DO KENYAN HOUSEHOLDS CHOOSE BETWEEN
FAMILY SIZE AND CHILD SCHOOLING

AN APPLICATION OF BECKER'S "QUANTITY -
QUALITY" MODEL.

BY

LOISE GICHIUHI, WAMBUI
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Gichuhi, Loise P
Do Kenya households
choose between

1995

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university

Loise P.W. Gichuhi

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

Mr. Kiranga Gatimu
Lecturer in Education
Department of Educational Administration, Planning and curriculum Development
Kenyatta University

Dr. G.M. Mwabu
Senior Lecturer
Department of Economics
Kenyatta University
DEDICATION

To my two sons, E.Wambugu and R.Gakinya, for their continued admiration for their mother as a student.
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Naturally, the responsibility for the final form of the thesis is solely mine, including deficiencies that may remain.
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World population has been increasing at an increasing rate more so in developing countries. Rapid population growth is exacerbating world development problem and making it more difficult to raise average level of welfare, and raising the level of human capital which is a primary issue in an economy’s development.

Kenya’s contribution to this world population is alarming. Kenya had one of the highest rates of population increase in the world for the period 1979 -1989 with a projection of further increase (35 million by the year 2000). This situation is a disturbing one noting the role the Family Planning Association of Kenya plays by educating -through all possible means and media -the side effects of high population as well as the possible solutions it offers to the public.

This study is an attempt to find out whether Kenyan families trade-off between child quality and the child quantity (family size). Education expenditure per child per household is taken as proxy for child quality. If families can trade off child quantity for child quality, then the population increase can be curtailed, a process that can supplement family planning programs.

However, this study is a single-period study. It may therefore not capture long-term changes in household choices induced by
persistent rise in the value of human capital. This has policy implication on family planning. If persistent increase in the value of human capital can induce households to trade-off child quantity for child quality, it implies that family planning programs can be enhanced by long-term macroeconomic policies which raise the value of human capital.

A total of 112 women from different households participated in the study. These were randomly selected from all women in the household aged 16-49. Cluster sampling method was used to get the households. From the five divisions of Nyeri District two clusters were taken randomly to make a total of ten clusters. 15 households were considered from each cluster. 112 women participated satisfactorily.

Regression methods were used to analyze the data. The trade-off expected between quantity of children and their quality was not apparent. The two variables had a positive relationship.

The positive relationship is not a surprise when we consider some of the characteristics of developing economies; Children are considered as investment good, a device for attaining income security in old age, extended family system where parents do not bear the full cost of educating their children- relatives and friends chip in some money- was also a possible factor.
1.00 BACKGROUND TO THE PROBLEM

1.10 INTRODUCTION:

Investment in Education (like other forms of human capital) such as training contributes to economic development and raises the income of the poor just as much as investment in physical capital (Psacharopoulos and Woodhall, 1985).

Education transforms 'raw' human beings into productive human capital by inculcating the skills required by both the traditional sector and the modern sector of the economy. Education including both technical training and general education contributes to economic growth through its ability to increase the productivity of population or the workforce in particular which leads to increase in individual earnings.

Psacharopoulos (1984), using modified growth accounting models showed that contribution of education to economic growth expressed as a percentage of the observed rate of growth explained by education ranged between 0.8 per cent in Mexico and 25 percent in Canada, the sample average being 8.7 per cent.¹

¹ Psacharopoulos however argues that all the estimates were underestimates as the education maintenance component of growth in workforce was not taken into account and this cost a downward bias ranging between 38% in United States to 90% in India.
The experience of nearly one hundred countries since 1960 suggest that education investment is an important variable explaining subsequent growth in per capita income (Baro, R. J. (1989) cited by Becker et al 1990). For Kenya, the growth accounting method suggests that the expansion of education has accounted for 12.4 percent of recent economic growth (Psacharopoulos and Woodhall, 1985).

A substantial proportion of income differences among countries could also be explained with the help of human capital models. Krueger (1968) found that education, age and sectoral distribution of population explained more than half of the differences in income levels between United States and a group of 28 countries. Countries with the same factor endowment did not enjoy the same per capita income due to "education gap".

Wheeler (1980)[ cited by Psacharopoulos and Woodhall(1985) and Psacharopoulos(1984)] found a stronger relationship between level of literacy and economic development. Marris (1982), extending the work of Wheeler, not only reaffirmed the importance of education to economic growth but also found a relatively weak role of investment in physical capital in economic growth.

ranging between 38% in United States to 90% in India
That education contributes to growth in output was clearly reaffirmed further by studies that considered non-monetary benefits, that is physical (real) output benefits particularly in agriculture. [A survey of eighteen studies which measured the relationship (in low income countries) between farmers education and their agricultural efficiency (as measured by crop production) concluded that if a farmer had completed four years of elementary education, his productivity was on the average, 8.7 percent higher than that of a farmer with no education (Lockheed et al, 1980).]

Education is also important in reducing poverty. From the available evidence (e.g. The World Bank, 1980) one expects that education and absolute poverty will be inversely related; the higher the levels of education of the population the lower would be the proportion of poor people in the total population, as education imparts knowledge and skills that are associated with higher wages. This effect can also be indirect through education influence on fulfilment of basic needs like better utilization of health facilities, water and sanitation, shelter and family size which in turn enhance the productivity of people, yield higher wages and reduce inequality in earnings (see e.g. Blau et al 1988).
Sahota (1978) argued that no income distribution theory can claim to be complete without taking the dynamic nature of the human capital into full account. Education may influence income distribution through influencing fertility, mortality, health and female labour force participation.\footnote{See psacharopoulos and woodhall,1985}

The contribution of education to other facets of development like improvement of health, fertility, control, improvement in mortality and life expectancy is well documented.\footnote{See Cochrane (1979);Cochrane,et al (1980) Psacharopoulos and woodhall(1985)for a survey of these aspects.} Similarly the non-monetary benefits of education and externalities are quite important though not measurable directly. These include non-market benefits to educated individuals like better communication skills, pleasures in life outside work and also enhancing political literacy.

However, there are a few theories to argue that the education role is limited; education serves only as a credential mechanism and a screening apparatus (Arrow, 1973). Criticisms are levelled at the marginal productivity hypothesis of taking wages as reflective of productivity (e.g. see Bhaduri, 1978), but these theories lack strong empirical support (Psacharopoulos and Layard 1978,cited by Tilak 1989). The screening role of education is not inconsistent with human capital theory.
Even if screening can explain the starting salaries of educated people it cannot explain the life time pattern of these salaries, in particular why the employers pay more to better educated workers at each and every stage. Moreover earnings of self-employed persons reflect the pattern predicted by human capital theory even when self-screening is ruled out in the case of the self-employed persons.

Quantitative evidence on the whole is still overwhelmingly in support of the human capital theory, a basic tenet of which is that education contributes positively to economic growth.¹

Investment in human capital is costly. It has direct and indirect costs in form of foregone earnings. Education financing takes a greater proportion of public funds in all countries [(Section 1.1.1 shows this for Kenya). It has started to decline with introduction of cost sharing.]. One of the problems facing developing countries is adverse macroeconomic conditions and keen inter-sectoral competition for public funds (World Bank 1980). This makes the resources to be thinly stretched. One of the reasons why the resources are ever squeezed is high rate of population growth. The high rate of population growth makes a country to have a heavy youth dependency on the working age. An important consequence

¹See Blaug (1973, 1976) for a critique of the screening models and other attacks on human capital.
of this unfavourable demographic structure is to reduce the government capacity to meet the basic needs of the growing number of children and youth (World Bank Development report 1990).

Education is one of the casualties, for sufficient money cannot be set apart for education on account of the heavy dependency burden. Large families make it hard if not impossible to facilitate the development of human capital in a situation of great expectation in human capital. The amount of human capital available in a country should depend, to a large extent, on choices the households make between child quality and child quantity. If households trade off child quantity for child quality, then the amount of human capital in the society will be large, and conversely. Fertility therefore, becomes an issue for both policy makers and education economists.

Kenya is unique within the world for both its high population growth and its high spending on education. At times, both its total fertility (Ominde, 1988) and its share of government spending going to education (Bali et al, 1984) were claimed to be the highest in the world.

To some extent it is not surprising that these two indicators should both be large; high fertility rate lead to children
becoming a large proportion of the population and hence to
greater total demands on educational spending.

However, the co-existence of such high levels of both
fertility and education expenditures does seem paradoxical
given the dominant economic theory about the determinants of
both of these variables. Indeed, Becker’s quality quantity
theory posits that families face a choice between having many
children (child quantity) and spending large amounts on
children's education (child quality).

This study is an attempt to verify whether Kenyan households
make choices as predicted by the theory. It is focused upon
the household. Do families face a trade off between
increasing fertility (family size/quantity) or raising child
schooling (quality)? If they do, why are both family size and
educational expenditures high in Kenya? If they do not, what
is it about the Kenyan situation that accounts for the
inapplicability of Becker's theory?

1.11 The Stylized facts of fertility and educational
expenditure in Kenya.

Kenya had one of the highest rates of population increase in
the world for the period 1979-1989. The intercensal popul-
ation growth rate was 3.34 per annum (Republic of Kenya,
Kenya's population is projected to reach at least 35 million by the year 2000 (Nobbe and Allen 1990). The current population is about 24 million. Associated with population growth has been an increase in total fertility rates. Total fertility has increased from the level of 6.0 children per woman in 1948 to 7.9 children per woman by 1979, a climax of 8.0 children per woman by 1981, 1982, 1983 and 1984 (Nobbe and Allen, 1990).

Although the implications of population growth differ considerably among countries, depending on their current social, economic and political conditions, such high population growth unmatched by economic growth may have adverse effects (World Bank, 1984, 1991). One of them is sharing the little resources among unlimited wants. Thus the demographic pressure arising from Kenya's exceptionally high population growth rate will provide a continuing impetus for the expansion of education but the government is already experiencing significant fiscal constraints in education financing.

Over the past two decades, the government has allocated the highest proportion of its budgeted resources to the education sector. During that period, except in fiscal years (1977/78 and 1978/79), education has consistently been allocated more than one fifth of all the government of Kenya's resources (World Bank 1989). However, in recent years the government has tried to limit education spending relying more on parental
contributions particularly in funding development costs. This cost sharing policy has increased the share of educational expenditures directly paid by households. This share has always been large and in 1989 was estimated at more than 50% (World Bank, 1989).

As indicated in the Introduction, long term high investment in education per capita is likely to contribute to further development. If wisely designed, education increases the existing stock of human capital and has a multiplier effect on rate of technology growth. That is to say, embodied knowledge and skills which enhance individual productivity and at macro level both in the short run and in the long run.

Fertility and education are therefore likely to be closely inter-related variables. Fertility can be viewed as the quantity of children, education as an investment in children’s future. This insight forms the starting point of the dominant economic theory of the relationship between fertility and education - Beckers quality - quantity model.

1.12 Becker’s quality - quantity model and its applicability in developing country context

This research is guided by the theoretical work of Becker (1960 cited by Muhindi 1980), Becker et al (1973, 1976, 1990)
on the interaction between quantity and quality of children. Becker (1960) argued that with limited household income, parents faced a choice between having many children (child quantity) and spending a lot on a few children (child quality). This choice is sharpened by the fact that increasing one (e.g. child quantity) raises the cost (or shadow price) of the other (e.g. child quality). Thus, if parents choose to have many children it will necessarily make it more expensive to maintain a given level of spending of each child.

The merit of Becker's theory was largely in providing one explanation for the observed behaviours. Fertility tends to be lower in higher income families and countries. To an economist this pattern is puzzling: as income rises, people can afford more children so why do they have fewer children? Becker's explanation is not that the demand for children falls with income. It is rather that the demand for child quality will rise even more rapidly with income than the demand for child quantity.

As parents' income rises, parents may send their children to school and make them stay there longer, that is, increase child quality. However, schooling itself and the loss of children's help are costly. So each child becomes more
expensive. As a result of this increase in expense of child, parents will tend to have fewer children as income rises. It should be noted, however, that the predictions of Becker’s model may not be correct. One reason for this is that households can use their resources on goods other than child quantity and child quality. By squeezing expenditures on such residual (adult) goods, they may be able to afford a large number of well educated children (conversely they may choose to have no children). Furthermore, developing countries such as Kenya, may not be well represented by Becker’s assumption of parents choosing between family size and child schooling. Traditions and social norms may be important as may affect other decision making. For example, if educated older siblings rather than parents pay for the schooling of younger family members, this may reverse child quality - quantity trade off (Gomes, 1984). Thus the Beckers model is based on various basic assumptions such as formal education which enhances positive use of contraceptives, and rational decision taking.

Applied in developing countries, is weakened by certain characteristics of developing countries, such as high mortality rates, poor knowledge and usage of family planning methods, greater use of children as security in the old age and the weight given to child labour in production.
As Mueller (1983) points out, the Becker's model applies more to industrial societies than to low income rural developing regions. The model applied to less developed rural areas, the relationship may be only weakly, negative, zero, or even positive. Therefore there is need of producing a general fertility model incorporating all the economies whether developed or developing.

However, before the accomplishment of such a general model the effort of this thesis has shown that fertility behaviour in a developing country context can be determined by the use of the basic fertility model as proposed by Becker et al (1973) without many modifications.

1.20 STATEMENT OF THE PROBLEM

That family size responds to social and economic variables is common knowledge. That the demographic transition generally found in more developed countries has its roots in social and economic development is also generally accepted. However, the exact underlying mechanisms and functional relationship are still debatable.

Access and knowledge of contraception has been considered the major determinant of the shrinking family size. This had received a great deal of influence in population policy.
Family planning programs have received great emphasis. Nevertheless, there is need to realize that family planning will produce less than desired declines in fertility (Van de Wall and Poste (1990 cited by Ainsworth 1992), Ainsworth (1992)) if the demand for children and quality of children are considered without regard to economic and social influences.

Although a lot of work has been done on the economics of family size in developed countries employing modern techniques in microeconomic and multi-variate analysis very little has been done using Kenyan data sets especially in a rural set up.

Researchers have wondered quite often whether the well known quantity quality theory of fertility pioneered by Becker would survive when tested with data from a rural households in a developing economy like Kenya. This study will attempt to shed light on this.

1.30 THE PURPOSE OF THE STUDY.

The task of this study is to identify and analyze the factors that can lead to the trade off between quantity and quality and the implication this may have on both rate of population growth and rate of investment in human capital, arguably the two most important influences on a country's rate of develop-
ment. They are particularly interesting in the Kenyan case, since this macro evidence of high population growth and high educational expenditure seems prima-facie evidence against the prevalent microeconomic theory.

In the course of researching this central issue of the quality quantity trade off more general issues surrounding these determinants of child quality and quantity will also be addressed.

In an attempt to tackle the main task the specific objectives of this study are:-

1. To identify and analyze the determinants of households educational expenditures in Nyeri District.
2. To examine the determinants of family size in Nyeri District.
3. To determine whether smaller families spend more on children’s education than larger families.
4. To suggest policy recommendations on the basis of the study findings.

1.40 RESEARCH QUESTIONS

Several research questions related to the above objectives will be considered.
1. Will fertility decline as income grows because better off families prefer smaller families with well educated children?

2. What is the effect of educational costs on fertility?

3. What is the effect of schooling expenditure on fertility?

4. Do family planning programs enhance educational attainment?

5. Are high fertility and low education positively correlated among low income households?

1.50 SIGNIFICANCE OF THE STUDY

1. Prediction and Planning:

Understanding the implications of income change on fertility will influence the government's response to population issues and more specifically will help it to predict population growth in the coming decades. This is important because there is need to adjust to a new sustainable balance between population growth and economic growth.
2. Effect of Education Investment on Fertility

Cost sharing is a well established and increasing phenomenon in Kenya. Parents are supposed to shoulder some of the costs of education and these costs are often in direct proportion to the number of their children in school.

This study will provide information on whether school costs have an impact on fertility and thus illuminate a neglected side effect of the cost sharing policy.

3. The Effect of family planning on educational Expenditure

If fertility has a positive impact on education expenditure, then this implies effective family Planning programs will affect the quality of children. In such a case family planning program advancement would not only lead to fertility decline, but would also improve the quality of children.

4. Distributional issues

If low education attainment and high fertility are largely confined to the poor, this may provide grounds for income redistribution or targeting of government services and subsidies as stop-gap corrective measures.
1.60 DEFINITION OF KEY TERMS:

1. Human Capital: Refers to productive capacities acquired through education and/or training and it enhances individual productivity. This is acquired only at a cost.

2. Total fertility: refers to the number of live births a woman has had by the end of her reproductive life.

3. Quantity of Children/The number of children: In this study this refers to the number of children a woman has. Fertility and family size will be used interchangeably with quantity of children.

4. Quality of Children:[In this study this term takes traditional meaning of Becker and Lewis (1973), Becker et al (1990)]. The justification of retaining the quality quantity terminology as originally used in the literature reviewed in this study, is to guard against deviation from now well established tradition consistent with the received economic theory. As such quantity and quality terminology, like other terminologies such as human capital, may not have the unique meaning if taken out of context of the new firmly established tradition in micro-economics.
It is defined as properties of children which yield utility (or disutility) to parents. Child quality may be household produced like wealth, intellectual development, school attainment, social adjustment and lifetime (future) income. However, child quality may also be endowed for example sex, natural intelligence and beauty. In this study emphasis will be placed on household-produced child qualities.

Specifically, child quality in this study will be proxied by household education expenditure per child. Education expenditures are one component of child quality since education is likely to give utility to parents. Education provides human capital to child and hence may raise the child’s future earnings.

5. Household: Refers to people who live within the same compound fenced or unfenced and share meals, have a common source of major income and have a common provisions for other essentials of general livelihood.

6. Cluster: Refers to a randomly selected group from various regions or areas, usually a sublocation or location. In this study a cluster will mean a sublocation.
7. Trade-off: The idea that we can only get one objective at the cost of moving away from another. (quantity-quality trade-off, you cannot get both simultaneously).

8. Child quality quantity trade off: There is inverse relationship between quantity of children and their quality.

1.70 ORGANIZATION OF THE REST OF THE STUDY:

The general literature on fertility and specific literature for subsaharan Africa is reviewed in section II. Theoretical framework is also covered in this section. Section III covers the following: Methodology, Study population, Sample selection, Data requirements and Data processing and Analysis. Section IV discusses the empirical analysis while Section V includes Summary and conclusions.
CHAPTER TWO

2.00 LITERATURE REVIEW

2.10 General Literature

Writers on population and demography have tried to ascertain the existence of a relationship between quality and quantity of children in a household set up. This has been done using both time series data and cross-section data.

Mueller (1983) suggested that rising incomes fosters a sense of Economic independence from children and raises the education aspirations of parents as well as the perceived cost of raising children.

A presumption of this literature is that as income changes it alters tastes in favour of educated children at the expense of child quantity. This change in taste implies (among other things) that the demand for child quality becomes progressively more income elastic and less price elastic relative to the demand for child quantity. Thus the demand for educated children may be viewed as a function of income, cost(price) and tastes as well as the structure of the society and economy.
Rigorous analyses have aimed at providing a framework for understanding fertility especially from the point of view of quantity - quality trade off. Such analysis include the work of Becker, (1960, 1965); Encauncurn (1968); cited by Muhindi (1980); Schultz T.P. (1969, 1970) De Tray D.N. (1973); Michael R.T. (1973) among others. In these models, families are seen as maximizing utility subject to a budget constraint.

One model of child quality quantity is that of Becker and Lewis (1973). They emphasized the substitution and income effects between the number of children as income increases. Thus, the birth rate could fall with increasing income even though children are not inferior goods (Becker and Lewis 1973). Quantity and quality of children interact inversely in the budget constraint. Consequently, an increase in quantity of children may decrease the demand for child quality by raising the shadow price of quality and vice versa. Thus although the quantity and quality need not be close substitutes (and indeed cannot be, if the system is to be stable in range of plausible values) an increase in demand for one will decrease the demand for the other. Hence, if socio-economic improvements raise the aspirations that the parents have for their children and cause them to undertake substantially greater child related expenditure as their incomes rise then this in effect increases the price per child. This price rise will reduce the demand for children and
may offset any increase in demand due to rising income (Kocher 1976, p.6).

Most of the studies carried out in both developed and developing countries consider different proxies. The model, applied to developing countries is weakened by certain characteristics of developing countries such as high illiteracy rates, older family siblings helping the young ones, high mortality rates, poor knowledge and usage of family planning methods, greater use of children as security in the old age and the weight given to child labour in production. This chapter tries to analyze the applicability of this model in developing countries. Very few studies if any have used education expenditure as a proxy of quality children. This makes it hard to have a related literature. The researcher has therefore decided to analyze the studies that have used the Becker and Lewis model (1973) under different proxies.

Behraman and Wolfe (1987) studied the role of family background and school availability on educational levels attained by members of a household in two generations in the pre-revolutionary Nicaragua. These factors underlie the demand and supply of schooling, but are usually ignored in empirical estimates. Data were on adult sisters and their offspring which was used to identify interfamilial and intra-
familial effects and also the control for unobserved family background. The study concludes that:

(a) Unobserved family background and school supply factors are important in the level of schooling achieved.

(b) Omission of these factors lead to overestimate of the impacts of parental schooling and family size.

(c) Both parental schooling and family size primarily represent unobserved family background and school supply in the standard estimates.

In a study of India using district and village level data, Sahota and Sahota (1980) found an interesting relationship between schooling and fertility.

(a) If investment in child quality is measured simply by the enrolment rates, the relationship is positive contrary to theory.

(b) If investment in school quality is measured by the proportion of non repeaters in a class, the relationship is negative.

The cost to the family rises as the quality of schooling desired for the child increases. Thus, one is more likely to observe a negative relationship between fertility and
child investment when the latter is associated not merely with enrolment, but rather with schooling quality.

Another Indian study by Rosenweig and Wolpin (1980) found that the negative relationship predicted by the model were born out by the data although statistically not significant.

Birdsall (1980) presents some data for Colombia which show the inverse relationship between number of children and investment in their schooling. However, this result is sensitive to the definition of the fertility variable.

Birdsall (1985) carried out another study on public inputs and child schooling in Brazil using household data from one percent sample of the 1970 Brazilian census. The data were to analyze the effect of public inputs e.g. the availability of schools on child's school attainment. The data were combined with measures of school availability and quality of education derived from the same census data.

The measures of quality are based on the income and education of school teachers in 169 different areas of the country. Several conclusions were given;
(a) Elasticities of demand with respect to these public inputs were estimated and found to be high in both rural and urban areas.

(b) In urban areas the positive effects of public inputs is greater for children from households that are relatively better off compared to other rural households.

A doctoral dissertation by Carol Clark (1979) on schooling decision in rural Guatemala noted that there is an increase in work time and reduction in school attendance for children when there are one or more siblings aged 15 - 18 in the household. Evidently quantity and quality in this instance were negatively related. She attributes this to lower income per capita associated with large numbers of children which induces greater labour despite the reduced opportunity cost of children's time.

Ron and Shutjer (1982) study in central Thailand find negative relationship between quality and quantity with a simultaneous equation framework. The income elasticity of expected children's education is also greater than the income elasticity of children born which is also in accord with the Becker model.
Hossain S.I. (1990) studied the interrelationship between child education, health and family size using data from Bangladesh between 1979 and 1980. He came up with a number of findings.

(a) The reduced form estimates suggested that mother's education and mother's childhood background have a significant effect on the demand for child quality.

(b) The demand for child quantity does not have a direct effect with mother's education and mother's childhood background. Hossain also examined the issue of whether greater number of children causes a lower per child education and survival per child. He found out that

(c) an increase in the number of children does not exert pressure on child schooling since the coefficient estimates of fertility and schooling were found to be positive and significant. Therefore, household in this sample does not view fertility and child education as strong substitutes. Child schooling does not rise indirectly by lowering family size. Quality of children is not necessarily higher in households with low fertility.

(d) He also found that income elasticity for child quality is negative. Results indicate that direct and indirect
costs are low because only younger children attend school. He also noticed that economies of scale exist in financing education since the older siblings and members of the household pay for younger siblings school fees.

Hossain findings can be supported by the existence of African extended family phenomena and the community support especially in Kenya. This can even result into a positive relationship between child education and parental fertility in the extreme cases.

2.20 Literature Specific to Sub-Saharan Africa

At the time of undertaking this research, little evidence exists of other studies on the quality - quantity trade off that have in the past been carried out in Kenya. Indeed, those that exist are mainly on fertility, mortality, nutrition and education from demographic, social and health points of view. Consequently this section also includes relevant studies of other sub-saharan African countries since these may be comparable to Kenya in some respects.

Study by Chernichousky (1981) in Botswana found that the larger the number of school age children in the households, the higher the probability of their school enrolment, and the higher their level of education. These findings can be in
part explained by the falling marginal product of labour in the household with any given amount of assets that reduces the indirect cost of schooling. The fall in productivity may lead to role assignment in household. Some children are kept for household and farm activities while others are assigned the school and allowed to concentrate.

Snyder's (1974) study of Sierra-leone revealed a positive and statistically significant relationship between quality and quantity children. He had taken education expenditure as a proxy for child quality.

Kelly's (1980) study of urban Kenya offered some hints to quality quantity trade off. He found that household investment in education increases as the number of children in the household increases but the per child investments tends to decline.

Anker and Knowles' (1982) study of urban and rural Kenya found that higher education attainment is positively related to fertility in rural areas. However, in urban areas neither enrolment rates nor the wife's expectation regarding children's education had a significant effect on fertility. Children were evidently seen as a 'good' investment' in rural areas.
Tan's and Haine's (1984) analyses of the quantity - quality trade off in less developed countries found that the trade off between quantity and quality is weak in the early stages of development when child quality investment refer mainly to primary schooling. However, in the more advanced less developed countries where universal primary education has been more or less established, declines in fertility are invariably associated with rising secondary school enrolment. This pattern reflects primary and secondary characteristics including cost considerations.

Tan and Haines (1984 p. 67) found that with rising education goals and as kinship ties and family obligations weaken (as they are likely to) with modernization and industrialization in Africa, the quantity quality trade off will tend to become stronger as the choice between quantity and quality becomes increasingly inescapable when the cost of child quality investment cannot be shifted elsewhere.

Mueller (1983) noted that the effect of rising educational aspiration on the number of children parents choose to have is not immediately apparent in the context of less developed countries. This is because the private returns to schooling accrue not only to the individual who went to school but also to his or her parents and siblings. If education improves employment opportunities and earning power and if children
remit part of their earnings to parents then it is rational for parents to have and educate many children.

Amobi (1980) carried out a study on the determinants of family size using urban data from the developing economies of Kenya and Nigeria. In a simultaneous equation context the determinants of the quality and quantity of children were estimated. He found the following.

(a) Family income, the duration of marriage and the age of women are all positively related to family size while polygamy has no significant effect on fertility.

(b) The education of women, infant mortality, migration, family planning practices and separate habitation of married couples all tend to depress fertility.

(c) The lifetime family income and wife's education interactive variable has a negative effect on family size while the individual variables have positive effect. Thus the interaction model explain the non-linear effects of these individual variables.

(d) The sequential model analyses of the additional number of sons desired showed that the motive of at least one or more sons was very strong. There were no major differences
Kibua (1977) using secondary data on Kenya found strong relationships between population growth, the growth of Gross domestic product and an increase in urbanization. He found an inverse relationship between population growth and female employment, health, market agricultural output and family planning utilization.

Muhindi (1980) found that average income and fertility are positively related. Parental education, female labour force participation were negatively related to fertility. Family Planning utilization, land holding, infant and child mortality were positively related to fertility. Infant mortality was very significant in its influence on fertility while parental ages were found to be otherwise.

Kibua (1981) using regression analysis found a positive relationship between fertility and mortality, husband education, income and property. On the other hand, there was a negative relationship between wife's education and land. Mortality was found to be the most crucial explanatory variable in the model.
Aoko (1989) carried a study in Nairobi. She considered the Mathare and Nairobi south regions to find out the effect of social-economic status on fertility. Socio-economic status (measured by educational levels, occupational status, age of a woman, age of a woman at first marriage, infant mortality and family planning practice) was found to be the main determinant of fertility levels in urban areas. People with low socio-economic status have more children than those with higher status.

Odunga (1992) carried out a study in Baringo District of Kenya to find out the interrelationship between education, health and family size. He found that parental education has a substitution effect away from larger families and towards higher quality children. Parental age has the expected positive effect on fertility with the larger and more significant effect being that of the mother's age. The effect of parental age on child quality are not significant and probably represent a combination of life cycle and cohort effects.

The trade off relationship may be complicated as Mueller (1983) concluded that the Becker type quantity quality trade off applies more to industrial societies than to low income, rural agrarian developed groups or regions. When education is extensive and prolonged and when income are high, the negative trade off can be found (e.g. De Tray, 1973). But in less
developed rural area, the relationship may be only weakly, negative, zero or even positive. The same conclusion was reached in a study by Birdsall and Cochrane (1982).

Most of the research studies use secondary data. This reduces flexibility in a study. Fertility analysis may be better studied with micro-data. Hence micro level data are required for this study. This is because the causal relationship of interest takes place at the individual or household level. This study deals directly on the subjects of the study - the individual rural household. The casual relationship will be established using the theoretical framework. (see Theoretical Framework).

2.30  THEORETICAL FRAMEWORK

2.31  Theoretical assumptions.

(a) This analysis is a one period, full certainty model that seeks to explain the number of children ever born to one woman in a household over the life cycle, and the quality of those children.

(b) It is assumed that parents maximize their joint utility function which is believed to have three arguments (Becker and Tomes (1976)) : the number of children (n), the
\[ R = (P_c n) q + (P_q n) + \Pi_z z \]
\[ = \Pi_q q + \Pi_n n + \Pi_z z \]

In general \( \frac{\partial n}{\partial q} < 0 \) because \( \frac{\partial n}{\partial \Pi_n} < 0 \) and \( \frac{\partial \Pi_n}{\partial q} > 0 \)

This is because \( \Pi_n \) depends on \( q \) (i.e. the shadow price of quantity depends on total quality per child) and that \( \Pi_q \)
depends on \( n \) (i.e. the shadow price of quality depends on total quantity) This in particular means that an increase in
quality per child \( q \) will raise the price of quantity \( (\Pi_n) \) by raising the cost of each child.

2.40 Empirical Specifications

To estimate equation (6) and (7) the reduced forms for child quantity and quality both the dependent variables "q" and "n" their arguments \( \Pi_n, \Pi_q, \Pi_z \) and \( R \) need to be specified in terms of observable variables.

In this analysis it is assumed that is constant across families in the same period.
quality per child (q), and the quantity of other goods they consume (z).

OR \( u = U(n, q, z) \) ..................... (1)

This utility function is maximized subject to full income budget constraint.

\[ Y = n \Pi_n + q \Pi_q + nq \Pi_{n,q} + z \Pi_z \] ............ (2)

where \( \Pi_z = \text{Price of other commodities.} \)

\( \Pi_n = \text{price which affects the quantity of children irrespective of their levels of quality.} \)

\( \Pi_q = \text{are costs which affect quality of children but do not depend on the quantity.} \)

\( n.q = \text{are costs of children which affect both child quality and quantity} \)

\( Y = \text{household income.} \)

The total amount spent on children \( \Pi_{n,q} \Pi_z \) is non-linear in "n" and "q" and it is this non-linearity which creates the quantity quality interaction. Becker et al (1973) attributed this non-linearity to the inverse relationship between the two
variables, n and q. This means that there is a trade-off between the two variables.

2.32 Theoretical Predictions

Maximizing (1) subject to (2) yields the following first order equilibrium conditions

\[ m_u n = \lambda (q \cdot n q + n) = 0 \] \hspace{0.5cm} (3)

\[ m_u q = \lambda (n \cdot n q + q) = 0 \] \hspace{0.5cm} (4)

\[ m_u z = \lambda (z) = 0 \] \hspace{0.5cm} (5)

where \( m_u \) = marginal utility

\( \lambda \) = lagrange multiplier

from (2), (3), (4) and (5) demand functions for n, q, z can be derived as a function of shadow prices and incomes.

Define \( U = u(n, q, z, n q, n, q, R) \)

\[ n = \delta U/\delta n \] \hspace{0.5cm} (6)

\[ q = \delta U/\delta q \] \hspace{0.5cm} (7)

\[ z = \delta U/\delta z \] \hspace{0.5cm} (8)

where \( R \) is the full shadow income (i.e. the shadow amounts spent on the different commodities)

[However equation (8) demand for (z) is not used in this study, the interest of the researcher being in (q) and (n)].
2.50 Definitions of variables.

2.51 Dependent Variables

1. Child quantity (N) refers to the number of children ever born per household. This is a subset of the number of children (n) in lifetime reflected in equation (1) above. (See also in definitions of key variables page 20.)

2. Child quality (Q). See detailed definition on page 20. Not many studies have taken this proxy, so it is of interest to find out its impact on fertility.

2.52 Independent Variable

(a) Proxies for price of children
   i. Mother’s Education (MEDUC)
   Mother’s education is measured by the number of years a woman has spent in school.

   (b) Proxies for full income, R.
   ii. Father’s Education (FEDUC)
   Father’s education is measured by the number of years the father has spent in school.
iii. Acres of land owned (ACRE)
   This variable is measured by the numbers of acres of land the family owns.

(c) Proxies for price of child quality.

iv. Distance to the nearest primary school (Dis)
   This variable is measured by the number of kilometres the household is far away from the nearest primary or secondary school.

v. Price of Education (PE)
   This variable will be measured by the amount of school fees paid by the household for each child.

(d) Other Variables

vi. Age of wife (AW) - This refers to the age of the wife. This is measured by the number of the years since birth.

2.60 Model Specification

Given the specification of empirical counterparts to the variables used in equation (6) and (7), the equations can be written so as to be empirically estimated. We assume a linear stochastic form for the equation. Thus equation (6) becomes
\[ N = a_0 + a_1 \text{MEDUC} + a_2 \text{FEDUC} + a_3 \text{AW} + a_4 \text{ACRE} \\
+ a_5 \text{PE} + a_6 \text{DIS} + U_1 \]  
\[ \text{6} \]

and equation (7) becomes

\[ Q = b_0 + b_1 \text{MEDUC} + b_2 \text{FEDUC} + b_3 \text{AW} + b_4 \text{ACRE} + b_5 \text{PE} \\
+ b_6 \text{DIS} + U_2 \]  
\[ \text{7} \]

However, rather than merely estimating the reduced form for child quantity given in equation \(6\), we are interested in the structural relation between "n" and "q" hence we will also estimate the following:

\[ N = C_0 + C_1 \text{MEDUC} + C_2 \text{FEDUC} + C_3 \text{AW} + C_4 \text{ACRE} + C_5 Q + U_3 \]  
\[ \text{9} \]

Estimating equation (9) is problematic because \(Q\) is an endogenous regressor. Ordinary Least Squares estimate would therefore result in biased parameter estimates. However, a consistent estimator can be found by taking predicted values of "Q" generated from the reduced form \(7\); substituting them for the actual values in equation 9 and then estimating this modified version of equation 9.

It should be noted that PE and DIS act as identifying variables for q, since there is no reason for them to directly affect n.
2.70 Expected signs of the Parameters to be estimated.

(a) Determinants of child quantity.

(i) The relationship between mother's education and child quantity is expected to be negative. Mother's schooling raises expected wages and thus the opportunity cost of women's time spent in rearing children, (Cochrane, 1979). Consequently it increases the price of children. It may also have other effects; women with no schooling may develop higher aspirations for their children schooling hence they may invest in more schooling per child rather than in a larger number of children.

(ii) The relationship between father's education and child quantity is expected to be negative. Higher father's education is likely to raise father's earnings (Snyders, 1974). This will have mainly an income effect because the households rely heavily on the head's earnings as the major source of income. By contrast, any price effects of FEDUC on fertility will be weak because raising children requires comparatively little of the father's time.

(iii) The relationships between wife's age and child quantity is expected to be positive. Due to
differences in the risk of pregnancy it is hypothesized that the number of children increases with the age of the mother (the biological capacity effect).

(iv) The relationship between acres of land and child quantity is expected to be positive since if children do a lot of work on family land, land acreage will positively affect the marginal product of child labour and hence lower the price of child quantity. There is a likelihood of this relationship being negative. This is because of the income effect which favors quality children than the number of children.

(v) The relationship between child quality and child quantity is expected to be negative. Becker et al (1990) proposed that there is a trade off between the two variables.

(vi) The relationship between distance to the nearest primary school and child quantity is expected to be negative. The further the distance the smaller the families.

(vii) The relationship between price of education and quantity of children is expected to be negative. This is because the higher the price the more the parents can not afford to pay for more children.
b. Determinants of child quality

(viii) The relationship between price of education and child quality is expected to be positive. This implies that the higher the school fees the higher the predicted child quality.

(ix) The relationship between distance from home to primary schools and child quality is expected to be negative. The longer the distance the more children will not attend the schools hence the quality of children falls.

(x) The relationship between mother's education and child quality is expected to be positive. This is mainly due to the income effect. Educated mothers are able to share out some of their income towards the education of their children. Also educated mothers are said to aspire for educated children.

(xi) The relationship between father's education and child quality is expected to be positive. This is due to the income effect since in general, well educated fathers are said to enjoy higher salaries.

(xii) The relationship between age of the wife and the child quality is expected to be positive.
(xiii) The relationship between acres of land owned and the child quality is expected to be positive due to the income effect.
CHAPTER THREE

3.00 METHODOLOGY

3.10 Introduction

This section covers the design and the methodology used in this study. It covers the description of the area of study, population, sampling techniques and the data collection instruments. Data analysis techniques is covered under this section also.

3.20 Location of the Study

This study was conducted in Nyeri District of Kenya. The district is one of the five districts of Central Province and forms parts of Kenya’s eastern highlands. It covers an area of 3,284 sq. km. The pattern of rainfall is typically equatorial for the district is situated within the highland equatorial zone of Kenya. There are two rainfall maxima: long rains from March to May and short rains from October to December. Annual rainfall varies from 750 mm in the central northern part of the district to 1,750 mm in the south western and north eastern parts. Mean temperatures on the upper slopes are less than 13°C and rise to 13°C - 17°C on the lower slopes and 17 - 21°C on the foot slopes. The soils are mainly red clay and
red humic lays, deep, well drained and fertile. Most people practice mixed farming. The average size of land holds is 1.5 ha in Mathira, Tetu and Othaya whilst in Kieni West and East is 7.3 ha on average.

3.21 Economic Background

The incomes of the people are derived from various sources, coffee, Tea, wheat as major cash crops as well as sale of surplus foodstuffs in the local markets. Other economic activities include small scale trading such as shop keeping, shoe repairs, dress making, green grocers and working for other people. The latter is usual during land preparation and weeding. The payment is negotiable though most times it is determined by the employer. The area is potentially rich being the central province headquarters.

3.22 Demographic and Social Background

According to national population census of 1969, 1979 the population of Nyeri District grew from 360, 845 to 486, 477 people at annual growth rate of 3.03% slightly less than national growth rate during the same period (3.41%). 8.4% of the districts population live in the urban centers. CBS (Central Bureau of Statistics) show an increasing trend of population (Table 3.71 shows this).
# TABLE 3.71

Population Projections by Division 1988 - 93

<table>
<thead>
<tr>
<th>Division</th>
<th>Actual 1979</th>
<th>1988</th>
<th>1990</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetu</td>
<td>102,273</td>
<td>144,549</td>
<td>154,787</td>
<td>170,562</td>
</tr>
<tr>
<td>Nyeri Municipality</td>
<td>35,753</td>
<td>50,544</td>
<td>54,047</td>
<td>59,640</td>
</tr>
<tr>
<td>Mathira</td>
<td>122,359</td>
<td>180,033</td>
<td>192,510</td>
<td>212,432</td>
</tr>
<tr>
<td>Othaya</td>
<td>68,500</td>
<td>96,825</td>
<td>103,535</td>
<td>114,249</td>
</tr>
<tr>
<td>Mukurweini</td>
<td>72,208</td>
<td>102,120</td>
<td>109,197</td>
<td>120,497</td>
</tr>
<tr>
<td>Kieni West</td>
<td>38,393</td>
<td>58,590</td>
<td>62,650</td>
<td>69,134</td>
</tr>
<tr>
<td>Kieni East</td>
<td>41,411</td>
<td>55,014</td>
<td>58,826</td>
<td>64,914</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>481,477</strong></td>
<td><strong>687,675</strong></td>
<td><strong>735,332</strong></td>
<td><strong>811,427</strong></td>
</tr>
</tbody>
</table>


The population density in Nyeri District was one of the highest densities in the country but within the district densities vary widely according to 1979 population census. 148 persons per square kilometre if the total area of 3,284 sq. km is taken into account and 233 persons per square kilometre if the forests and national parks are left out.
### Table 3.72

Population Density per division in Nyeri District 1979

<table>
<thead>
<tr>
<th>Division</th>
<th>Population</th>
<th>area (sq km)</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nyeri Municipality</td>
<td>35,753</td>
<td>71</td>
<td>497</td>
</tr>
<tr>
<td>Othaya</td>
<td>68,500</td>
<td>170</td>
<td>401</td>
</tr>
<tr>
<td>Tetu</td>
<td>102,273</td>
<td>311</td>
<td>329</td>
</tr>
<tr>
<td>Mathira</td>
<td>122,359</td>
<td>324</td>
<td>392</td>
</tr>
<tr>
<td>Mukurweini</td>
<td>72,288</td>
<td>179</td>
<td>404</td>
</tr>
<tr>
<td>Kieni West</td>
<td>41,411</td>
<td>546</td>
<td>75</td>
</tr>
<tr>
<td>Kieni East</td>
<td>38,893</td>
<td>488</td>
<td>79</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>486,477</strong></td>
<td><strong>2,088</strong></td>
<td><strong>233</strong></td>
</tr>
</tbody>
</table>

Source: Population Census 1979 - CBS.

Approximately 90 per cent of the people are of Kikuyu origin. Women and children constitute the largest proportion of the district labour force (Republic of Kenya, (1989 b))

### 3.23 Culture and Traditional Beliefs

Most people are affiliated to one kind of denomination/or either catholic or protestants. Traditions are being eroded but they are fairly playing a part for example women who are infertile are regarded as social failures. They are looked at as people who have not fulfilled their social duties e.g.
continuing the lineage of the family. The man has the last say in most of all family matters in particular family size, use of family planning services, education of children to mention a few.

3.30 Rationale for Selection of Area of the Study.

Nyeri district is comprised of sections with high levels of education and other sections with low levels of education. This helped the researcher to compare households who have invested heavily in education and those who have not; controlling for household incomes. Nyeri district had the highest population density in 1979 census, CBS (1980). This made it credible for the study because other factors that influence family size e.g land scarcity were taken into account. The researcher was also familiar with the area. This helped in collecting high quality data. Interaction with people became easier and the data were collected more efficiently. Money and time were also an important consideration. A familiar area was important for effective interviewing especially where time and financial constraints were most pressing.
3.40 Study Population

The population under study were household units in Nyeri District where the unit of study was women between the age of 16 - 49 since they are the ones in the active work of rearing children. Administratively, Nyeri District is subdivided into seven divisions namely; Othaya, Mukurweini, Mathira, Kieni East, Kieni West, Nyeri Municipality and Tetu. These are further subdivided into twenty four locations and one hundred and fifty six sub locations. Based on 1979 census, the number of households were 66895. Ideally all households in the district should have been included in the study but time and fund available limited the researcher to a representative sample.

3.50 Sample Selection

The sampling method employed was Cluster sampling. From the seven divisions, 5 divisions were chosen at a random. From the 5 divisions 2 clusters were chosen at random from the number of divisional sublocations. The total number of clusters were 10. The researcher was interested with 150 households. So from each cluster 15 households were considered. To get the households, the method involved first defining the geographical limits of the cluster area, then selecting a central location in the area e.g. a church, business
center, school. The researcher considered a school. From the school the researcher selected northwards direction in order to get the first household. The next households were got by skipping 4 households until the desired sample size was attained. The majority of the women co-operated well.

The response was 112 respondents out of 150. This was about 70 percent of all the respondents. About 30 percent of the respondents never co-operated with the researcher, some refusing entry to the compound. Most of them were complaining about similar projects that never brought them feedback.

This method was used because it is otherwise cumbersome within a developing world context to list all households in the selected clusters so as to draw the required size employing a random number table. The cost and time were also drastically reduced.

3.60 Data requirements

Primary data were needed for the study. This data was collected on the variables given on the empirical model on page 38. These are for quality of children variables:

a. PE, the price of education.

b. DIS, the distance to the nearest primary school.

For the child quantity I will have:
a. MEDUC, education of the woman.
b. FEDUC, education of the man.
c. AW, age of the wife.
d. ACRE, number of acres of land owned.

To collect the data interview schedules were used. (See Appendix 1). These interview schedules were administered to one woman in a household (randomly chosen from all women in the household aged (16-49)).

Two research assistants were used to help in administering the interview schedules after some basic training. The research assistant were paid a basic amount to meet some of the expenses in the research. To administer the interview the researcher started from a central point that was Nyeri town and the movement to the other areas were determined by the ease of getting transport. After going round with the research assistants, covering a number of clusters, the remaining clusters were divided into three groups. Each research assistant took one area and the remaining part by the researcher.

After data were collected, both the researcher and the research assistants went through the answers to check any disorders, to be rectified.
The researcher verified whether the needed data was collected. Then a coding manual was prepared according to the interview schedules that were filled out. After the coding the data was put into a personal computer in the Economics Department (Kenyatta University).

The statistical analysis was done using SSP computer software packages. The statistical results are presented in form of graphs and charts in an attempt to show any underlying relationships in the data.

Correlation analysis was done to determine the degree of association among variables. Regression methods were used to estimate causal relationships suggested by research equations.
4.00 EMPIRICAL ANALYSIS

This chapter is based on findings from interviews with 112 women (16-49) years old randomly selected in Nyeri District, Central Province. The statistical analysis is based on the estimates of reduced equations shown in the Empirical specifications.

4.10 Descriptive Results

Table 4.1 below reports the means of the variables in the equations that are estimated using Ordinary Least Squares method.

**TABLE 4.1 Mean of all the variables in the model.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Number of children ever born</td>
<td>2.67</td>
</tr>
<tr>
<td>Q</td>
<td>Quality of children measured by education expenditure (Kshs)</td>
<td>356.00</td>
</tr>
<tr>
<td>MEDUC</td>
<td>Mother's education measured in years of schooling</td>
<td>5.04</td>
</tr>
<tr>
<td>FEDUC</td>
<td>Father's education measured in years of schooling</td>
<td>6.50</td>
</tr>
<tr>
<td>AW</td>
<td>Age of the wife measured in years since birth</td>
<td>26</td>
</tr>
<tr>
<td>ACRE</td>
<td>Acres of land owned</td>
<td>3.67</td>
</tr>
<tr>
<td>DIS</td>
<td>Distance to the nearest primary school measured in Km.</td>
<td>1.92</td>
</tr>
<tr>
<td>PE</td>
<td>Price of education measured in Kshs.</td>
<td>250.00</td>
</tr>
</tbody>
</table>
The table shows that on average, fathers are more educated than the mothers. The age mean of the wife indicates that the sample women were below 30 years on average. The size of the land owned is relatively small with an average of 3.67 acres. The distance to the nearest primary school on average is slightly below 2 kms. The price of education is very low on average mainly because of lack of school fees in public primary schools where the sample children attend in big numbers. Most parents interviewed had no children at the secondary level, that fact made the PE to be on the lower side. Table 4.2 below shows the correlation matrix. This is a correlation matrix for all the variables that appear in the estimated equations (see table 4...)

**Table 4.2: Correlation Matrix**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>MEDUC</th>
<th>FEDUC</th>
<th>AW</th>
<th>ACRE</th>
<th>DIS</th>
<th>PE</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDUC</td>
<td>-0.09</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEDUC</td>
<td>-0.06</td>
<td>-0.14</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AW</td>
<td>+0.87</td>
<td>-0.12</td>
<td>0.02</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACRE</td>
<td>-0.03</td>
<td>-0.25</td>
<td>-0.36</td>
<td>-0.05</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIS</td>
<td>0.06</td>
<td>-0.07</td>
<td>0.33</td>
<td>0.22</td>
<td>-0.41</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.53</td>
<td>-0.08</td>
<td>-0.12</td>
<td>0.47</td>
<td>-0.73</td>
<td>0.06</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>0.46</td>
<td>-0.08</td>
<td>-0.04</td>
<td>0.34</td>
<td>0.12</td>
<td>0.03</td>
<td>0.86</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The values range between -1 to +1.
Some of the Correlation coefficients on the correlation matrix are very strong indicating a sign of multicollinearity problem that might appear in the regression results. The problem of multicollinearity arises in econometrics when some or all of the independent variables in a multiple regression equation are themselves related. The consequences of multicollinearity (among others) include, 'wrong' signs for the coefficients and insignificant t-ratios with significant F-ratios.

The variable ,N, has a weak negative correlation with mother’s education (MEDUC), father’s education (FEDUC) whereas it is strongly positively correlated with the age of wife (AW). With acres of land owned (ACRE), the correlation is negative but weak.

The correlation of N with the distance to the nearest primary school (DIS) is a very weak one but positive. As for PE-Price of education - and N, the correlation is positive and fairly strong.

Quality of a child, Q, has strong positive correlation with the price of education (PE), fairly strong correlation with, AW which is positive and a very weak positive correlation with ACRE and DIS. MEDUC and FEDUC have a weak negative correlation with the quality of children, Q.
PARAMETER TESTING

Before the analytical results, it is important to note that, for statistical significance, the t-test was used by the study using a two tailed test. In this study the level of significance was fixed at 5 per cent and a two tailed test was chosen to test the significance of the parameters used as indicated on page 41.

For the purpose of this study, if the calculated value of $t$ is greater than the tabulated value of $t=1.96$, the variable is said to have a significant effect. If otherwise, no significant effect.

4.20 ANALYTICAL RESULTS.

The results of all the equations are reported, followed by a detailed discussion of each set of results under this section. Table 4.3a reports the estimates of the parameters of the quantity equation.
Table 4.3a Reports the multi-variate regression estimates for the parameters of the quantity equation.

Table 4.3a
Multi-variate Ordinary Least Squares regression results for the number of children ever born.

DEPENDENT VARIABLE: CHILDREN EVER BORN,(N).

<table>
<thead>
<tr>
<th>Regressor Variable</th>
<th>Estimated Coeff.</th>
<th>T-ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.457</td>
<td>-0.731</td>
</tr>
<tr>
<td>MEDUC</td>
<td>0.033</td>
<td>0.102</td>
</tr>
<tr>
<td>FEDUC</td>
<td>-0.131</td>
<td>-1.231</td>
</tr>
<tr>
<td>AW</td>
<td>1.105</td>
<td>8.872</td>
</tr>
<tr>
<td>ACRE</td>
<td>-0.041</td>
<td>-0.501</td>
</tr>
<tr>
<td>DIS</td>
<td>0.092</td>
<td>0.657</td>
</tr>
<tr>
<td>PE</td>
<td>-0.054</td>
<td>-0.440</td>
</tr>
</tbody>
</table>

F-ratio = 18.78

$R^2 = 0.7013$

DF = 63
Table 4.3b reports the multi-variate regression estimates for the parameters of the quality equation.

### Table 4.3b

**Multi-variate Ordinary Least Squares Regression Results for the Quality of Children.**

**DEPENDENT VARIABLE : QUALITY OF CHILDREN, Q.**

<table>
<thead>
<tr>
<th>Regressor Variables</th>
<th>Estimated Coeff.</th>
<th>T-Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.653</td>
<td>2.975</td>
</tr>
<tr>
<td>MEDUC</td>
<td>-0.065</td>
<td>-0.129</td>
</tr>
<tr>
<td>FEDUC</td>
<td>0.065</td>
<td>1.647</td>
</tr>
<tr>
<td>AW</td>
<td>-0.158</td>
<td>-2.267</td>
</tr>
<tr>
<td>ACRE</td>
<td>0.039</td>
<td>1.275</td>
</tr>
<tr>
<td>DIS</td>
<td>-0.021</td>
<td>-0.393</td>
</tr>
<tr>
<td>PE</td>
<td>0.292</td>
<td>11.649</td>
</tr>
</tbody>
</table>

**F-ratio = 27.78**

**$R^2 = 0.7764$**

**DF = 63**
Table 4.4 reports the multi-variate regression estimates for the parameters of the quantity equation interacted with the estimated quality equation.

Table 4.4
Multi-variate Ordinary Least Squares Regression Results for the Quantity-Quality Equation.

**DEPENDENT VARIABLE : NUMBER OF CHILDREN EVER BORN, N.**

<table>
<thead>
<tr>
<th>Regressor Variable</th>
<th>Estimated Coeff.</th>
<th>T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.055</td>
<td>0.106</td>
</tr>
<tr>
<td>MEDUC</td>
<td>0.090</td>
<td>0.279</td>
</tr>
<tr>
<td>FEDUC</td>
<td>-0.084</td>
<td>-0.812</td>
</tr>
<tr>
<td>AW</td>
<td>1.160</td>
<td>10.157</td>
</tr>
<tr>
<td>ACRE</td>
<td>-0.042</td>
<td>-0.537</td>
</tr>
<tr>
<td>Q</td>
<td>0.089</td>
<td>0.994</td>
</tr>
</tbody>
</table>

F-ratio = 22.91
R^2 = 0.6563
DF = 65
4.30 INTERPRETATION AND DISCUSSION OF RESULTS.

4.31 Quantity Equation

Effects of the Wife's Age (AW)

From the regression results, the number of children ever born increases with mother's age as one would expect. When the mother's age is squared (see Appendix 2) the coefficient is smaller but the resulting effect is still significant. This may be due to two factors. First, the delay marriage by younger women effectively shortens their active reproductive cycle. Second, the relatively younger women have not fully completed their fertile cycles and are likely to have more children in the future. This is as expected. This finding is in accord with Marcia (1991) cited by Ainsworth (1992).

Effect of Mothers Education

Education attainment of the mother is an important determinant of the family size. Following the underlying assumption that market wages of mothers is a good proxy for their Education level and that child production is time intensive, this variable is expected to be negatively related to the size of the family, but the results from the regression show a positive insignificant wage effect. This may be due to the relationships among some of the explanatory variables in the equation. This is one of the consequences of the multicollinearity problem mentioned earlier.
Due to the fact that wage is associated with increasing value of mother's time in the labour market, the positive association of MEDUC and N is difficult to interpret.

Educated mothers are said to substitute quality for a number of children and better knowledge and practice of contraception.

Other studies in the literature report different results on the same variable. Ben Porath (1973) using data from Israel, Kogut (1974) using data from Brazil reported a u-type effect of mother's education on fertility. This means that fertility falls with low levels of mother's education and rises at higher levels of mother's education. This may be due to income effect connected with higher levels of education. Cochrane (1979) reported an increase of fertility with low levels of mother's education and a decrease at a higher level of mother's education.

Schultz T.P. (1970) in an analysis of fertility in rural Egypt found no differentials in fertility among various educational classes. Most of these studies report a likelihood of a threshold level of education effect on fertility. This is not apparent in this study. The data employed in this research does not permit an investigation of the threshold effect.
Effect of Father Education (FEDUC)

This variable was taken as a proxy for income. The regression results of Table 4.3a show a negative but insignificant results. This finding though insignificant is in consonance with the expected results, higher father's education is likely to have a positive income effects on the household decision, towards a smaller family size to better educated children.

The general view that children take of mother's time than father's is in accordance with this finding that father's education has little effect on family size, but this conclusion may be taken with caution since the result is insignificant. For more detail see World Bank (1974).

However, Bowman (1976) said that, through a path model indirect effect of husbands education via occupation and income can be traced. The findings from the path model would give a clearer picture of this variable on N that could have been underestimated by the reduced model used.

Due to the weak predictions of the variable (FEDUC) on N, another variable as a proxy for income was considered.
ACRE is considered in this model as a good proxy for income. The Effect of this variable on fertility is as expected. The results show a negative relationship between ACRE and fertility. The "insignificance" of some of the coefficients in this study could be due to the multicollinearity problem because the F-ratio of 22.91 shows that the overall explanatory power of the regression model is strong. The evidence from both time series (e.g. Demographic Transition) and Cross section analysis indicates a negative but insignificant relationship between income and fertility. Thus ACRE depicts a better proxy for income than father's education if this is something to go by.

Mincer 1963 points out that the adverse substitution effects of income on fertility (the price of a child increases as the opportunity cost of the children rises) tends to outweigh the favourable income effect.

This observed negative income relationship with the number of children does not necessarily mean that the number of children, in the conventional sense, is an inferior good, but it may be as a result of quantity - quality interaction of children.
Other studies are in accord with this finding. Faroog (1985) reported an inverse relationship between fertility rate and income; but he pointed out that the result could have been influenced by poor family income data.

Driver (1963) found no significant influence on family size of family income. However, Rele (1973), Kogut (1974) and Dov Chernichousky (1981) reported a positive effect of income on fertility.

Effects of Infrastructural Variables.

Distance to the Nearest primary School (DIS)

The regression results show a positive but statistically insignificant association of distance and family size. This relationship can be explained by the fact that most villages considered in the research area have both a primary and a secondary school nearby. This is not a good measure of cost of children’s education.

Effect of Education Cost (PE)

The multivariate results, report a weak negative effect. It is tempting to conclude from this observation, that this is in accordance with the casual observation that as school fees increases parents will tend to have smaller families. This
finding predicts that the cost sharing policy in education may reduce fertility in the long run. Most parents in the study area have children in primary schools which are public. Thus the school fees component in the child expenditure is minimal. That is why the PE variable is not likely to influence fertility.

The $R^2$ ratio in the table 4.3a shows that 70.13 percentage of the changes in the dependent variable (N) is jointly explained by all the variables in the equation. This is a good explanatory power whereas the remaining 29.87 percentage is explained by other variables not included in the model, errors in data collection or the deficiencies of the variables used.

The F-ratio of 18.78 (on the same table 4.3a) indicates that the joint effect of all the variables on the dependent variable is statistically significant.

4.32 Quality Equation.

Before discussing the results of quality equations, it would be in order to say a word about the reliability of the variable, Q.

Q, the quality of children, is measured by the education expenditure per household per child. This variable is generally approximated because majority of parents in the
research area (like in all developing economies) do not keep any expenditure records of expenditure on their children. No doubt, it would have been better to use the actual expenditure on education of the children. The data were not, however, available. Nevertheless, it is hoped that the proxy used will help to investigate the behaviour of the quality-quantity model for the Kenyan situation.

The Effect of Wife's Age (AW)

The result from table 4.3b shows a statistically significant negative effect of wife's age on the quality of children. The result is not as expected. The expected effect of AW on $Q$ was positive. This is because as the age of the wife increases the resultant increase in her efficiency results in an increase in the equality of children demanded. This may be because, due to age the women have realized the benefits of educating children, and also their needs are fewer with age i.e. considering the opportunity cost of educating children, they start valuing children's education more strongly. The negative effect of AW on $Q$ may be difficult to interpret but it may again be due to the multicollinearity problem.

Effect of Mothers' Education (MEDUC)

The results show a negative but insignificant effect of mothers education on quality of children. Educated mothers
are said to aspire for higher education for their children (Ainsworth, 1992). Thus the research finding are not as expected. This may be because of the structural differences that exist between the subgroups considered.

The Effect of the Father’s Education (FEDUC)

The results of FEDUC on Q showed a positive but insignificant influence on Q. These findings are difficult to interprete because the expected result was a strong positive association of FEDUC with Q.

Educated fathers are likely to have large incomes. This is supposed to increase Q, meaning that the FEDUC should be positively related to Q.

The Effect of Acres of land Owned (ACRE).

The regression results show that the number of acres owned does increase quality of children as expected although this influence is statistically insignificant.

Expenditure per child that parents consider necessary rises with income. Duesen berry (1960) cited by Mueller (1983): There is very low opportunity cost of quality children when income is high.
Effect of Distance to the nearest primary School (DIS)

The results for this variable (DIS) are as expected. The regression results show a very negative relationship between distance to the nearest school and child quality. These results seem to concur with the expected result, that as the DIS decreases, the quality of children increases.

This conclusion may be a very tentative one as this variable may not be a good measure of child’s education. This is because, most households considered are near schools.

The Effect of Price of Education (PE)

The regression results reports a statistically significant influence of PE on Q. This result is positive as expected. As PE increases the quality of children increases which concurs well with the measure of quality - Education Expenditure - The empirical findings match very well with the expected results.

The $R^2$ ratio in table 4.3b shows that 77.64 percent of the changes in the dependent variable (Q) is jointly explained by all the variables in the equation, whereas the remaining 29.87 percent is explained by other variables not considered in the model.
The F-ratio shows that the joint effect of all the variables on the dependent variable is statistically significant.

The researcher appreciates with disappointment the non-significant effect of the variables used. This could have been due to multicollinearity problem explained above.

### 4.33 Quantity - Quality Interaction

Table 4.4 above reports the interaction of the two variables, Q and N. The results revealed a positive but insignificant effect of Q on N. This is in contrast to the Becker's model which indicates a negative relationship between N and Q.

Inspite of acknowledged data problems as indicated by the multicollinearity problem, this finding is not surprising because many studies in developing countries have revealed the same. The finding can be explained partly because parents often regard a child as an investment good, a devise for attaining income security in old age, and an educated child has more earning power and hence more social security value than uneducated one.

Furthermore, the parents often do not bear the full cost of educating the child under the extended family system: relatives, friends and old children sometimes chip in expect-
ing to reap further benefits when the child completes school and starts to earn. Either or both of these factors may cause parents to seek large families and high education per child. These results are in accord with Hossain (1990), Snyder (1974) and Ron and Shutjer (1982) reported a negative relationship between N and Q with a simultaneous equation framework. Rosenweerg and Wolpin (1980) found the negative relationship although statistically insignificant. Therefore the research findings indicate that in the sample considered fertility and child quality are not strong substitutes.
CHAPTER FIVE

5.00 SUMMARY AND CONCLUSION

5.10 Summary

The effort of the researcher was to construct and test the basic fertility model (Pioneered by Becker et al (1973)), using micro data from one of the Kenyan District - Nyeri.

The framework for this analysis was a one-period, full certainty model, in which parents maximize their joint utility function. Time series data would give the same results. The time magnitude needed for such a study was limited, one-period data was preferred.

The thesis has identified the factors influencing the demand for children and the demand for higher quality children as well as the possible trade-offs between them.

The results show that higher household income mean smaller families with higher quality children. These results are consistent with other findings, and imply that parents substitute quality for quantity as the income in the household rises.
Although this study is not a longitudinal study, nevertheless, the observed tendency by the high income groups to have small family sizes can be used as a circumstantial evidence supporting the hypothesis that when the value of human capital increases above the value of other form of capital investment, households with high incomes reduce fertility (counter intuition) of the time when they can afford educational costs (Becker et al (1990)).

According to prior expectations educated mothers tend to have fewer children. The research findings reported unexpected negative but insignificant effect of mother's education on child quality. The research findings did not reveal which of the two variables - mothers education and fathers education - has a stronger effect on the trade off.

The distance to the nearest primary school (a proxy of the cost of education) showed a mixed effect on both the size of the family and quality of children. This fact was contributed to the households nearness to the schools.

Price of education was found not to be a good measure on the family size in this research. Most of the sample households enroll their children in public primary schools where the fees are minimal. Most of the parents interviewed had no children
in secondary schools; thus PE was at the minimal side. PE had a significant, positive effect on Quality of children as expected.

However, the tradeoff between quantity and quality of children was not apparent in this study. The interaction of the two variables showed positive relationship which was contrary to the Becker's theory. This as indicated in section 4.33 is due to various reasons.

5.20 Conclusion.

In interpreting any of the above results caution must be taken. It might be improper to generalize the results for an entire country, since the data used are from a survey in one of the Kenya's districts.

The fertility model (Becker et al (1973)) has not been constructed to allow for any constraints peculiar to low-income countries. In these countries there is simultaneous market activity and child production by women. The cost of women's time, or opportunity cost, is determined by the market wage rate. An increase in the market wage increases the price of children, which reduces the quantity of children demanded.
In low-income countries the highest percentage of women are housewives. If they involve themselves in any market activities, the opportunity cost is low compared to those women employed in the labour markets in the high-income countries.

The rate of illiteracy is still very high, despite the government efforts to eradicate it (the literacy rate is about 66 per cent (Sunday Nation, 30th October, 1993)).

Infant mortality is high (time series data indicate a downward trend (C.B.S, 1992)). Also there is still unmet need for family planning contraceptives. The contraceptive prevalence has not yet reached 100 per cent (C.B.S. 1986c). Children tend to be used as old age support by their parents. This means that children are still seen as assets for the future consumption rather than as a present liability.

5.30 POLICY IMPLICATION

The ultimate objective of any policy maker is to increase both economic growth and economic development at macro levels and to increase individual welfare at micro levels, through various channels.
Reducing fertility and increasing the amount of education per child would help to achieve such a goal. Given the demand for children and for children's education are jointly determined by the parents, policies that directly affect the number of children or quality of these children will induce trade-offs. It is important to take these trade-offs into consideration when evaluating the direct effects of these policies.

There is also a need to evaluate the cost sharing policy [which is a new Kenyan policy for curbing government overspending on public utilities] especially at micro level. This means checking the impact of cost-sharing at individual households. Such an evaluation would help in checking the extent of the effect of cost sharing on fertility.

The results of this study have shown that the price of education (taken as a measure of cost of education) has a weak negative effect on quantity of children but a positive and significant effect on the children's quality. Thus cost sharing should be a concern of both the governments and family planning institutions with respect to population curbing.

Of worth noting is the effect of increasing the income across the board to check how different social groups would behave towards the trade-off as income increases.
This is important because income has been shown in this study to have a negative child quantity effect. Understanding income implications for fertility would influence the government strained effort on population issues. Population is a major drawback on development in most of the developing countries.

This would also help in finding more about whether low education and high fertility is confined to the poor a case for income redistribution. As it is the case with low levels of income, the study revealed that as income increases (ACRE) the number of children decreases.

Accumulating evidence on the economic benefits of schooling and training (eg see Mincer (1974)) tends to accentuate the importance of human capital in policy discussions. This new faith in human capital can reshape the way the governments approach the problem of stimulating growth and productivity. This would help the government by diverting resources from non-beneficial projects to enhance human capital development.

The study finding predicts that as a country develops, the time spent on child care becomes more expensive since the higher value of time raises the cost of children and thereby reduces the demand for large families. This is consistent with Becker, Tamura, Murphy (1990) theoretical model. Therefore, if
the Kenyan government would want to achieve much economic growth and development the two variables cannot increase simultaneously. Family Planning must be done at all costs for sustained growth of a country. This asks for both individual and government effort.

This study has revealed that parents in the study area do not trade-off child quantity for child quality. One of the reasons is probably because children are considered as investment good, a device for attaining income security at old age. The higher the quantity (family size) the better. Becker (1992) indicates that, even in rich countries, many parents want old-age support. They underinvest in their children's education and other care. They therefore, underinvest because they cannot compensate themselves for greater spending on children.

The per capita income of a country determines the welfare of the individuals, ceteris paribus. Rich parents can afford to leave more bequests to their children. These parents, therefore, do not need old-age support because instead they help out their children.

This would have long term implication for the size of the family (Becker 1992). That is if a country develops and
consequently per capita income rises people eventually would lower the family size.

Becker (1992) pointed that altruistic parents who leave bequests to their children, also tend to invest more in their children's skills. This is because they gain more from financing all investments in the education and skills of children that yield a higher rate of return than the return on savings. This is only possible if the level of economic development is high. They can indirectly save for old-age by investing in children, and then reducing bequests when elderly. Both the children and parents would be better off if the parents agreed to invest more in the children in return for commitment by the children to care for them when they need help. This is a difficult task but economists and lawyers usually recommend a written contract to ensure commitment, however these contracts are difficult to enforce.

The study has shown that quantity and quality of children are not strong substitutes in the study area. Perhaps it would be important for the policy makers to consider both short and long term effect of each on the other.

This would help, because there are short term and long term measures that policy makers can use when for example quantity of children outweighs the quality of children in a country.
One of the short term measures could be to increase supply of contraceptives devices to the people especially where there is unmet demand for them (or even consider a remote solution, that is widely objected, of giving school girls pills to curb unwanted pregnancies).

5.40 SUGGESTED AREAS FOR FURTHER RESEARCH

There is need to have an economic analysis to find out the effect of social security payments on the education of the beneficiaries' children. Whether those who gain social security payment have a trade-off between quantity and quality of their children needs to be investigated.

The following possible hypothesis could be tested:

"People who need social security payment do not need their children's help at old-age and hence they have smaller families"

This hypothesis may qualify more in a situation where social security fund scheme is more developed. In developing economies, in relative and absolute terms, the size of the population that falls in this category is rather small. However, this does not disqualify the hypothesis from being tested since it is one of the facets the government can use in the long run.
BIBLIOGRAPHY


APPENDIX I

NYERI DISTRICT HOUSEHOLD INTERVIEW SCHEDULE

DATE: April-----May 1993

Household serial No. _______

The unit of observation is one woman in a household of child bearing age between 16 - 49 years.

PERSONAL CHARACTERISTICS

1. Get all the names of women in the household aged 16-49 years and ask whether they are in.

   Names:        Are they in:

   01  _______  _______  
   02  _______  _______  
   03  _______  _______  
   04  _______  _______  
   05  _______  _______  
   06  _______  _______  

Choose one woman who is in at random and interview.

2. How old are you? ___ years  [  ]
3 (a) Did you go to primary school?
1. yes [ ]
2. no [ ]
3 (b) If 'yes' up to what standard? [ ]

4 (a) Did you go to secondary school? [ ]
1. yes [ ]
2. no [ ]
(b) If 'yes up to what form? [ ]

5. Have you ever gone to university or college?
1. yes [ ]
2. no [ ]
(b) If 'yes' How many years? [ ]

CHILDREN RELATED CHARACTERISTICS
6 (a) List all the names of children you have.

<table>
<thead>
<tr>
<th>NAME</th>
<th>SEX</th>
<th>AGE</th>
<th>HIGHEST EDUCATION</th>
<th>ARE THEY STUDENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td></td>
<td></td>
<td>01 no school</td>
<td>-----------------</td>
</tr>
<tr>
<td>02</td>
<td></td>
<td></td>
<td>02 Pre school</td>
<td>-----------------</td>
</tr>
<tr>
<td>03</td>
<td></td>
<td></td>
<td>03 Primary</td>
<td>-----------------</td>
</tr>
<tr>
<td>04</td>
<td></td>
<td></td>
<td>04 Secondary</td>
<td>-----------------</td>
</tr>
<tr>
<td>05</td>
<td></td>
<td></td>
<td>05 University</td>
<td>-----------------</td>
</tr>
<tr>
<td>06</td>
<td></td>
<td></td>
<td>06 Others(specify)</td>
<td>-----------------</td>
</tr>
</tbody>
</table>
6 (b) List of children as in 6(a).

School Expenditure (Ksh) per year. How much do you spend on each of the following items.

<table>
<thead>
<tr>
<th>FEES</th>
<th>HARAMBEE</th>
<th>BOOKS</th>
<th>UNIFORMS</th>
<th>TRANSPORT</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>--------</td>
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<td>02</td>
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<td>03</td>
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<td>04</td>
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<td>05</td>
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<td>06</td>
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</tr>
</tbody>
</table>

6 (c) Do you receive any money from bursaries to help pay these costs?
1. yes [ ]
2. no [ ]

6 (d) If 'yes' how much per year? Ksh. __________

7 (a) Did you have children who have died?
1. yes [ ]
2. no [ ]

7 (b) If 'yes' how many? __________
7 (c) How many died at child birth ________

HOUSEHOLD CHARACTERISTICS.

8 (a) Who is the household head?
1. yourself (if yourself go to question 10)
2. female [ ]
3. male [ ]

8 (b) Age of the household _____ years.

(c) Did your household head go to primary school
1. yes [ ]
2. no [ ]
If 'yes' up to what standard ? ________

(d) Did your household go to secondary school?
1. yes [ ]
2. no [ ]

8(e) Has your household head ever gone to University or college?
1. yes [ ]
2. no [ ]

9. What relation is the household head to you.
1. husband [ ]
2. father/mother [ ]
3. brother/sister [ ]
4. other relative [ ]
5. no relationship [ ]
6. n/a [ ]

10. How many people are in your household? (including yourself)
   1. men [ ]
   2. women [ ]
   3. boys [ ]
   4. girls [ ]
   (please count those aged 16 or over as adults on respective order)

HOUSEHOLD INCOME/CONSUMPTION CHARACTERISTICS.

11. (a) About how much does your household spend a week? ___________ (ksh).

(b) Do you produce any food for your own use
   1. yes [ ]
   2. no [ ]

(c) If 'yes' how much value is that food per week if you did not produce it yourself? __________
12(a) Does your household own any land?
1. yes [ ]
2. no [ ]
If 'yes' how many acres? ________________

(b) how much does one acre cost? ____________

ACCOMMODATION

13 (a) Housing
What is the wall made of
1. mud [ ]
2. wood [ ]
3. stone/bricks/concrete [ ]
4. iron sheets [ ]
13 (b) What is the roof made of?
1. iron sheets [ ]
2. thatched [ ]
3. tiles [ ]

(c) How many rooms are in the house? [ ]

SOCIAL SERVICES.

14. Local services.
(a) How far is the nearest primary school?______ km
(b) What is the name of the primary school?_______
15. (a) How far is the nearest public secondary school? _____ km

(b) What is the name of the public secondary school? __

16. (a) How far is the nearest private secondary school? __ km.

(b) What is the name of the nearest private secondary school? ______

17. (a) How far is the nearest Dispensary? _____ km

(b) How far is the nearest tarmac road? _____ km

(c) How far are you from Nyeri Town? _______ km

(d) How many shillings per day do casual workers get in this area? _______ ksh.
**APPENDIX 2**

Multi-variate Ordinary Least Squares Regression Results for the Quantity Equation. (when variables are squared).

**DEPENDENT VARIABLE: NUMBER OF CHILDREN , N.**

<table>
<thead>
<tr>
<th>Regressor var.</th>
<th>Est.Coeff.</th>
<th>T-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>0.203</td>
<td>0.043</td>
</tr>
<tr>
<td>MEDUC²</td>
<td>0.117</td>
<td>0.362</td>
</tr>
<tr>
<td>FEDUC²</td>
<td>-0.017</td>
<td>-1.217</td>
</tr>
<tr>
<td>AGE²</td>
<td>0.193</td>
<td>9.685</td>
</tr>
<tr>
<td>ACRE²</td>
<td>-0.004</td>
<td>-0.350</td>
</tr>
<tr>
<td>DIS²</td>
<td>0.025</td>
<td>1.062</td>
</tr>
<tr>
<td>PE²</td>
<td>-0.009</td>
<td>-0.705</td>
</tr>
<tr>
<td>Q²</td>
<td>0.148</td>
<td>2.091</td>
</tr>
</tbody>
</table>

DF = 63  
F = 18.07  
R² = 0.693