

| age group | children 0-35 months | children exactly 36 months | women currently breastfeeding |
|---|---|---|---|
| 1 | 71 | 1 | 49 |
| 2 | 266 | 9 | 152 |
| 3 | 234 | 13 | 139 |
| 4 | 169 | 7 | 99 |
| 5 | 84 | 3 | 55 |
| 6 | 43 | 4 | 32 |
| 7 | 16 | — | 10 |
| Total | 883 | 37 | 536 |

Ci = 20/18.5+I ; i =14.76 ⇒ Ci = 20/18.5+14.76 = 0.6013

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 423 | 51 | 0.1206 | 35 | 0.0827 | 0.3440 |
| 2 | 373 | 218 | 0.5845 | 100 | 0.2681 | 0.4587 |
| 3 | 305 | 256 | 0.8393 | 88 | 0.2885 | 0.3437 |
| 4 | 250 | 207 | 0.8280 | 68 | 0.2720 | 0.3285 |
| 5 | 162 | 136 | 0.8395 | 33 | 0.2037 | 0.2426 |
| 6 | 142 | 125 | 0.8803 | 15 | 0.1056 | 0.1200 |
| 7 | 99 | 81 | 0.8182 | 8 | 0.0808 | 0.0988 |
| Total | 1794 | 1074 | | 347 | 1.3014 | 1.9363 |

$C_m$ =f(a)/g(a) =1.3014/1.9363 = 0.6721

**3. Computation of the index of contraception, $C_c$**

| method | women using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 41 | 0.0382 | 0.9000 | 0.0344 |
| IUD | 19 | 0.0177 | 0.9500 | 0.0168 |
| Sterilisation | 66 | 0.0615 | 1.0000 | 0.0615 |
| Others | 164 | 0.1527 | 0.7000 | 0.1069 |
| Total | 290 | 0.2700 | | 0.2195 |

$C_c$ = 1-1.08(U)(E)

E = 0.8129 ⇒ $C_c$ = 0.7629

**WESTERN**

**1. Computation of the index of infecundability,$C_i$**

| age group | children 0-35 months | children exactly 36 months | women currently breastfeeding |
|---|---|---|---|
| 1 | 47 | — | 33 |
| 2 | 139 | 2 | 80 |
| 3 | 119 | 1 | 64 |
| 4 | 104 | 3 | 67 |
| 5 | 68 | 2 | 42 |
| 6 | 28 | 2 | 19 |
| 7 | 7 | — | 1 |
| Total | 512 | 10 | 306 |

$C_i = 20/18.5+I$ ; $i = 14.67 \Rightarrow Ci = 0.6030$

**2. Computation of the index of non-mareiage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 252 | 44 | 0.1746 | 28 | 0.1111 | 0.3100 |
| 2 | 193 | 121 | 0.6269 | 50 | 0.2591 | 0.4133 |
| 3 | 128 | 110 | 0.8594 | 34 | 0.2656 | 0.3091 |
| 4 | 125 | 113 | 0.9040 | 32 | 0.2560 | 0.2832 |
| 5 | 118 | 106 | 0.8983 | 18 | 0.1525 | 0.1698 |
| 6 | 73 | 68 | 0.9315 | 7 | 0.0959 | 0.1030 |
| 7 | 56 | 49 | 0.8750 | 1 | 0.0179 | 0.0205 |
| Total | 945 | 611 | | 170 | 1.1581 | 1.6089 |

Cm = f(a)/g(a) = 1.1581/1.6089 = 0.7198

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 36 | 0.0589 | 0.9000 | 0.0530 |
| IUD | 12 | 0.0196 | 0.9500 | 0.0187 |
| Sterilisation | 25 | 0.0409 | 1.0000 | 0.0409 |
| Others | 78 | 0.1277 | 0.7000 | 0.0894 |
| Total | 151 | 0.2471 | | 0.2020 |

$C_c$ = 1-1.08 (U)(E) ; E = 0.8172

$C_c$ = 0.7819

**URBAN**

**1. Computation of the index of lactation, $C_i$**

$C_i$ = 20/18.5+i

i = 12.37

$C_i$ = 0.6479.

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 246 | 32 | 0.1301 | 15 | 0.0610 | 0.2500 |
| 2 | 319 | 156 | 0.4890 | 52 | 0.1630 | 0.3333 |
| 3 | 230 | 163 | 0.7087 | 36 | 0.1565 | 0.2208 |
| 4 | 176 | 124 | 0.7045 | 24 | 0.1364 | 0.1936 |
| 5 | 98 | 65 | 0.6632 | 7 | 0.0714 | 0.1077 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 57 | 39 | 0.6842 | 3 | 0.0526 | 0.0769 |
| 7 | 35 | 28 | 0.8000 | 1 | 0.0286 | 0.0358 |
| Total | 1161 | 607 | | 138 | 0.6695 | 1.2181 |
| | | | | | | |

$C_m = f(a)/g(a) = 0.6695/1.2181$

$= 0.5496$

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 90 | 0.1483 | 0.9000 | 0.1335 |
| IUD | 53 | 0.0873 | 0.9500 | 0.0829 |
| Sterilisation | 33 | 0.0544 | 1.0000 | 0.0544 |
| Others | 80 | 0.1318 | 0.7000 | 0.0923 |
| Total | 256 | 0.4218 | | 0.3631 |

$C_c = 1\text{-}1.08(U)(E)$

$E = 0.8607$

$C_c = 0.6079$

**RURAL**

**1. Computation of the index of lactation, $C_i$**

$Ci = 20/18.5+i$

$i = 14.69$

$C_i = 0.5765$

**2. Computation of index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 1542 | 229 | 0.1485 | 152 | 0.0986 | 0.3301 |
| 2 | 1286 | 761 | 0.5918 | 335 | 0.2605 | 0.4402 |
| 3 | 969 | 815 | 0.8411 | 283 | 0.2921 | 0.3472 |
| 4 | 936 | 808 | 0.8632 | 222 | 0.2372 | 0.2748 |
| 5 | 645 | 546 | 0.8465 | 114 | 0.1767 | 0.2088 |
| 6 | 596 | 491 | 0.8238 | 52 | 0.0872 | 0.1059 |
| 7 | 405 | 326 | 0.8049 | 17 | 0.0420 | 0.0521 |
| Total | 6379 | 3976 | | 1175 | 1.1943 | 1.7591 |

$C_m = f(a)/g(a) = 1.1943/1.7591$

$= 0.6789$

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 304 | 0.0765 | 0.9000 | 0.0688 |
| IUD | 127 | 0.0319 | 0.9500 | 0.0303 |
| Sterilisation | 228 | 0.0573 | 1.0000 | 0.0573 |
| Others | 564 | 0.1419 | 0.7000 | 0.0993 |
| Total | 1223 | 0.3076 | | 0.2557 |

$C_c = 1 - 1.08\,(U)(E)$ ; $E = 0.8313$

$C_c = 0.7238$

**NO EDUCATION**

**1. Computation of the index of lactation, $C_i$**

$C_i = 20/18.5+i$

i=16.00

$C_i = 0.5797$

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 60 | 20 | 0.3333 | 8 | 0.1333 | 0.2298 |
| 2 | 82 | 62 | 0.7561 | 19 | 0.2317 | 0.3064 |
| 3 | 142 | 123 | 0.8662 | 43 | 0.3028 | 0.3496 |
| 4 | 235 | 205 | 0.8723 | 61 | 0.2596 | 0.2976 |
| 5 | 262 | 204 | 0.7786 | 51 | 0.1947 | 0.2501 |
| 6 | 269 | 211 | 0.7844 | 24 | 0.0892 | 0.1137 |
| 7 | 247 | 194 | 0.7854 | 13 | 0.0526 | 0.0670 |
| Total | 1297 | 1019 | | 219 | 1.2639 | 1.6142 |

Cm = f(a)/g(a) =1.2639/1.6142

= 0.7830

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 28 | 0.0275 | 0.9000 | 0.0248 |
| IUD | 11 | 0.0108 | 0.9500 | 0.0103 |
| Sterilisation | 61 | 0.0599 | 1.0000 | 0.0599 |
| Others | 100 | 0.0981 | 0.7000 | 0.0687 |
| Total | 200 | 0.1963 | | 0.1636 |

$C_c = 1 - 1.08(U)(E)$ ; $E = 0.8333$

$C_c = 0.8233$

**PRIMARY INCOMPLETE**

**1. Computation of the index of lactation, $C_i$**

$Ci = 20/18.5+i$; $i = 14.03$

$Ci = 0.6148$

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 1035 | 167 | 0.1617 | 97 | 0.0937 | 0.3117 |
| 2 | 663 | 450 | 0.6787 | 187 | 0.2821 | 0.4156 |
| 3 | 347 | 302 | 0.8703 | 114 | 0.3285 | 0.3775 |
| 4 | 359 | 306 | 0.8524 | 81 | 0.2256 | 0.2647 |
| 5 | 237 | 200 | 0.8439 | 38 | 0.1603 | 0.1900 |
| 6 | 266 | 223 | 0.8383 | 23 | 0.0865 | 0.1031 |
| 7 | 142 | 113 | 0.7958 | 4 | 0.0282 | 0.0354 |
| Total | 3049 | 1761 | | 544 | 1.2049 | 1.6980 |

$C_m = f(a)/g(a) = 1.2049/1.6980$

$= 0.7115$

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 108 | 0.0613 | 0.9000 | 0.0552 |
| IUD | 49 | 0.0278 | 0.9500 | 0.0264 |
| Sterilisation | 96 | 0.0545 | 1.0000 | 0.0545 |
| Others | 225 | 0.1278 | 0.7000 | 0.0895 |
| Total | 478 | 0.2714 | | 0.2255 |

$C_c = 1-1.08(U)(E)$ ; $E = 0.8310$

$C_c = 0.7564$

PRIMARY COMPLETE

**1. Computation of the index of lactation, $C_i$**

$C_i = 20/18.5+i$

$i = 14.50$

$C_i = 0.6061$

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 315 | 46 | 0.1460 | 36 | 0.1143 | 0.3419 |
| 2 | 342 | 204 | 0.5965 | 93 | 0.2719 | 0.4558 |
| 3 | 289 | 235 | 0.8131 | 78 | 0.2699 | 0.3319 |
| 4 | 234 | 192 | 0.8205 | 52 | 0.2222 | 0.2708 |
| 5 | 126 | 107 | 0.8492 | 17 | 0.1349 | 0.1589 |
| 6 | 64 | 57 | 0.8906 | 7 | 0.1094 | 0.1228 |
| 7 | 30 | 28 | 0.9333 | — | 0.0000 | 0.0000 |
| Total | 1400 | 869 | | 283 | 1.1226 | 1.6821 |

$C_m = f(a)/g(a) = 1.1226/1.6821$

$= 0.6674$

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 104 | 0.1197 | 0.9000 | 0.1077 |
| IUD | 30 | 0.0345 | 0.9500 | 0.0328 |
| Sterilisation | 50 | 0.0575 | 1.0000 | 0.0575 |
| Others | 138 | 0.1588 | 0.7000 | 0.1112 |
| Total | 322 | 0.3705 | | 0.3092 |

$C_c = 1 - 1.08(U)(E)$ ; $E = 0.8345 \Rightarrow C_c = 0.6661$

**SECONDARY AND HIGHER**

**1. Computation of the index of lactation, $C_i$**

$C_i = 20/18.5 + i$ ; $i = 13.82 \Rightarrow C_i = 0.6188$

**2. Computation of the index of non-marriage, $C_m$**

| age group | fpop | married fpop | m(a) | BL12 | f(a) | g(a) |
|---|---|---|---|---|---|---|
| 1 | 378 | 28 | 0.0741 | 26 | 0.0688 | 0.3284 |
| 2 | 518 | 201 | 0.3880 | 88 | 0.1699 | 0.4379 |
| 3 | 421 | 318 | 0.7553 | 85 | 0.2019 | 0.2673 |
| 4 | 284 | 229 | 0.8063 | 53 | 0.1866 | 0.2314 |
| 5 | 118 | 100 | 0.8475 | 15 | 0.1271 | 0.1500 |
| 6 | 54 | 39 | 0.7222 | 1 | 0.0185 | 0.0256 |
| 7 | 21 | 19 | 0.9048 | 1 | 0.0476 | 0.0526 |
| Total | 1794 | 934 | | 269 | 0.8204 | 1.4932 |

$C_m = f(a)/g(a) = 0.8204/1.4932 = 0.5494$

**3. Computation of the index of contraception, $C_c$**

| method | married using method | U(m) | e(m) | U(m)e(m) |
|---|---|---|---|---|
| Pill | 147 | 0.1574 | 0.9000 | 0.1416 |
| IUD | 84 | 0.0899 | 0.9500 | 0.0854 |
| Sterilisation | 63 | 0.0675 | 1.0000 | 0.0675 |
| Others | 189 | 0.2024 | 0.7000 | 0.1416 |
| Total | 322 | 0.5172 | | 0.4361 |

$C_c$ 1-1.08(U)(E)

$E = 0.8432$

$C_c = 0.5290$