ESTIMATION OF SOME REPRODUCTIVE

BEHAVIOUR INDICES OF WOMEN

IN KENYA FROM CENSUS DATA

BY

OTIENO ALFRED TITUS AGWANDA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university to the best of my knowledge.

signature ATAStephen
OTIENO A.T.A.

This thesis has been submitted for examination with our approval as university supervisors:

signature 23/3/89
DR. J. A. M. OTTIENO

signature Charles R. Hammerslough 3-7-89
PROF. CH. HAMMERSLOUGH

signature
DR. A.B.C. OCHOLA-AYAYO

Population Studies and Research Institute
University of Nairobi
P. O. Box 30197,
Nairobi

DEDICATION

Dedicated to my Parents and Family.

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ABSTRACT

This thesis was set to present estimates of some indices of reproductive behaviour of women in Kenya at regional level from information derived from 1969 and 1979 censuses. The indices estimated are mean age at birth of first child, mean age at birth of last child, mean length of time between birth of first child and last child and the mean inter-birth spacing.

Two methods have been applied to obtain these estimates namely: Suchindran-Horne (1984) and Sivamurthy (1987) methods. Suchindran-Horne method uses the age specific fertility rates as the main input data. Sivamurthy's method uses the life table approach to derive the indices on assumption that the age specific fertility rates act as the unconditional probabilities of birth rates with the respective ages. The data required in this case are the schedules of the age specific fertility rates. In the application of these methods, the indices so obtained are synthetic and refer only to the hypothetical cohorts who experience the schedule of the age specific fertility rates.

In chapter two the derivation and computational procedure is presented. The results of the application are presented in chapter three and in chapter four we have the summary conclusion and recommendations.

From the results of the analysis it is observed that mean age first birth at national level was around 19 years in 1969 and 1979 while the mean age at last birth was around 41 years

resulting into a mean length of time between first and last birth of just over 21 years and a mean inter birth spacing of about 33 months. At regional (district) level mean age is found to cluster between 19 to 20 years in both periods. Most of the observed changes in the indices over the period is in Rift Valley and Coast Provinces. Substantial variations in the indices was observed when level of education was considered than residence. Although in all the regions considered urban fertility was lower than rural there was no much variation in mean age at first birth.

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GENERAL INTRODUCTION

INTRODUCTION

Timing of first live births normally measured by a woman's age at first birth has been shown to have considerable effects on both individual as well as aggregate level of achieved fertility (Casterline and Trussell, 1980; Rindfuss et al, 1983). In addition to demographic influence, early childbearing may adversely affect health of mothers, infants and economic welfare of families as well as marital stability (Bumpass et al,1978).

Similarly age at last birth has influence on demographic profile. Wide variations in completed fertility has been shown to be explained by variations in age at last birth (Lomba, 1986; Macdonald, 1984; Sivamurthy, 1987, 1988). Its influence on maternal and infant mortality have been cited (Horne and El-Khorazarty, 1986).

Bongaarts' (1978) fertility model also indicates that fertility is influenced directly by biological and behavioral factors and the influence of these factors is through either starting, spacing or stopping of childbearing.

This study is concerned with estimating indices which measure these temporal aspects of fertility behavior from census data across different Kenyan sub-populations in order to identify various differences in these indices and distribution across the regions of Kenya.

1.1 STATEMENT OF THE PROBLEM

Kenya is widely cited and frequently discussed as a country in which fertility rates are high. Previously, estimates have shown that the growth rates have increased from 3% in 1962 to 3.3% in 1969 and to about 4% per annum in 1980 (CBS, 1984).

Apart from the rising level of fertility, it has been noted that high levels of fertility in Kenya are due to late age at which women stop childbearing and that the interval between first and last births is among the longest among many Latin American, African and Asian countries for which data are available (MacDonald, 1984; Sarma, 1985). In addition, about 10% of women begin childbearing as early as age 14 or 15 (Ferry and Page 1984).

In these studies, estimates of timing of the childbearing events in Kenya have only been done when Kenya is considered in cross-country analysis based on World Fertility Survey data and thus few studies have considered estimates and variation of these reproductive indices across the sub-regions of this country.

Attempts to estimate age at which a woman gives birth to a first child and last child have had methodological problems. Interpolation between mean ages for women who have completed their fertility at the mean parities has been criticized (Feightinger, 1987).

The other method which has been suggested is the use of fertility data for women in the age group 40 - 49 assumed to have completed their childbearing. This is only useful when doing comparison but not for trends. The method depends on the quality of age estimation across the different populations.

Recently, other methods have been developed through the use of indirect estimation based on analysis of age-specific birth rates (Sivamurthy, 1987, 1978; Suchindran and Horne, 1984). This study is then also aimed at applying these new techniques to estimate reproductive behaviour indices namely; mean age at birth of first child, mean age at birth of last child and other related indices of women in Kenya.

1.1.1 OBJECTIVES OF THE STUDY

The main objective is to estimate the synthetic measures of timing of reproductive events for the Kenya women, specifically:

1) to estimate trends in mean ages at first and last births and hence length of time taken in reproduction for women in Kenya at national level.

2) to estimate and assess the regional variations in mean ages at first and last birth and the length of time taken in reproduction.

3) to estimate the mean ages at first, last birth and length of time taken in reproduction by level of education and by rural-urban residence.

1.1.2 STUDY RATIONALE/JUSTIFICATION

The importance of age at birth of first child in determining the average rate of population growth is a long recognised phenomenon and its relation with birth rates and infant mortality rates has been documented (Horne and El-Khorazarty, 1986; Coale and Tye, 1961; Casterline, 1980).

Age pattern of women at first birth is an important component of overall fertility as it signals the entry into the state of motherhood. This change in the life course status has influence on demographic, social and economic status, rendering the event worthy of study. Its relationship with aggregate level birth rate as well as infant mortality rates for developing countries like Kenya points out its significance to public policy making.

An understanding of onset of childbearing has been cited in literature to be important in the study of determinants of fertility levels and patterns especially in societies like Kenya where active control of fertility is low.

Age at last birth has also been recognised as a good indicator for the onset of fertility decline (Leridon and Ferry, 1985; Knodel, 1978; Osterud and Fulton, 1981) and has been pointed out as a significant indicator of aggregate level of fertility (Macdonald, 1984).

Thus mean ages at first birth and last birth, length of reproductive span and mean inter-birth spacing are important events which summarise the temporal aspects of aggregate fertility behaviour.

This study is particularly geared to two aspects of fertility study in Kenya; to identify distribution and differentials in these aspects of fertility behaviour, and on the other hand as an extension of study in analysis of age-specific fertility rates. The age specific fertility rates have been used to estimate the total fertility rate as a summary index of fertility but they can further be used to estimate other fertility indices like mean age at first birth, mean age at last birth, average length of reproductive span, average inter-live birth intervals and parity progression ratios at aggregate level.

1.2 LITERATURE REVIEW

1.2.1 DEVELOPED COUNTRIES

Craig (1982) studying differentials existing in fertility levels between black and white women in the United States pointed out that one of the partial factors responsible was the early age at which black women began their childbearing. The subsequent difference in pace of childbearing was also attributed to differences in age at start of childbearing.

Finnas and Hoem (1980) using Danish National Institute of Social Research data collected in 1975 from a survey on family formation and employment in Denmark also pointed that early age at the start of recorded exposure to childbearing is indicative of rapid pace and high level of subsequent fertility.

Strong inverse relationship between age at first birth and lifetime fertility of women has been shown to have weakened among younger women in recent years in the United States (Trussell and Menken, 1978; Millman and Hendershot, 1980). Similar observation was made by Balakrishnam et al, (1988) using a national sample of Canadian women in Canadian National Fertility Survey of 1984. They observed that excess cumulative fertility of those who started families early over others steadily decreased, a difference of approximately two births between early and late starters among older women reduced to approximately half a child among younger women.

Tsui (1982) looked at timing of birth events in the context of family formation where childbearing behaviour within the family is viewed as a cumulative response to changing series of decisions over family life cycle. These events were not only viewed in descriptive terms but also via covariate models. In the study, childbearing history data from June 1975 Population Survey of 17000 United States white women of 1930 - 1969 marriage cohorts once married and still in marriage was examined by using a model where childbearing is assumed to be a continuous-time poisson process in which birth events are in discrete states.

Using social-economic variables like education, family income, urban residence, current work status and variables related to timing of birth events like, duration of first birth interval, duration of successive birth intervals and duration of family formation process measured by the period between first and last birth and age at marriage, he pointed out that first birth interval was an important phase of family formation and informative of prospective length of time to be spent in childbearing. In addition, high family income was significant in the duration of time spent in family formation. For later cohorts, participation in labour force was highly related to short duration of childbearing. Older cohorts were observed to spread their births over a longer period time while younger cohorts had fewer births spread over a shorter period of time.

Bloom (1982) in his study of age pattern of women at first birth in United States, fitted in his analysis the Coale-McNeil marriage model to the age distribution of first birth frequencies for a number of recent white and non-white women and found lower mean ages at first birth among non-white women than white women and in addition, mean age at first birth was increasing across cohorts of white but stable across cohorts of non-white women. He has also fitted the model to several European countries and found that it was also suitable for projections of first birth frequencies.

In estimation of incidences of delayed childbearing and permanent childlessness and their determinants in the United States, Bloom and Trussell (1984) fitted Coale-McNeil marriage model to survey data on age at first birth and letting parameters of the model depend on co-variates. In their findings, low age at first birth fertility rates experienced by US women in 1970s was attributed to both delayed childbearing and to increasing levels of childlessness. They further pointed out that delayed childbearing was less prevalent among black women than non black. Education was indicated as a factor which was positively related to heterogeneity among women in their age at first birth and childlessness, and also to increased dispersion of age at first birth. Race differences had no significant effect on childlessness.

Day (1986) using Australian census data of 1971 pointed out that group differences in age at completion of childbearing are affected by factors which operate through one or more of factors related to age at commencement of childbearing, pace of childbearing and the number of children ever born.

Other studies on ages at last birth in developed countries has involved the use of historical populations in which age at last birth has been used as an indicator of family limitation (Knodel, 1978; Osterud and Fulton, 1981) and in family life cycles (Glick and Parke, 1975; Krishnamoorthy, 1979).

1.2.2 DEVELOPING COUNTRIES

While in developed countries there exist a long series of data relevant for vital studies, a number of developing countries do not have enough data from which detailed fertility behaviour indices could be obtained. Most of such studies have relied on using incomplete data and or indirect estimation. In one such study, Sivamurthy (1987, 1988) used a model in which the age-specific fertility rates are used to construct a "life table" to estimate indices of fertility behaviour in addition to the traditional total fertility rate index.

The indices which can be obtained from this method are; mean or median ages at first birth and last birth, mean birth intervals, parity progression ratios and proportion remaining childless, from census, survey or vital registration data. The data used was derived from Demographic Year Books. The model has been applied to several developed and developing countries. From his analysis, he has observed that decreased mean ages at last birth rather than increased mean ages at first birth accounts for substantial change to low fertility levels in addition to increased proportion of women who do not reproduce.

In an attempt to estimate life cycle events of an individual woman Krishnamoorthy (1979) has developed poisson-type approximation to estimate parity distribution, mean ages at first and last birth, mean time taken between first and last births and other individual life cycle events of a woman just born when only age specific birth and death rates are available and applied the model to data from United States, Venezuela and Madagascar. Pullum (1987) has criticized the model as satisfactory in a natural fertility setting but too broad in situations where fertility is controlled by contraception.

Horne and El-Khorazarty (1986, 1987) have applied a model developed by Suchindran and Horne (1984), Horne (1985) to data from Egypt and several Arab Countries. In Egypt, they have estimated trends in age at completion of childbearing in the period 1930 - 1980 in which they observed that trends indicate that greater changes have occurred in mean ages at last birth and length of reproductive span rather than age at first birth.

In application of the method to other Arab countries they have indicated that Arab women have moderate mean age at first birth but very old mean age at last birth and hence very long reproductive span. On considering the estimates of the indices by various differentials, later mean age at first birth was observed in North African countries of the Arab world than those in Western Asia. Further, mean age at first birth was seen to increase with level of formal education and urban residence. On the other hand, mean age at last birth seem to decrease with level of education and urban residence. They also found that mean age at first birth was negatively related to both crude birth rates and infant mortality rates while mean age at last birth and length of reproductive span had a positive relation. When associations were considered with other fertility and mortality indicators, mean length of reproductive span was indicated as better predictor of aggregate level of fertility. Associations with socio-economic indicators revealed that possibly childbearing behaviour in Arab countries was influenced strongly by customs, traditions and beliefs.

The model mentioned above has been applied by several demographers to both African and Asian countries. Guo (1986) using Chinese national One Per Thousand Fertility Survey estimated and analysed mean ages at first and last birth for the Chinese population for the period 1950 - 1979. He noted that with the corresponding changes in the level of fertility rates there have been substantial decreases in mean ages at last birth and mean length of reproductive span in both rural and urban areas.

In a comparative study of a number of Asian countries, Rindfuss et al, 1983 have examined determinants of timing first births in Sri Lanka, South Korea, Taiwan, Hong Kong, Malaysia and Philippines, using multiple linear regression analysis. Level of education, country ethnicity, rural-urban origins and birth cohort ages were used as predictor variables of age at birth of the first child. Timing of first child was found to vary considerably at different times in different places. Level of education of the women was found to have a strong delaying effect everywhere. Ethnic groups seemed to display similar behaviour across the various countries, however, rural-urban origins did not affect timing of entry into motherhood in any of the societies considered.

Similarly, Macdonald (1984) also examined ways in which nuptiality patterns affect starting, spacing and stopping behaviour across 34 developing societies. He observed that where active fertility control is low, early age at first marriage was associated with early age at stopping reproduction and late age at marriage with late age at stopping in Nepal, Pakistan, Syria, Northern Sudan and among Malay of Malaysia and Indians of Haiti. On the other hand, Korea showed a different pattern where those who married at an early age end their childbearing at later years than those who married late and some countries like Senegal showing no pattern.

He also pointed out that in African countries, women have longer birth intervals and relatively stop giving birth at very late ages. Some countries like Senegal have high fertility because of very early age at which women begin childbearing while in Kenya it is particularly due to very late age at which they stop their childbearing. Latin American countries were observed to have high fertility because of shorter birth intervals. Using correlational analysis between selected characteristics of starting, spacing and stopping behaviour and based on cross-cultural data from the 34 societies, he found that age at last birth was a significant predictor of aggregate completed fertility.

Rahman (1984) using only Bangladesh Fertility Survey in which he examined maternity histories of 466 women in the age group 40 - 49, observed no variations in age at first birth, however age at last birth varied widely and depended on the parity of the women. He also observed that in Bangladesh, women who had longer reproductive spans had also very short birth intervals.

1.2.3 AFRICAN COUNTRIES

Henin (1969) in a study to examine the effect of nomadism and settlement on fertility from a demographic survey carried out in Sudan in 1968, made comparisons using age at first maternity, length of reproductive span, age at which last child is born, and birth intervals as fertility indices.

He noted that large proportions of nomadic women were childless and those who bore children tended to start childbearing at later ages and also complete it earlier than the settled women. Their birth intervals were also longer. He pointed out two major factors as responsible causes of the differentials; those related to marriage patterns which included late marriage, those remaining single, incidences of broken marriage, and marriage to polygamous husbands and those related to medical physiology where nomadic women experienced pregnancy losses from severe conditions of life, malaria, venereal diseases, low nutritional standards and longer breastfeeding habits. He also noted that shorter reproductive span of nomadic women could have been due to late age at which they reach puberty and earlier onset of menopause.

Gaisie (1984) using World Fertility Survey data from Ghana, studied the proximate determinants of fertility by looking at the determinants of age at first birth, birth spacing and age at last birth. He pointed out that rural women had slightly earlier age at first birth than urban women and that level of education tended to raise the age at first birth. However, in Ghana, he noted that widowhood, divorce, separation and terminal abstinence had very little effect on stopping patterns. The major determinant of age at last birth being the onset of secondary sterility.

1.2.4 KENYA

In Kenya, Omondi-Ahawo (1981) did a study on the relationship between age at first marriage among adolescent women using data drawn from Kenya Fertility Survey (1977/78). He used chi-square as the main statistical technique to determine the relationship between the variables and also proportions and means for comparison of various distribution of ages. He found the average age at menarche as 14.4 years, average age at first marriage as 15.8 years and the average age at first birth as 16.6 years. All these varied between regions, level of education and ethnic groups.

Further studies on fertility behaviour differentials in Kenya have been done by Lomba (1986) who examined the variations in entry into motherhood and length of reproductive span using also data drawn from 1977/78 Kenya Fertility Survey. He used cross tabulations of maternity history data for women in the age group 40 - 49 by rural-urban residence, socio-economic status, major ethnic groups, provinces and marital status. He pointed out that rural-urban differentials in age at first births were very small even when classification was considered between metropolitan areas. Women with higher education had older age at first birth but regions as well as ethnic groups had little variations although Eastern, Central, Nairobi and Coast possessed higher mean ages. Large variations existed when mean age at last birth and mean length of reproductive span were considered between regions, rural-urban, ethnic groups and where marriage was intact or dissolved. Longer length of reproductive span was observed among the Kikuyu, Kalenjin and Kamba ethnic groups and among catholic and protestants.

Garsan (1986) has examined the fertility indices in Nairobi as a metropolitan area and noted that in Nairobi first birth intervals are short and that many women marry when either pregnant or have already had a first birth. He also found that age at first birth varies with level of formal education.

Ang'awa (forthcoming) has also used 1977/78 Kenya Fertility Survey to study age at first birth and at first marriage and their relationship with the level of fertility and found that early marriage is predominant in Coastal region and Nyanza, late marriage in Central, Eastern and Nairobi. Using multiple stepwise linear regression, he observed that age at first marriage explains a lot of variation in age at first birth.

In an analysis of the proximate determinants and their effects on fertility patterns in Kenya, Leridon and Page (1984) have used World Fertility Survey data to examine the process of family formation by looking in turn the starting pattern of family formation, spacing pattern and stopping patterns. The method of analysis and presentation was done in terms of duration of variables; that is the time elapsed before a particular event is experienced. The summary of the detailed distributions for the variables was given as a series of quartiles, Tx, the time elapsed before x per cent of persons concerned have experienced the event in question. The overall measure of central tendency used was the tri-mean which is the weighted average of the quartiles that gives twice as much weight to the median as to other two quartiles i.e. (T25 + 2T50 + T75) or the arithmetic mean.

In their findings, the average age at first birth was around age 19 but 10% of the women start as early as 14 or 15 years. There was a difference of 4 to 5 years between the average age at menarche and average age at first birth and attempts to delay first birth through contraception was small. The birth intervals were relatively short, just over two years, because duration of post partum ammenorhea and abstinence were relatively short by African standards. The mean age at last birth was found to be around 40.4 years and estimated mean age at menopause was 49 years, four higher than mean age at reporting oneself as infecund although not post menopausal. Their suggestion was that women do not stop earlier than natural processes dictate and also even among those widowed or divorced, few fail to remarry quickly.

1.3 THEORETICAL FRAMEWORK

The fertility behaviour of a given population is influenced by a number of complicated factors which are not clear cut hence difficulties in constructing an appropriate universal model for its analysis. In spite of these problems, various studies have placed emphasis on role of demographic, socio-economic and cultural variables determining differences in fertility behaviour between and within populations (Bongaart's, 1978; Davis and Blake, 1956).

Davis and Blake (1956) first outlined a group of eleven variables which directly determine fertility level. These factors falling in three categories are those affecting exposure to intercourse, exposure to conception and factors affecting gestation and parturition. Of these factor some are subject to control by individual while others are not. In addition, a notable omission which has subsequently been added by demographers is the group of factors related to duration of post-partum infecundability, including the duration of breastfeeding.

Bongaarts' (1978) modified the original Davis and Blake framework and identified biological and behavioral factors called the intermediate variables which are acted upon by socio-economic, socio-cultural, and environmental factors called the indirect determinants which affect the fertility and are responsible for its variation both at individual and aggregate levels. Bongaarts' classification of the original intermediate variables are as follows:-

I. Exposure Factors

1) proportion of reproductive period spent in marriage or stable unions

II. Deliberate Marital Fertility Control Factors

2) Contraception

3) Induced abortion

III. Natural Marital Fertility Factors

4) Post-partum infecundity including abstinence and lactational ammenorhea

5) Frequency of intercourse

6) Sterility (related to menarche, menopause or disease)

7) Spontaneous foetal mortality

8) Duration of fertile period (in each menstrual cycle)

Differentials and trends in fertility within a country have been traced to the differences in one or more of these intermediate factors on assumption that potential level of fertility is the same in all the societies and all factors accounted for.

One of the most encountered difficulties in analysis of fertility differences have been in estimation of each of these intermediate variables and their contribution to the fertility level. Bongaarts' (1978) and Bongaart's and Potter, 1983 have suggested an empirical model in which they have tried to apportion out the contribution of each of these proximate (main) determinants to the overall level of fertility or specifically to age specific fertility rates.

While fertility is the ultimate dependent variable, studies of the components of internal dynamics of fertility-age at first birth, birth intervals, age at last birth which are also determinants of fertility are themselves determined by cross-national patterns of different social, cultural, economic, biological and behavioral factors.

From the review of literature, studies have revealed that the differentials in age patterns at first and last birth and birth intervals are caused by such independent variables as education, rural-urban residences, religion, ethnicity or race, occupation and family background. The effects of these factors are largely manifested through the main determinants i.e biological factors and behavioural factors.

McDonald (1984) notes that patterns of starting, stopping and spacing of childbearing are influenced by proximate determinants such as contraception, duration of post partum, non-susceptible period, rates of pregnancy loss but the relative influence of these factors are varied across societies although it can be observed that in some groups of societies the effects are almost similar. One such factors that has been pointed out to cause substantial variation in societies with less prevalence of contraception is nuptiality (marriage factors). He particularly points out that where contraception is low, age at last birth positively relates to age at first marriage but where there is no apparent control, the relationship is not clear. However, age patterns at first marriage are directly related to age patterns at first birth even in societies where active control of fertility is exercised (Casterline 1980).

The influence of education is hypothesized to act through mainly three paths in addition to attitude of highly educated women towards deliberate fertility control. These are the tendency of educated women to delay entry into marital unions (nuptiality factor), shorter duration of breast feeding, reduced prevalence of infant/child mortality among educated women and lastly their observed behaviour of observing post-partum abstinence less than others. Some of these factors have been found to have positive influence on fertility while others negative.

Differentials due to urban-rural residence centre around the argument that the urban women are more educated, live in environments where there are health facilities with modern contraceptive information and supply in addition to participation in labour force. This however is dependent on the length of stay in the environment for a period of time as these factors manifest their effects after a long period of exposure (United Nations, 1987). However, the rural-urban differential is bound to be small when little control of fertility is exercised in the society. The small differences in fertility behaviour that may arise are probably due to rural-urban differences in marriage patterns, health facilities and other factors that might have non-intentional impact on fertility behaviour but the direction of the influence is not always obvious (United Nations, 1987).

Whereas hypotheses about education - fertility and rural-urban residence effects on fertility have been mentioned. it has been noted that the regional differences in the observed fertility and patterns of its components exist due to other factors that may not be easily measured.

Hypotheses have been suggested that the effect of regional differences may arise due to varying differences in such factors as institutional characteristics, community characteristics in addition to the dominant ethnic or race group that may live in the region. However, there exists the effect of such causes which range from social to economic and historical characteristics which are unique to a specific region or geographical area. This may propound the hypothesis that even if regional inequality in education, occupation, income, urbanization and other socio-economic factors are eliminated, excess fertility would not be eliminated.

The following conceptual hypotheses may then be proposed:-

1) Fertility behaviour in particular, pattern of first birth timing, birth spacing and pattern of completion of childbearing varies across regions.

2) Patterns of first birth timing, family formation process and last birth timing is influenced by level educational attainment of the women population.

3) In a country like Kenya, where active fertility control is less prevalent, the magnitude of urban-rural differences in the first birth timing is likely to be small. Although we expect substantial variations in age at completion of childbearing.

4) Even if control for education, residence, is made, first and last birth timing are likely to vary across the Kenyan women population. This may be due to distribution of the ethnic groups in each of the regions and background historical and cultural characteristics that may have prevailed across the regions.

Despite the hypotheses conjectured, testing such hypotheses is often difficult due to data problems methodological issues regarding the units of analysis and measurement issues. Whatever the causal mechanism involving fertility behaviour indices, our basic purpose originally was an empirical problem of applying certain statistical models in the Kenyan situation. Such problem is within the constraints of adequate source of data. With this view, determinants of childbearing indices do not become our issue and is beyond our scope.

Since the type of data available for our purpose was the census publications of the age-specific fertility rates our methodology was based on existing analytical procedures which would use the type of data available with little loss of information. The only way that would make us determine some of the hypotheses would be the ability to obtain the measures of reproductive behaviour performance across the categories of the sub-population and thus compare the resulting estimates.

To do this our measure for patterns of first birth timing would be the mean age at first birth, while the measure for patterns of completion of childbearing would be the mean age at last birth. Patterns of family formation process would be measured by the average length of time between the intervals.

From such measures we can now test the following hypotheses about patterns of first birth, last birth and level of fertility, with the population categorized by level of education, urban-rural residence and region.

1.3.1 OPERATIONAL HYPOTHESES

The following hypotheses can then be tested:-

1) The mean age at first birth for women with higher education is likely to be higher than for those with lower education.

2) The mean age at last birth for women with secondary education is likely to be lower than for those with primary or no education.

3) The mean age at last birth for women in urban areas is likely to be lower than for those in the rural areas.

4) Regions where total fertility rate is high are also likely to have older mean ages at last birth.

5) Length of reproductive span is likely to be longer in regions with higher total fertility rates.

1.4 SOURCES AND QUALITY OF DATA

The main sources of demographic data are censuses, surveys and vital registration. In this study the main source of data are the 1969 and 1979 censuses.

The data required from the sources was mainly the age specific fertility rates which are obtained and adjusted from use of information on the number of children ever born(e) by the female population classified by five year age-groups and information on children born in the past year prior to the census.

The accuracy of census information has varied from time to time, from region to region and by different classes of population all over the world. However, some generalizations can be made about the inherent types of errors found in them. Two main types can be singled out: error of coverage which can be over-enumeration or under-enumeration and errors of content. These two types of errors are particularly serious in cases where the population is nomadic as in the cases in North Eastern Province and some parts of Rift Valley close to North Eastern Province.

The errors of content includes among others age errors where they can occur due to digital preference or age shifting among certain sections of the population, like older age groups. Age heaping occurs in the form where certain respondents might prefer to report only certain ages ending in some preferred digits like say 0 or 5.

Under-reporting of some of the births is also one of the errors which tend to occur with older mothers where they can fail to report some of their children especially those that might have died long ago.

1.5 SCOPE AND LIMITATION OF THE STUDY

The study aims at estimation of some reproductive behaviour indices of the Kenyan women by regional, level of education and residence differentials by applying Suchindran-Horne (1984) technique and also Sivamurthy (1987) method at national and at district level. The study then aims at estimating the differentials by comparison of the estimated indices and thus will be descriptive.

Suchindran-Horne method has been pointed out to have a weakness especially in estimating mean age at last birth when the age specific fertility rates are likely to be unstable and analysis is only suitable in cases where data is large. Sivamurthy's technique uses the age specific fertility rates as the unconditional probability of a birth even in the absence of suitably estimated conditional probabilities an assumption which could probably limit its use. Although the two methods have applied elsewhere in many African and Asian countries extensive sensitivity analysis and robustness have not been tested in a wide variety of cases. The estimates obtained using these methods again carry the weaknesses of total fertility rates which they are a function of. Since the data is derived from census information, their interpretation are within the limits of the census errors.

1.6 DEFINITION OF CONCEPTS

Biological factors: These refer to age at menarche, menopause, fecundity, conception, gestation and parturition primary, secondary and adolescent sterility etc.

Cultural factors: These are factors related to the way of life people in a society. They include such factors as family norms, marriage norms, initiation rites and institutions.

Demographic factors: These include variables such as age, age at first marriage, age at first birth, duration of marriage, remarriage rates, marital status, mortality rates and children ever born.

Socio-economic factors: These refer to indices of economic status, such as education, occupation, place of residence, income, etc.

Mean age at first birth (MAFB): This is the average age at which a woman will give birth to her first child.

Mean age at last birth (MALB: This is the average age at which a woman who has ever given birth will give birth to her last child.

Mean length of reproductive span (MSPAN): This is the average length of time taken between births of the first child and last child.

Mean inter-birth spacing (MIBS): This is the average length of time taken between any two live births.

Total fertility rate (TFR): This is the average number of children a woman will give birth to during the entire reproductive lifespan according to the prevailing fertility rates without experiencing mortality.

Urban area is a place which has a population of more than 2000 people.

Education: The level of education is measured in terms of years in schooling classified into 3 categories; primary (1 - 8 years), secondary (9 and above years) and those who have never attended as none.

In this thesis, the reproductive behaviour indices: MAFB, MALB, MSPAN and MIBS that are estimated in the next chapters are derived as synthetic measures and are functions of the age specific fertility rates and hence are also functions of total fertility rates.

They then carry the same meaning as that accorded to the total fertility rates for example, MAFB is the average age at which a woman will give birth to her first child if she experiences given schedules of age specific fertility rates.

1.7 OUTLINE OF THE THESIS

Chapter one of the thesis is the introduction. In chapter two has the derivation of methods that have been used in estimating MAEB and MALB and computational procedures that have been applied, that is Suchindran-Horne method and Sivamurthy's method. In chapter three the results of application of Suchindran-Horne and Sivamurthy methods to Kenya's data from the 1969 and 1979 censuses at both national and regional (district) level is presented. Chapter four is on summary, conclusion and recommendations.

CHAPTER TWO

DERIVATION OF SUCHINDRAN-HORNE AND SIVAMURTHY METHODS FOR ESTIMATING MEAN AGES AT FIRST AND LAST BIRTHS

Suchidran-Horne Technique of Estimating Mean Age at First, Last Birth

Introduction

During the past years, indirect techniques have taken greater role in estimating vital events in developing countries. This has been necessary since, most developing countries have scant data or if there are, have large errors which cause greater inaccuracies in the estimation. Most of these techniques of estimation are either to limit the extent of errors or to use mathematical formulation with which to approximate these events.

In this section, we present Suchidran-Horne (1984) method which is one of the techniques to estimate indices of reproductive behaviour indices for women following an indirect procedure.

The type of input data required for estimation purposes are the schedules of age specific fertility rates which can be readily obtained from censuses, or surveys or vital registration. The main assumption here is that fecundity does not vary much with women and age.

The derivation of mathematical formulation and estimation procedure is presented next.

2.1 ESTIMATION OF MEAN AGE AT FIRST BIRTH (MAFB)

2.1.1 Derivation of Synthetic Mean Age at First Birth

Let m(x) dx denote the probability that a woman of age x will have a birth in the age interval (x, x + dx). Further let A and B be the lowest and the highest ages at which reproduction can take place and assuming that m(x) is a continuous function.

We have $m(x) = 0$ for $x \leq A$ and $x \geq B$.

We define the expected number of children that a new born girl will ever have if mortality is assumed absent as the total fertility rate (TFR) given by

$$TFR = \int_0^w m(x)\,dx \quad \text{where } w \text{ is the last age at which life is possible.}$$

$$= \int_A^B m(x)\,dx \; ..... \; (2.1.1.a).$$

We then have the probability that a woman will not give birth before a given age x given by

$$X(x) = \exp\left[-\int_0^x m(t)\,dt \right] .... \; (2.1.1b).$$

Thus, the probability that a new born girl will not give birth before age x and then immediately give birth in the age interval (x, x + dx) is given by

$$g_i(x) = \begin{cases} m(t) \exp\left[-\int_0^x m(t)dt\right] \; ...... \; (2.1.1c) \\ 0 \text{ elsewhere.} \end{cases}$$

We can now compute the probability S_i of a new born girl ever becoming a mother by integrating equation (2.1.1c) over the entire reproductive span.

Thus, $S_i = \int_A^B m(x).\ \exp\left[-\int_A^x m(t)\,dt\right] dx$ .... (2.1.1d)

But $\frac{d}{dx} \exp\left[-\int_A^x m(t)dt\right] = \left\{ \frac{d}{dx}\left[-\int_A^x m(t)\right] \exp -\int_0^x m(t)dt \right\}.$

Here we are treating m(x) as the force of fertility, and assuming that the interchange between the integral and derivative function are possible.

$$\frac{d}{dx} \exp\left[-\int_A^x m(t)dt\right] = -[m(x) - m(A)] \exp\left[-\int_A^x m(t)dt\right] \quad \text{since } m(A)=0$$

$$= -\ m(x) \exp\left[-\int_A^x m(t)\ dt\right]$$

Therefore $S_i = \int_A^B - \frac{d}{dx} \exp\left(-\int_A^x m(t)\ dt\right) dx$

$$= -\left[\exp\left(-\int_A^B m(t)\ dt\right) - \exp -\int_A^A m(t)\ dt\right.$$

$$= -[\exp(-TFR) - \exp 0]$$

$$= 1 - \exp(-TFR) \ \ldots\ldots. \ (2.1.1e).$$

The mean maternal age at first birth (MAFB) is then given by

$$MAFB = \frac{\int_A^B x.\ g_i(x)\ dx}{\int_A^B g_i\ (x)\ dx}$$

$$= \frac{\int_A^B x\ g_i(x)\ dx}{1 - \exp\ (-TFR)}$$

$$\frac{\int_A^B x\, g_i(x)\, dx}{S_i} \quad \ldots . \; (2.1.1f)$$

To simplify the numerator of equation (2.1.1f) we proceed as follows

$$\int_A^B x\, g_i(x)\, dx = \int_A^B x.\, m(x).\, \exp\left[-\int_o^x m(t)\, dt\right] dx$$

Using integration by parts

we let $u = x$ $\quad dv = m(x).\, \exp\left[-\int_o^x m(t)\, dt\right] dx$

$$= \underline{d} \exp\left[-\int_o^x m(t)\, dt\right] dx$$

which implies $du = dx$ and $v = \exp\left[-\int_o^x m(t)\, dt\right] dx$

Therefore

$$\int_A^B x\, g_i(x)\, dx = \left[-x.\, \exp - \int_o^x mt\, dt\right]_A^B + \int_A^B \exp\left(-\int_o^x m(t)\, dt\right) dx$$

$$= \left(-B \exp\left(-\int_o^B m(t)\, dt\right) + A \exp\left(-\int_o^A m(t)\, dt\right) + \int_A^B \exp\left(-\int_o^x (m(t)\, dt\right) dx\right.$$

$$= -B \exp\left(-\int_A^B m(t) dt\right) + A \exp\left(-\int_A^A m(t) dt\right) + \int_A^B \exp\left(-\int_A^x m(t)\, dt\right) dx$$

$$= A \exp 0 - B \exp(-TFR) + \int_A^B \exp\left(-\int_A^x m(t)\, dt\right) dx$$

If we assume child bearing begins after age 15 and ends before age 50,

then $A = 15$ and $B = 50$

$$\int_{15}^{50} x\, g_i(x) = 15 - 50 \exp(-TFR) + \int_{15}^{50} \exp\left(-\int_{15}^x m(t)\, dt\right) dx.$$

$$MAFB = \frac{15 - 50\exp(-TFR) + \int_{15}^{50} \exp\left(-\int_{15}^{x} m(t)\,dt\right) dx}{1 - \exp(-TFR)} \quad (2.1.1g)$$

In equation (2.1.1g) we have the expression $\int_{15}^{x} m(t)\,dt$ appearing in the numerator. This expression is similar to that for the definition of Total Fertility Rate (TFR) we had earlier said; it represents, the cumulative fertility from age 15 up to age x and from now on denoted as TFR(x) in this chapter.

Also in equation (2.1.1g) we need to evaluate the expression $\int_{15}^{50} \exp\left(-\int_{15}^{x} m(t)\,dt\right) dx$. We can only do this through use of approximation.

We have

$$\int_{15}^{50} \exp\left(-\int_{15}^{x} m(t)dt\right)dx = \int_{15}^{20} \exp\left(-\int_{15}^{x} m(t)dt\right)dx + \int_{20}^{25} \exp\left(-\int_{15}^{x} m(t)dt\right)dx + \ldots$$

$$+ \int_{45}^{50} \exp\left(-\int_{15}^{x} m(t)\,dt\right) dx.$$

$$\simeq 5\exp\left(-\int_{15}^{17.5} m(t)dt\right) + 5\exp\left(-\int_{15}^{22.5} m(t)dt\right) + 5\exp\left(-\int_{15}^{27.5} m(t)\,dt\right)$$

$$+ \quad 5\exp\left(-\int_{15}^{32.5} m(t)dt\right) + 5\exp\left(\int_{15}^{37.5} m(t)dt\right) +$$

$$5\exp\left(-\int_{15}^{42.5} m(t)dt\right) + 5\exp\left(-\int_{15}^{47.5} m(t)\,dt\right).$$

$$= 5[\exp(-TFR(17.5)+\exp(-TFR(22.5)+(\exp-TFR27.5) + \ldots$$
$$+ \exp(-TFR\ 47.5)].$$

Let m_i be the i^{th} age specific fertility rates which are assumed constant within the i^{th} group then we have

$TFR(17.5) = 0 + 2.5m_1$

$TFR(22.5) = 5m_1 + 2.5m_2$

$TFR(47.5) = 5(m_1 + m_2 + m_3 + m_4 + m_5 + m_6) + 2.5m_7$

Therefore we can estimate the value of the integral

$\int_{15}^{50} \exp(-\int_{15}^{x} m(t)\, dt)dx$ that is,

$$\int_{15}^{50} \exp(-\int_{15}^{x} m(t)\, dt)dx = 5 \left[\sum_{i=1}^{7} \exp(- TFR\ x_i) \right]$$

Where x_i refers to the mid-age interval in the i^{th} age group.

$$MAFB \simeq \frac{15 - 50 \exp(- TFR) + 5 \sum_{i=1}^{7} \exp[- TFR(x_i)]}{1 - \exp(- TFR).} \quad (2.1.1h)$$

The variance of the mean age at first (VAFB) is then given by

$$VAFB = \frac{\int_A^B x^2 g_i(x)}{\int_A^B g_i(x)} - (MAFB)^2$$

$$= \frac{\int_A^B x^2 m(x) \exp(-\int_o^x m(t)\, dt)\, dx}{\int_A^B m(x) \exp(-\int_o^x m(t)\, dt)\, dx} - (MAFB)^2 \quad (2.1.1i)$$

In equation 2.1.1i)(MAFB) and $\exp\int_A^B m(x) \exp(-\int_o^x m(t)dt)\, dx$ have already been evaluated.

We now only need to evaluate $\int_A^B x^2 m(x) \exp(-\int_o^x m(t)\, dt)dx$

Therefore

$$\int_A^B x^2\, m(x) \exp\left(-\int_o^x m(t)dt\right) dx = \int_A^B x^2 - \frac{d}{dx} \exp\left(-\int_o^x m(t)\, dt\right)dx$$

Using integration by parts as before on the R.H.S of the equation

We let $u = x^2$ which implies $\frac{du}{dx} = 2x;$

$$\frac{dv}{dx} = \frac{d}{dx} \exp\left(- \int_o^x m(t)\, dt\right) \qquad \text{which implies}$$

$$v = - \exp\left(-\int_o^x m(t)\, dt\right)$$

Then

$$\int_A^B x^2 m(x)\exp\left(\int_o^x m(t)dt\right) = \left[-x^2\exp-\int_o^x m(t)dt\right]_A^B - \int_A^B -2x\exp\left(-\int_o^x m(t)dt\right)dx$$

$$= \left[-B^2 \left(\exp\int_o^B mt\, dt\right) + A^2\exp\left(-\int_o^A m(t)dt\right) + 2\int_A^B x \exp\left(-\int_o^x mtdt\right)dx\right.$$

$$= A^2\exp\left(-\int_A^A m(t)dt\right) - B^2\exp\left(-\int_A^B mtdt\right) + 2\int_A^B x \exp\left(-\int_A^x m(t)dt\right) dx$$

$$= A^2 - B^2\exp(-TFR) + 2\int_A^B \exp\left(-\int_A^x m(t)dt\right) dx$$

$$\int_{15}^{50} x^2 m(x)\exp\left(-\int_o^x mtdt\right)dx = 15^2-50^2\exp(TFR)+ \int_{15}^{50} x \exp\left(-\int_{15}^x mtdt\right) dx$$

Hence

$$VAFB = \frac{15^2-50^2\exp(-TFR) + 2\int_{15}^{50} x \exp\left(-\int_{15}^x m(t)dt\right)dx}{1 - \exp(-TFR)} - (MAFB)^2 \qquad \ldots\ldots(2.1.1j)$$

Now

$$\int_{15}^{50} x \exp\left(-\int_{15}^{x} m(t)dt\right)dx = \int_{15}^{20} x \exp\left(-\int_{15}^{x} mtdt\right)dx + \int_{/20}^{25} x \exp\left(-\int_{/15}^{x} m(t)dt\right)dx$$

$$+ \ldots\ldots + \int_{45}^{50} x \exp\left(-\int_{15}^{x} mtdt\right)dx$$

$$\simeq 5[17.5 \exp(-TFR\ 17.5) + 22.5 \exp(-TFR\ 22.5)$$

$$+ \ldots\ldots + 47.5 \exp(-\ TFR\ 47.5)]$$

$$= \quad 5 \sum_{i=1}^{7} x_i \exp[-TFR(x_i)]$$

Therefore

$$VAFB = \frac{15^2 - 50^2 \exp(-TFR) + 2.5 \sum_{i=1}^{7} x_i \exp(-TFR(x_i)]}{1 \ - \ \exp(-TFR)} - (MAFB)^2 \qquad \ldots\ldots\ldots(2.1.1k)$$

2.1.2 COMPUTATIONAL PROCEDURE FOR ESTIMATING MAFB AND VAFB

In order to estimate the mean maternal age at first birth and its variance we need the schedules of the age specific fertility rates.

In this section we use the age specific fertility rates from the 1969 census data (table 2.1.1a).

Step 1: The age specific fertility rates (ASFR) are always tabulated in 5-year age groups from age 15 - 19 to 45 - 49.

The TFR is obtained by summing up the values for ASFR and then multiplying by five. The ASFR are given in column four of table 2.1.1a. The sum of the ASFR schedules multiplied by 5 is given as 8.026705 $\simeq$ 8.03.

$$TFR = 5 \times \sum_{i=1}^{7} (ASFR)$$

$$= 5 \times 1.605341$$

$$\simeq 8.03$$

<u>Step 2</u>: <u>Estimation of Cumulative fertility up to age x_i, TFR(x_i)</u>

To obtain the estimates of TFR(x_i) we cumulate ASFR in each of the age group below the age group in which x_i belongs and multiply the cumulative value by 5 - we then add this value to 2.5 times the ASFR in the age group in which x_i belongs where x_i is mid-point of the age group x.

For example in the age group 5 that is i = 5, the cumulative ASFR up to age group 4 is given by 0.160949 + 0.355570 + 0.350587 + 0.302318 = 1.16924. Multiply 1.16924 by 5 gives 5.84712. Add this value to 2.5 multiplied by ASFR in age group 5 gives 5.84712 + 2.5 x 0.237047 = 6.4397375.

The rest of other values are given in column 5 of table 2.1.1a.

<u>Step 3</u>: In this step we obtain the negative exponent of each of values obtained in step 2 above. These values are given in column (6) of table 2.1.1 and then we obtain the sum and multiply by 5. The value obtained is 4.463965.

Step 4: In this last step we obtain the estimated mean age at first birth by substituting the following in the equation below which was obtained in the previous section.

$$MAFB = \frac{15 + 5 \sum_{i=1}^{7} \exp(-TFR\ xi) - 50 \exp(-TFR)}{1 - \exp(-TFR)}$$

$5 \times \sum_{i=1}^{7} \exp - TFR(Xi)$ which was obtained in step 3 = 4.463965.

The TFR which was obtained in step 1 = 8.026705.

$$MAFB \simeq \frac{15 + 4.463965 - 50 \exp(-8.026705)}{1 - \exp(-8.026705}$$

$$= \frac{15 + 4.463965 - 0.0163311}{1 - 0.0003266}$$

$$= \frac{19.463965 - 0.0163311}{0.9996734}$$

$$= 19.4539876$$

$$\simeq 19.45$$

Step 6: In order to obtain the variance and hence standard deviation, we multiply each of the values of x_i in column (3) by the corresponding value in column (6) table 2.1.1a. The rest of the values are shown in column 7. From the values obtained, we get the sum and multiply by 10.

This is given as 170.0708.

Step 7: We then substitute the values obtained as follows in the formula below.

$$\exp(-TFR) = 0.0003266$$

$$50^2 \exp(TFR) = 0.8165$$

$$1 - \exp(TFR) = 1 - 0.0003266$$

$$= 0.9996734$$

$$(MAFB)^2 = 378.4576335$$

$$10 \sum_{i=1}^{7} xi \ \exp(TFR \{xi\}) = 170.0708.$$

$$VAFB = \frac{15^2 - 50^2 \exp(TFR) - 10 \sum_{i=1}^{7} xi \exp(TFR \{xi\})}{1 - \exp(TFR)} - (MAFB)^2$$

$$= \frac{225 - 2500 \times 0.0003266 + 170.0708}{0.9996734} - 378.4576335$$

$$= 15.92547$$

Standard deviation = 3.99.

Table 2.1.1a: <u>ILLUSTRATION TABLE FOR ESTIMATION OF MAFB AND VAFB</u>

AGE GROUP	(i)	$_iX$	ASFR	TFR(xi)	exp(-TFR(xi))	x exp(-TFR(xi))
(1)	(2)	(3)	(4)	(5)	(6)=exp(-15)	(7)=(3)x(6)
15-19	1	17.5	0.160949	0.402372	0.668731	11.70280
20-24	2	22.5	0.355570	1.693670	0.183843	4.136480
25-29	3	27.5	0.350587	3.459062	0.031459	0.865129
30-34	4	32.5	0.302318	5.091325	0.006149	0.199870
35-39	5	37.5	0.237047	6.439737	0.001596	0.059880
40-44	6	42.5	0.135472	7.371035	0.000629	0.026741
45-49	7	47.5	0.063398	7.86821	0.000382	0.018179
			5xSum = 8.026705		5xSum=4.463965	10xSum=170.0708

Note: Some of the values are truncated and are not exactly as they are to appear.

2.2 ESTIMATION OF MEAN MATERNAL AGE AT LAST BIRTH (MALB)

2.2.1 Derivation of Synthetic Mean Age at Last Birth

Let as before m(x) dx denote the probability that a woman of age x will give birth in the age interval (x, x + dx). With assumptions taken as in section 2.1.1 we have

$T(x) = \exp(-\int_x^B m(t)\, dt$ as the probability that a woman aged x will not give birth after age x.

Thus the probability that a woman will have her last birth at age x is given by

$$g_I(x)=m(x).\ T(x) = \begin{cases} m(x).\exp(-\int_x^B m(t)dt) & A\leq x \leq B \\ 0 \text{ elsewhere} \end{cases} \quad \ldots\ (2.2.1a)$$

Then the mean maternal age at last birth is given by

$$\text{MAFB} = \frac{\int_A^B x.\ m(x).\ \exp(-\int_x^B m(t)\ dt)\ dx}{\int_A^B m(x)\ \exp\ (-\int_x^B m(t)\ dt)\ dx} \quad \ldots\ldots.\ (2.2.1b)$$

To evaluate the denominator of expression (2.2.1b)

We have

$$\int_A^B m(x)\ \exp\ (-\int_x^B m(t)\ dt)\ dx = \int_A^B \frac{d}{dx}\ (\exp - \int_x^B m(t)dt)dx$$

Since $\frac{d}{dx} \exp\left(-\int_x^B m(t)dx\right) = \left[\exp\left(-\int_x^B m(t)dt\right)\right]_A^B \frac{d}{dx}\left(-\int_x^B m(t)\,dt\right)$

$$= [-m(t)]_x^B.\quad \exp\left(-\int_x^B m(t)dt\right)$$

$$= (-m(B) + m(x))\quad \exp\left(-\int_x^B m(t)\,dt\right)$$

$$= m(x)\exp\left(-\int_x^B m(t)\,dt\right).$$

Thus $\int_A^B m(x)\exp\left(-\int_x^B m(t)dt\right)8x = \left[\exp\left(\int_x^B m(t)\,dt\right)\right]_A^B$

$$= \exp\left(-\int_B^B m(t)\right) - \exp\left(-\int_A^B mtdt\right)$$

$$= 1 - \exp(-TFR) \quad ...(2.2.1c)$$

$$= S_1$$

We numerator of the expression (2.2.1b) that is

$$\int_A^B x\, m(x)\exp\left(-\int_x^B mtdt\right) = \int_A^B x \frac{d}{dx}\exp\left(-\int_x^B m(t)dt\right)dx$$

using integration by parts on R.H.S

We let $u = x$, $dv = \frac{d}{dx}\exp\left(-\int_x^B m(t)dt\right)dx$

Which implies

$$du = dx \qquad v = \exp\left(-\int_x^B m(t)\,dt\right)$$

$$\int_A^B x\, m(x)\exp\left(-\int_x^B m(t)dt\right) = \left[x\exp -\int_x^B m(t)dt\right]_A^B - \int_A^B \exp\left(-\int_x^B m(t)dt\right)dx$$

$$= B\exp\left(\int_B^B m(t)dt\right) - A\exp\left(-\int_A^B mt\,dt\right) - \int_A^B \exp\left(\int_x^B m(t)dt\right)dx$$

$$= B - A\exp(-TFR) - \int_A^B \exp\left(-\int_x^B m(t)dt\right)dx.$$

but we have that TFR

$$\int_A^B m(t)\,dt = \int_A^x m(t)\,dt + \int_x^B m(t)\,dt.$$

Therefore $\int_x^B m(t)dt = \int_A^B m(t)\,dt - \int_A^x m(t)\,dt$

$= TFR - TFR(x).$

$\therefore \int_A^B x.m(x)\exp(-\int_x^B m(t)dt) = B-A\exp(TFR) - \int_A^B \exp(-TFR-TFR(x))dx.$

Letting A = 15, and B = 50

$$MALB = \frac{50 - 15\exp(-TFR) - \int_{15}^{50} \exp[-(TFR - TFR(x))]\,dx}{1 - \exp(-TFR)} \quad \ldots\ldots (2.2.1d)$$

But

$$\int_{15}^{50} \exp[-(TFR - TFR(x))]dx$$

$$= \int_{15}^{20} \exp[-(TFR - TFR(x)] + \int_{20}^{25} \exp[-(TFR - TFR(x)]$$

$$+ \ldots + \int_{45}^{50} \exp[-(TFR - TFR(x))].$$

$$\simeq 5\exp-(TFR - TFR(17.5)) + 5\exp-(TFR - TFR(22.5))$$
$$+ 5\exp-(TFR - TFR(27.5)) + 5\exp-(TFR - TFR(32.5))$$
$$+ 5\exp-(TFR - TFR(37.5)) + 5\exp-(TFR - TFR(42.5))$$
$$+ 5\exp-(TFR - TFR(47.5)).$$

$$= 5[\sum_{i=1}^{7} \exp-(TFR - TFR(xi)]$$

where xi refers to midpoint of the i^{th} age group.

$$MALB \simeq \frac{50 - 15\exp(-TFR) - 5\sum_{i=1}^{7} \exp-(TFR - TFR(x))}{1 - \exp(-TFR)} \quad \ldots .(2.2.1e)$$

To obtain the variance of mean age at last birth (VALB we note that

$$VALB = \frac{\int_A^B x^2 g_i(x)}{\int_A^B g_i(x)} - (MALB)^2$$

$$= \frac{\int_A^B x^2 m(x).\ \exp\left(-\int_x^B m(t)\,dt\right)dx}{\int_A^B m(x)\ \exp\left(-\int_x^B m(t)\,dt\right)dx} - (MALB)^2 \quad (2.2.1f)$$

Other expressions in (2.2.1f) have been evaluated except

$$\int_A^B x^2\ m(x)\ \exp\left(-\int_x^B m(t)\ dt\right) dx$$

Thus $\int_A^B x^2\ m(x)\ \exp\left(-\int_x^B m(t)dt\right)dx = \int_A^B x^2\ \frac{d}{dx}\ \exp\left(\int_x^B m(t)dt\right.$

Using integration by parts,

Let $u = x^2$ which implies $du = 2\ x\ dx$

and $dv = \underline{d}\ \exp\left(-\int_x^B m(t)dt\right)$ which implies $v=\exp\left(-\int_x^B m(t)dx\right)$

Then

$$\int_A^B x^2 m(x)\exp\left(-\int_x^B m(t)dt\right)dx) = \left[x^2 \exp-\int_x^B m(t)dt\right]_A^B - \int_A^B \exp\left(\int_x^B m(t)dt\right)dx$$

$$= B^2\ \exp\left(-\int_B^B m(t)dt\right) - A^2\ \exp\left(-\int_A^B m(t)dt\right) - \int_A^B 2x\ \exp\left(-\int_x^B m(t)dt\right)dx$$

$$= B^2 - A^2\ \exp(\ -TFR) - 2\int_A^B x\ \exp\left(-\int_x^B m(t)\ dt\right)\ dx$$

Letting A = 15 and B = 50

$$\int_{15}^{50} x^2 m(x)\exp\left(-\int_x^B m(t)dt\right) = 50^2 - 15^2\exp(-TFR) - 2\int_{15}^{50} x\ \exp\left(-\int_x^{50} m(t)dt\right)dx$$

Now

$$\int_{15}^{50} x\ \exp\left(-\int_x^{50} m(t)dt\right) = \int_{15}^{20} x\ \exp\left(-\int_x^{50} m(t)dt\right)dx\ +$$

$$\int_{20}^{25} x\ \exp\left(\int_x^{50} m(t)dt\right)dx + \ldots\ldots + \int_{45}^{50} x\ \exp\left(-\int_x^{50} mtdt\right)dx$$

$$\simeq 5[17.5\ \exp -(TFR-TFR(17.5) + 22.5\ \exp - (TFR - TFR(22.5)$$

$$+ \ldots\ldots\ldots + 47.5\ [\exp -(TFR - TFR(47.5))].$$

$$= \ 5\sum_{i=1}^{7} xi\ \exp\ [-\ (TFR - TFR(xi)]$$

Therefore

$$VAFB = \frac{50^2 - 15^2\exp(-TFR) - 2.5\ \sum_{i=1}^{7} xi\ \exp\ [-(TFR-TFR(xi)]}{1 - \exp(-TFR)} - (MALB)^2$$

2.2.2 COMPUTATIONAL PROCEDURE FOR ESTIMATING MALB AND VALB

Given that most of the values to be used have been already estimated as in section 2.1.2 we only illustrate the procedure left.

Step 1: Estimating the Cumulative fertility from age x onwards, TFR - TFR(xi)

Since the cumulative fertility up to age x (TFR(x)) had been found in step 2 of section 2.1.2 and similarly the TFR had been found in step 1 of the same section, what we need to obtain is the difference between TFR and TFR(xi) which is given in column (4) of table (2.1.1b).

Step 2: In this step is to obtain the negative exponent of values obtained in section 1 above summing them up and multiplying by 5.

This is given from the table as 8.214121.

Step 3: Estimation of MALB)

In this step is to substitute already obtained values in the formula

$$MALB = \frac{50 - 15\exp(-TFR) - 5\sum_{i=1}^{7} \exp(-TFR - TFR(xi))}{1 - \exp(-TFR)}$$

$$= \frac{50 - 15 x(0.0003266) - 8.214121}{1 - 0.0003266}$$

$$= \frac{50 - 0.004899 - 8.214121}{0.9996734} = 41.79463$$

$$\simeq 41.79$$

Step 4: Estimating VALB

To estimate the variance, we multiply columns (3) and (5) of table 2.1.1b to obtain column (6).

Then

$$VALB = \frac{50^2 - 15^2 \exp(-TFR) - 2x \text{ Sum(Column 6)} - (MALB)^2}{1 - \exp(-TFR)}$$

$$= \frac{2500 - 1225 \exp(-TFR) - 10 \text{ Sum (Column6)} - (MALB)^2}{1 - \exp(-TFR)}$$

$$= \frac{2500 - 1225 \times 0.0003266 - 723.2986}{0.9996734} - (41.79463)^2$$

$$= \frac{2500 - 0.073485 - 72366 - 723.2986}{0.9996734} - (41.79463)^2$$

$= 30.4172544$

Standard deviation = 5.51518

$\simeq 5.52$

Table 2.1.1b: TABLE ILLUSTRATION FOR ESTIMATION OF MALB AND VAFB

AGE GROUP	(i)	X_i	TFR-TFR(xi)	exp-[TFR-TFR(xi)]	xi exp-[TFR-TFR(xi)]
(1)	(2)	(3)	(4)	(5)	(6) = (3) x (5)
15-19	1	17.5	7.624332	0.000438	0.008547
20-24	2	22.5	6.333035	0.001776	0.039974
25-29	3	27.5	4.567642	0.010382	0.285516
30-34	4	32.5	2.935388	0.053110	1.726092
35-39	5	37.5	1.586967	0.204544	7.670435
40-44	6	42.5	0.655670	0.519094	22.06156
45-49	7	47.5	0.158495	0.853427	40.53779
				5xsum = 8.214121	10xSum=723.2986

Note: The values were generated by computer and as such some of the decimals are truncated and are not as exact.

2.2.3 LENGTH OF REPRODUCTIVE SPAN AND MEAN INTER-BIRTH SPACING

After considering the mean age at first and last birth we can then estimate the length of time taken for reproduction, here in this thesis referred to as Mean reproductive span (MRSPAN). This is then the "hypothetical" measure of the average length of time taken by a woman to complete her child bearing and is thus spanned by mean age at first and last birth. The difference between the mean age at last and first birth is used as a measure of the mean reproductive span. The mean inter-birth spacing would then measure the average "speed" at which reproduction would take place. Given the average number of children a woman would have and the average length of time she would take to complete her child bearing then the mean inter birth spacing is obtained by dividing the length of reproductive span by the average number of children. It is estimated as follows:

MRSPAN = MALB - MAFB and

$$\text{MIBS (Mean inter-birth spacing)} = \frac{\text{MBPAN}}{\text{TFR}}$$

We note that since these measures are obtained from the age specific fertility rates for the current period, they are hypothetical in the sense that they only apply if a new cohort experiences these set of schedules throughout her life time.

As an example using the already derived data for 1969, the TFR was 8.03 births, MRSPAN is now 41.79 - 19.45 which equals 22.34 years and mean inter birth spacing becomes 2.78 years.

It should be noted here that strictly speaking the reproductive span can only be defined for women who have at least two children. Thus the conclusions that can be made are done here with this kind of bias.

2.3 SIVAMURTHY'S LIFE TABLE TECHNIQUE

INTRODUCTION

If detailed age specific fertility schedules are available there is often a possibility of obtaining a better understanding of the fertility behaviour in a population and examination of its changes over time. The age specific fertility rates by single years possess a distinct advantage in measurement of fertility performance in that the variable age is not affected by any aggregate or individual behaviour. What happens during one year of reproductive life in two or three sets of countries or in two time periods in terms of fertility performance could be quite different and would be reflected by comparative value of the respective schedules of specific fertility rates.

In any given situation, a woman has approximately 9 months period of gestation required for a human live birth and period of ammenorrhea following live birth may be at least between 2 to 4 months then the probability of occurrence of more than one live birth in the same year of age can be assumed to be negligible that is assumption regarding the possibility of occurrence of multiple births. Thus any changes in spacing or in terms of limiting the number of children born, will be reflected by changes in the single year of age specific fertility rates.

The fertility performance follows a sequential process such that a woman can have parity two after having parity one and parity 3 after parity 2 and so on. This then makes it possible to estimate chance of proceeding from one state to another using a set of age specific fertility rates within some assumptions. Essentially, the age specific fertility rates at age x can be regarded as the unconditional chance that a woman of age x will give birth before attaining x + 1 in completed years.

Analysis of age specific fertility rates have been done and presented by Sivamurthy (1987, 1988) using data drawn from Demographic Year Books for several countries by using the single year age specific fertility rates and then extending the notion to when data is given in five - year age groups.

An assumption regarding this idea is that the age specific fertility rates of a particular year or time period remain constant and can be applicable to a hypothetical cohort of women passing through reproductive ages. The methodology used to construct gross nuptiality tables can be applied using schedules of single year age specific fertility rates.

The occurrence of a first or last birth to a given woman are events which occur once in a life time like death hence the use of life table approach.

In many developing countries, and Africa in particular age specific fertility rates are not available for single years since most of the data set are derived from either surveys or censuses. In addition, they may also be affected by reporting errors. In view of this, use of five year age groups in the analysis is more suitable and hence use the abridged life table format from schedules of age specific fertility rates.

The format of presentation is then given in the next section.

2.3.1 STEPS IN CONSTRUCTION OF THE LIFE TABLE

Let f(x) represent the ASFR for the age group (x, x + 1) and x = a and x = b be the starting and ending age of reproduction. Thus no child bearing is assumed before age a and after age b.

Since no child bearing will have began before age a, we start by a radix Cl(a) to represent a cohort of childless persons at age x who have not experienced any child bearing. In this analysis, Cl(a)is taken as 10,000

The other columns are computed as below.

Cl(x + 1) = the number of persons in the cohort who have no birth by age (x + 1).

$$CI(x+1) = Cl(x) .(1 - f(x) \quad .... \quad 2.3.1$$

NFB(x) = the number of first births in the age interval

(x, x + 1)

$$NFB(x) = Cl(x) - Cl(x + 1) \quad .... \quad 2.3.2$$

NLB = the number of last births in the age interval (x, x + 1)

$$NLB(x) = Cl(x).\ [f(x)].\ [1- f(x + 1]\ [1 - f(x + 2]\ ...$$

$$(1 - f(b) \qquad ..... \quad 2.3.3)$$

ECl(x) = Expectation of reproductive life time with no child bearing from age x onwards.

$$ECL(x) = \sum_{i = x}^{b} \frac{[Cl(i) + Cl(i + 1]}{2} \Big/ Cl(x) \quad .... \quad (2.3.4)$$

e(xm) = Expectation of reproductive life time to be spent in motherhood from age x onwards.

$e(xm)$ = Total reproductive life time remaining at age x minus $[ECl(x)]$

$$e(xm) = (b - x) - ECl(x) \quad \ldots\ldots\ldots (2.3.5)$$

Mortality is assumed not affecting.

These indices would be the main columns of the life table from which the following indices below can be derived.

(a) Expected ultimate proportion not reproducing $(PNR) = CL(b)/ Cl(a)$

(b) Total fertility rate (TFR) $= \sum_{a}^{b} f(x)$

(c) Expectation of reproductive life time to be spent in motherhood at age a $= e(am)$

(d) Expected proportion of reproductive life to be spent in motherhood at age a = $Pe(am) = \dfrac{e(am)}{b-a}$

(e) Mean (or Median) age at first birth, $(MAFB) = \dfrac{\sum (x+0.5)NFB(x)}{NFB(x)}$

(f) Mean (or Median) age at last birth $(MALB) = \dfrac{\sum (x+0.5)NFB(x)}{NFB(x)}$

(g) Mean age of the fertility schedule $(MACB) = \dfrac{\sum (x+0.5)f(x)}{f(x)}$

2.3.2 EXTENSION TO FIVE YEAR AGE GROUP (ASFR)

When the ASFR are available by five year age groups we can then obtain an abridged life table instead of the above.

The main issue is to estimate the probability of not having a birth during a given five year age interval.

We then assume that the age specific fertility rate for a given five year age group denoted as GASFR(i) is the same for all the five single years of ages included in that age group. Then the probability that a woman will not have a birth in that five year age interval denoted as GF(i) can be estimated as:

$$GF(i) = \{1 - GASFR(i)\}^5 \text{ for } i = 1, 2, \ldots 7$$

Once GF(i) is obtained other life table functions can be obtained as in section 2.3.1 with Cl(a) = 10,000

$$Cl(x + 5) = Cl(x).\ GF(i) \quad \ldots\ldots (2.3.6)$$

where GF(i) refers to age group (x, x + 5)

$$NFB(x) = Cl(x) - Cl(x + 5) \quad \ldots\ldots\ldots (2.3.7)$$

$$NLB(x) = Cl(a)\ [1 - GF(i)].\ GF(i + 1) \ldots GF(7) \ldots (2.3.8)$$

$$ECl(x) = \int_x^{x+5} Cl(t)dt$$

assuming that Cl(t) is a function of the form $e^{a + bt}$ where a and b are constants.

$$\int_x^{x+5} Cl(t)dt = \int_x^{x+5} e^{a+bt} = \frac{1}{b}[e^{a+b(x+5)} - e^{a+bx}]$$

$$\text{from } e^{a+bt} = Cl(t)$$

$$a + bt = \log_e Cl(t) \quad \text{assume further that}$$

$$a = 0 \text{ and } b < 0 \text{ then,}$$

$$b = \frac{1}{t}\log_e Cl(t)$$

$$\text{Therefore } \int_x^{x+5} Cl(t)dt = \frac{t}{\log_e Cl(t)} [Cl(x)-Cl(x+5)] \text{ since } b < 0$$

$$t = x + 5 - x = 5$$

$$\int_x^{x+5} Cl(t)dt = \frac{5}{\log_e Cl(x) - \log_e Cl(x+5)} [Cl(x) - Cl(x + 5)]$$

$$= \frac{5 \{Cl(x) - cl(x+5\}}{\log_e Cl(x) - \log_e Cl(x+5)}$$

$$\text{Therefore } ECl(x) = \sum_{i=x}^{b} \left\{ \frac{5[Cl(i) - Cl(i+5)}{\log_e Cl(i) - \log_e Cl(i+5)} \right\} / Cl(x) \quad .. (2.3.9)$$

$$e(xm) = (50 - x) - ECl(x) \quad .... (2.3.10)$$

We can also alternatively interpolate the GASFR(i) to obtain single years ASFR. Use of interpolated values are presented on table 2.3.1b

If GASFR(i) ..., GASFR(7) to be the fertility rates for the age groups (15 - 19), ..., (45 - 49) then we can obtain by interpolation single year ASFR for ages 15, 16, 17, .., 48, 49 by assuming that

$$ASFR(17) = GASFR(1),\ ASFR(22) = GASFR(2)\ \ldots\ GASFR(47) = GASFR(7)$$

$$ASFR(15) = \frac{0.5}{2.5}\ GASFR(1) \quad \ldots\ldots. (2.3.11)$$

$$ASFR(16) = \frac{1.5}{2.5}\ GASFR \quad \ldots\ldots. (2.3.12)$$

$$ASFR(x) = k\ GASFR(i) + (i-k)\ GASFR(i+1) \quad \ldots (2.3.13)$$

$$i = 1, 2, 3, \ldots.. 6$$

$$x = ([5\ (i-1) + j+2] + 14$$

$$k = \frac{(5 - j + 1}{5} \quad \text{for } j = 1, 2, \ldots. 5.$$

$$ASFR(48) = \frac{1.5}{2.5}\ GASFR(7) \quad \ldots\ldots. (2.3.14)$$

$$ASFR(49) = \frac{0.5}{2.5}\ GASFR(7) \quad \ldots\ldots. (2.3.15).$$

2.3.3 COMPUTATIONAL PROCEDURE

This is illustrated with values given in table 2.3.1a.

DATA REQUIRED

Age specific fertility rates classified by five-year age groups. These will be denoted as GASFR(i) for a given five-year age group i and will be assumed to be the same for all the single years of ages included in that age group. The data used in the illustration of the computational procedure is from 1969 Kenya National Census data. The ASFR have been adjusted using Coal - Trussell procedure.

Step 1: CALCULATION OF THE PROBABILITY THAT A WOMAN WILL NOT HAVE A BIRTH IN THAT FIVE YEAR AGE INTERVAL. GF(i)

GF(i) is estimated as follows:-

$GF(i) = \{1 - GASFR(i)\}^5$ for i = 1, 2, ...7 where the indexes i refer to the age groups 15 - 19, 20 - 24, ... 45 - 49; where i = 1 is for age group 15 - 19, i = 2 for age group 20 - 24 and so on up to i = 7 for age groups 45 - 49.

The results are shown in table 2.3.1a.

For i = 3,

$GF(3) = \{1 - GASFR(2)\}^5$

From the table, GASFR(3) = 0.350587

$GF(3) = [1 - 0.350587]^5$

$= 0.115506$

Step 2: CALCULATION OF NUMBER OF CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE x. Cl(X)

This represents also the number of women in the cohort who have had no birth by age x.

It starts with a radix at age 15 where it is assumed that no birth has occurred.

Thus at age 15, $Cl(15)$ = radix here taken as 10,000. Other values are as shown in the table.

We illustrate by calculating $Cl(40) = Cl(35) \times [GF(5)]$ (see table 2.3.1a).

$$
\begin{aligned}
Cl(40) &= (8.8.33697)\ (0.258516) \\
&= 2.283659 \\
&\simeq 2
\end{aligned}
$$

STEP 3: CALCULATION OF THE NUMBER OF FIRST BIRTHS IN AGE INTERVAL (x. x + 5)

The number of first births in the age interval x to x + 5, NFB(x) is calculated as follows:-

$$NFB(x) = Cl(x) - Cl(x + 5)$$

for the age interval 15 - 19, here denoted as NFB(15)

$$
\begin{aligned}
&= Cl(15) - Cl(20) \\
&= 10,000 - 4158.548 \\
&= 5841.451
\end{aligned}
$$

which can be approximately be rounded to 5841

Step 4: CALCULATION OF THE NUMBER OF LAST BIRTHS IN THE AGE INTERVAL (x, x + 5)(NLB(x)

NLB(x) = Cl(15) [(1 - GF(j + 1)... GF(7)].

where GF(j) refers to age interval (x, x + 5)

for example in the age group 25 - 29. j = 3

GF(3) = 0.115506

The product GF(4) * GF(5) * GF(6) = 0.014889.

Now [1 - GF(3)] * GF(4) * GF(5) * GF(7 = 0.013169

NLB(25) = 10,000 x .0.13169

= 131.6956

$\simeq$ 132 births.

Step 5: CALCULATION OF MEAN AGE AT FIRST BIRTH (MAFB)

Here xi refers to mid-age interval for the age group i

$$MAFB = \frac{\sum (xi + 0.5) * NFB(x)}{NFB(x)}$$

$$= \frac{5841.451 \times 17.5 + 3696.358 \times 22.5 + ... + 0.307995}{5841.451 + 3696.358 + ... + 0.307995}$$

= 19.84097.

$\simeq$ 19.84

Step 6: CALCULATION OF MEAN AGE AT LAST BIRTH (MALB)

$$MALB = \frac{\sum (X + 0.5)\ (NFB(x))}{NLB(x)}$$

$$= \frac{(1.116557 \times 17.5) + (15.2867 \times 22.5) + \ldots + (2792.653 \times 47.5)}{(1.116557 + 15.2867 + \ldots + 2992.653)}$$

$= 41.62396$

$\simeq 41.62$

Step 7: CALCULATION OF MEAN AGE OF THE FERTILITY SCHEDULE (MACB)

$$MACB = \frac{\sum (x + 0.5) * GASFR(i)}{GASFR(i)}$$

$$= \frac{17.5 \times 0.160949 + 22.5 \times 0.35557 + \ldots + 47.5 \times 0.063398}{0.160949 + 0.35557 + \ldots + 0.063398}$$

$= 29.8636$

$= 29.86$

Step 8: ESTIMATION OF EXPECTION OF REPRODUCTIVE LIFETIME WITH NO CHILDBEARING [i.e. NON-REPRODUCTIVE LIFETIME FROM AGE x ONWARDS] ECL(x)

This is estimated from the equation

$$\sum_{i-1}^{b} \left\{ [CL(i) + CL(i+5)]\frac{5}{2} \right\} / CL(x)$$

for x = 15

$$= \frac{2.5[10{,}000+2(4158.548+412.19+ \ldots + 1.102876)+ 0.794]}{10{,}000}$$

$\simeq$ 4.8 This is indicated in table 2.3.1a as a.

Or we can alternatively use the formula

$$ECL(x) = \sum_{1=x}^{b} \frac{5[CL(i) - CL(i+5)]}{Log_e CL(i) - Log_e CL(i+5)} \Big/ CL(x)$$

$$ECL(15)=\left\{\frac{5[Cl(15)-Cl(20)}{log_e Cl(15)-log_e Cl(20)} + \frac{5[Cl(20)-Cl(25)}{log_e Cl(20)-log_e Cl(25)} +..+ \frac{5[Cl(45)-Cl(50)}{log_e Cl(45)-log_e Cl(50)}\right\}/10,000$$

$$= \frac{5(10,000 - 4158.548)}{0.877419} + \frac{5(4158.548 + 462.19)}{2.196945} + \frac{5(462.19 - 53.38576)}{2.158432}$$

$$+ \frac{5(53.38576) - 8.833697}{1.798970} + \frac{5(8.833697 - 2.283659)}{1.352795}$$

$$+ \frac{5(2.283659 - 1.102876)}{0.727858} + \frac{5(1.102876 - 0.794881)}{0.327484}\} /10,000$$

$= \{33287.69949 + 8412.4955 + 946.9936 + 123.8266 + 24.2092$

$+ 8.1114 + 4.76244\}/10,000$

$= 42808.03823/10,000$

$= 4.28$ These are denoted in the table 2.3.1a as b.

Step 9: CALCULATION OF REPRODUCTIVE LIFETIME TO BE SPENT ON MOTHERHOOD FROM AGE x ONWARDS (ALSO TOTAL REPRODUCTIVE LIFETIME REMAINING AT AGE x MINUS EC1) e(xm) WHEN MORTALITY IS ASSUMED NOT AFFECTING

$e(xm) = (50 - x) - EC1(x)$

Thus at age 15, $e(15m) = 35 - 4.8$

$= 30.2$

or from second method $= 35 - 4.28$

$= 30.72$ from second method denoted as b in table 2.3.1a.

This when divided by 50 - 15 would give the proportion of expectation reproductive life time to be spent in motherhood

$$= \frac{30.2}{35} = 86.28\%.$$

This represents the proportion of life spent in motherhood during the child bearing period.

TABLE 2.3.1a

CONSTRUCTION OF ABRIDGED NON-REPRODUCTIVE LIFE TABLE FOR KENYA, 1969

AGE(x)	FERTILITY RATE GASFR (PER 1000	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE (x)	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(x)		EXPECTATION OF MOTHER-HOOD LIFE e(xm)	
					a	b	a	b
15	160.949	10,000	5841	1	4.8	4.28	30.2	30.72
20	355.57	4159	3696	15	3.13	2.29	26.87	27.71
25	350.587	462	409	132	3.21	2.40	21.79	22.6
30	302.18	53	45	751	3.66	3.01	16.34	16.99
35	237.047	9	7	2581	4.33	4.18	10.67	10.82
40	135.472	3	1	3726	3	5.61	7	4.39
45	63.398	1	0.3	2793	5	4.26	0	0.74
50	----	1	----	----	--	---	--	---
TOTAL			9999	9999				

SUMMARY INDEXES

(a) Expected Ultimate proportion of women not reproducing = PNR

$$= \frac{Cl(50)}{Cl(15)} \times 100 = 0.01\%.$$

(b) Total fertility rate = TFR = 8.03.

(c) Expectation of reproductive life to be spent in motherhood.

at age 15 = e(15m) = 30.2 years.

(d) Expected proportion of reproductive life to be spent in motherhood = P E(15m) = 86.28%.

(e) Mean age at first birth = MAFB = 19.84 years.

(f) Mean age at last birth = MALB = 41.62 years.

(g) Mean age of the fertility schedule = MACB = 29.86 years.

TABLE 2.3.1b

CONSTRUCTION OF NON-REPRODUCTIVE LIFE TABLE FOR KENYA, 1969

AGE x	FERTILITY RATE ASFR Per (1000)	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE x	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(X)	EXPECTAT OF MOTHERHOO LIFE e(XM)
15	32.190	10,000	322	--	5.0	30.0
16	96.569	9678	935	--	4.2	29.8
17	160.949	8743	1407	--	3.6	29.4
18	199.873	7336	1466	--	3.2	28.8
19	238.797	5870	1402	1	2.9	28.1
20	277.722	4468	1241	1	2.6	27.4
21	316.722	3227	1022	1	2.4	26.6
22	355.658	2205	784	3	2.3	25.7
23	394.494	1421	560	5	2.3	24.7
24	353.577	861	305	7	2.4	23.6
25	352.580	556	196	10	2.4	22.6
26	351.584	360	126	15	2.5	21.5
27	350.587	234	82	24	2.5	20.5
28	349.590	152	53	36	2.7	19.3
29	331.224	99	33	51	2.8	18.2
30	321.543	66	21	74	3.0	17
31	311.861	45	14	104	3.1	15.9
32	302.180	31	10	144	3.3	14.7
33	292.493	21	6	197	3.6	13.4
34	276.127	15	4	256	3.9	12.1
35	263.100	11	3	332	4.1	10.9

TABLE 2.3.1b CONTD

AGE x	FERTILITY RATE ASFR Per (1000)	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE x	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(X)	EXPECTATION OF MOTHERHOOD LIFE e(XM)
36	250.074	8	2	421	4.4	9.6
37	237.047	6	1	523	4.8	8.2
38	224.024	5	1	637	4.6	7.4
39	196.417	4	1	696	4.6	6.4
40	176.102	3	1	757	5	5
41	155.787	2	-	800	6.3	2.7
42	135.472	2	-	797	5.3	2.7
43	115.157	2	-	767	4.3	2.7
44	106.642	2	1	792	3.3	2.7
45	92.228	1	-	757	5	-
46	77.813	1	-	693	4	-
47	63.398	1	-	598	3	-
48	38.388	1	-	369	2	-
49	12.680	1	-	125	1	-
50	----	1	-	--	-	-
TOTAL	7810.497		9994	9994		
	TFR ~ 7.8		Mean= 20.05	mean= 41.42		

TABLE 2.3.2a

CONSTRUCTION OF ABRIDGED NON-REPRODUCTIVE LIFE TABLE FOR KENYA, 1979

AGE(x)	FERTILITY RATE GASFR (Per 1000)	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE (x)	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(x)		EXPECTATION OF MOTHER-HOOD LIFE e(xm)	
					a	b	a	b
15	166.668	10,000	5981	1		4.7		30.3
20	390.539	4019	3681	11		2.96		22.04
25	394.393	338	310	132		3.01		21.99
30	320.836	28	24	850		3.61		16.39
35	242.577	4	3	2993		5.25		9.75
40	123.246	1	0.5	3708		8.5		1.5
45	51.055	1	0.1	2305		3.5		1.5
50	----	0.4	----	----		--		--
TOTAL								

Source:

SUMMARY INDEXES

(a) Expected ultimate proportion not reproducing (PNR) = 0.004%

(b) Total fertility rate (TFR) = 8.45

(c) Expectation of reproductive life to be spent in motherhood at age 15[e(15m)] = 30.3 years

(d) Expected proportion of reproductive life to be spend in motherhood P e(15m) = 86.6

(e) Mean age at first birth (MAFB) = 19.69

(f) Mean age at last birth (MALB) = 41.09

(g) Mean age of fertility schedule (MACB) = 29.44

TABLE 2.3.2b

CONSTRUCTION OF NON-REPRODUCTIVE LIFE TABLE FOR KENYA, 1979

AGE x	FERTILITY RATE ASFR Per (1000)	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE (x)	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(X)	EXPECTATION OF MOTHERHOOD LIFE e(XM)
15	33.334	10,000	333	--	4.9	30.1
16	100.001	9667	967	--	4.0	30.0
17	166.668	8700	1450	--	3.4	29.6
18	211.442	7550	1533	--	2.9	29.1
19	256.216	5717	1465	--	2.6	28.4
20	300.991	4252	1284	--	2.4	27.6
21	345.765	2972	1027	1	2.2	26.8
22	390.539	1945	760	1	2.1	25.9
23	391.310	1185	464	2	2.1	24.9
24	392.081	721	283	3	2.1	23.9
25	392.851	439	173	5	2.1	22.9
26	393.622	266	105	8	2.2	21.8
27	394.393	161	63	14	2.3	20.7
28	379.682	98	37	22	2.4	19.6
29	364.970	61	22	34	2.6	18.4
30	350.836	39	14	51	2.8	17.2
31	335.547	25	8	75	3.0	16.0
32	320.836	17	6	108	3.2	14.8
33	305.184	11	3	151	3.7	13.3
34	289.532	8	2	207	3.9	12.1
35	273.881	6	2	275	4.1	10.9

TABLE 2.3.2b CONTD

AGE x	FERTILITY RATE ASFR Per (1000)	CHILDLESS WOMEN IN HYPOTHETICAL COHORT AT AGE x	NUMBER OF FIRST BIRTHS NFB(x)	NUMBER OF LAST BIRTHS NLB(x)	AVERAGE CHILDLESS LIFE ECL(X)	EXPECTATION OF MOTHERHOOD LIFE e(XM)
36	258.229	4	1	357	4.9	9.1
37	242.577	3	1	453	5.3	7.7
38	218.711	2	-	539	6.8	5.2
39	194.845	2	1	614	5.8	5.2
40	170.978	1	-	669	10	0
41	147.112	1	-	695	9	0
42	123.246	1	-	683	8	0
43	108.808	1	-	687	7	0
44	94.370	1	-	668	6	0
45	74.156	1	-	580	5	0
46	65.483	1	-	554	4	0
47	57.055	1	-	462	3	0
48	30.633	1	-	294	2	0
49	10.211	1	-	101	-	0
50	---	1	-	--	-	-
TOTAL	TFR = 8186.105 TFR = 8.186105 $\simeq$ 8.19		9999 MAFB = 19.853135	8313 MALB 41.48514	MACB =	

CHAPTER THREE

RESULTS OF APPLICATION OF SUCHINDRAN-HORNE AND SIVAMURTHY METHODS TO KENYAN DATA

3.1 APPLICATION OF SUCHIDRAN - HORNE METHOD TO KENYA'S DATA AT NATIONAL LEVEL

The results of application of Suchidran - Horne technique for estimating the reproductive indices are shown in table 3.1.

The age specific fertility rates were obtained from the censuses after adjusting using Coale - Trussell indirect method of using P/F ratios to adust the fertility rates.

When results are considered for censuses above, the trend indicate a declining mean age at first birth and mean inter birth spacing with greatest decline between periods 1962 and 1969. On the other hand, mean age at last birth fluctuates with 1962 indicating lowest estimates and 1969 highest estimates. Similar trend is also shown by the mean reproductive span. The overall level of fertility as indexed by the total fertility rates increase from 1962 to 1979. This could probably be due to decreasing mean age at first birth and decreasing mean length of birth spacing.

Considering results from survey data, there are inconsistencies in estimates obtained from KFS and NDS where KFS indicate lower estimates for MAFB, MALB, MIBS and TFR and higher estimates for MRSPAN. However, the differences in all the cases are small. The KCPS indicate slightly lower MAFB than 1977 NDS but higher estimates for MALB, MSPAN, MIBS and lower TFR than the other two surveys.

Apart from 1962 census which indicate higher MAFB, lower MALB, shorter MSPAN, longer MIBS and low TFR; other periods show the same cluster. The MAFB is around 19 years while MALB is around 41 years with the MSPAN around 22 years. The total fertility is close to 8 births per woman.

These results indicate that the Kenyan women on average spend a long time in child bearing coupled with short inter birth spacing of just about 33 months. They also have higher period level of fertility.

TABLE 3.1

ESTIMATED TREND IN REPRODUCTIVE INDICES AT NATIONAL LEVEL (MAFB, MALB, MSPAN, MIBS AND TFR)

INDEX / YEAR	MAFB (YEARS)	MALB (YEARS)	MSPAN (YEARS)	MIBS (MONTHS)	TFR
1962(Census)	21.61	40.29	18.68	42.72	5.24
1969(Census)	19.45	41.79	22.34	33.36	8.03
1977* NDS	19.39	40.98	21.59	32.52	7.96
1977/78*KFS	18.82	40.69	21.87	33.24	7.90
1979(Census)	19.25	41.28	22.03	31.32	8.45
1984* KCPS	19.32	41.48	22.16	34.68	7.67

3.2 APPLICATION TO DISTRICT AND PROVINCES

One of the main aims of this thesis was to apply Suchindran - Horne technique to present estimate of some child bearing indices for women in Kenya at regional level. After considering the trend in estimates at national level in the introductory section of this chapter, estimates at regional level are presented.

Estimated indices for provinces and districts for the two periods 1969 and 1979 presented are in tables 3.2a, 3.2b and the change in the estimates over the ten year period are presented lastly in table 3.2c.

CENTRAL PROVINCE

In this province, we observe from tables 3.2a, 3.2b that fertility level is high and total fertility rate for most districts in the province is just over 8 births per woman in both periods. In Nyandarua, the level of fertility is among the highest over 9 births per woman in both periods. In all the districts, the level of fertility is just above the national value.

The mean age at first birth presented in both periods is over 19 years with negligible changes in the periods as can be seen in table 3.2c. It is evident that the pattern of first births has slightly declined.

The mean age at last birth for most districts in the province was very high in 1969 above 42 years. Evidence of declining MALB is seen as most districts in this province register a decrease about 1 year (table 3.2c) except in Kirinyaga with positive change.

The resulting effect of mean age at first and last birth is translated in mean length of reproductive span which is over 22 years for all the districts in 1969 with Nyandarua having the highest figure in the whole republic.

It can be said that probably the high fertility rates in this province could be due to very long reproductive span. Although in most districts the mean age at first birth is relatively high compared to other districts, the long span is evidently due to late age at last birth coupled with relative short mean inter birth spacing. Over the period, table 3.2c shows that there was little change in mean inter birth spacing in this province except in Kirinyaga district which kind of displays unique pattern in all the cases.

COAST PROVINCE

Fertility levels in the districts in this province are relatively low. However, comparing the levels of fertility in both periods, there is evidence of increased level of fertility as seen in table 3.2c with the highest increase in Lamu, Tana River and Kilifi.

Mean age at first birth in this province is modest and is just about the national average in both periods and ranged from 19.17 years to 20.30 in 1969 and 18.69 to 19.54 in 1979. However, all districts in this province realize a decline in average age at first birth as in most districts in Central province with greater decline in Kilifi which is over one and half years.

Mean ages at last birth shown by most districts in this province were among the lowest in the country, especially in 1969, most districts had a mean age of lower than 40 years. Lamu and Mombasa have the lowest mean ages. In spite of this, it is evident that nearly all districts including the highly urbanized Mombasa registerd increase in mean age at last birth. The very high increase in Lamu which is close to 6 years is particularly suspect which could probably be due to errors in data in 1969.

Similarly, most districts (due to decreased mean age at first birth and increased mean age at last birth) registered very high increase in length of reproductive span and also decrease mean inter birth spacing.

This points out that increase in level of fertility in this province could be as a result of decreased mean age at first birth and increased mean age at last birth coupled with reduced mean inter birth spacing.

EASTERN PROVINCE

Fertility patterns displayed by districts in this province could be divided into two classes. Some districts display similar patterns as in Central Province particularly Embu and Meru. While Isiolo and Marsabit display similar characteristics as districts in North Eastern Province.

The level of fertility in Embu, Meru, Kitui and Machakos is close to those in Central Province and the total fertility rate just close to that of national level. Isiolo and Marsabit have very low levels of fertility in both 1969 and 1979 periods. Nearly all districts registered changes in level of fertility in 1979 except in Meru. Although the changes were not as big as in Coast province which was less than one child per woman in all the cases.

The mean ages at first birth for all the districts in this province were among the highest and similar to those in Central province in 1969 and 1979. Change in this index for most districts was negative implying decrease though slight except in Embu and Marsabit with a slight increase.

In 1969, nearly all the districts had very old ages at last births relative to other regions, except in Marsabit. However, in 1979, the ages at last births for most districts in this province were close to one another making the lower mean age at last birth in Marsabit suspect. It could be probably due to errors in the data as this district has some of the inhabitants leading nomadic way of life.

Changes in mean reproductive span and mean inter birth spacing were small compared to other districts except for the case of Marsabit where nearly all the indices increased.

NORTH EASTERN PROVINCE

Data from this province is always suspect because of the way of life of most inhabitants living in this region in the rural areas. It is inhabited by mostly nomadic people and hence relatively fewer errors might only occur from respondents living in major urban centres. However, despite these problem, the data from the census indicate high fertility in Garissa in 1969 but relatively clustered level of fertility in 1979 indicating that the wide variation in the level of fertility shown from 1969 might have been due to errors in the data.

The low fertility in this region could probably be due to relatively very late age at first birth. Mandera had the highest mean in both 1969 and 1979. This could probably concur with what Henin (1969) found out in Sudan where women living nomadic way of life had higher mean age at maternity than those living in settled life.

Despite high mean age at first birth, the mean age at last birth is particularly old and similar to those observed in Eastern Province.

The spacing patterns were also long (among the longest) in both periods.

NYANZA PROVINCE

Fertility level in Nyanza Province in general is close to that of national level. While Kisumu, Siaya and South Nyanza have level of fertility close to one another, Kisii district has the highest level of fertility in the province and even in the whole republic. In this province, change in the level of fertility in the periods was very minimal and infact Kisii and Kisumu registered slightly lower value and on the other hand Siaya and South Nyanza slightly higher value.

In this province, there is evidence that age at first birth is very low as indicated in both periods. Infact in 1979, all the districts have average age at first birth below 19 years. The changes in mean age at first birth over the period in most districts were small.

The mean ages at last birth in Kisumu and Siaya was about 40 years and in South Nyanza slightly over 41 years whereas Kisii has very old age close to 44 years in 1969.

The mean lengths of child bearing for all the districts in this province were long which could be mainly because of very early mean age at first birth coupled with relatively short mean inter birth spacing.

RIFT VALLEY PROVINCE

In this province, the pattern and levels of fertility were quite varied among the districts especially in 1969. Except for Kericho, Nakuru, Trans Nzoia and Kajiado, the total fertility in all the other districts was about 7 or less with the lowest being in Turkana and Laikipia. In 1979, there were quite a big changes in total fertility rates. The only exceptions are Elgeyo Marakwet, Nakuru and Samburu districts. Laikipia had the highest increase in the level of fertility. In 1979, very high levels of fertility were registered in Kericho, Trans Nzoia, Kajiado and Nakuru.

The mean age at first birth was also varied index just as the level of fertility in 1969. Kajiado, Samburu and Turkana had relatively older ages above 20 years in 1969. Early ages in this period were shown by Trans Nzoia, West Pokot, Laikipia, Baringo and Nandi where the averages were below 19 years. In 1979, there were decreases in mean ages at first birth in most districts. About five districts had an average of below 19 years and four others just about 19 years. It is only again in Turkana and Samburu where the mean ages were about 20 years.

While in 1969, the mean age at last birth was relatively low in most districts, very many districts showed increased mean ages at last birth in 1979 with highest increase being in Trans Nzoia and Laikipia. This increase in mean age at last birth and with slight decline in age at first birth for most districts in 1979, resulted in very long reproductive span in most districts in the province. Whereas in 1969, only one district had a mean length of about 23 years, about 7 districts have a length of reproductive span of about 23 years. The combination of low mean ages at first birth very old mean ages at last birth hence very long length of reproductive span for most districts in the province could be then the cause for increased and high levels of fertility in most districts in the province.

WESTERN PROVINCE

In Western province, the level of fertility was high in both periods. The districts here had low mean age at first birth similar to districts in Nyanza province and very old mean age at last birth. In addition, the mean inter birth spacing in this province was among the shortest.

Evidence from table 3.2c indicate minor changes in the indices in the period.

NAIROBI

Nairobi which is the largest urban centre had one of the lowest fertility rates shown in both periods although there is evidence of increase in level of fertility. The mean age at first birth was among the highest in both periods. Evidence of early age at completion of childbearing is shown as it can be observed that the mean age at last birth was among the lowest in both periods.

SUMMARY

While in 1969 the total fertility rates in most districts were low, high levels of fertility was observed to in districts in Western and Central provinces with median levels in Nyanza except Kisii. Rift Valley, (some districts) Coast and North Eastern Provinces had the lowest levels.

High fertility rates in most districts may be due (partly) to either early age at first birth as in Nyanza and Western provinces or very late ages at last birth as in Central and Eastern provinces. A combination of very early age at first birth and very late age at last birth was seen in Kisii and Bungoma districts.

Change to higher level of fertility in 1979 were in all the districts in Rift Valley province and most districts in Coast province. Greater cause of change to high level could be due to increased older mean ages at last birth as in cases of Lamu, Trans Nzoia, Laikipia, Uasin Gishu, Marsabit, West Pokot and Narok.

Central province, Nyanza Western and some districts in Eastern province seem to have constant levels of fertility as they realize minimal increase or decrease in all the fertility indices considered. Central and Nyanza provinces realized no change or negligible change in mean inter birth spacing.

TABLE 3.2a

ESTIMATED REPRODUCTIVE BEHAVIOUR INDICES OF WOMEN IN KENYA AT NATIONAL AND REGIONAL LEVELS 1969

REGION	TFR	MAFB (Years)	S.D	MALB (Years)	S.D	MSPAN (Years)	MIBS (Months)
KENYA	8.03	19.45	3.97	41.79	5.45	22.34	33.4
NAIROBI	5.81	20.10	5.21	38.70	6.01	18.60	38.4
CENTRAL	8.54	19.88	3.88	42.44	5.01	22.56	31.7
KIAMBU	8.72	19.92	3.84	42.32	4.96	22.40	30.8
MURANGA	8.43	19.94	3.84	42.43	4.99	22.49	32.0
NYERI	8.62	20.08	3.87	42.30	4.95	22.22	30.9
NYANDARUA	9.36	19.50	3.86	43.99	5.10	24.49	31.4
KIRINYAGA	7.51	19.58	4.12	41.72	5.90	22.14	35.4
COAST	6.25	19.42	4.44	40.31	6.77	20.89	43.9
MOMBASA	5.10	19.58	4.53	36.17	6.86	16.59	39.0
KWALE	6.40	19.17	4.44	41.79	7.14	22.62	42.4
TAITA	7.01	19.86	4.06	39.88	5.52	20.02	34.3
LAMU	4.44	19.95	4.80	34.25	6.13	14.30	38.6
KILIFI	5.49	20.30	5.05	39.87	6.82	19.57	42.8
TANA	6.24	19.36	4.39	38.62	4.88	19.26	37.0
EASTERN	7.95	19.91	4.10	42.29	5.51	22.38	33.8
MACHAKOS	7.92	19.86	4.15	42.37	5.50	22.51	34.1
KITUI	7.64	19.84	4.10	41.40	5.60	21.56	33.9
EMBU	8.50	19.45	3.86	42.02	5.26	22.57	31.9
MERU	8.42	20.05	4.83	43.36	5.37	23.31	33.2
ISIOLO	6.27	19.79	4.61	41.42	6.74	21.63	41.4
MARSABIT	5.56	20.53	4.93	37.26	4.06	16.73	36.10
N. EASTERN	6.27	21.89	4.59	41.83	6.00	19.94	38.2

Table 3.2a Contd

MANDERA	5.06	23.51	5.41	42.31	6.56	18.80	44.6
GARISSA	8.63	20.45	3.79	43.32	5.44	22.87	31.8
WAJIR	7.17	20.84	4.21	40.47	4.95	19.63	32.9
NYANZA	8.71	18.91	3.76	41.79	5.50	22.88	31.5
KISII	10.37	19.41	3.65	43.90	4.70	24.49	28.3
KISUMU	8.45	18.58	3.78	40.97	5.96	22.39	31.8
SIAYA	7.85	19.15	3.90	40.06	5.62	20.91	32.0
S. NYANZA	8.45	18.48	3.69	41.11	5.68	22.63	32.1
RIFT VALLEY	7.05	19.42	4.12	40.04	5.79	20.62	35.1
BARINGO	7.31	18.89	3.95	40.67	5.77	21.78	35.8
ELGEYO	7.27	19.86	4.10	41.47	5.89	21.61	35.7
KAJIADO	7.82	20.11	4.29	42.37	5.29	22.26	34.2
KERICHO	8.12	19.13	3.97	41.59	5.46	22.46	33.2
NAKURU	8.61	19.34	3.76	42.44	5.48	23.10	32.3
NANDI	7.06	18.96	4.04	40.61	6.30	21.65	36.8
NAROK	6.15	19.38	4.64	39.39	5.64	20.01	39.0
T. NZOIA	8.07	18.14	3.24	35.25	4.81	17.11	25.4
TURKANA	4.77	20.90	4.97	40.19	8.52	19.29	48.5
LAIKIPIA	5.36	18.88	4.04	37.17	5.36	18.29	40.9
W. POKOT	6.80	18.82	4.03	39.01	5.93	20.19	35.6
U. GISHU	6.96	19.64	4.26	39.58	5.27	19.94	34.4
SAMBURU	6.83	20.96	4.04	40.85	5.54	19.89	34.9
WESTERN	9.26	18.89	3.66	41.62	5.01	22.73	29.5
BUNGOMA	9.48	19.13	3.67	41.54	4.57	22.41	28.4
BUSIA	8.63	18.98	3.68	41.12	5.33	22.14	30.8
KAKAMEGA	9.11	18.86	3.70	41.67	5.16	22.81	30.0

TABLE 3.2b

ESTIMATED REPRODUCTIVE BEHAVIUOR INDICES OF WOMEN IN KENYA AT NATIONAL AND REGIONAL LEVELS 1979

REGION	TFR	MAFB (YEARS)	S.D	MALB (YEARS)	S.D	MSPAN (YEARS)	MIBS (MONTHS)
KENYA	8.45	19.25	3.79	41.28	5.42	22.03	31.3
NAIROBI	5.99	19.90	4.32	37.82	6.27	17.92	35.9
CENTRAL	8.47	19.71	3.81	41.53	5.31	21.82	31.9
KIAMBU	8.16	19.79	3.89	41.45	5.41	21.74	32.0
MURANGA	8.50	19.58	3.68	41.25	5.34	21.67	30.6
NYERI	8.16	19.85	3.79	40.99	5.45	21.14	31.1
NYANDARUA	9.47	19.44	3.67	42.49	4.98	23.05	29.2
KIRINYAGA	8.70	19.63	3.74	41.85	5.32	22.22	30.6
COAST	7.10	19.03	3.97	39.64	6.17	20.61	34.8
MOMBASA	5.66	19.54	4.35	36.90	6.48	17.36	36.8
KWALE	7.33	18.77	3.91	40.16	6.18	21.39	35.0
TAITA	8.06	19.45	3.81	40.64	5.61	21.19	31.5
LAMU	7.32	19.32	3.98	39.99	6.14	20.67	33.9
KILIFI	7.36	18.69	3.82	39.66	6.17	20.97	34.2
TANA	8.13	19.30	3.85	41.82	5.71	22.52	33.2
EASTERN	8.26	19.68	3.85	41.46	5.51	21.78	31.6
MACHAKOS	8.57	19.75	3.74	41.81	5.46	22.06	30.9
KITUI	8.10	19.43	3.81	40.80	5.57	21.37	31.7
EMBU	8.93	20.00	3.76	42.51	5.24	22.51	30.2
MERU	8.13	19.50	3.89	41.14	5.52	21.34	31.5
ISIOLO	6.79	19.77	4.18	40.42	6.10	20.65	36.5
MARSABIT	6.47	20.71	4.50	40.74	6.00	20.03	37.1
N. EASTERN	6.99	20.52	4.26	40.77	5.48	20.25	34.8
MANDERA	7.30	20.82	4.32	42.12	5.53	21.30	35.0

Table 3.2b Contd

GARISSA	7.92	19.81	3.94	41.86	5.53	22.05	33.4
WAJIR	7.12	20.50	4.22	41.36	5.63	20.86	35.2
NYANZA	8.69	18.49	3.60	40.63	5.45	22.14	30.6
KISII	10.03	18.67	3.47	41.91	5.05	23.24	27.8
KISUMU	8.10	18.33	3.64	39.71	5.59	21.38	31.7
SIAYA	8.10	18.52	3.66	39.77	5.57	21.25	31.5
S. NYANZA	8.50	18.26	3.59	40.71	5.62	22.45	31.7
RIFT VALLEY	8.48	18.94	3.74	41.58	5.52	22.64	32.0
BARINGO	8.38	19.19	3.90	40.80	5.51	21.61	30.9
ELGEYO	7.31	19.84	3.91	39.84	5.80	20.00	32.8
KAJIADO	8.89	18.61	3.65	41.85	5.58	23.24	31.4
KERICHO	9.82	18.61	3.55	42.25	5.06	23.64	28.9
NAKURU	8.85	19.03	3.76	42.24	5.31	23.21	31.5
NANDI	8.57	18.63	3.64	41.17	5.61	22.54	31.6
NAROK	8.03	18.69	3.86	41.47	5.79	23.08	34.8
T. NZOIA	9.32	18.54	3.59	42.03	5.24	23.49	30.2
TURKANA	6.72	20.23	4.37	41.49	6.28	21.26	38.0
LAIKIPIA	8.64	19.18	3.79	42.10	5.42	22.92	31.8
W. POKOT	8.29	18.78	3.70	41.02	5.79	22.24	32.2
U. GISHU	8.66	19.06	3.74	41.89	5.58	22.83	31.6
SAMBURU	6.96	20.05	4.27	40.97	5.95	20.92	36.1
WESTERN	8.96	18.95	3.65	41.18	5.16	22.23	29.8
BUNGOMA	9.42	19.03	3.64	41.66	4.84	22.63	28.8
BUSIA	8.07	18.72	3.70	40.14	5.63	21.42	31.9
KAKAMEGA	9.07	18.98	3.64	41.30	5.15	22.32	29.5

TABLE 3.2c

ESTIMATED CHANGES IN REPRODUCTIVE BEHAVIOUR INDICES OF WOMEN IN KENYA AT NATIONAL AND REGIONAL LEVELS.

REGION	TFR	MAFB	MALB	MSPAN	MIBS
KENYA	+0.42	-0.2	-0.51	-0.31	-2.1
NAIROBI	+0.18	-0.2	-0.88	-0.68	-2.5
CENTRAL	-0.07	-0.17	-0.91	-0.74	-0.8
KIAMBU	-0.56	-0.13	-0.87	-0.66	1.2
MURANGA	+0.07	-0.36	-1.18	-0.73	-1.4
NYERI	-0.46	-0.23	-1.31	-1.08	0.2
NYANDARUA	+0.11	-0.06	-1.50	-1.44	-2.2
KIRINYAGA	+1.19	+0.05	+0.13	+0.08	-4.8
COAST	+0.85	-0.39	-0.67	-0.28	-9.1
MOMBASA	+0.56	-0.04	+0.73	+0.77	-2.2
KWALE	+0.93	-0.4	-1.63	-1.23	-7.4
TAITA	+1.05	-0.41	+0.76	+1.17	-2.8
LAMU	+2.88	-0.63	+5.74	+6.34	-4.7
KILIFI	+1.87	-1.61	-0.21	+1.4	-8.6
TANA	+1.89	-0.06	+3.2	+3.16	-3.8
EASTERN	+0.31	-0.23	-0.83	-0.6	-2.2
MACHAKOS	+0.65	-0.11	-0.56	-0.45	-3.2
KITUI	+0.46	-0.41	-0.6	-0.19	-2.2
EMBU	+0.43	+0.55	+0.49	-0.06	-1.7
MERU	-0.29	-0.55	-2.22	-1.97	-1.7
ISIOLO	+0.52	-0.02	-1	-0.98	-4.9
MARSABIT	+0.91	+0.18	+3.48	+3.3	1
N. EASTERN	+0.72	-1.37	-1.06	+0.31	-3.4
MANDERA	+2.24	-2.68	-0.19	+2.5	-9.6

Table 3.2c Contd

GARISSA	-0.71	-0.64	-1.46	-0.82	1.6
WAJIR	-0.05	-0.34	+0.89	+1.23	2.3
NYANZA	-0.02	-0.42	-1.16	-0.74	-0.9
KISII	-0.347	-0.74	-1.99	-1.25	-0.5
KISUMU	-0.35	-0.25	-1.26	-1.01	-0.1
SIAYA	+0.25	-0.63	-0.29	+0.34	-0.5
S. NYANZA	+0.05	-0.22	-0.4	-0.18	-0.4
RIFT VALLEY	+1.43	-0.48	+1.54	+2.02	-3.5
BARINGO	+1.07	+0.3	-0.13	-0.17	-4.9
ELGEYO	+0.04	-0.02	-1.63	-1.61	-2.9
KAJIADO	+1.07	-1.5	-0.52	+0.98	-2.8
KERICHO	+1.7	-0.52	+0.66	+1.18	-4.3
NAKURU	+0.24	-0.31	-0.2	+0.11	-0.7
NANDI	+1.51	-0.33	+0.56	+0.89	-5.2
NAROK	+1.88	-0.69	+2.08	+3.07	-4.2
T. NZOIA	+1.25	+0.4	+6.78	+6.38	4.8
TURKANA	+1.95	-0.67	+1.3	+1.97	-10.5
LAIKIPIA	+3.28	+0.3	+4.93	+4.63	-9.1
W. POKOT	+1.49	-0.04	+2.01	+2.05	-3.4
U. GISHU	+1.7	-0.58	+2.31	+2.89	-3.3
SAMBURU	+0.13	-0.91	+0.12	+1.03	1.7
WESTERN	-0.3	+0.06	-0.44	-0.5	0.3
BUNGOMA	-0.06	-0.1	+0.12	+0.22	-0.4
BUSIA	-0.56	-0.26	-0.98	-0.72	1.1
KAKAMEGA	-0.04	+0.12	-0.37	-0.49	-0.5

NOTE: + Means increase in the index

- Means decrease in the index

3.3 COMPARISON OF THE INDICES MAFB, MALB, MSPAN, MIBS AND TFR BETWEEN THE REGIONS

In order to summarise the relative dispersion in the indices; TFR, MAFB, MALB, MSPAN and MIBS obtained for the different administrative regions, we can employ a more simple method in terms of numerical and graphic representation following the method of exploratory data analysis due to Tukey (1977). This technique has been used by Kim (1987) to summarise fertility indices among the I A S A countries.

In this form of analysis, the basic numbers that can lead us infer about a collection of a batch of numbers as a whole are the two extremes (minimum and maximum) and a middle value. The middle value of the batch of numbers is called the median and is a measure of location. In addition, lower and upper quertices add more information about the numbers and the range between them called the mid-spread.

These values, i.e. median, lower and upper quartiles act as numeric summary indices for the population disaggregation or variation: as the mid-spread is a measure of spread of the central half of the values when ordered from the lowest to highest.

The numeric summary can be turned into graphic summary for quick comparisons. The schematic (box) plots has been shown to be a convenient way of presenting the distribution.

The plots which are given in figures 3.2a, 3.2b, 3.2c and 3.2d are such that the box represents the length of the mid-spread from the plotted upper and lower quartiles. The vertical line indicates the position of the median value. The length of the midspread can be used as a unit of measure of the relative positions of the value lying within one unit of the midspread length of the upper and lower quartiles and are shown by an x, the maximum value is denoted Δ and minimum by □ and the sign o marks the position of one and half units of the midspread. Points which lie between 1 unit and $1^{1}/2$ units of the midspread are the outliers. This kind of representation is chosen since when the numbers follow a normal distribution, the numbers outside the crosses marked by x on average approaches the level of 5% (Kim, 1986).

The numerical summaries are given in table 3.3 and graphic summaries presented in figures 3.2a to 3.2e (see page 93 - 94).

TABLE 3.3

SUMMARY FOR REGIONAL VARIATION IN THE REPRODUCTIVE INDICES

	MAFB		MALB		MSPAN		MIBS		TFR	
	1969	1979	1969	1979	1969	1979	1969	1979	1969	1979
Minimum	18.14	18.26	34.25	36.90	14.30	17.36	25.4	27.8	4.4	5.7
Lower quartile	19.13	18.72	39.87	40.71	19.63	21.30	31.9	30.9	6.3	7.3
Median	19.58	19.32	41.12	41.30	21.65	21.70	34.2	31.7	7.5	8.0
Upper quartile	20.05	19.80	42.31	41.86	22.49	22.60	37.0	34.2	8.5	8.7
Maximum	23.51	20.82	43.99	42.51	24.49	23.64	48.5	38.0	10.4	10.0
Midspread	0.97	1.08	2.44	1.15	2.86	1.30	5.1	3.3	2.2	1.4
Range	5.37	2.56	9.74	5.61	10.19	6.28	23.1	10.1	6.0	4.3

Fig. 3.2A VARIATION IN TOTAL FERTILITY RATE

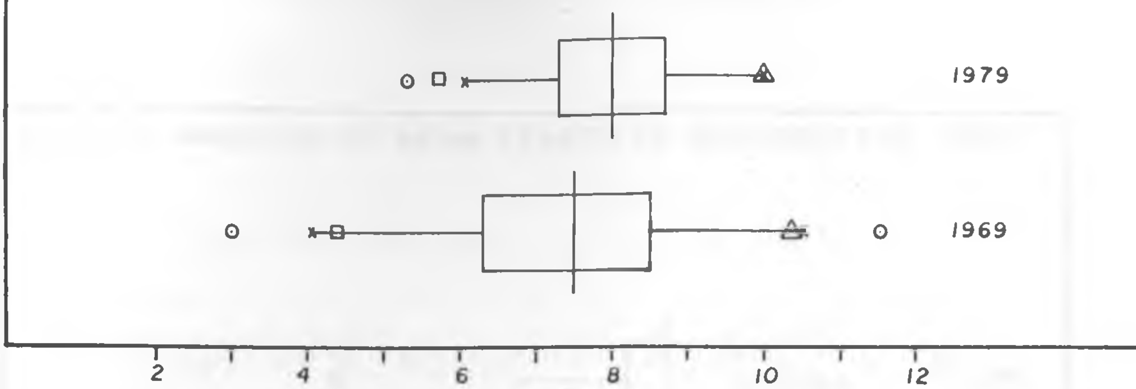


Fig. 3.2B VARIATION IN MEAN AGE AT FIRST BIRTH 1969 AND 1979, SMAM 1979

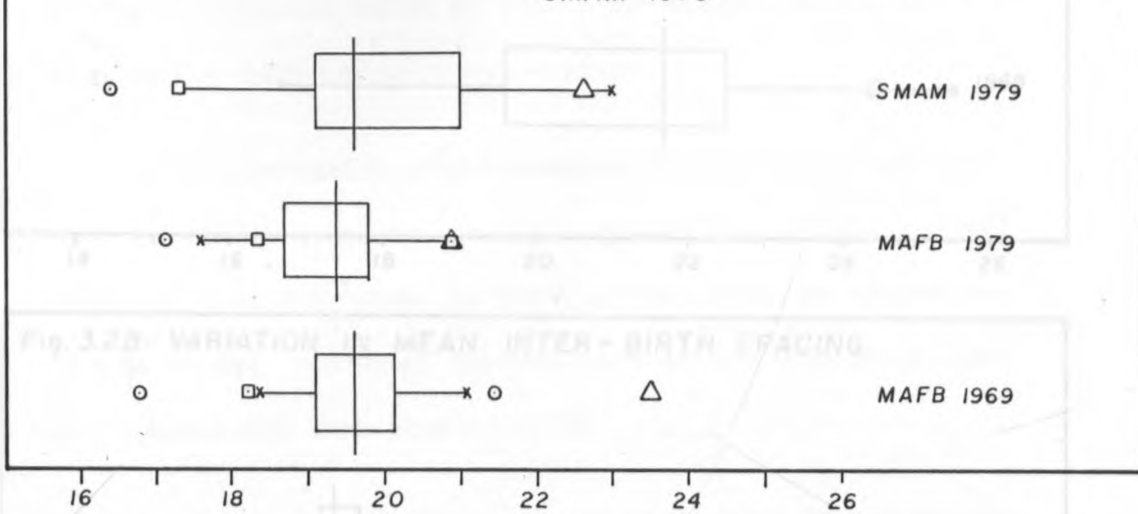
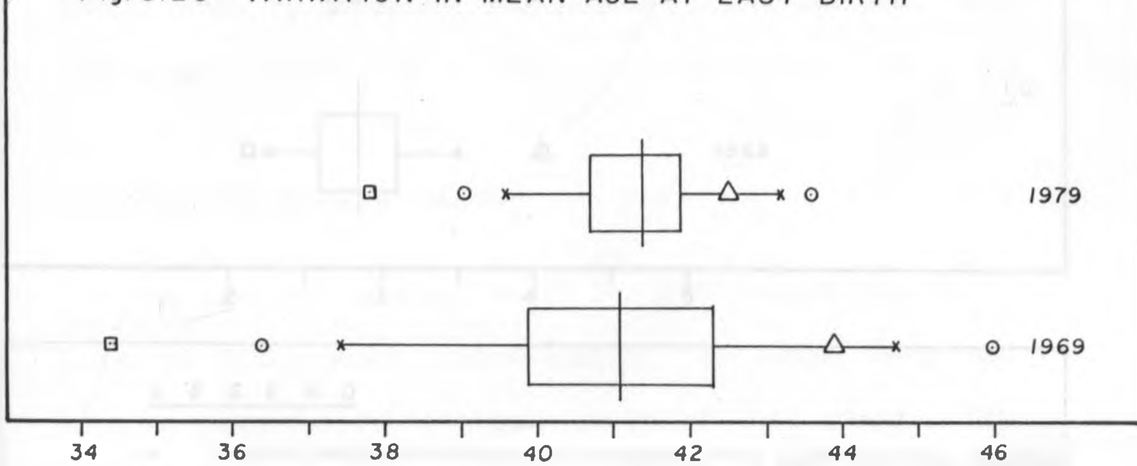


Fig. 3.2C VARIATION IN MEAN AGE AT LAST BIRTH



L E G E N D

x Marks position of 1.0 units of midspread from upper and lower quartiles

⊙ Marks position of 1.5 units of midspread from upper and lower quartiles

□ The position of the minimum value

△ The position of the maximum value

Source : Table 3.3

Fig. 3.2D VARIATION IN MEAN LENGTH OF REPRODUCTIVE SPAN

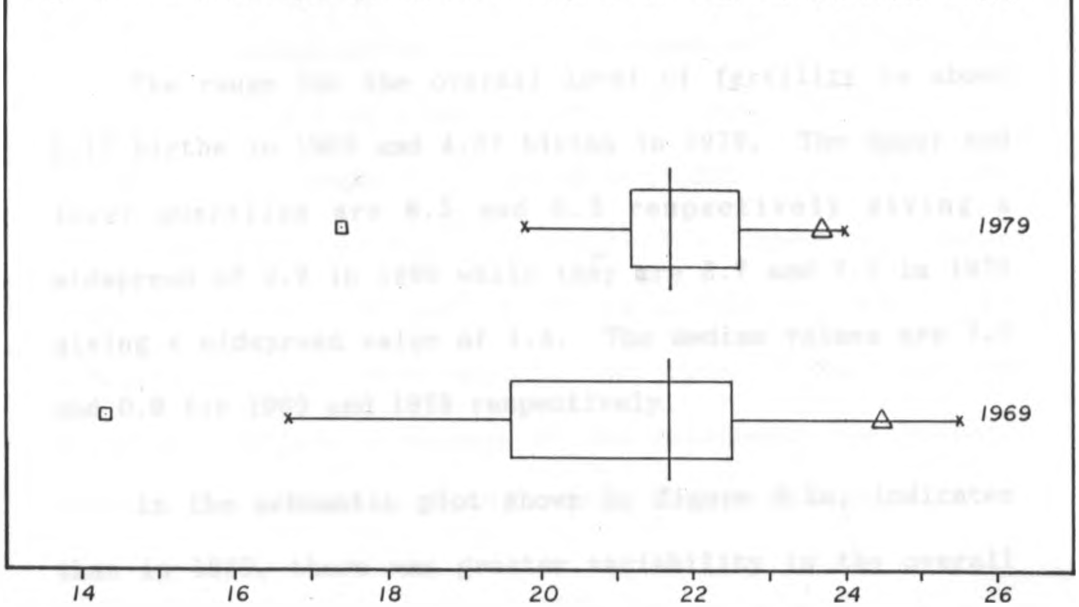
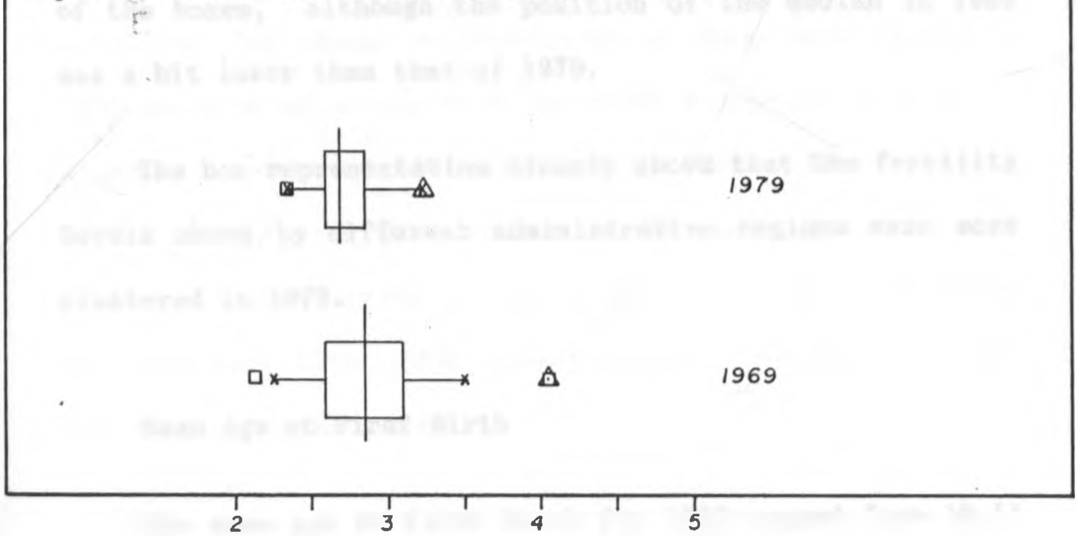


Fig. 3.2B VARIATION IN MEAN INTER-BIRTH SPACING



L E G E N D

x Marks position of 1.0 units of midspread from upper and lower quartile

□ The position of the minimum value

△ The position of the maximum

Source : Table 3.3

Total Fertility Rate

The range for the overall level of fertility is about 6.13 births in 1969 and 4.37 births in 1979. The upper and lower quartiles are 8.5 and 6.3 respectively giving a midspread of 2.2 in 1969 while they are 8.7 and 7.3 in 1979 giving a midspread value of 1.4. The median values are 7.5 and 0.8 for 1969 and 1979 respectively.

In the schematic plot shown in figure 3.2a, indicates that in 1969, there was greater variability in the overall level of fertility than in 1979 as indicated by comparison of the boxes, although the position of the median in 1969 was a bit lower than that of 1979.

The box representation clearly shows that the fertility levels shown by different administrative regions were more clustered in 1979.

Mean Age at First Birth

The mean age at first birth for 1969 ranged from 18.14 years to 23.51 years (corresponding to Trans Nzoia and Mandera respectively) giving a range of 5.37 years. The median value was about 19.58 years which is close to the national average of 19.69 years. The lower and upper quartiles were 19.13 years and 20.05 respectively giving a midspread length of 0.97 years.

In 1979, the range was between 20.82 years and 18.26 years (corresponding to women in Mandera and South Nyanza) the range being 2.56 years almost half range in 1969. The median is 19.32 years (national mean 19.25) which is lower than that obtained for 1969 while the upper and lower quartiles were 19.80 and 18.72 years respectively. The midspread is 1.08 years which is very close to that observed in 1969. Despite closeness of the midspread, the graphic summary figure 3.2b distinctly shows increased clustering in mean age at first birth.

In 1969, there are outliers while in 1979 there are no outliers. The change in clustering of these mean values in 1979 could be as a result of increased migration or relative accuracy in data of 1979 compared to 1969. If we compare MAFB for 1979 with SMAM values, it is evidently clear that the age at first birth is rather more clustered than first marriage ages with SMAM values skewed towards the right and slightly more varied.

<u>Mean Age at Last Birth (MALB)</u>

The range for MALB in 1969 is 9.74 years, maximum being 43.99 in Nyandarua and minimum 34.25 in Lamu. The median is 41.12 years with upper and lower quartiles being 42.31 and 39.87 years respectively giving a midspread of 2.44 years. Compared to MAFB in the present case, this is more varied index as indicated by both range and midspread. Comparing estimates of MALB obtained for the districts, it could be observed that five regions have a mean value 1.0 units of midspread form the lower quartile representing about 10% of the regions.

In 1979, maximum value is 42.51 years shown by Embu and minimum of 36.90 years for Mombasa. The range is now reduced to 5.61 years. 34 districts had mean age at last birth beyond 40 years about 83% compared to only 68% in 1969. This was due to increased MALB for majority of the districts in Rift Valley and Coast Provinces.

The median value was almost constant about 41.30, a change of only 2 months from 1969 median. The lower and upper quartiles were 40.71 and 41.86 resulting to a midspread length of only 1.15 years almost half recorded in 1969.

The box plot in figure 3.2c provides the graphic picture and comparison in the two periods. Mombasa and Nairobi are in this case the outliers and the graphic picture indicates decreased level of dispersion in the index. However, average age at completion of childbearing remains constant (constant median).

Mean Length of Reproductive Span

Figure 3.2d upper panel represents the graphic representation of length of reproductive span in the two periods and quick comparison points out at the extent of decreased relative dispersion of the index in 1979 compared to 1969.

In 1969, the range was 10.19 years i.e. from maximum of 24.49 years in Nyandarua and Kisii to minimum value of 14.30 years in Lamu. The median length was 21.65 years, lower and upper quartiles 19.63 and 22.49 years respectively resulting to a midspread length of 2.86 years. Outliers here were Mombasa, Lamu and Marsabit and the distribution of the averages skewed towards the left as indicated by the position of the median indicating that majority of the regions had length of reproductive span towards higher values. The length of midspread further indicates that this index was more varied across among the regions.

In 1979, the length of reproductive span ranged from 17.36 years in Mombasa to 23.64 years in Kericho. The minimum length increased by about 3.06 and maximum decreased by about 0.85 years respectively. The range was 6.28 years. Despite the relative decreased dispersion, the median length remained constant about 21.7 years and negligible increase in the upper quartile, but increased lower quartile by about 1.62 years. The shift in the lower quartile was due to increased mean length of reproductive span registered in

Rift Valley and Coast province which is also due to increased mean age at last birth. The distribution of the average values was skewed towards the right as opposed to situation in 1969 indicating their clustering was between lengths 20 and 21 years respectively.

Figures 3.4a, 3.4b and 3.4c are scatter plots between MAFB, MALB, MSPAN and MIBS against the total fertility rate.

In figure 3.4a, panel A is between MAFB and TFR, panel B is MALB against TFR and panel C is MSPAN against TFR for the period 1969 and figure 3.4b with similar panel labelling is for the period 1979. The figures indicate non - linear relationship between MAFB and TFR at aggregate level. There is slightly positive linear relationship between MALB and TFR although in 1969, figure 3.4 panel B, there is rather 'wild' scattering. Panel C of figure 3.4a and 3.4b are for plots of MSPAN against TFR which shows slightly more systematic postive linear association between the two indices at aggregate level. Further, 1979 figure show more linearity. This indicates then that regions with longer length of reproductive span are likely to have higher total fertility rates. Figure 3.4c panels A and B are the scatter plots of MIBS against TFR. Panel A is for the period 1969 and Panel B is for the period 1979. The plots indicates that the MIBS is negatively related to TFR in both periods although panel A which is 1969, the plots are rather non-uniform (not pronounced much).

The figures further indicate that 1979 estimates give more uniform scatters than in 1969 which corresponds to earlier box plots where more clustering of the indices was observed in 1979 than in 1969.

This could partly be attributed to the facts that 1979 had better data than 1969.

3.4 DIFFERENTIALS IN MAFB AND MALB

In this section, we have considered the differentials in mean age at first birth and last birth when the regional population is sub-divided into rural - urban residence and in the last section when they are divided by level of education, 1979 census only.

3.4.1 Differential By Residence

The results of the estimated indices are presented in table 3.4a giving estimates for mean age at first birth, last birth and level of fertility.

At national level, the mean age at first birth for women in urban centres were slightly higher than those in the rural areas by magnitude of less than 1 year. The mean age at last birth for women in the urban centres are lower than in rural areas by 2.44 years. The total fertility rate for women in urban regions were subsequently lower by about 2 births.

In Nyanza province, Kisumu, Siaya and Kisii women in urban areas had slightly higher mean age at entry into child bearing in which differences ranged from about 0.18 years in Siaya to 0.69 in Kisumu, while South Nyanza those rural women show slightly higher but negligible difference. On the other hand, it is clearly evident that women in urban areas tend to end child bearing earlier by about 1 year in Kisumu, Siaya and Kisii and the opposite happens in South Nyanza. The rural women had on average more than one birth higher than those in rural in the three districts except South Nyanza where it was only 0.5 births.

In Central province, postponement of first birth in urban areas was small. It is in age at last birth where the major effect of urbanisation was evident in Nyandarua, Muranga, Kirinyaga and Kiambu districts women in urban areas tended to stop child bearing earlier. Differences between mean ages at last birth ranged from more than 1 year to about 3 years in Kirinyaga, while on the other hand, Nyeri showed unique trend. Urbanisation effect was negligible to the tune of less than 1 month and infact higher. Looking at the level of fertility, urban women had fewer children than rural, the difference which ranged from 1.5 births to about 2.34 births an average of two births. The rural - urban differentials were greater in this province than in Nyanza.

In Coast province, it was only in Kilifi and Taita Taveta districts where the mean ages at first birth for urban women were higher than in the rural areas, while on the other hand, in all the other districts urban women tend to end child bearing earlier than the rural women. Differences in mean age at last birth ranged from about 1 year in Tana River district to about 3 years in Kilifi district.

In Eastern province, rural women had higher mean age at first birth in nearly all the districts, although they still have older age at last birth than the urban areas. The differences happens to be less than 1 year in most cases, despite the implied slightly lower level of fertility shown by those in urban areas.

As in the case of Eastern Province, Western Province showed similar position. The effect of urbanisation was on the age at last birth.

In Rift Valley province, Laikipia, Samburu, Turkana and Uasin Gishu, mean ages at first birth for women in rural residence were higher than for those in urban. The effect was in fact greater in Laikipia, Samburu and Turkana districts where there are no major urban centres. Urban residence had only effect on age at last where mean ages at last birth were lower. In Nandi, West Pokot and Baringo mean age at last birth for rural women is lower than for urban women. Infact Nandi's case is unusual which might possibly be due to greater extent of errors in the age data or reporting of children born. The extent of lower age at last birth could then approximately explain the urban - rural differences in level of fertility where in most districts urban women have less children between 0.11 births and 1.92 births.

In conclusion, it is apparent that in most of the districts, urban residence effect is seen in age at last birth than in age at first birth. However, the magnitude of urban - rural differences is not large in most cases, a situation which is observed when level of fertility is also considered.

TABLE 3.4a: ESTIMATED MAFB, MALB AND TFR BY PLACE OF RESIDENCE

	MAFB			MALB			TFR		
REGION	RURAL	URBAN	DIFFE-RENCE	RURAL	URBAN	DIFFE-RENCE	RURAL	URBAN	DIFFE-RENCE
KENYA	19.32	19.69	-0.37	41.16	38.72	2.44	8.32	6.23	2.09
NAIROBI	--	19.90	---	---	37.82		--	5.99	--
CENTRAL	19.81	19.99	-0.18	41.97	40.30	1.67	8.67	6.54	2.13
KIAMBU	19.89	19.75	0.14	41.04	39.75	1.29	7.96	6.41	1.55
MURANGA	19.99	20.14	-0.15	41.63	39.80	1.83	8.27	6.49	1.78
NYERI	20.06	20.24	-0.18	41.20	41.28	-0.08	8.12	6.6	1.52
NYANDARUA	19.56	19.85	-0.29	42.86	40.76	2.1	9.5	7.16	2.34
KIRINYAGA	19.87	20.20	-0.33	42.44	39.51	2.93	8.54	6.5	2.04
COAST	19.04	19.71	-0.67	40.29	37.11	3.18	7.44	5.54	1.9
MOMBASA	---	19.54	---	---	36.90	---	--	5.66	---
KWALE	18.98	18.94	0.04	40.21	38.94	1.27	7.16	6.21	0.95
TAITA	19.68	19.85	-0.17	40.83	39.12	1.71	7.89	7.41	0.48
LAMU	19.62	19.54	0.08	39.58	38.43	1.15	6.75	6.30	0.45
KILIFI	18.80	19.43	-0.63	39.95	37.06	2.89	7.34	5.72	1.62
TANA	19.41	19.31	0.1	42.12	41.05	1.07	8.08	7.50	0.58
EASTERN	19.91	20.34	-0.43	41.53	42.39	-0.86	7.79	7.84	-0.05
MACHAKOS	20.01	19.81	0.20	42.01	41.71	1.30	8.39	7.7	0.69
KITUI	19.58	19.45	0.13	41.07	40.19	0.88	8.01	6.52	1.49
EMBU	20.33	20.03	0.03	42.67	40.95	1.73	8.49	6.98	1.51
MERU	19.93	19.86	0.07	41.05	40.32	0.73	7.48	7.21	0.27
ISIOLO	19.80	19.61	0.19	41.11	40.12	0.99	7.04	6.78	0.26
MARSABIT	21.27	20.12	1.15	40.58	41.89	-1.31	6.11	7.04	0.93

Table 3.4a Contd

NYANZA	18.74	18.95	-0.21	40.89	39.01	1.88	8.5	6.96	1.54
KISUMU*	18.84	18.92	-0.38	40.08	38.74	1.34	8.04	6.84	1.2
KISII	18.81	19.50	-0.69	41.00	40.35	+0.75	9.18	7.80	1.38
SIAYA	18.93	19.11	-0.18	39.77	38.91	0.86	7.62	6.52	1.1
S. NYANZA	18.50	18.47	0.03	40.87	41.94	-1.07	8.23	7.73	0.5
WESTERN	19.12	19.02	0.1	41.49	40.14	1.35	8.85	7.68	1.17
BUNGOMA	19.14	19.09	0.05	42.05	40.81	2	9.1	8.19	1.21
BUSIA	18.84	18.53	0.31	40.45	38.68	1.77	8.07	7.04	1.03
KAKAMEGA	19.21	19.36	-0.15	41.58	40.42	1.16	8.9	7.68	1.22
RIFT VALLEY	19.16	19.40	-0.24	41.89	40.48	1.41	8.37	7.05	1.32
BARINGO	19.12	19.37	-0.25	41.23	41.97	-0.74	8.56	8.07	0.49
ELGEYO	19.61	20.24	-0.63	40.12	38.06	2.06	7.53	6.94	0.59
KAJIADO	19.07	19.31	-0.24	41.66	38.64	3.02	7.89	6.62	1.27
KERICHO	18.93	19.20	-0.27	42.18	40.84	1.34	8.98	7.72	1.26
NAKURU	19.34	19.44	-0.1	42.71	40.59	2.12	8.96	7.04	1.92
NANDI	18.46	19.27	-0.81	37.44	42.24	-4.8	7.20	6.95	0.25
NAROK	18.91	19.07	-0.16	41.65	41.17	0.48	7.78	7.21	0.57
LAIKIPIA	19.34	18.39	0.95	42.51	41.14	1.37	8.72	8.61	0.11
SAMBURU	20.45	19.50	0.95	41.51	40.26	1.25	6.77	7.02	-0.25
T. NZOIA*	18.56	19.42	-0.86	42.31	41.47	0.84	9.18	7.41	1.77
TURKANA	20.74	19.69	1.05	41.74	39.60	2.17	6.48	5.76	0.72
U. GISHU*	19.49	19.01	0.48	41.81	40.05	1.76	8.06	7.45	0.61
W. POKOT	19.14	19.84	-0.7	41.19	42.71	-1.53	7.99	7.38	0.61
N. EASTERN	20.57	19.98	0.59	42.37	40.37	2.00	7.45	6.99	0.46
GARISSA	20.11	19.40	0.71	42.76	38.66	4.10	8.09	6.72	1.37
MANDERA	20.94	20.81	0.13	42.51	40.99	1.53	7.20	7.34	-0.14
WAJIR	---	---	---	---	---	---	---	---	---

3.4.2 Differentials in Mean Age at First Birth by Level of Education

From the results given in table 3.4b we observe that in Central province the mean age at first birth for those with no education was around 18 years (between 17.93 years and 18.37 years). Those with primary education had slightly higher mean with Nyandarua having the least 19.32 and Kirinyaga the highest 19.56. The magnitude of differences were slightly over one year. Those with secondary and above had means lying between 20 years to 21.5 years. It is evident then that in this province, women with higher education eventually enter into motherhood at later age.

In Nyanza, similarly characteristics can be observed, although it is observed that for those with no education, the mean ages were slightly lower than those observed in Central province, and the values were below 18 years for other districts except Siaya. Those with primary education, had slightly higher mean ages. Similar pattern could be seen for those with level of education of secondary and above, the mean ages were above age 20.

In Coast province, as can be seen from table 3.4b Lamu and Tana River the mean ages were above 19 years and in other districts between 18 years and 19 years for those with no education. For those with primary education, the mean ages were above 19 years but lower than 20 years. The women secondary education had mean ages above 22.00 years except Taita Taveta and Kwale.

In Eastern Province, there are higher mean ages at first birth especially for women with secondary education, but varying. In Isiolo and Marsabit, women with primary education have slightly lower mean age at first birth than those with none. Western province, has similar pattern as in Nyanza province, where mean age at first birth increases with level of education.

In Rift Valley like Eastern province, there are similar characteristics; mean age at first birth is higher with respect to level of education, except in Turkana and Samburu. These two regions (Turkana and Samburu) have similar characteristics as Isiolo and Marsabit. However, in all these four districts, age at first birth is high as already seen in previous case when only regions were considered. On the other hand, majority of the population in these regions are nomadic and few especially those who live in urban areas are settled. Quality of data form those districts can also be questionable.

At national level, the aggregate results indicate rising age at first birth with level of education.

3.4.3 Differentials in Mean Age at Last Birth

From table 3.4b we can be observe that mean age at last birth varied extensively with the level of education.

In Central province, those with no education and with primary education, display similar characteristics, as can be observed that mean age at last birth is close. When we consider secondary education and above, it can be seen that they had lower age at last birth in almost all the districts except in Kirinyaga.

In Nyanza province, Kisii and South Nyanza display same characteristics as Kirinyaga in Central province where those with secondary education had high mean age at last birth. In Siaya, the mean age at last birth for those with primary education was the highest while those with secondary and above and none were similar. In Kisumu, those with secondary education had lower mean age while those with primary and none did not differ much.

In Coast province, it is clear cut that those with secondary education had lowest mean age at last birth while the highest was those with primary education and the pattern can be described by a "U" shape when level of education is plotted against mean age at last birth.

Eastern province, had similar characteristics as in Coast province although the ages were higher. It can still be pointed out that in Marsabit, those with secondary education and those with no education had almost similar mean age at last birth.

In Western province, Busia and Bungoma districts, had similar characteristics as Kisii and South Nyanza in Nyanza, and Kirinyaga in Central. The mean ages at last birth for women with secondary education were very high above 40 years. In Busia, the pattern show increased MALB with level of education; while in Bungoma, those with primary education had highest mean age.

In Rift Valley province, similar characteristics was shown as in Central province, Coast province, but it can be observed that in Trans Nzoia, the age at last birth did not vary with level of education. In Baringo, the mean age at last birth was beyond age 40 and increased with level of education as is the case of Busia. In Trans Nzoia, the differences between the means were less than one year. In West Pokot, though those with secondary education had a lower mean age, it was beyond age 40.

At national level despite the smaller fluctuations, the mean age at last birth decreased with level of education indicating that at aggregate level, those with higher education are likely to stop reproduction earlier.

The mean age at first birth, for women with secondary education was higher in all the districts although the magnitude varied.

However, when we consider mean age at last birth, most districts show lower mean age at last birth for women with secondary education and above, but it can be observed that a number of districts, namely: Kirinyaga, Kisii, South Nyanza, Bungoma, Busia, Baringo, Trans Nzoia, West Pokot and Marsabit, this was contrary to the observed patterns of differences expected.

TABLE 3.4b: ESTIMATED MAFB, MALB BY LEVEL OF EDUCATION

	NONE		PRIMARY		SECONDARY	
	MAFB	MALB	MAFB	MALB	MAFB	MALB
KENYA	18.54	40.36	19.40	42.66	21.61	36.03
NAIROBI	18.56	40.46	19.20	37.91	22.13	34.28
KIAMBU	17.32	41.91	19.45	40.45	21.41	36.50
KIRINYAGA	17.93	41.36	19.56	41.84	21.58	43.32
MURANGA	18.12	41.51	19.41	42.09	20.92	37.08
NYANDARUA	18.01	42.40	19.32	40.44	20.74	35.48
NYERI	18.37	41.81	19.42	41.10	21.32	37.16
KISUMU	17.70	40.97	18.69	40.13	20.45	37.27
KISII	17.50	41.26	19.05	43.19	21.41	42.07
SIAYA	18.25	38.57	18.90	42.12	20.94	36.54
S. NYANZA	17.65	37.31	18.59	41.60	20.27	41.63
KILIFI	18.50	39.26	19.69	41.10	22.04	37.77
KWALE	18.28	39.63	19.66	41.14	21.74	32.65
MOMBASA	18.66	36.76	19.40	36.82	22.08	33.14
LAMU	19.22	39.94	19.52	41.40	22.16	28.17
TAITA	18.11	39.67	19.68	41.79	20.04	38.71
TANA	19.26	41.79	19.62	42.09	22.04	27.48

TABLE 3.4b CONTD.

	NONE		PRIMARY		SECONDARY	
	MAFB	MALB	MAFB	MALB	MAFB	MALB
EMBU	18.78	42.33	19.70	41.73	22.11	37.77
ISIOLO	19.10	40.23	19.79	33.92	23.08	33.31
KITUI	18.74	40.63	19.93	42.10	21.59	38.57
MACHAKOS	18.80	40.90	19.98	42.63	23.31	37.71
MARSABIT	20.78	40.64	20.08	44.49	21.14	40.06
MERU	18.77	40.59	19.70	42.14	22.00	34.38
BUNGOMA	18.07	41.36	19.28	43.91	20.49	42.09
BUSIA	17.84	38.60	19.15	40.56	21.09	42.68
KAKAMEGA	17.95	40.19	19.38	41.77	20.98	40.26
BARINGO	18.20	41.31	19.39	42.89	21.38	43.31
ELGEYO	18.38	40.69	19.80	42.81	22.14	39.51
KAJIADO	18.49	41.68	18.93	41.71	20.84	36.67
KERICHO	17.76	41.77	20.29	43.74	21.31	39.02
NANDI	17.67	41.35	18.80	42.17	20.69	34.16
NAKURU	17.97	42.66	19.01	42.10	21.03	35.91
LAIKIPIA	18.57	42.72	19.17	41.45	20.96	34.04
SAMBURU	20.32	41.51	19.59	40.14	---	---
T. NZOIA	17.67	42.03	18.83	42.51	20.53	42.43
TURKANA	20.30	41.75	19.87	40.43	---	---
U. GISHU	17.93	42.09	19.17	41.87	21.40	37.38
W. POKOT	18.70	41.29	19.15	43.44	22.31	40.11
NAROK	18.53	41.68	18.96	44.21	21.16	32.47

TABLE 3.4c

ESTIMATED TOTAL FERTILITY RATES BY LEVEL OF EDUCATION

DISTRICT	TOTAL FERTILITY RATE		
	NONE	PRIMARY	SECONDARY
NAIROBI	7.18	6.39	3.82
KIAMBU	8.94	8.08	5.10
KIRINYAGA	8.88	8.67	7.15
MURANGA	9.91	9.26	6.46
NYANDARUA	9.71	8.24	5.30
NYERI	9.05	8.60	6.33
LAMU	7.40	8.61	1.9
MOMBASA	5.98	5.83	3.72
KWALE	7.12	7.64	3.88
TANA RIVER	8.09	8.86	2.9
KILIFI	7.23	7.88	4.34
TAITA TAVETA	7.88	8.32	5.77
EMBU	9.09	8.83	6.12
MACHAKOS	7.73	8.86	6.05
KITUI	8.21	8.49	5.73
MERU	7.93	8.54	4.64
MARSABIT	6.39	7.36	3.68
ISIOLO	6.71	5.19	3.08
KISUMU	8.39	8.12	5.35
KISII	9.92	10.20	6.23
SIAYA	6.96	10.68	5.87

TABLE 3.4c CONTD.

DISTRICT	TOTAL FERTILITY RATE		
	NONE	PRIMARY	SECONDARY
SOUTH NYANZA	7.89	8.43	6.80
BUNGOMA	9.33	10.70	7.13
BUSIA	7.54	8.44	7.86
KAKAMEGA	8.74	9.27	7.02
BARINGO	9.01	9.32	6.64
ELGEYO MARAKWET	8.07	8.57	6.14
KERICHO	9.11	8.91	6.04
WEST POKOT	8.32	9.88	5.84
NAKURU	9.36	8.76	5.19
NANDI	8.60	9.23	5.48
KAJIADO	8.22	8.05	5.67
NAROK	7.89	9.54	4.24
LAIKIPIA	9.13	8.56	4.81
UASIN GISHU	9.02	8.97	4.96
TRANS NZOIA	9.23	9.63	7.23
SAMBURU	7.12	7.44	--
TURKANA	6.71	7.21	--

When we consider regional variation in the indices MAFB and MALB when the population is disaggregated by level of education and residence, the summary of the variation in terms of numeric and graphic representation of the distribution is presented in table 3.4d and graphic summary in figures 3.4, 3.5a and 3.5b.

Mean age at first birth had small variation as indicated by the length of midspread and range although with increased level of education, it showed a wider range.

The mean age at last birth showed a wider dispersion shown by the range in all the cases although when we consider also the midspread, only secondary education had greater dispersion.

Rural-Urban residence had no significant difference in the variation of the events as the plots indicate almost similar position of median and quartiles in MAFB with slightly lower positions and wider midspread in MALB.

The box plots for level of education in figure 3.4 panel A indicate a rising pattern of mean age at first birth with increasing level of education and almost constant mean ages at last birth for those with no education and primary education but lower for those with secondary education when we consider positions of median and quartiles.

Table 3.4d: NUMERIC SUMMARY OF MAFB, MALB AND TFR BY LEVEL OF EDUCATION AND RESIDENCE

		Min.	Lower quartile	Median	upper quartile	Max.	Mid-spread	Range
NONE	MAFB	17.50	17.9	18.4	18.8	20.32	0.9	2.82
	MALB	36.76	40.2	41.3	41.8	42.72	1.6	5.96
PRIMARY	MAFB	18.69	19.1	19.4	19.7	20.29	0.6	1.6
	MALB	33.92	40.8	41.8	42.6	44.49	1.8	10.57
SECONDARY	MAFB	20.04	20.9	21.3	22.1	23.08	1.2	3.04
	MALB	27.48	34.1	36.9	39.7	43.32	5.6	15.84
RURAL	MAFB	18.46	19.00	19.5	20.00	21.27	1.00	2.8[illegible]
	MALB	38.06	40.7	41.4	42.2	42.76	1.5	4.7
URBAN	MAFB	18.39	19.2	19.5	19.9	20.81	0.7	2.42
	MALB	36.90	38.9	40.3	41.1	42.72	2.2	5.82

TOTAL FERTILITY RATE

	Min.	Lower quartile	Median	upper quartile	Max.	Mid-spread	Range
NONE	5.98	7.42	8.22	9.04	9.92	1.62	3.94
PRIMARY	5.19	8.07	8.59	9.25	10.7	1.18	4.51
SECONDARY	1.9	4.49	5.69	6.28	7.86	1.79	5.96
RURAL	6.11	7.41	8.03	8.55	9.5	1.14	3.39
URBAN	5.66	6.52	7.03	7.41	8.61	0.89	2.95

Fig. 3.5 VARIATION IN MEAN AGE AT FIRST BIRTH, AND LAST BIRTH AND TOTAL FERTILITY RATE BY RESIDENCE

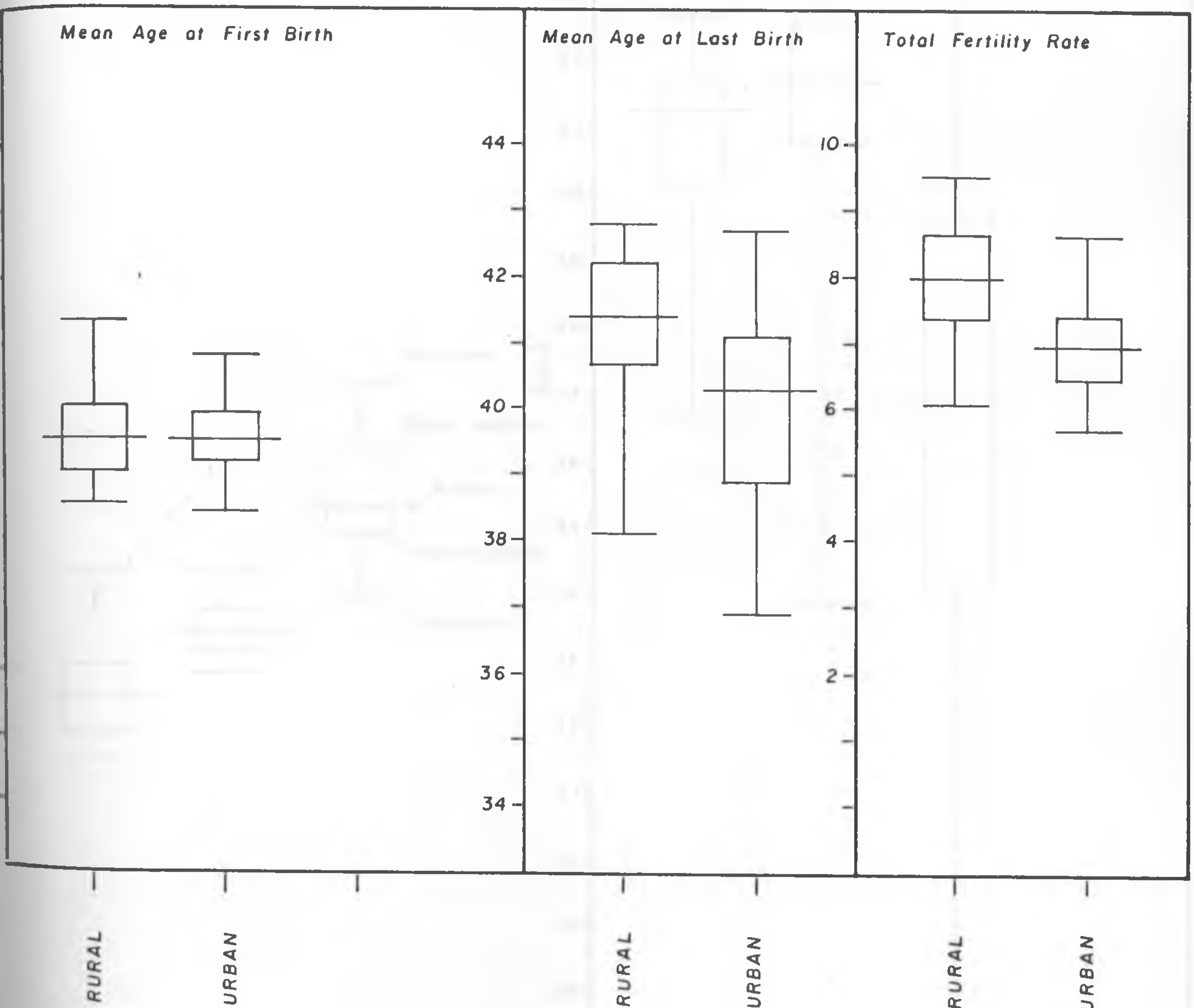


Fig. 3.6 VARIATION IN MEAN AGE AT FIRST AND LAST BIRTH BY LEVEL OF EDUCATION (REGIONS)

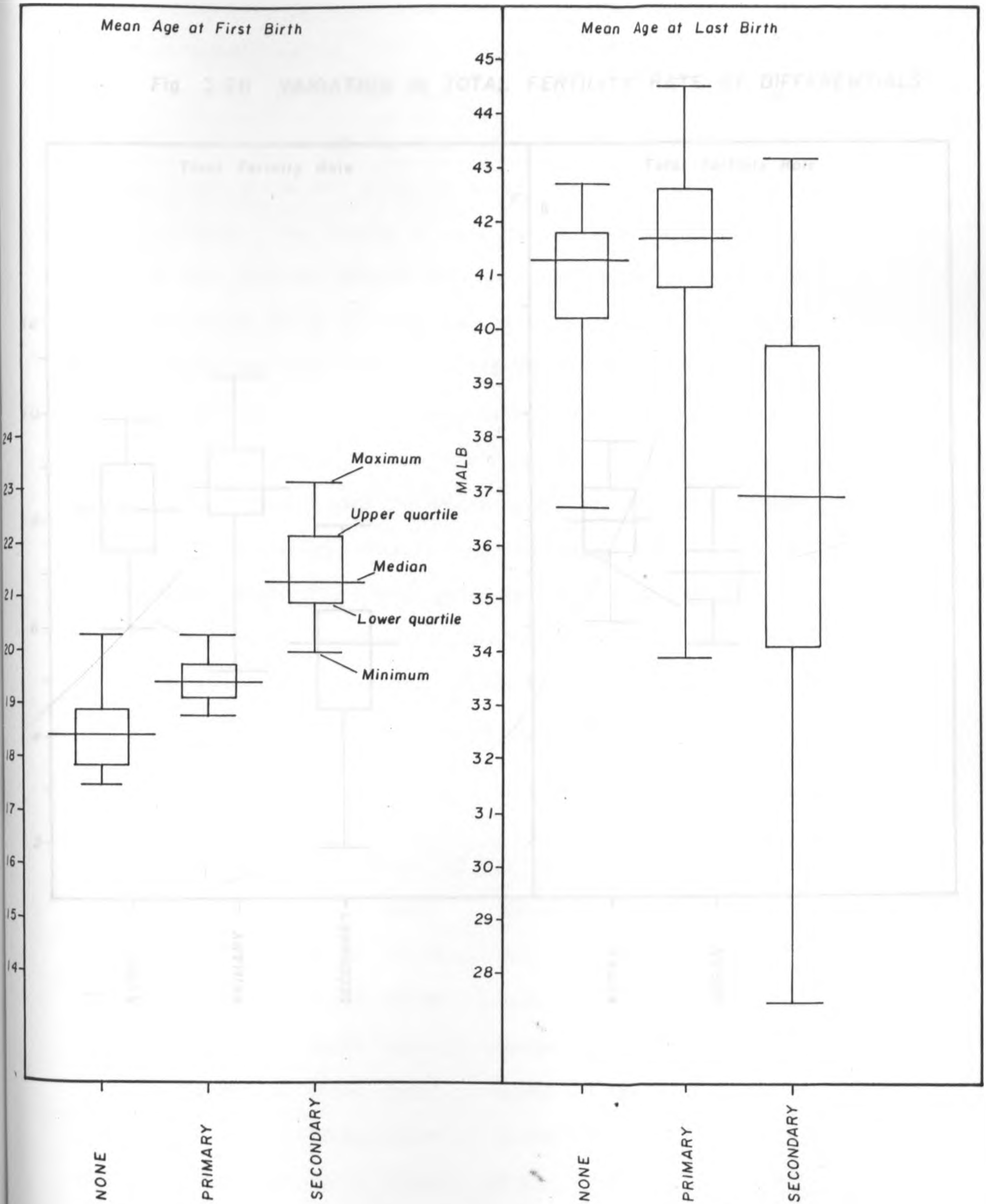
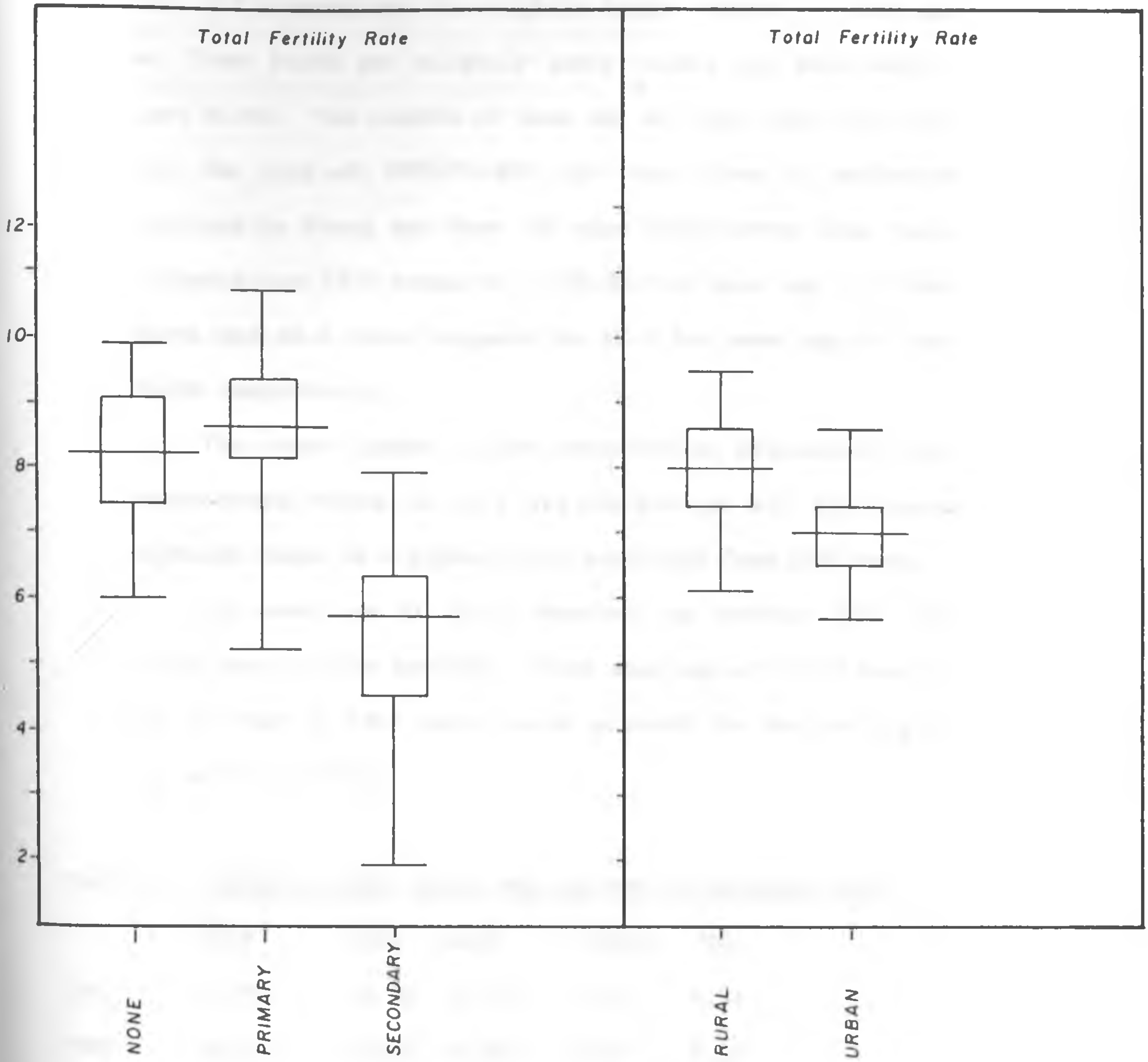


Fig. 3.6B VARIATION IN TOTAL FERTILITY RATE BY DIFFERENTIALS



3.5 APPLICATION OF SIVAMURTHY'S METHOD AT NATIONAL LEVEL

In table 3.5, we have the results of application of Sivamurthy's method to Kenya's data at national level.

As in the previous case, the trends are similar, the only differences are the slightly higher values for mean age at first birth and slightly lower values for mean age at last birth. The results of mean age at first and last birth for the case of 1977/78 KFS are very close to estimates obtained by Ferry and Page who also used survey data their estimate was 19.3 compared to 19.24 for mean age at first birth and 40.4 years compared to 40.5 for mean age at last birth respectively.

The other index is the proportion ultimately not reproducing which is very negligible in all the years although there is a higher value indicated from 1962 data.

The mean age at child bearing was between 29.4 and 31.50 years in the periods. Older mean age at child bearing was noticed in 1962 which could probably be due to higher age at first birth.

TABLE 3.5: TREND IN MAFB, MALB, PNR AND TFR AT NATIONAL LEVEL

	MAFB	MALB	MACB	PNR(%)	TFR
1962	21.78	40.20	31.50	0.31	5.24
1969	19.84	41.62	29.86	0.01	8.03
1977	19.81	40.80	29.41	0.008	7.96
1977/78	19.24	40.52	29.92	0.009	7.90
1979	19.69	41.09	29.44	0.004	8.45
1984	19.72	40.79	29.45	0.01	7.67

3.5.1 APPLICATION OF SIVAMURTHY'S METHOD AT PROVINCIAL AND DISTRICT LEVEL

The results of application of Sivamurthy's method to districts and provinces is presented in tables 3.6 for periods 1969 and 1979 respectively.

The patterns of range in mean age at first birth and last birth remain as those indicated by Suchindran - Horne method of the previous section. What was noticed was that this method had slightly higher estimates for mean age at first birth in all the regions although the differences did not exceed one year. Further, the method had lower estimates for mean age at last birth in all the cases considered but the differences were still smaller than one year.

The mean age at child bearing is one of the indices which was obtained using this method but not by Suchindran - Horne method was indicated in the second column. This index does not indicate extent of level of fertility but only show whether the reproductive behaviour is towards early or late child bearing.

Higher mean ages at child bearing were in all districts in Central province, North Eastern, Samburu and Kajiado in Rift Valley province, Kisii in Nyanza, Machakos in Eastern and Bungoma in Western province in 1969 where the index was above 30 years. The mean age at last birth in these regions were well beyond 41 years, indicating that in these regions child bearing ends late or indication of broad peaked fertility pattern. Lower mean age at child bearing in 1969 were in Siaya, South Nyanza and Kisumu in Nyanza province, Lamu, Mombasa and Tana River in Coast province. These regions had slightly lower mean age at first birth while in Nairobi, Marsabit, Mombasa and Lamu, it could be particularly due to earlier ending of childbearing

The same pattern could be observed when 1979 values were considered, mean ages at child bearing were younger in Nairobi, Kisumu, Siaya, South Nyanza, Mombasa, Kwale, Lamu, Kilifi, West Pokot and Busia, and older ages were still reflected in North Eastern province, Marsabit and Embu in Eastern, Turkana, and in Central province.

As in the previous section, the districts like Trans Nzoia, Laikipia, Marsabit, Lamu, had contrasts in the indices over the period especially in mean age at child bearing and mean age at last birth. Such big deviations which reveal changes in reproductive behaviour could be misleading as they tend to occur due to changes in the age specific fertility rates in the older age groups.

TABLE 3.6: ESTIMATED MAFB, MACB AND MALB FROM SIVAMURTHY'S METHOD

REGION	MAFB		MACB		MALB	
	1969	1979	1969	1979	1969	1979
KENYA	19.84	19.69	29.86	29.44	41.62	41.09
NAIROBI	20.38	20.22	28.69	28.19	38.57	37.65
CENTRAL	20.30	20.18	30.52	29.83	42.23	41.32
KIAMBU	20.35	20.22	30.57	29.83	22.08	41.26
MURANGA	20.38	20.10	30.47	29.53	42.22	41.04
NYERI	20.51	20.32	30.78	29.61	42.51	40.80
NYANDARUA	19.89	19.94	31.12	30.21	43.78	42.25
KIRINYAGA	19.95	20.12	29.72	29.89	41.60	41.64
COAST	19.71	19.42	28.80	28.41	39.83	39.49
MOMBASA	19.86	19.85	27.18	27.53	36.03	36.74
KWALE	19.47	19.17	29.29	28.49	41.76	40.02
TAITA	20.28	19.90	29.17	29.12	39.71	40.35
LAMU	20.19	19.71	26.73	28.77	34.09	39.83
KILIFI	20.49	19.12	29.49	28.15	39.79	39.52
TANA	19.68	19.74	28.75	29.58	38.30	41.64
EASTERN	20.27	20.72	30.38	29.73	42.12	41.28
MACHAKOS	20.22	20.24	30.43	30.85	42.20	41.62
KITUI	20.21	19.88	29.91	29.26	41.23	40.61
EMBU	19.88	20.49	29.95	30.39	41.83	42.31
MERU	20.45	19.92	29.65	29.52	43.20	40.95
ISIOLO	20.04	20.12	29.64	29.22	41.37	40.30
MARSABIT	20.74	21.00	28.87	30.10	37.03	40.60

TABLE 3.6 CONTD

NYANZA	19.35	18.98	29.90	28.64	41.86	40.43
KISUMU	19.02	18.81	28.75	28.14	40.82	39.52
KISII	19.91	19.21	30.92	29.35	45.65	41.66
SIAYA	19.55	18.98	28.58	28.27	39.85	39.57
S. NYANZA	18.95	18.76	28.86	28.50	40.93	40.53
WESTERN	19.36	19.43	29.52	29.28	41.37	40.95
BUNGOMA	19.61	19.52	30.13	29.66	42.14	41.39
BUSIA	19.46	19.17	29.22	28.52	40.91	39.95
KAKAMEGA	19.32	19.47	29.49	29.34	41.44	41.06
RIFT VALLEY	19.72	19.38	29.20	29.35	40.73	41.40
BARINGO	19.29	19.67	28.87	29.07	40.53	40.61
ELGEYO	20.24	20.28	29.79	29.01	41.34	39.66
KAJIADO	20.43	19.09	30.78	29.22	42.19	41.67
KERICHO	19.51	19.11	29.63	29.56	41.41	42.02
NAKURU	19.80	19.48	29.89	29.79	42.28	42.04
NANDI	19.33	19.10	28.79	28.89	40.50	40.19
NAROK	19.63	19.10	29.04	21.15	39.20	40.99
LAIKIPIA	19.25	19.62	27.53	29.75	36.97	41.92
SAMBURU	21.30	20.35	30.48	29.77	40.61	40.87
T. NZOIA	18.77	19.04	25.92	29.38	34.94	41.82
TURKANA	21.21	20.55	29.31	30.00	41.16	41.39
U. GISHU	19.96	19.52	29.14	29.49	39.41	41.72
W. POKOT	19.20	19.24	28.13	28.86	38.86	40.86
N. EASTERN	22.19	20.70	31.27	30.10	31.71	40.70
GARISSA	20.97	20.23	30.93	29.99	43.15	41.70
MANDERA	23.69	21.15	32.48	31.10	42.25	41.11
WAJIR	21.22	20.87	30.33	30.29	40.23	41.19

CHAPTER FOUR

SUMMARY, CONCLUSION AND RECOMMENDATION

4.1 SUMMARY

The object of this thesis was to estimate some fertility indices for women in Kenya using data from censuses.

The estimation procedure was based on the use of age specific fertility rates which was obtained from the use of information on children born prior to the census period and the number of women in the child bearing age group during the period. Since in most censuses the information based on reported children born during the year preceeding the census have varied errors, the obtained schedules of age specific fertility rates were further adjusted through application of indirect procedures. In this thesis, P/F ratios were used following the model of Coale and Trussel to adjust the schedules of the age specific fertility rates. This further required the use of information on children ever born by women of child bearing age to provide for adjustment.

Suchindran-Horne (1984) method described in chapter two was the main method used in estimating the indices and supplemented by Sivamurthy (1987) method for comparative purposes. All the two methods have analogy of the life table procedures used in classical mortality analysis. The application of these methods depends on the assumption that women are homogenous and that the age specific fertility rates remain constant within a given period.

In the Suchindran-Horne method, the age - specific fertility rates have been used as an indicator of the force of fertility within a given age or age group. The indices obtained from the procedure were mean age at first birth, mean age at last birth, mean length of interval between first and last birth and mean inter-birth spacing. These indices were obtained as summaries of the reproductive behaviour of women at aggregate level. From the procedure, they refer only to the hypothetical women who will undergo the given schedules of the set of age specific fertility rates and thus are synthetic and do not refer to real cohorts of the population. Their interpretation is then similar to that accorded to total fertility rate.

In the Sivamurthy's method, age specific fertility rates were used although they only represent unconditional probabilities of giving birth within the respective age intervals. This was done due to absence of the conditional probabilities. Thus more accurate information can be obtained when conditional probabilities are used.

In chapter three, the results of application of the methods to Kenya's data was presented both at national, regional level and by level of education and residence.

At regional level (districts), the mean age at first birth in 1969 ranged from 18.14 years in Trans Nzoia district to 23.31 years in Mandera. Majority of the districts had mean ages between 19 and 20 years showing quite a high regularity in the age pattern at first birth.

In 1979, the lowest mean age at first birth was observed in South Nyanza district, about 18.26 years and the highest still Mandera about 20.82 years. Only six districts had a mean ages above 20 years while fourteen had mean ages below 20.00 years. Despite the slight changes observed between data set for 1969 and 1979, there still existed an amount of clustering of mean age between 19 and 20 years as depicted in both the box plots and/or the numeric summaries. The scatter plots between total fertility rate (TFR) and mean age at first birth indicated no sign of strong linear relationship between indices.

Lower mean ages at first birth was observed in districts in Nyanza, Western and some in Rift Valley provinces, while higher mean ages at first birth was observed mainly in North Eastern province, some districts in Rift Valley bordering North Eastern province, Eastern and Central provinces in both periods.

On the pattern of completion of child bearing, earlier mean ages at last birth was particularly observed in districts in Coast province in 1969 and the major urban centres; that is Nairobi and Mombasa. About 28 districts had a mean ages at last birth above 40 years with the highest being observed in Kisii and Nyandarua (43.99 years) districts. It could be noted that these two districts had also the highest fertility rates as indicated by the total fertility rates estimated (figure 3.2a), and the shortest mean interbirth spacing.

In 1979, the pattern varied between 36.90 years in Mombasa and 42.51 years in Embu. 34 districts had a mean ages above 40 years compared to 28 in 1969. Most districts in Rift Valley province and Coast province which had lower mean ages at last birth were seen to have had an increase. The highest increase were observed in Trans Nzoia, Lamu, Laikipia, Marsabit, Tana River and Narok districts respectively. These districts also showed increased level of fertility as indicated by the total fertility rates. While on one hand such big changes in the index over short span could be attributed to the relative differences in the error on the data, (Pitcher 1987) also observed that during the intercensal period, these districts received large volume of immigrants from other provinces, a factor which could relatively bring different estimates of fertility. The rest of other districts registered a change of about 1 year.

Rural/urban differences in in the fertility indices considered here were not much. Although fertility levels were consistently higher for rural than urban areas, the magnitude of the differences were small. When we considered the patterns of age at first birth, it is observed that the magnitude of the differences between mean age at first birth did not exceed one year. The direction of the differences was not well established as about half of the regions rural mean age at first birth were lower than the urban mean ages at first birth. This was even reflected in the cases of Nairobi and Mombasa which are the most urbanized areas. The mean ages at first birth in these regions were lower than those observed in other districts, although they did rank among the highest. However, when we considered age at last birth, the mean ages at last birth in wide number of areas for urban women were lower than for the rural women. The magnitude being close to about 2 years.

Differentials in the indices by level of education was significant only when we considered secondary education. In most cases, those with primary education registered higher fertility than those with no education. Women with secondary education had lower fertility than those with primary education and those with no education. It was observed that the index was not uniform across the regions as TFR varied from a low of 2.9 births to high of about 7 births in Bungoma, Kirinyaga, Kisii and Trans Nzoia.

The mean age at first birth for women with secondary education were significantly higher than those with no education or primary education. The magnitude was between 3 to 4 years.

The women with secondary education did have the lowest mean ages at last birth but there were cases like Bungoma, Tran Nzoia, Busia, Kirinyaga and Kisii where it was high. It could also be observed that the mean age at last birth for women with primary education is the highest in quite a number of districts corresponding to their high fertility.

It was observed that there were variations in reproductive behaviour indices across the regions. Although, small variation was exhibited in age at first birth, particularly when all the population was considered in each of the regions, there were observed slight substantial variations when the population was disaggregated by level of education particularly in age at last birth.

These variations then raise such questions as to whey districts like Kisii, Bungoma, Trans Nzoia, Laikipia, Kirinyaga, Kakamega, Kericho and Nakuru where there is high potential agricultural land have lower mean ages at first birth, older mean ages at last birth and very high level of fertility. This is also observed even in cases of women residing in urban centres and women with high level of educational attainment (secondary education).

4.2 CONCLUSION

In the foregoing conclusion, we have estimated some of the reproductive indices for Kenya women. These indices are synthetic and do not refer to real cohort indices. However, the indices point that child bearing in Kenya starts at very early age of about 19 years and ends very late around age 40. The differentials in the indices, indicate that differences in level of education have substantial effect. Higher education corresponds with higher mean age at first birth, lower mean age at last birth and lower level of fertility. The rural-urban differential in the indices was small particularly on the age at first birth.

In addition, when the regional differentials were considered in both the periods 1969 and 1979, we observe that in 1979, the magnitude of the differentials were much smaller. It is particularly noted that regions where there was low fertility showed increased fertility and also the other indices move in direction that favours higher fertility.

On methodological issues, it was observed that both methods which were used present similar results as there were very little differences in the estimates.

It is not enough to conclude the thesis without mentioning the characteristics of the problems in measurements of these child bearing indices that is, mean age at birth of first and last child and the length of time between birth of first and last child.

The measurement of age at first birth raises the statistical problem of whether to use mean or median since the distribution of the event is skewed. On the other hand, what types of data set are needed to estimate the age at birth of last child. A suggestion to this, is the use of biographical data which can be obtained from either longitudinal or retrospective surveys which is the gist of recommending such studies to survey data although the problem of truncation bias cuts in.

Secondly, in the estimation of the average length of time between first and last birth is done though this would not measure the time more accurately. The time length was obtained only as a pointer. In actual fact, such estimates are only suitable when the universes are the same. The estimate of the averages will not in real sense be continually applying to some sets of persons when estimated on period basis. In addition, such means only refer to women who have parity two and above.

4.3 RECOMMENDATIONS

The results of the estimates of the fertility indices indicate that child bearing starts at an early age among the Kenyans and continues up to very late age. Since these indices are important in studies related to family formation, more research is needed to establish the ages at first birth, last birth, length of time taken for reproductive and their correlates. Further research is needed to determine the extent of the causal mechanism between these indices and other socio-cultural aspects of the society. In addition, more research should also be directed to the link between time taken for reproduction, the effects on child survival, economic status of the family or household as these aspects directly relate to the level of fertility. This could only be achieved if the data is obtained through surveys where other indices of family, household and eventually at individual level could be obtained.

As has been pointed out earlier, that women with secondary education had higher age at first birth, lower mean age at last birth and thus have shorter time to be spent during child bearing. If this is accompanied by longer inter-birth spacing, then the family size will necessarily be low. Education of the women then still remains one of the principal ways at which low fertility can be achieved but this is only possible when it is up to secondary level.

Also to the family planners, it should be noted that even if low fertility is to be achieved through birth spacing, it could further be reduced if campaigns of children only at prime ages rather than at old ages (above 35) is intensified so that fertility control both parity dependant as well as age dependant.

On methodological issues, there is more need to study the age pattern of onset of motherhood, termination of motherhood as part of life cycle analysis whether on individual level or at family level. The study of these events should be incorporated in other studies which have already been done especially on nuptiality and mortality and how these aspects of demography affect the age at birth of first child and last child.

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APPENDIX A

DISTRICT	SINGULATE MEAN AGE AT MARRIAGE (1979 (FEMALES)
KILIFI	17.34
NAROK	17.59
NANDI	18.06
KWALE	18.17
SOUTH NYANZA	18.51
KAJIADA	18.63
TANA RIVER	18.72
BUSIA	18.91
KISUMU	18.96
WEST POKOT	18.98
ISIOLO	19.14
SAMBURU	19.16
MANDERA	19.20
SIAYA	19.25
TRANS NZOIA	19.29
GARISSA	19.31
WAJIR	19.33
MARSABIT	19.35
KERICHO	19.36
BUNGOMA	19.43
LAMU	19.56
BARINGO	19.72
UASIN GISHU	19.87
KITUI	19.88
ELEGEYO MARAKWET	19.96

DISTRICT	SINGULATE MEAN AGE AT MARRIAGE (1979 (FEMALES)
MOMBASA	19.97
KAKAMEGA	20.17
KISII	20.23
LAIKIPIA	20.35
NAKURU	20.65
MERU	21.00
NYANDARUA	21.03
NAIROBI	21.26
TURKANA	21.32
KIRINYAGA	21.33
MURANGA	21.38
MACHAKOS	21.45
EMBU	21.59
TAITA TAVETA	21.66
KIAMBU	22.03
NYERI	22.61
KENYA	19.69

Source: Marbel Nyarango: Estimation of Nuptiality using census data for Kenya. Unpublished M.A. thesis. University of Nairobi. PSRI, 1985

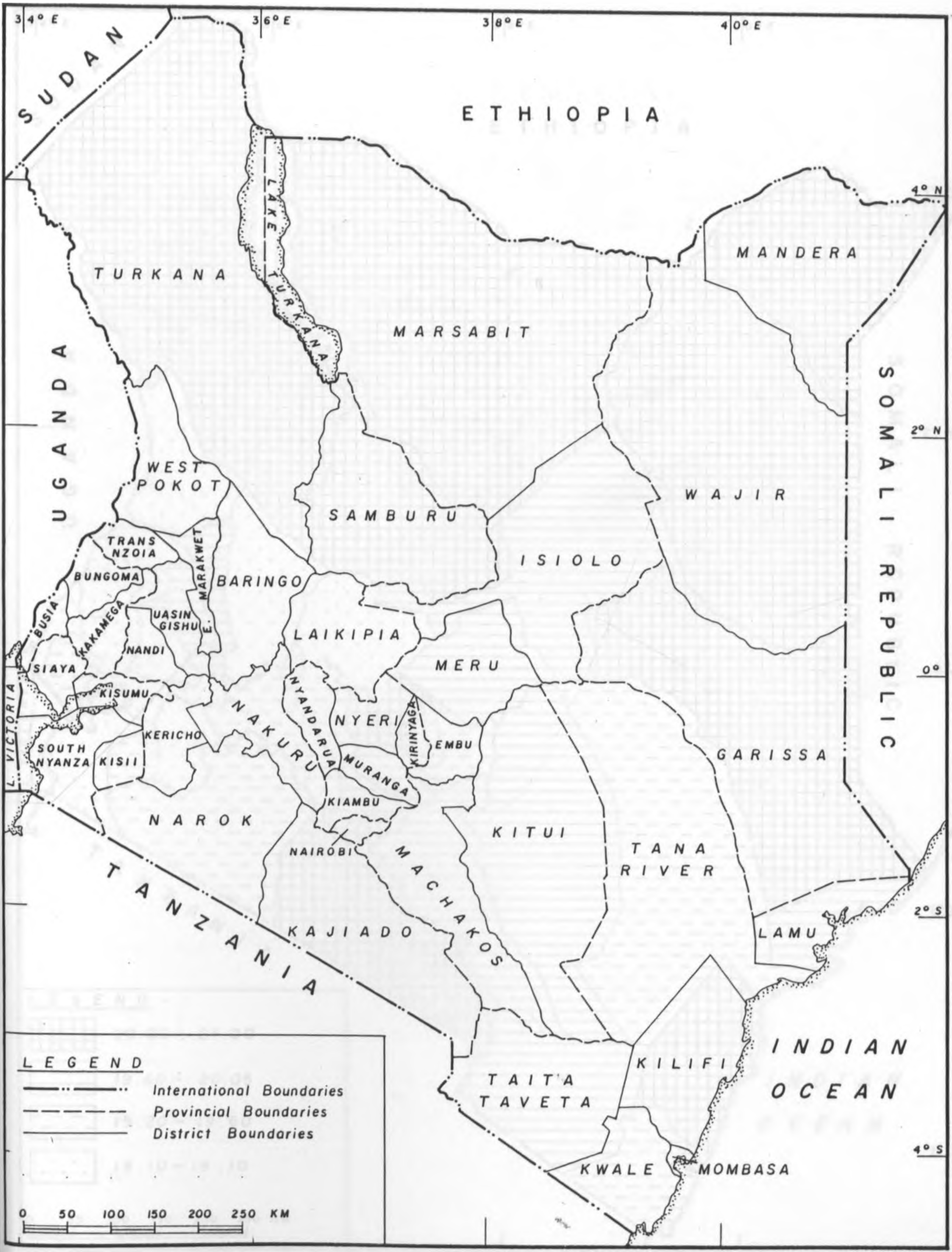


Fig.3.3a: KENYA : ADMINISTRATIVE BOUNDARIES

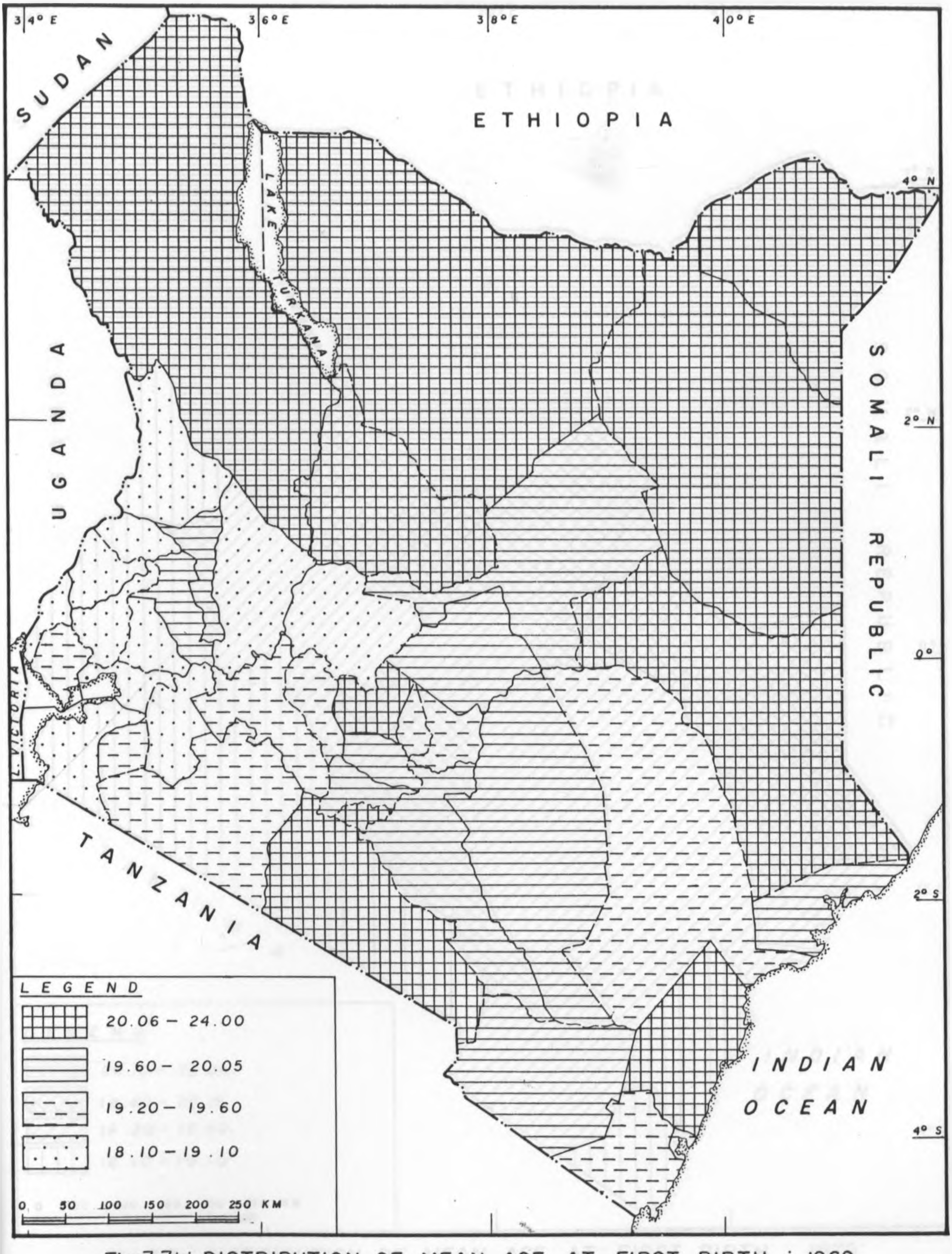


Fig.3.3b: DISTRIBUTION OF MEAN AGE AT FIRST BIRTH : 1969

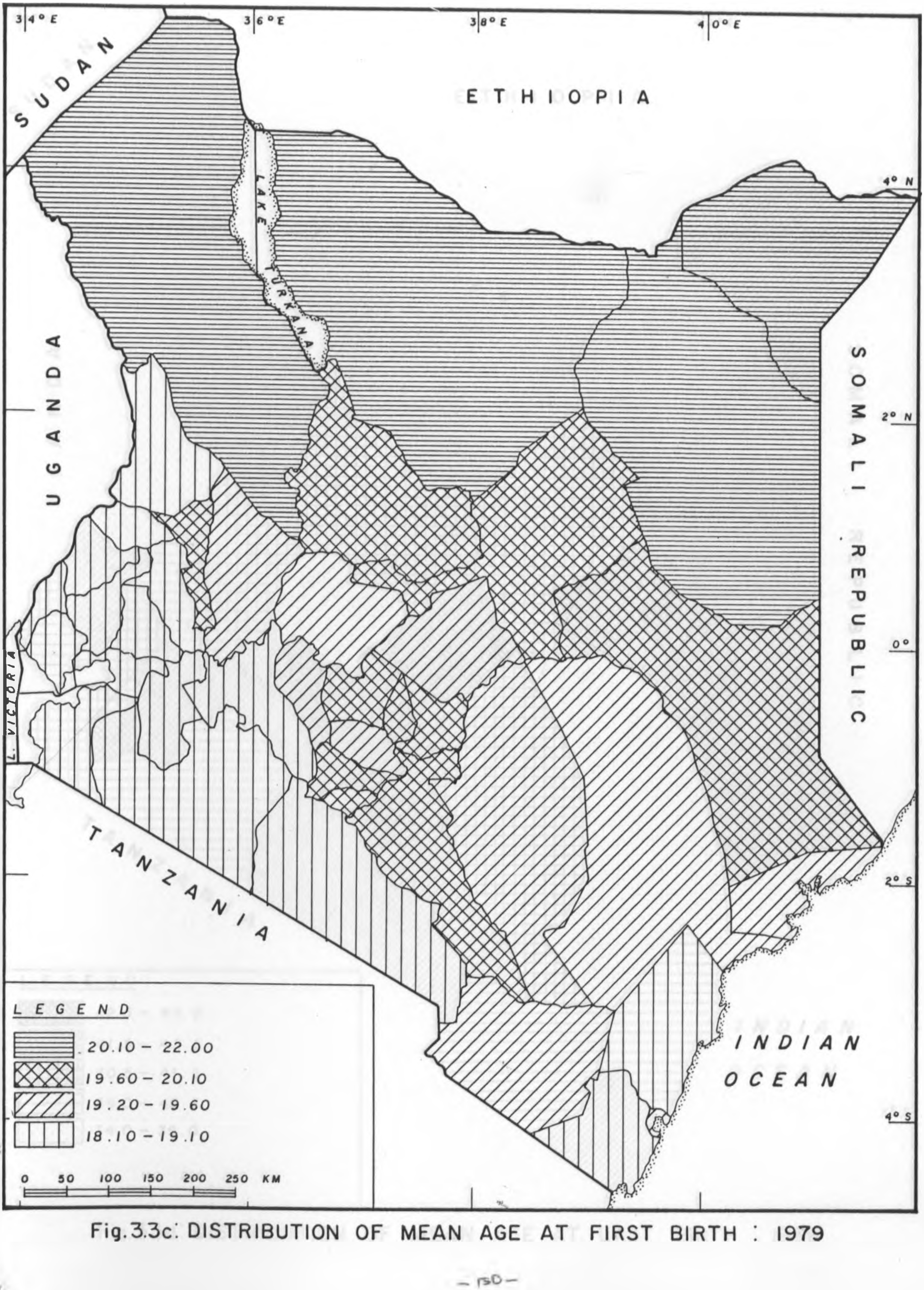


Fig. 3.3c: DISTRIBUTION OF MEAN AGE AT FIRST BIRTH : 1979

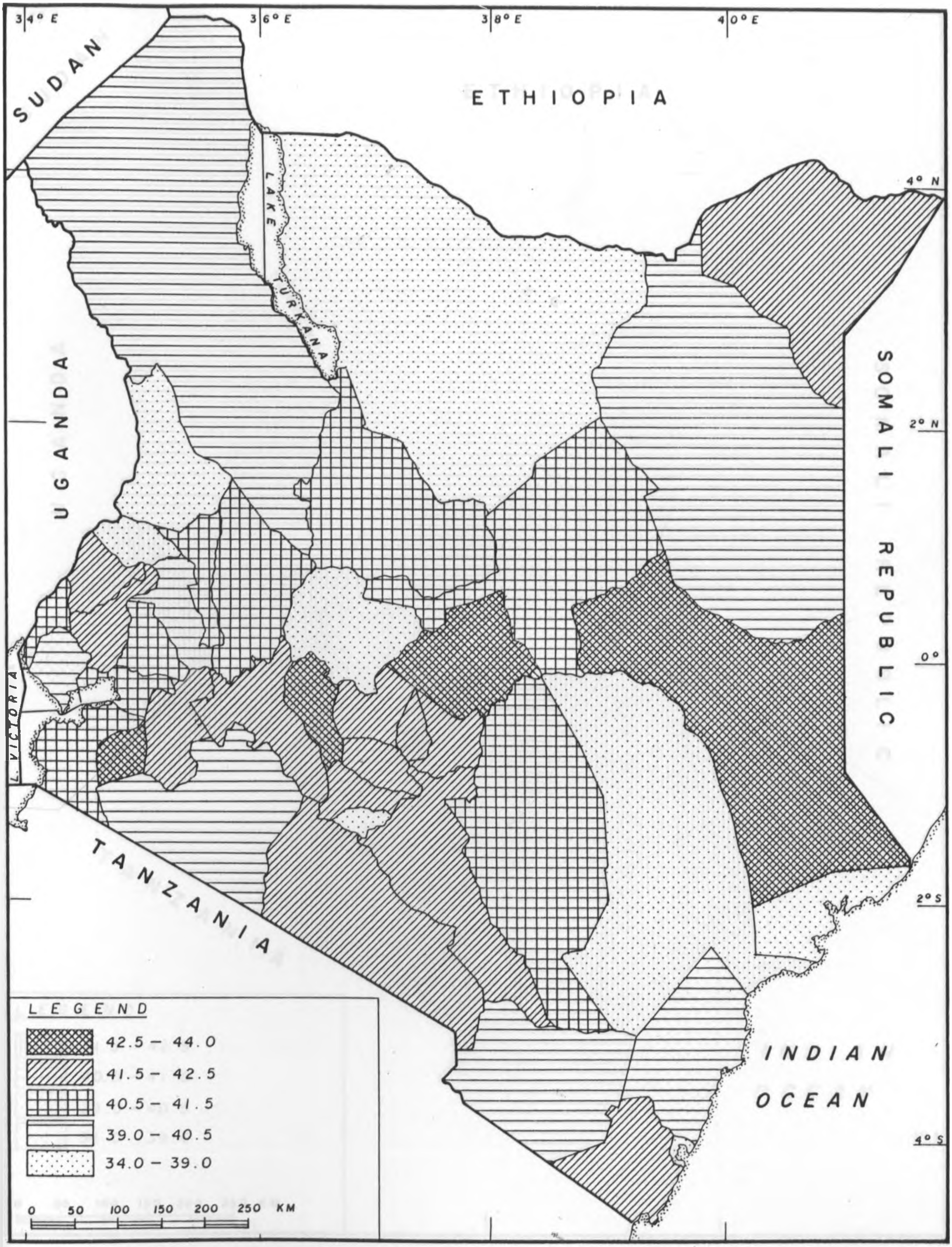


Fig. 3.3d: DISTRIBUTION OF MEAN AGE AT LAST BIRTH : 1969

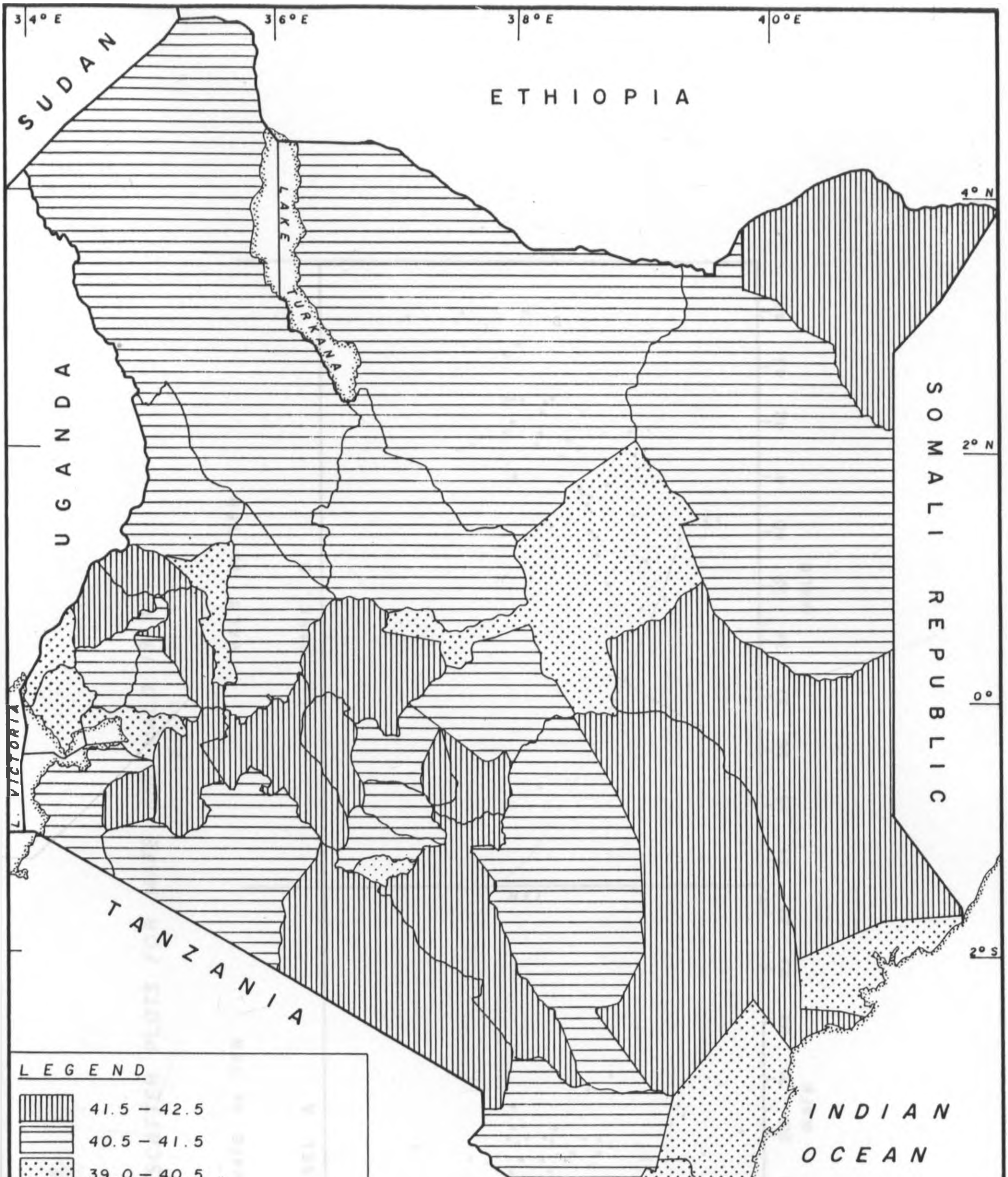


Fig.3.3e DISTRIBUTION OF MEAN AGE AT LAST BIRTH : 1979

Fig. 3.4A SCATTER PLOTS FOR MAFB AND MALB 1969

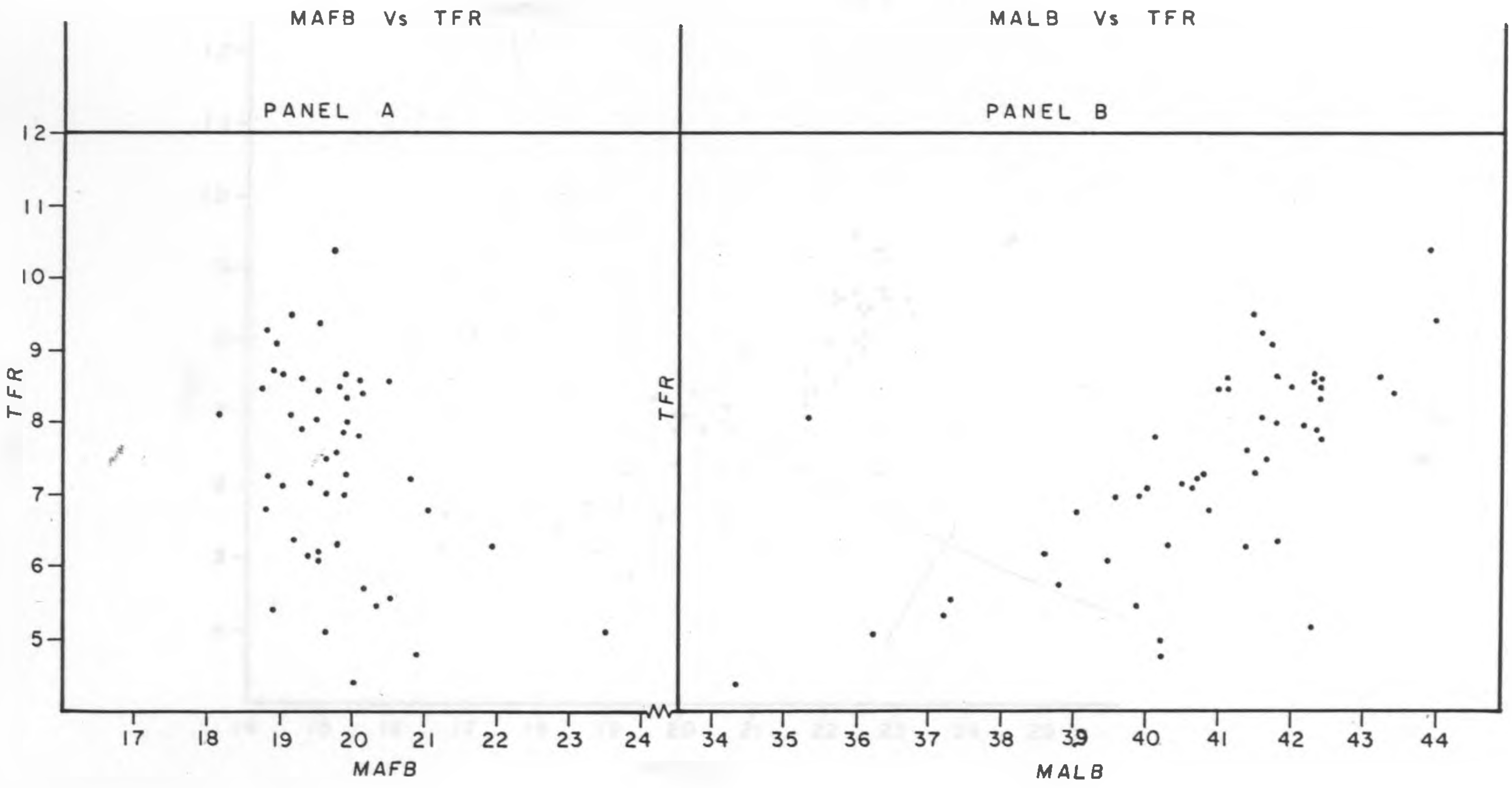
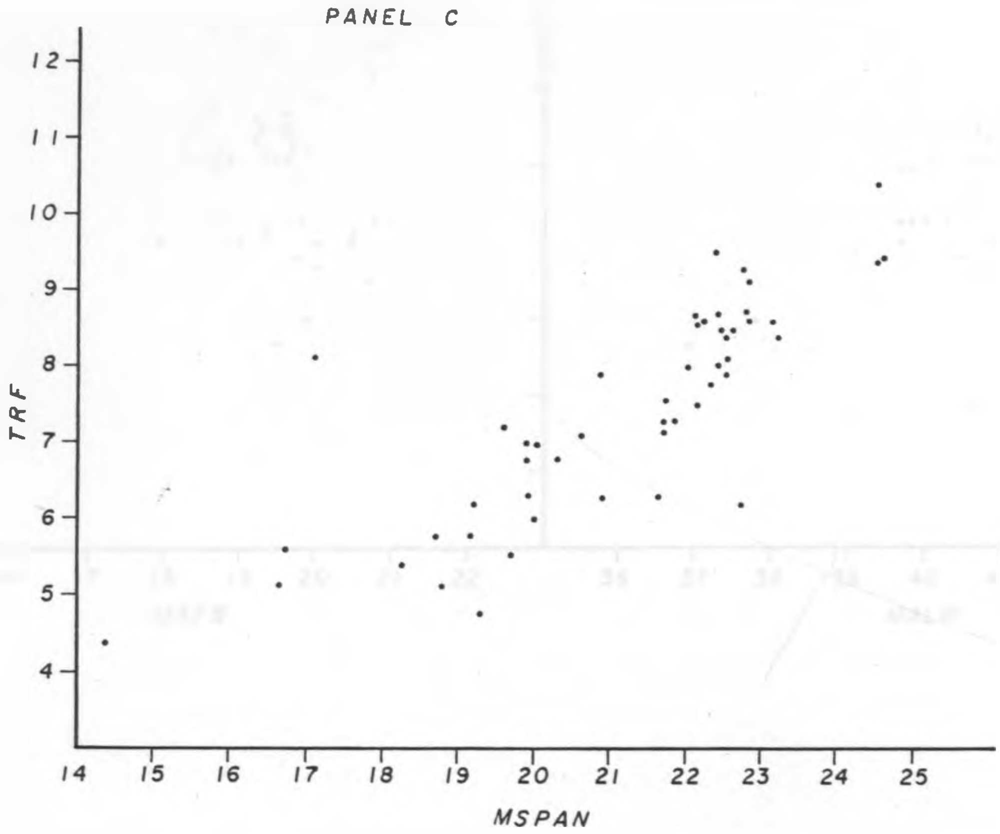


Fig. 3.4A SCATTER PLOTS FOR MSPAN 1969



... PLOTS FOR MAFB, MALB, AND MRSPAN AGAINST TFR : 1979

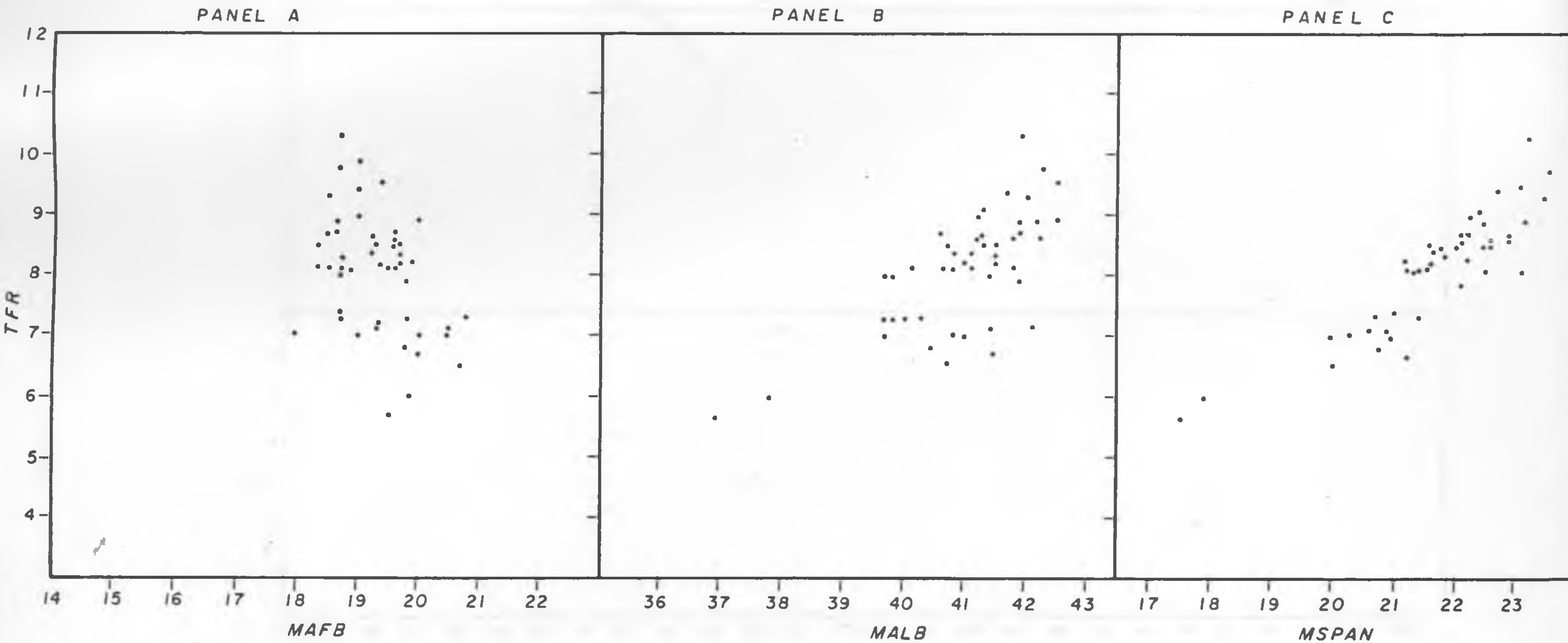


Fig 3.4C SCATTER – PLOTS FOR MIBS AGAINST TFR FOR 1969 AND 1979