ENVIRONMENTAL GOODS COLLECTION WORK AND CHILDREN'S SCHOOLING: THE CASE OF SCHOOLING IN KIAMBU DISTRICT

BY

SIMON WAGURA

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UNIVERSITY OF NAIROBI

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DECLARATION

This research paper is my original work and has not been presented for a degree award in any other University.

NAME: SIMON WAGURA

SIGNATURE: .....

DATE: 28TH AUGUST, 2007.

APPROVAL

This research paper has been submitted for examination with our approval as University supervisors.

NAME: DR. WILFRED NYANGENA

SIGNATURE: .....

DATE: 28TH AUGUST 2007

NAME: MR. GEORGE NJIRU

SIGNATURE: .....

DATE: 28 - AUGUST - 2007

DEDICATION

'There is no excuse for those who could be scholars and are not' Way 332 by *Josemaria Escrivá*

I dedicated this research work to my Dad and Mum, my Brothers and Sisters, indeed you all inspired me to have a reason to study.

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LIST OF ABBREVIATIONS AND ACRONYMS

AERC	African Economic Research Consortium
CBS	Central Bureau of Statistics
DFID	Department for International Development, United Kingdom
EAs	Enumeration Areas
EC	European Commission
FPE	Free Primary Education
IV	Instrumental Variables
KAAD	'*Katholischer Akademischer Auslander-Dienst* (Catholic Academic Exchange Service)
KASEA	KAAD Association of Scholars in East Africa
MDGs	Millennium Development Goals
OLG	Overlapping Generation
OLS	Ordinary Least Squares
GoK	Government of Kenya
UNEP	United Nations Development Programme
WRI	World Resources Institute
2SCML	Two-Step Conditional Maximum Likelihood

ABSTRACT

This study examines the link between environmental goods collection and children schooling in Kiambu District, Kenya. The study was carried out against the increasing consensus in the literature on household dependence on natural resources and the suggested consequences on households investing more time in collection of those scarce resources especially firewood and water. Children schooling is measured as the child's school attendance and performance in school.

The study uses cross sectional data collected from Kiambu district in Lari, Ndeiva and Kikuyu division in May 2007. Both descriptive and econometrics techniques are employed to achieve the study objectives. Descriptive statistics indicates that 88 per cent of the sampled children attend school with a drop out rate of 10 per cent. It also indicates that 59 per cent of school going children combines schooling and resource collection. The data further shows that 83 per cent of children are in public schools relative to private schools.

Possible endogeneity of resource collection work in the school attendance equation is corrected for using bivariate probit and instrumental variable probit estimation. The probit model was also estimated for the performance model. The econometrics results support the hypothesis of a negative relationship between children resource collection work and their probability of attending school. The results also suggest that performance in school does not depend on environmental goods'resource collection work of children. Finally the study recommends ways of increasing water supply to reduce the time children spend on collecting it and ways of substituting firewood.

CHAPTER ONE

INTRODUCTION

1.0 Background

The inter-linkage of population, environment and poverty has been a debatable issue and concern to policy makers. Therefore, the link between poverty, population, degradation of natural resources in many countries is not well understood. The inter-linkages between population, agriculture and the environment have been documented in many studies (Boserup 1965, Nerlove 1991, Dasgupta 2000, Kabubo-Mariara 2003). Dasgupta (2000) concluded his study on population, resource and welfare as what he called population problem in developing countries.

Importantly, the growing concern about population and environment interlinks reflects to Malthus (1798) essay on the principle of population. Despite laying the foundation of population resource interrelationships, which asserts that a geometrically growing population tends to outrun an arithmetically growing food supply, he further assumed that natural resources are fixed and population would only decline through natural checks, such as famine. In response to this assumption, Boserup (1965) criticized Malthusian theory on the basis that it ignored the role of technological changes occasioned by population pressure, thereby reversing the Malthus argument that growing population would expand into more marginal land, and returns to labour would inevitably decline.

Based on the foregoing concept, others have evolved the Neo- Malthusian perspectives, emphasizing the positive and negative changes of population. Some Neo-Malthusians consistently argue that natural resources are absolutely limited and finite. To this effect, Hardin (1968)[1] contended that users of a common resource (water, land, air) will inevitably destroy the very resource upon which they depend on. A classic neo-Malthusian argument for natural limits, Hardin's article was seminal to the population-resources debate. On the other hand, Boserup (1965) points that population increase has positive effects, since it stimulates innovation and intensification. She hypothesizes that

[1] See his article on Tragedy of the Commons

population growth leads to improvement in agricultural technology, which has remained a major contributor to the debate on effects of population on agriculture and hence environment. Conversely, others have emphasised the negative relationship between population growth and the quality of environmental resources.

Most literature on the interaction regarding population, the environment, and poverty tend to indicate that population growth is a major cause of environmental degradation (Malthus 1798, Boserup 1965, Nerlove 1991, Hardin 1968, Dasgupta 2000). However, some studies have quantified the reverse impact, and indicated that the environment may affect demographic behaviours. This is evidenced in Nepal, Malawi and Pakistan (Filmer and Pritchett 1996, 1997, Cooke 2000, Nankhuni and Findeis, 2003). Therefore, it is vitally important to conduct studies, considering a thorough investigation regarding the inter-link between environment and education, since inadequate research has been implemented on the issue of natural resources scarcity on schooling. This will inform policy makers and provide the need to enhance human capital development, as well as prudent management of natural resources especially the common properties which are at a high risk of degradation when there is resource scarcity.

1.1 Dependency of Household on common property

Since the environment is important to people entrapped in poverty, the survival of the poor is often anchored to a wide range of natural resources and ecosystem services[1] for their livelihoods. Specifically, while the rural poor people are particularly concerned with secure access to and the quality of natural resources, such as arable land and water, crop and livestock diversity, forest products and biomass for fuel, the urban poor consider issues, such as water, energy, sanitation and waste removal, drainage, and secure tenure as key concerns (DFID 2002).

[1] The ecosystem services enjoyed by humans include provision services, regulating services, cultural services and supporting services. In this study we shall focus on provision of services such as water and fuels. (see WRI 2007 pp. 4)

In this regard, one might inquire if there is scarcity of firewood, where it is collected from and who collects it. Appropriate response to this issue is based on given options for households on where to get the resources, depending on their income levels, asset base and the local resource base to obtain the resources. Local resource bases comprise assets such as ponds and streams, boreholes and aquifers, fallows and threshing grounds, woodlands and forests, grazing lands, village tanks and taps, fisheries and wetlands. For firewood the options include, one's own land, markets, common places such as the forests and fallow land bare hills which are commonly owned properties. They are for the most part common property. Attempts have been made to uncover the pathways by which poverty and reproductive behaviours among rural people are linked to the state of their local resource base. Dominant component of common property resource literature significantly claims that since poor people are more dependent on natural resources than non-poor households, they consequently derive higher economic benefits from the local commons. (Dasgupta and Mäler 2004)

1.2 Population and environment in Kenya

The total land surface in Kenya is 576.000km^2 which is used for agriculture and livestock. However there have been increased human processes in Kenya leading to land degradation, (GoK 2003). Forest cover is also a major resource in Kenya especially for firewood, timber, among many other uses. In the rural areas, the main fuels consumed are wood, charcoal and crop residues, 84 per cent of the population do not have access to electricity while firewood which is becoming increasingly scarce as forest area declines accounts for about 70 per cent of all energy consumed in Kenya, but firewood, (UNEP 2005).

As population increases, firewood consumption are expected to increase, further constraining fuel supply. This increase in firewood demand negatively impacts on biodiversity and other provisioning services that forests provide Often, these environmental goods are collected from neighbouring forest, this leads to serious

deforestation both for fuel and cultivation land. This is the major cause of firewood scarcity in the rural areas in Kenya, (GoK 2003).

There has been wanton deforestation in catchments areas of Mt. Kenya, Upland forest in Lari Division, Mau Forest, Aberdare and Mt. Elgon. Deforestation is largely being caused by firewood demand for tea processing, timber for domestic and export markets, agricultural production, among others. Households also use crop residue as a supplementary energy source. The use of crop residue as a fuel source is however, entirely dependent on the availability of firewood and the size of the harvests. The decline in agricultural and livestock productivity imply similar circumstances for the supply of dung and crop residue, (UNEP 2005).

The other scarce resource in rural areas is water. Agriculture accounts for the largest withdrawals of water in Kenya. Due to inconsistent and poor distribution of water, 50 per cent of Kenyan households do not have access to safe drinking water, (UNEP 2005). The rapid depletion of natural resources can have significant consequences on the quality of the lives of rural women and children who are primarily responsible for collection of firewood and water.

1.2 Child labour and schooling issues

The care and schooling of children has been a subject of research by a number of disciplines using different approaches In economics, child care and schooling are viewed as investment activities (Klevmarken 1998). Furthermore there has also been interest in studying child labour issues in developing countries, (Fares *et al.*, 2007, Ilahi 2001, Basu 1999, 2001).

Child labour indicator in general include schooling status, status in employment and hours of work .Children in the school going age who did not attend school during the school year but were reported to have worked are, therefore, considered to have been

engaged in child labour. This also applies to work by children who did not proceed to secondary school after completing the primary school. Going by schooling indicator, it can be stated that child labour in Kenya stood at 1.3 million children by the year 1999, (CBS 2003).

The labour force survey 1998/99 has indicated that a large number of schooling children (58.2 percent) worked for more than 25 hours in a week (CBS 2003). This is equivalent to more than 4 hours a day in a 6 day working week. Their academic performances are likely to be adversely affected since some of the tasks they performed were quite demanding in terms of physical effort and time. The survey revealed that 1.3 million working children aged between 5 to 17 years were out of school. This is likely to have affected the development of their knowledge base necessary for normal life. In addition, it found out that 18.4 percent of the working children who were out of school had no formal education.

In Kenya, the general curriculum is that children are admitted to Standard One for the 8 years of primary education at an average age of 6 years, and complete Standard Eight at the average age of 13 years. The data from the labour survey 1998/99 indicates that the majority of school-age children in Kenya stop schooling at/after the primary level. Access to secondary education is constrained not only by the limited number of secondary schools, but also by the high cost of secondary education against the background of deepening poverty. An analysis of the gross enrolment rates attending secondary school to the total number population aged between 14 and 17 years, (CBS 2003) There is therefore a need to further link this child labour/ collection activities issues in Kenya with environment to document their effects on schooling.

1.2.1 Trends in primary schooling

Schooling has long been seen by Kenyan families as a path out of poverty. Investments in human capital development are widely recognized as a key to sustainable development in

any country. Fees for secondary schooling have relatively risen contrary to rural incomes. This has constrained many rural households children education attainment to primary level. This has led to the vicious circle of cohort wastage[1] in our education system especially in poor households.

The policy of Free Primary Education (FPE) was implemented in 2003 by the government and which increased school enrolment from 93 to 104 percent as shown in table 1.1.

Table 1.1: primary school enrolment rates, 1999-2004

	1999	2000	2001	2002	2003	2004
Boys	94%	93%	93%	94%	106%	108%
Girls	93%	92%	92%	91%	104%	101.6%
Total	93%	92%	93%	93%	104%	104.8%

Source GoK 2005

It was widely welcomed especially in the rural areas where school fees are a major challenge for most of the households. However, this expansion has come at the cost of poorer quality which can be shown by overcrowding and the low grades obtained by children from public schools in national exams compared to those from private schools (GoK. 2005). The high enrolment rate brought about by FPE coupled with the increasing demand and importance attached to education by rural dwellers may have an impact on children involvement on resource collection activities since most of their time is spent in school.

[1] Hummel 1977 defined a cohort as a group of persons who jointly experience a series of specific events over a period of time. Accordingly, we may define a 'school cohort' as a 'group of pupils (students) who join the first grade of a given cycle in the same school year, and subsequently experience the events of promotion, repetition, dropout or successful completion of the final grade, each in his/her own way'. In this regard cohort wastage is the difference between the enrolment levels and graduation level of a given cohort, that is those who dropout of an education system. The dropout rate is defined as the percentage of students enrolling in the first grade of the primary cycle that drops out before reaching a specified grade

1.3 Resource scarcity and resource collection in Kenya

The state of environment report in Kenya, (GoK 2003) shows that households in rural areas of Kenya often rely profoundly on the natural resources such as land, water, forests for firewood which accounts for over 75 per cent of their cooking energy, and fodder for livestock. These resources have been declining due to population pressure, deforestation and climatic conditions making them scarce. A study by Pattanayak et al. (2004) found that access to forests for firewood is substantively important to local people and household labour is the chief input of fire wood collection. Fisher, (2004) examines the economic dependence on forests in Malawi and her finding suggests that there is substantial reliance by household on forest activities.

Wood fuel and water scarcity affect women and children in specific ways because they are the ones primarily responsible for all domestic related tasks for instance firewood collection, water collection, and domestic chores, (Nankhuni and Findeis, 2003). Women in Africa were reported by Ilahi (2001) to work more hours than men in domestic work, in South Africa women were reported to be main collectors of water, (Aggarwal, *et al.*, 2001). In livestock rearing households, children are expected to graze the animals thus environmental degradation may enhance the marginal productivity of children. These tasks that arise from environmental degradation are expected to cause women and children to travel long distance to access the resource. This might lead to an increased demand for children (Nerlove 1991, Filmer and Pritchett 1997).

This study is motivated by the decline in firewood availability in rural areas in Kenya and water scarcity which demands collection activities by household members. The study attempts to shed light on the linkage between resource collection activities and schooling

1.4 Statement of the Problem

Rural households often rely heavily on environmental goods and services such as biomass (firewood, charcoals, crop residues dung and fodder) and water. Given the increasing pressure on biomass resources in many rural areas in Kenya and the common gender division of collection labour, there is concern that women and children in particular will bear the burden due to increased resource scarcity by having to spend more labour time and effort to collect environmental goods. This resource collection pressure may have effects on children schooling which is the fundamental nature of this study.

The labour and school outcomes of children have received increasing attention recently, especially with the emergence of the problem of child labour. In the empirical literature on child labour and schooling, there is a tendency to narrow the discussion and analysis of the determinants of children's activities to two non-leisure activities— market labour and schooling. However, it is widely known that work at home constitutes a large part of children's work—especially that of girls.

Research has shown that when environmental goods are scarce, households will have to spend more time collecting these products, which significantly increases the work burden on women and children. Meticulous studies on the reverse impact of the interaction between population and the environment, for developing countries especially in Asia are documented by Kumar and Hotchkiss (1988), Filmer and Pritchett (1996, 1997), and Cooke (2000). In addition, though the issue of resource scarcity, resource collection and child schooling has been well studied in Malawi by Nankhuni and Findeis (2003), our knowledge has not captured any study of similar nature carried out in Kenya. Accordingly, this study seeks to analyse issues relating to resource scarcity, resource collection and their effects on schooling in Kenya.

1.5 Study Objectives

Using deforestation and water scarcity as examples of environmental degradation, the study's main objective is to investigate how long hours of work spent by women and children in firewood and water collection activities and other environmental degradation variables affect the schooling of children.

The specific objectives are

1. To determine the proportion of household time spent on resource collection
2. To investigate the linkages between resource collection and schooling
3. To investigate the effect of time children take to collect firewood and water on their school attendance and performance.
4. To suggest recommendations for policy makers in the management of water and forest resources

1.6 Research questions

The research questions to be addressed by this study are as follows;

1. What proportion of household time is spent on firewood and water collection?
2. Does the time that children spend collecting firewood and water affect their attendance in school?
3. To what extent does the time children spend in firewood and water collection affect their performance in school?

1.7 Justification of the study

This study will provide a comprehensive understanding of the reverse causal relationship of population and environmental resource scarcity. It will provide quantitative measures explaining how work related to collection of environmental goods affects the household welfare in particular the schooling of children. The study will also contribute to the child labour, population, environmental and poverty debate linking environmental degradation to children education. Based on the results to be generated, the study will offer policy prescription on forest and water resource management in Kenya

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents a review of the studies that have investigated the effects of household production and consumption behaviour, resource collection on their quality of life Empirical Studies on environmental degradation and welfare issue arising from resource scarcity will be reviewed too.

2.1 Theoretical literature review

2.1.1 The standard production household model

Household production models are based on Becker's (1965) unified model of the family. The general structure of the household production model is the agricultural household model as presented in Singh, Squire and Strauss (1986) can be written as

$$U_h = U(X_a, X_m, X_l) \tag{2.1}$$

Where U_h is the household utility function, X_a is agricultural staple, X_m is market purchased good and X_l is leisure enjoyed by household members

Household utility is maximized subject to a household budget constraint, time constraint and a specified home production technology

$$P_m X_m = P_a(Q - X_a) - w(L - F)$$

$$X_l + F = T \tag{2.2}$$

$$Q = Q(L, A)$$

P_m, P_a and w are prices of the market good, home good, and labour respectively. Prices are exogenously determined. It is assumed that commodity and labour markets are perfect and the household is a price taker. Q represents the household's production of the staple. $Q-X_a$ is the marketed surplus of this product. L is the total labour input demanded by the household. F is the family labour input. L-F is the hired labour demand if positive or hired labour supply if negative, off farm labour supply. T is the total time endowment of

the household composed of household leisure X_l and work time F. A is fixed quantity of land used in producing farm output.

The three constraints above can be collapsed into a single constraint by substituting the production constraint into the cash income constraint for Q and substituting the time constraint into the cash income constraint for F yields a single constraint of the form

$$P_m X_m + P_a X_a + W X_l = WT + \pi \qquad (2.3)$$

Where $\pi = P_a Q(L, A) - WL$ is the measure of farm profits.

In this equation, the left hand side shows total household expenditure on three items i.e. the market-purchased commodity, the household purchase of its own output, and the household purchase of its own time in the form of leisure. The right hand side is a development of Becker's concept of full income in which the value of the stock of time (WT) owned by household is explicitly recorded as is any labour market (Becker 1965). The extension for the agricultural households includes a measure of farm profits (P_aQ-Wl) with all labour valued at the market wage, this being a consequence of the assumption of price-taking behaviour in the labour market. Households will make production decisions independently of consumption decisions; this is a recursive property of household production models and it enables the researcher to estimate demand functions for goods and leisure independently of production functions (Singh *et al.*, 1986).

Micro-economic analysis of household time-use has usually used the model of the household as a producing and consuming unit which maximizes its utility subject to a set of constraints However in developing countries consumption and production decisions are non-separable. This gives serious econometrics consequences in estimating the empirical household models. Recursive models tries to examine if household decisions of production and consumption are made separately, which makes estimation of household model much easier (Singh *et al.*, 1986).

Rosenzweig and Evenson (1977) derived an economic model from the general household production framework designed to be applied in household behaviour in rural agricultural areas of developing countries. They examined jointly decisions of children investment i.e. schooling, family size and child labour-force participation, in an economic analysis to obtain multidimensional test of applicability of the household production model in developing countries.

2.1.2 Environmental degradation and population model

Nerlove (1991) considered a two period Overlapping Generation (OLG) model to relate the links between environmental degradation and population, where parents increase utility by surviving children affecting their perception of having an additional child. When he was examining the effects of desertification on live stocking households he formulated optimization problems and after finding their optimal conditions he argued that in areas of marginal agricultural productivity, worsening environmental conditions may cause households to substitute toward livestock production, an activity in which children have a comparative advantage. Here, environmental degradation causes a substitution toward the activity in which children have a comparative advantage and so provides families with strong incentives to have more children.

Following Nerlove's (1991) "The parable of firewood" model and subsequent modification by Pritchett (1997) in which he takes a mother maximizes per capita firewood collection by choosing the number of children n

$$\max_{n} \frac{W(n,S)}{n+1} \tag{2.4}$$

Where W (.) represents the firewood collection and S is the firewood scarcity. Extending the dynamic Nerlove's model yields the following utility function

$$U(n, C/(n+1)) \tag{2.5}$$

Where n is the number of his or her children and C represents aggregate household consumption. Assume that C is produced using a combination of collected firewood, W,

and the household's agricultural production, Q, we have

$$C = C(W, Q) \tag{2.6}$$

Maximization of the above utility function subject to relevant budget and time constraint of the household yields the first order conditions. These optimal levels of consumption goods quality of children and leisure depend on the shadow prices of these goods. Quality of children can be measured by the level of investment in children's education or by their education attainment levels. Environmental degradation is represented by increases in time spent on water and firewood collection which increases the cost of quality of children. This gives a clear direction that unpriced household goods are modelled using the concept of Shadow prices.

2.2 Empirical literature review

2.2.1 Household natural resources collection activities

Households are generally involved in domestic works which are typically done by women however, there is some evidence that certain activities are also carried out by men. For instance Fafchamps and Quisumbing, (1998) who analyzed intra-household time use patterns in three rural districts in Pakistan found that water collection is in the domain of women while wood collection for energy are largely male activities.

Filmer and Pritchett (1996) explored the hypothesis that because of the important role children play in collection activities (firewood, water,1 and other domestic activities such as grazing the demand for children may increase as local environmental resources are depleted, setting up a vicious circle between resource depletion and population growth in Pakistan. Using the 1991 Pakistan Integrated Household Survey data, they found that collection activities absorb a substantial part of household resources. Collection absorbs a quarter of the time of children (Filmer and Pritchett, 1996).

The hypothesis of children demand and environmental deterioration is strongly supported by Nerlove 1991 who was concerned about the comparative advantage of children. He

argued that since children in developing countries have a comparative advantage as the environment deteriorates the comparative advantage of children is enhanced in livestock production households leading to an increased demand for children. These studies have contributed to the linkage between resource scarcity and fertility decisions of households and they are in agreement with Aggarwal's investigation on access to natural resources and fertility decision of woman in South Africa (Nerlove 1991, Filmer and Pritchett, 1996 Aggarwal *et al.*, 2001). However there is a research gap on resource scarcity and fertility decision in Kenya which is beyond the scope of this study.

Using data from the Nepal energy and nutrition survey, Cooke (1998) focused on the allocation of time to environmental good collection and found that the price of collecting grass is significant in decreasing male's allocation of time to farm work while that of fodder collection reduces women's allocation of time to farming. The results of her study indicate that the increase in time spent collecting environmental goods which is associated with higher shadow prices comes predominantly from women's time. These findings are in agreement with results from South Africa where women are reported to be the main collectors of water in 90 percent of the households (Aggarwal *et al.*, 2001).

In the hill villages of Nepal, where women perform 82 percent of the firewood collection, extensive deforestation increases their time on this task by 75 percent per load of firewood. For women in deforested areas, this translates to an additional 1.13 hours per day spent collecting firewood (Kumar and Hotchkiss 1988). Later Pritchett and Loughran (1997) found that 69 per cent of water collectors and 61 per cent of firewood collectors are women, (Pritchett and Loughran 1997) when they explored the hypothesis that household fertility increases or decreases in response to increasing scarcity. In their study, they used time for collection of firewood per month as a measure of scarcity of firewood. The justification for this is crucial to this study since the use of quantity of firewood has a major problem of defining a standard firewood measure for each household. Both studies emphasis the role women play in resource collection activities in developing countries.

The predominance of women and children in resource collection work implies that degradation of environment is expected to affect women more (Nankhuni and Findeis 2001). Their study in Malawi shows that girls spend more hours on resource work and are more likely to be going to school while burdened by this work. Their results support the hypothesis of a negative relationship between environmental degradation and the education status of children.

In studying the consequences of deforestation on women's time in the hills of Nepal using cross-sectional data Cooke (1988) showed that deforestation increased the amount of time women spent on collection of firewood. In a similar study in the hills of Nepal using panel data, she showed that household collection time decreased between 1982 and 1997 which maybe a result of increased availability of local environmental resources. This was due to one's own land to produce firewood as a way of coping with forest resource scarcity (Cooke 2000).

In particular women total collection time had decreased from 80 per cent in 1992/83 to 65 per cent in 1997. She also showed the presence of more youth 6-15 in a household decreased the percentage of time that men and women spent on collection activities while presence of adults did not decrease youth's percentage of total collection time. Their finding also showed that men spent less total time on collection of environmental goods in households with more women and youth. Their findings suggest that women are primarily responsible for collection work, followed by children however there is no study in Nepal which links resource collection and schooling. This study will also estimate the multinomial probit model which does not suffer from independence of irrelevant alternatives which is the major criticism of the multinomial Logit model used by Nankhuni and Findeis (2003) to estimate the alternatives in school attendance and resource collection works.

Using panel data from Peru, Ilahi (2001) investigated the effects of time allocation of

boys and girls on schooling, housework and income-generating activities. The econometric findings suggest that changes in household welfare affect the schooling and work of girls more than boys. Even though educational attainment rates of boys and girls are the same in the study, girls' education responds more to changes in household welfare than that of boys. Similarly, girl children are more likely to adjust their home time in response to changes in adult female employment and to sickness of household members than boys. Lack of access to energy infrastructure lowers the educational attainment of both boys and girls but has little effect on their labour (Ilahi, 2001).

2.2.2 Overview of literature reviewed

Both theoretical and empirical work on time allocation traces its roots to Becker (1965), who first formulated a utility-maximizing model of Z goods which were produced by both time and market goods inputs. This model has been widely used to analyze choices of hours worked and later extended by Gronau (1977) to include home production and leisure. Recent empirical work on time allocation in developing countries, have taken the work of Becker (1965), Gronau (1977) and Singh *et al.*, (1986) as a starting point, however they had to deal with the realities of home production and household structure in these countries (see for instance Rosenzweig and Evenson (1977)).

The literature clearly shows that there is significant evidence on household involvement in resource collection especially in Asia (Kumar and Hotchkiss 1988, Filmer and Pritchett 1996, 1997, 2002, Cooke 1998, 2000). Children are significantly involved in helping their parents in various activities (Nankhuni and Findeis 2003, Filmer and Pritchett 2002). Nerlove (1991) argued that children have comparative advantage in household tasks compared to adults. Environmental degradation is associated with poor water quality and scarcity and firewood scarcity which are environmental parameters in those studies. The study by Nankhuni and Findeis (2003) established that environmental degradation negatively affects schooling of children in Malawi; however, this is the only study in Africa on effects of environment and schooling we have identified. Thus study will contribute to the literature on relationship between resource collection and schooling in Africa.

CHAPTER THREE

METHODOLOGY

3.1 Theoretical Framework

The model by Rosenzweig and Evenson (1977) which capture time allocation aspect, in the context of developing country will be adopted in this study. This model has also been applied by Nankhuni and Findeis (2003) in studying resource collection and schooling in Malawi. In this model parents maximize a utility function (presented below) composed of four commodities, the quantity of children, Z_N, the schooling, Z_E, and leisure Z_L, per child and a composite commodity Z_S

$$U(Z_N, Z_E, Z_L, Z_S) \tag{3.1}$$

The Z_j are produced using a household production function:

$$Z_j = f_j(X_j, T_j, E, A) \quad \text{j=N, E, L, S} \tag{3.2}$$

Where, X_j are the market-bought good inputs and T_j are the time inputs from each of the household members. E is environmental quality and A is the fixed capital/land.

Noting the expenditure on goods must equal total income, Rosenzweig and Evenson (1977) presented the full income constraint as

$$W\Omega_c Z_N + W_w\Omega_w + W_m T_m = Z_N(P_N x_N + t_{Nw}W_w) + Z_N Z_E(P_E x_E + t_{Ec}W_c) + Z_N Z_L(P_L x_L + t_{Lc}W_c) + Z_L(P_I x_I + t_{Iw}W_w) \tag{3.3}$$

Where X_j is aggregated bundles of goods, purchased in the market at price P_j. Children also work T_{wc} units of time at a wage rate W_c and the husband and wife spend T_{wm} (full time) and T_{ww} units of time in employment and earn wage rates Wm and W_w respectively.

Maximization of equation 3.1 subject to equation 3.3 yields a set of commodity shadow prices Π_j corresponding to the commodity set:

$$\Pi_N = P_N x_N + t_{Nw}W_w - T_{wc}W_c + Z_E P_E x_E + Z_I P_I x_I \tag{3.4a}$$

$$\Pi_L = Z_L(P_L x_L + t_{LW} W_L) \quad (3.4b)$$

$$\Pi_f = Z_N(P_L x_L + t_{LW} W_L) \quad (3.4c)$$

$$\Pi_s = P_s x_s + t_{sw} W_s \quad (3.4d)$$

Following Rosenzweig and Evenson (1977), the shadow price of children (Π_N) in equation 4a above is thus a positive function of the price of the goods used to produce children, the wage of the wife, and the levels of child schooling and leisure chosen, but is negatively related to total earnings per child. The shadow prices of child schooling and leisure , however, are positively correlated with the number of children and the opportunity cost of school attendance and child leisure, the child wage rate. The impact on child quantity is mixed because there may be an induced demand for more children resulting from the increased labour requirement (Nerlove 1991)

The empirical results obtained by Rosenzweig and Evenson (1977), support the use of this model in the context of developing countries and suggest the importance of price effects associated with the economic contribution of children as well as the mother in the allocation of family resources to children and child schooling.

3.2 Model Specification

To cater for the stated study objectives, different models will be estimated as illustrated in the proceeding discussion.

To achieve the first objective, the study will generate descriptive statistics such as; the mean and standard deviation of the domestic work variables. The other two objectives will be achieved by estimating a series of models which takes care of the endogeneity problem. The standard probit regression for dichotomous variables ignores the potential bias due to endogeneity and it results in biased estimates if the two decisions are correlated (Bollen *et al.*, 1995). The endogeneity is expected from being joint in decision

making to participate in resource collection and also attendance in school. The bivariate probit model of school attendance and resource collection work participation is suggested to correct for this problem. The bivariate probit model as outlined by Greene (1998) and also adopted from Nankhuni and Findeis (2003) can be written as

$$\eta_{i1} = \beta_1 x_{i1} + \varepsilon_{i1} y_{i1} = 1 \text{ if } \eta_{i1} > 0 \;\; y_{i1} = 0 \text{ otherwise} \tag{3.5a}$$

$$\eta_{i2} = \beta_2 x_{i2} + \varepsilon_{i2} y_{i2} = 1 \text{ if } \eta_{i2} > 0 \,, \; y_{i2} = 0 \text{ otherwise} \tag{3.5b}$$

$[\varepsilon_{i1}, \varepsilon_{i2}, \rho]$ – Bivariate normal (BVN)

Where individual observations on y_1 and y_2 are available for all i, the y_{i1} and y_{i2} are the choices of school attendance and participation in resource collection work observed in the data, respectively; η_{i1} and η_{i2} are the latent variables from which the decisions to participate in these two choices are defined; X_1 and X_2 are the independent variables (household characteristics, environmental variables, demographic variables and child characteristic variables) in the school attendance model and the resource collection work model respectively; and ε_1 and ε_2 are the error terms which may be correlated.

The Lagrange multiplier (LM) statistic is a convenient device for testing the absence of for the absence of correlation in this model. The Lagrange Multiplier statistics for testing *Ho*: ρ = 0, in a bivariate probit model as outlined in Greene (2003) is:

$$LM = \frac{\left[\sum_{i=1}^{n} q_{i1} q_{i2} \dfrac{\phi(w_{i1})\phi(w_{i2})}{\Phi(w_{i1})\Phi(w_{i2})}\right]^2}{\sum_{i=1}^{n} \dfrac{[\phi(w_{i1})\phi(w_{i2})]^2}{\Phi(w_{i1})\Phi(-w_{i1})\Phi(w_{i2})\Phi(-w_{i2})}} \tag{3.6}$$

If we reject the above null hypothesis then the error terms are correlated. However, a non-statistically significant ρ does not necessarily mean that the two choices are not correlated (as was the case in the gender economics courses in Liberal Arts Colleges example discussed in Greene 2003). On the other hand a statistically significant ρ indicates that the two binary choices are jointly determined. If ρ is positive, the omitted

variables influence the two choices in a complementary way, therefore the two choices are complementary, otherwise, they are exclusive (substitutable). Thus, a test of the two decisions being decided jointly is a test of the significance of ρ. If ρ is not statistically significant, univariate probit models provide reliable estimates.

Burnett (1997) proposed a bivariate probit model for the presence of a gender economics course in the curriculum of a liberal arts college which will be adopted for this study's simultaneous equations.

$$y_1 = X_1\beta_1 + \gamma_2 + \varepsilon_1 \quad (3.7a)$$

$$y_2 = X_2\beta_2 + \varepsilon_2 \quad (3.7b)$$

In this model independence arises between y_1 (school attendance) and y_2 (participation in resource collection work), because y_2 appears in the right hand side of 3.7a. So the model is a recursive simultaneous equation model.

3.2.1 Marginal effects in bivariate probit model

In order to compute marginal effects in a binary choice model, one must scale the coefficients. In a simple binary probit model, Greene (1998) presents the following procedure for computing marginal effects

$$E[y_i|x_i] = \Phi(\beta'x_i) = \text{Prob}[y_i = 1] \quad (3.8)$$

So that, for a continuous variable, z_i,

$$\partial E[y_i|x_i]/\partial z_i = \partial\Phi(\beta'x_i)/\partial z_i = \phi(\beta'x_i) \times \beta_z \quad (3.9)$$

Where $\phi(\cdot)$ is the density function of the standard normal distribution and β_z is the coefficient on that variable. If z_i is a binary variable, then the appropriate way to measure the marginal effect is to use

$$\text{Effect on } E[y_i|x_i] = E[y_i|x_i z=1] - E[y_i|x_i z=0] \quad (3.10)$$

The approach in the general bivariate probit model is basically as shown above, but the computations are quite a bit more involved (Greene 1998). The computations involve the preceding derivatives, as well as, for example, for a variable z that might appear in either equation.

$$\partial BVN(\Phi(\beta'x_1 + \gamma, \alpha'x_2, \rho))/\partial z_k = \{\phi(\beta'x_1 + \gamma)\Phi[(\alpha'x_2 - \rho(\beta'x_1 + \gamma))/\sqrt{1-\rho^2}]\}\beta_z +$$

$$\{\phi(\alpha'x_2)\Phi[(\beta'x_1 + \gamma) - \rho(\alpha'x_2))/\sqrt{1-\rho^2}]\}\alpha_z \qquad (3.11)$$

The result of this is that the joint probability is the product of the marginals. The conditional mean function in the model analyzed is

$$\begin{aligned} E[y_1|x_1, x2] &= Ey2\ E[y_1 \mid x_1, x2, y2] \\ &= \text{Prob}[y_2 = 1]\ E[y_1 \mid x_1, x2, y2 = 1] + \text{Prob}[y_2 = 0]\ E[y_1 \mid x_1, x2, y2 = 0] \\ &= \Phi(\alpha'x_2)\,\Phi(\beta'x_1 + \gamma) + \Phi(-\alpha'x_2)\,\Phi(\beta'x_1), \qquad (3.12) \end{aligned}$$

Where we have used the symmetry of the normal distribution in $\Phi(-\alpha'x_2) = 1 - \Phi(\alpha'x_2)$. For y_2,

$$E[y_2|x_2] = \Phi(\alpha'x_2). \qquad (3.13)$$

Greene (1998) further proposes that one will account for the direct marginal effect and the indirect marginal effects. In a variable in the school attendance equation is the sum of terms. One will account for the direct effect of a change in that variable on the probability that y1 equals one, and the other will measure the indirect effect of the change in this variable on the probability that y2 equals one in the resource collection work equation which, in turn, affects the probability that y1 equals one. Thus:

(1) For a continuous variable, z, which might appear in x_1 and/or x_2, we have

$$\partial E[y_1|x_1,x_2]/\partial z = [\Phi(\alpha'x_2)\,\phi(\beta'x_1 + \gamma) + \Phi(-\alpha'x_2)\,\phi(\beta'x_1)]\,\beta, \quad \text{(direct effect)}$$

$$+ \quad [\phi(\alpha'x_2)\,\Phi(\beta'x_1 + \gamma) \; + \; \phi(-\alpha'x_2)\,\Phi(\beta'x_1)]\,\alpha_z \quad \text{(indirect effect)} \qquad (3.14)$$

Where β_z and α_z are the coefficients on z in the two equations. Greene 1998 noted that either of these may be zero.

(2) For a binary variable, q, which might appear in x_1 and/or x_2, we have

$E[y_1 \mid x_1, x_2, q=1] - E[y_1 \mid x_1, x_2, q=0] = [\Phi(\alpha'x_2)\,\Phi(\beta'x_1 + \gamma) + \Phi(-\alpha'x_2)\,\Phi(\beta'x_1)] \mid q=1 - [\Phi(\alpha'x_2)\,\Phi(\beta'x_1 + \gamma) + \Phi(-\alpha'x_2)\,\Phi(\beta'x_1)] \mid q=0.$ (3.15)

(3) For the second, endogenous binary variable, y_2, we have

$$E[y_1 \mid x_1, x_2, y_2 = 1] - E[y_1 \mid x_1, x_2, y_2 = 0] = \Phi(\beta'x_1 + \gamma) - \Phi(\beta'x_1) \qquad (3.16)$$

3.2.1 Instrumental variables and Two Stage Least Squares models

In this section we consider the instrumental variable estimation which is an alternative to the bivariate probit model. The model outlined above focus on participation of children in resource collection work as an endogenous explanatory variable in the schooling equation. School attendance may however, be affected by the amount of time that a child spends on resource collection. Therefore, school attendance may be sensitive to the time that a child spends collecting firewood or water. Since the decision to participate in resource collection and school attendance are jointly determined there is a problem of endogeneity if the resource collection time will be estimated as an explanatory variable in the school attendance equation. Thus the errors of the school attendance equation and the natural resource collection equations will be correlated and it is an econometrics concern to model the two decisions separately using the univariate probit models. Since our main hypothesis is to establish the effects of resource collection on school attendance. We include the resource participation as an endogenous discrete explanatory variable in the schooling equation and this will require correction of endogeneity using the proceeding models.

The method of Instrumental Variables (IV) provides a general solution to the problem of

an endogenous explanatory variable. (Wooldridge 2002). To correct for endogeneity for continuous explanatory variables in a probit regression, Rivers and Vuong (1988) propose a two-stage estimation procedure. To motivate the need for the method of instrumental variables, we consider the following structural form equation for schooling and reduced form equation for resource collection.

$$y_1 = \beta x_1 + \gamma y_2 + \varepsilon_1 \quad (3.17a)$$

$$y_2 = \alpha x_1 + \delta z + \varepsilon_2 \quad (3.17b)$$

Where, the structural equation of school attendance, variable y_1 is given by equation 3.17a, while the reduced form equation of the resource participation, variable y_2 is given by equation 3.17b. The instrumental variables (z) such as distance to the source of resource or the time taken to the source are included in the reduced form equation but excluded from the structural form. The common exogenous covariates which belong in both equations are given by the vector x.

To use the IV approach with y_2 endogenous, we need an observable, z which is not in equation 3.17a that satisfies two conditions. First, z must be uncorrelated with ε_1, that is, it influences resource collection but has no effect on schooling;

$$Cov(z, \varepsilon_1) = 0 \quad (3.18)$$

The second requirement involves the relationship between z and the endogenous variable y_2. This requires the linear projection of y_2 onto the entire exogenous variable as shown in equation 3.17b where, the error term ε_2 is uncorrelated with x_1 and z. The key assumption on the linear projection is that the coefficient of z is nonzero.

3.7.2 Model Identification and estimation

The critical question is whether each equation in the system is identified. The first challenge in estimating the causal impact of resource collection on education outcome is the possibility of unobserved characteristics of households which influence their decision to collect resources also playing a role in their schooling decisions. For example, parents who care more strongly about the education of their children may not engage their

children in intensive resource collection activities despite the fact that there is resource scarcity. Moreover a household that has many children who are out of school may reduce the burden of resource collection for those who are in school.

The arising problem is isolating the effect of participation in resource collection activities on the school attendance and academic performance of the children. This problem has been solved by using variable z as an instrument for y_3 (resource collection activity). An instrumental variable estimation relies on the exogenous assumption, that z is exogenous and valid

3 2 3 Simultaneous probit models

Two-step probit model estimation is estimated using the instrumental variable approach. First, we estimate equation 3.7b by OLS and use the estimated coefficients to predict effects of resource works for each child in the sample. This predicted value has been purged of the correlated unobservable; it replaces the actual resource participation in equation 3.7a. Then we use probit regression to obtain consistent estimators of the coefficients. A similar procedure was done by Bollen *et al.*, 1995 to correct for endogeneity when estimating decision to have an additional child and the propensity to use contraceptives. The IV probit procedure in Stata 9.2 implements these steps automatically

Rivers and Vuong (1988) proposed a similar alternative to the two stage estimation discussed above. The only substantive difference between this approach and the two step estimation described above is that Rivers and Vuong (1988) provide formulas for the asymptotically correct covariance matrix (Bollen *et al.*, 1995). The two-step Conditional Maximum Likelihood (2SCML) developed by Rivers and Vuong (1988) composed of a structural equation that is of primary interest and a set of reduced form equations for the endogenous explanatory variables. The 2SCML model as outlined by Rivers and Vuong (1988) is:

$$y_i^1 = Y_i\gamma + X_{1i}\beta + u_i \tag{3.19a}$$

$$Y_i = \Pi X_i + V_i \tag{3.19b}$$

Where Y_i, X_{1i}, and X_i are m×1, k×1, and p×1 vectors, respectively, with X_i and X_{1i} related by the identity

$$X_{1i} = J X_i \tag{3.20}$$

Where J is the appropriate selection matrix. The following are the models assumptions:

(1) (X_i, u_i, V_i) i.i.d (independently, identically, distributed) with X_i having a positive definite covariance matrix $\sum_{xx}$ and u_i and V_i having, conditional on X_i, a joint normal distribution with mean zero, and finite positive definite covariance matrix.

$$\Omega = \begin{pmatrix} \sigma_{uu} & \sum_{uv} \\ \sum_{vu} & \sum_{vv} \end{pmatrix} \tag{3.21}$$

(2) (Identification) rank $(\Pi, J) = m + k$

(3) (Parameter space) $(\gamma, \beta, \Pi, \Omega)$ is known to lie in the interior of a compact convex subset of the Euclidean space, Θ

The 2SCML estimator is computed in two steps. First, estimators Π and $\sum_{vv}$ are obtained by maximizing the marginal log likelihood for Y_i,

$$L_n^1(\Pi, \sum_{vv}) = \sum_{i=1}^{n} \log g(Y_i \mid X_i; \Pi, \sum_{vv}) \tag{3.22}$$

With respect to Π and $\sum_{vv}$. Second, the conditional log likelihood for y_i, setting $\Pi = \hat{\Pi}$, is maximized with respect to the remaining parameters:

$$L_n^2(\gamma, \beta, \lambda, \hat{\Pi}) = \sum_{i=1}^{n} \log f(y_i \mid Y_i, X_i; \gamma, \beta, \lambda, \hat{\Pi}). \tag{3.23}$$

The two step procedure suggested by Rivers and Vuong (1988) is proposed for a probit model in which one or more of the right hand side variables are endogenous, but

continuous. They further suggested that both of these steps can be easily carried out with standard regression and probit programs.

1 Regress Y_2 on X_1 to obtain Π. $\sum_{vv}$ is estimated in the usual way by $n^{-1}\sum_{i=1}^{n} V_i V_i'$

where $V_i = Y_i - \Pi X_i$ denotes the least squares residuals.

2 Probit analysis of y_1 with Y_2, X_1, and V_i as explanatory variables provides estimates

(γ, β, λ)

In addition a convenient feature of the procedure is that it provides an estimate of λ that can be used to construct tests for exogeneity. Exogeneity of Y_2 implies that Y_2 and u_1, in equation 3.9a, are not correlated. That is, $\sum_{uv} = 0$ or equivalently, $\lambda = 0$. Under the null hypothesis $H0: \lambda = 0$

Following this, an OLS regression of resource collection work is estimated, in the first stage. Residuals from the stage 1 regression are then retained. In the second stage, a probit model of school attendance is estimated, with resource collection work and the residuals from the OLS regression included among the explanatory variables. If the estimated coefficient of the residuals is statistically significant, this indicates that the resource collection minutes are endogenous in the school attendance probit. Smith and Blundell (1986) used a similar procedure for the Tobit models. This can be done directly by the Instrumental variables probit (IV-Probit) in Stata 9.2. The IV-Probit has the advantage of estimating the Wald test of exogeneity with the null hypothesis that there is exogeneity thus accepting the null hypothesis shows that the instrumental variable, z and the error term ε_1 are uncorrelated.

3.3.1 Study area

This study is based on data collected from Kiambu District in May 2007. This study was limited to Lari, Kikuyu and Ndeiya Divisions in Kiambu District which have continued to

experience increased incidences of poverty and environmental degradation. The main reason for selecting this district is due to the continued deforestation of the upland forest which has brought the firewood and water scarcity problems in the district especially Lari division and some parts of Kikuyu Division.

Kiambu is one of the seven districts in the Central Province of Kenya by the year 2002[1]. It is located in the south of the province and has a total area of 1,323.9 km^2 with the population of 802,625,000 persons as per the 1999 census; with a projected growth rate of 2.56 per cent per annum. Kiambu borders Nairobi City and Kajiado District to the south, Nyandarua to the northwest, Nakuru District to the west and Thika district to the east. Kiambu District is divided into seven administrative Divisions namely Kiambaa, Githunguri, Limuru, Kikuyu, Ndeiya, Lari and Kiambu Municipality. Lari Division is the largest with a spatial area of 441.1 km^2 while Kiambaa is the smallest division with an area of 91.1 km^2, (GoK, 2002).

The primary natural resource in the District is land. Ndeiya Division and Karai Location in Kikuyu Division have low agricultural potential compared to other parts of the District. Other natural resources in the district include water, forestry and some minerals. Water resources in Kiambu District comprise both surface and ground water potential which are well distributed throughout the District except in Karai Location and Ndeiya Division. Forest as a resource serves as the main source of raw materials for wood products, firewood which contributes 66.8 percent of the household fuel, charcoal which contributes 11.7 percent of the household fuel, (GoK, 2002).

Kiambu District only contributes 1.48 per cent to the national poverty. However, in Lari Division 30 per cent of the population lives below the poverty line while in Ndeiya Division it is estimated that 60 per cent of the population is poor. Indeed in the dry season, the nearest potable water point is on average 7 km in Ndeiya division. Child

[1] By March 2007 the number of Districts in Central province was increased from 7 to 11 where Kiambu District was divided into Kiambu East and Kiambu West. The study was therefore carried out in Kiambu West. However, the Districts are yet to be gazetted by August 2007

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labour is also a severe problem in the district, since children between the schooling ages between 10 to 18 years are estimated to be working children in the agricultural related activities and other household chores, (GoK, 2002).

3.3.2 *Sources of data*

We relied mainly on primary data collected from a cross-section of 200 rural households in Kiambu rural areas using structured questionnaires. A detailed questionnaire was used to collect the basic data and probed the socio-economic characteristics of households, economic activities, collection activities and children schooling details. (See questionnaire in appendix). Interviews were also conducted and use of statistics from publications

3.3.3 *Sampling procedures*

This study was carried out in Kiambu district of the Central province of Kenya. Data was collected from a sample of 200 households drawn from 20 villages where 9 are from Lari division, 6 from Kikuyu division and 5 from Ndeiya division (targeting households living near uplands and Nyandarua forests in Lari Division while those from Ndeiya Division and Karai Location in Kikuyu Division experience the same agro ecological conditions) in April and May 2007. Purposive sampling methods were used to select the divisions and locations of study, owing to the presence of the characteristics of interest and taking into account the scope of the study, time and financial considerations. The study sample was generated using the sampling framework provided by the Kenya National Bureau of Statistics. To ensure equal representation, all the three divisions were sampled using the proportion of Enumeration Areas (EAs) created for the 1999 Census. Multistage sampling was then used to select the sample, namely sub-location, villages (EAs) and households. In the first stage the three divisions were selected namely Kikuyu Lari and Ndeiya. Following the EAs information the study proportionately sampled 9 EAs out of 102 EAs, 6 EAs out of 68 EAs and 5 EAs out of 47 EAs from Lari division, Kikuyu division and Ndeiya Division respectively. A total of 20 villages were systematically

sampled translating into a village from each sub-location. Then 10 households were randomly selected from each village. This translated to a sample size of a total of 200 households or 90 households, 60 households, 50 households from Lari, Kikuyu and Ndeiya respectively.

3.4 Study Limitation

Time allocation data are quite problematic because these data involve a recall of activities for which people in the study area do not keep record of. However this was not a major problem since the error is assumed to be normally distributed. On the firewood collection the study was exposed to measurement errors especially the distance from where the households' collects resources. Majority of the people had no idea of the distance they travel to collect resources. The firewood load was also difficult to measure since majority carried a load depending on their body energy. The information on the market for firewood could not be used to estimate firewood demand function due to lack of information on household assets and income. The study was also constrained by lack of enough instruments to correct for endogeneity during the two stage estimation. Variables such as distance were not consistent with the study expectation that they would be good instrumental variables. The study was not also able to obtain information about several examinations results thus we were not able to control for other factors that affects performance. The study was not able to compute the direct and the indirect marginal effects due to the estimation package, Stata 9.2 that was used, however, the stated shortcomings did not comprise the data that was used for the analysis.

CHAPTER FOUR

EMPIRICAL RESULTS

4.0 Introduction

This chapter gives an account of the research findings starting with the descriptive statistics followed by the econometrics models such as bivariate probit, instrumental variable probit for school attendance and resource collection work. For the school performance the probit model is estimated.

4.1 Descriptive statistics for sampled households

The social-economic characteristics of the 200 sampled households are presented in Table1. The data display low female headed households, at 13 percent of all households in the sample. The results indicate low average terminal level of education of household head with years of schooling, suggesting an average of primary education for most of household heads (8 years of schooling). This is also supportive of the education attainment dummies which indicate that only 38 per cent of all household heads had completed post primary education compared to 60 per cent who had completed primary education.

Table 1: Social economic characteristics of the 200 households sampled

variable	Mean	Std. Dev	Min	max
Male head	0.87	0.337	0	1
Age of head	42.475	9.49	22	83
Head years of schooling	8.675	2.81	0	16
No education	0.02	0.12	0	1
Primary education	0.60	0.49	0	1
Post primary education	0.38	0.48	0	1
Household size	6.16	1.54	3	11
Number of children	4.10	1.59	0	9
Children age < 6 years	0.12	0.32	0	1
Children age 6 to 14 years	0.33	0.47	0	1
Children age 15 to 18 years	0.12	0.32	0	1
19 to 24 years adults	0.08	0.27	0	1
Over 25 years	0.35	0.48	0	1

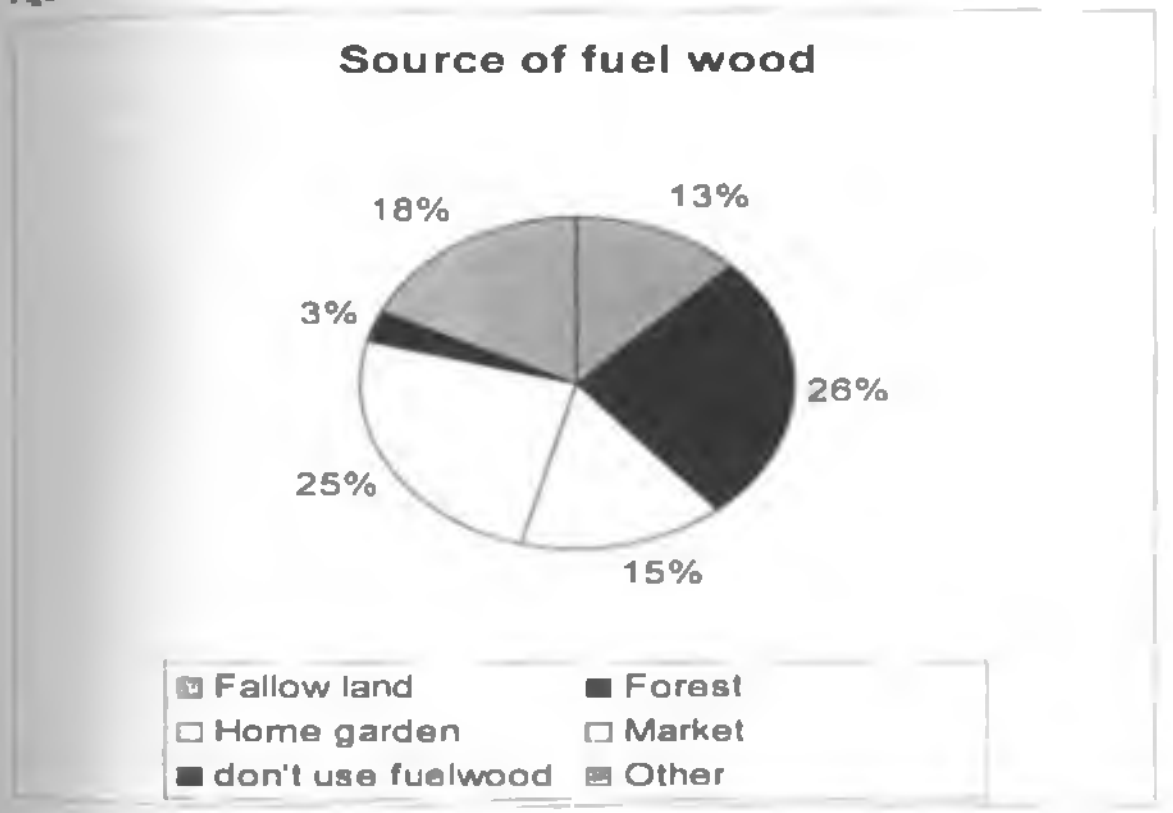
Source: *Field survey data 2007*

The age categorization indicates that 45 per cent of the sampled age groups are school going children (age 6 to 18 years) who will be considered for the schooling models. Moreover, the household size on average is six members with an average of four children indicating that households with more children who are out of school are likely to participate in resource collection reducing the burden of resource collection to those school going children.

Firewood collection data

Households were asked questions on where they collect firewood and their responses are reported in the figure 1 below.

Figure 1: Sources of firewood for households



Source Field survey data 2007

The statistics reveal that around 25 per cent of sampled household obtain firewood from the market while another around 18 per cent combine buying firewood and collection from commons. These clearly indicate that there is a well defined market of firewood in

the sampled areas of Kiambu District. The prices of firewood vary depending on the source of firewood and the perceived scarcity by the dwellers. For instance firewood prices from Karai were collected from the major distributor of firewood who has a well organized firewood business. In Ndeiya Division firewood is bought from households who collect firewood for selling purposes and they either take the firewood to their customers or in some cases the customers buy the firewood from their homes.

In Lari division, where 48 per cent collect firewood from the forest, they pay a monthly fee of Ksh. 45 to the forest department, which is meant for any firewood collection by hand or body once a day from the forest. However, this monthly rental rate is quite low and it can not be used as a proxy for resource scarcity as discussed by Gardner and Barry (1978), when they were exploring the alternative measures of natural resource scarcity. Those who collect firewood for sale usually collect on average 57 pieces of approximately 1 meter long bamboo tree which is sold at an average cost of Kshs. 135.

Table 2: Mean time taken by households' member to source of firewood in minutes

Source	Karai	Lari	Ndeiya
Fallow land	228.75	240	168.57
Forest	254	269.5	195
Home garden	57.27	102.92	80.18
Market	25.26	27	28.22

Source: Field survey data 2007

Another measure of resource scarcity is time per trip as suggested by Filmer and Pritchett (1996); Households were asked if they had a problem of supply of firewood which would normally be indicated by travel time and distance to source of firewood. The average time of a two way trip plus collection time to collect firewood depends on the source of the firewood with firewood from the forest taking the highest number of minutes, with the market taking the least time. Average collection and travel time two way to collect firewood in the forest is 257.85 minutes, ranging from a minimum of 30 minutes to 600 minutes and an average distance of around 3 km. This varies from 0 km to 10 km, with

Lari division having the highest collection time as shown in Table 2.

Market for firewood

Those who collect firewood from the market buy it from dealers who operate a firewood [illegible] with various firewood pieces with a different price tag. Table 2 shows the different pieces and their prices per piece.

Table 3: firewood price per cubic Metre

Price per piece of wood	Volume of a firewood piece in cubic Metres
Ksh 1.50 piece	0.0029
Ksh 2 piece	0.0035
Ksh 2.50 piece	0.0042
Ksh 3 piece	0.0048
Ksh 5 piece	0.0064
Ksh 7 piece	0.0096

Source: Field survey data 2007

The table indicates that the price of firewood varies considerably with the different volumes of firewood pieces that customers select from the categories of firewood provided by the firewood dealers. Households buy the piece they prefer depending on the amount of money they have and their consumption of firewood per day. The households buy firewood ranging from Ksh. 20 to Ksh. 150 in a single bundle purchased.

The firewood dealers informed the author that they obtain the firewood for sale from different sources, which includes; own farm, buying trees from farmers, collecting from the fallow land and forest. Trees bought from the farmers depend on the thickness of the tree and its location.

Table 4: cost of fuel per month

Fuel type	Mean cost	Std. dev	Min	max	Average Quantity
Kerosene	330.07	164.15	0	680	2 litres
Firewood	249.17	391.62	0	3150	50 pieces
Charcoal	345.08	324.58	0	2000	1 bag

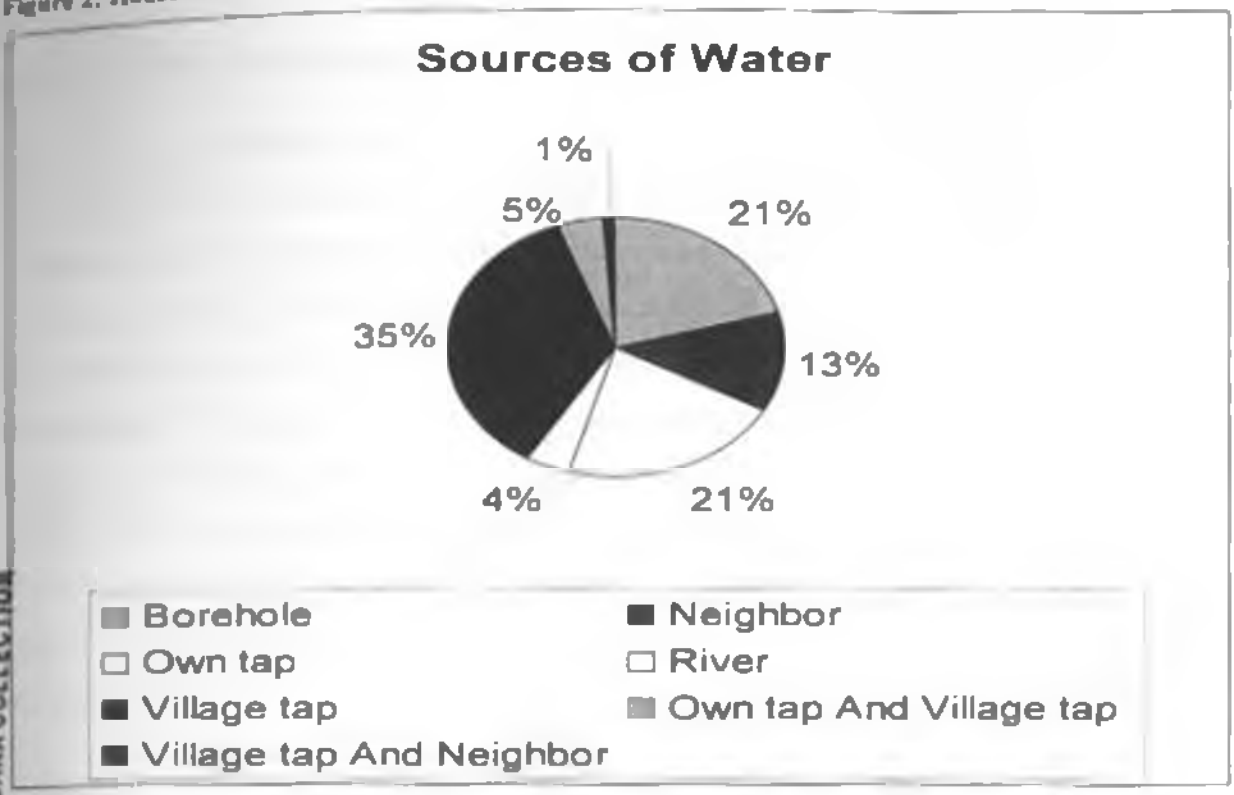
Source: Field survey data 2007

Households indicated that they substitute three main fuel sources namely, firewood charcoal and kerosene. Firewood and charcoal are mainly used for cooking and heating while kerosene is used for lighting with a few using it for cooking. Table 4 shows the sampled households' expenditure on three main fuel type used. Firewood recorded the lowest mean of Ksh 249 and also the maximum cost of Ksh 3150. This indicates that there is evidence of households which combine firewood collection and purchase while others obtain their entire firewood from the market. The study also revealed that charcoal is a close substitute of firewood.

Household water collection statistics

Households sampled reported that they collect water from different sources depending on the water table in the area. In Karai Location of Kikuyu Division and Ndeiya Division household obtain their water mainly from village tap which accounts for approximately 35 per cent of water source in the sampled areas and some from own tap which accounts for 21 per cent where water is supplied three times a week and during the dry seasons tap water is scarcely supplied and all households are forced to collect water in the village tap. Whereas in Lari Division, households dig manual borcholes to get water, a few obtain water from the rivers.

Figure 2: Households' sources of water



Source: Field survey data 2007

Table 4 reports the collection and queuing time plus the two way travel time mean time spent in collecting water in respect to the different sources in the sampled areas.

Table 5: Mean time taken to source of water in minutes

Source	Karai	Lari	Ndeiya
Borehole	-	26.42	-
Neighbour	30	31.11	25
Own tap	12.56	9.5	10.5
River	-	70	-
Village tap	128.52	102.35	107.95

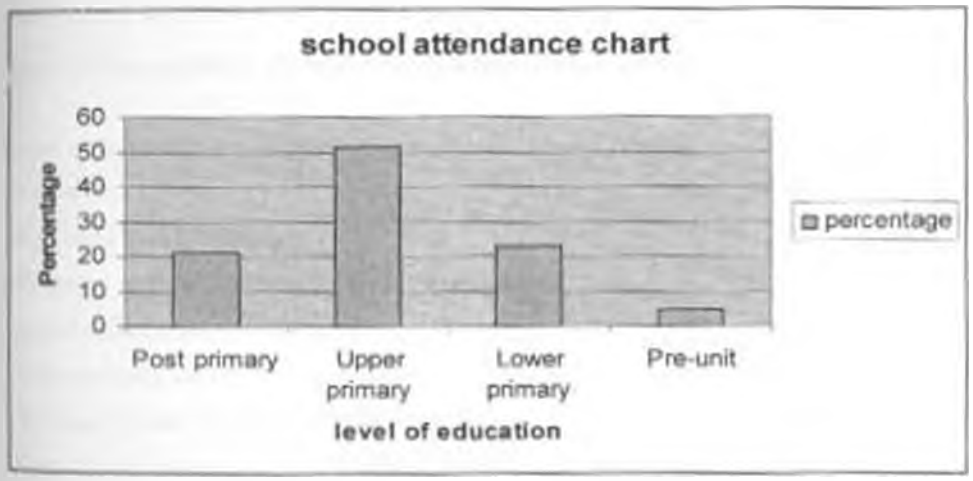
Source: Field survey data 2007

From Table 5 it appears that there is no household which collects water from boreholes or rivers in both Ndeiya and Karai location. However in Lari division majority obtains their water from boreholes and few from rivers. Village taps are key points for water collection in these three areas while Karai location recorded the highest mean time of 129 minutes which is largely spent on queuing due to scarcity especially during the dry season.

4.2 Children schooling and resource collection work

From the sample, the total number of children aged between 5 to 18 years is 609 who are the main focus for schooling children in pre-unit, primary, and post primary level of education in Kenya. Children on average were reported that they start nursery school at an average age of 5 years and join standard one at the age of 6 or 7 years depending on the number of years they spend in pre-unit. Out of the 609 children with education information who are aged between 5 to 18 years sampled, 51 per cent have attained a level of upper primary education. 23 per cent and 4 per cent are in lower primary school and pre unit level respectively. The post secondary level has 21 per cent children who are either in secondary school, polytechnic, universities or have just completed Form Four studies. The school attendance data is summarized using four major categories as shown in figure 3 below

Figure 3; school attendances in primary and post primary school 2007

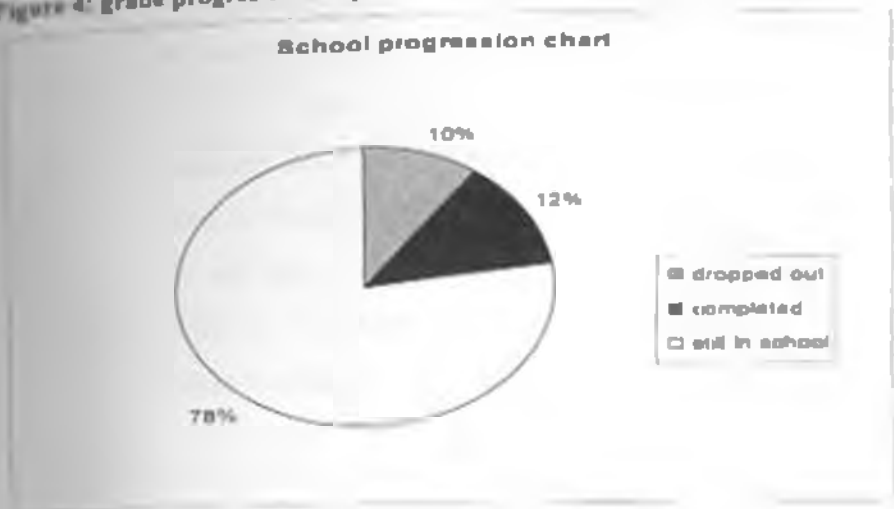


Source Field survey data 2007

Out of the 609 children 19 per cent are out of school while 81 per cent are still in school. 10 per cent of the sampled children are out of school due to lack of school fee.

The pie chart below shows the percentage of school progress in the sampled children.

Figure 4: grade progressions in primary and post primary school



Source: Field survey data 2007

Those who have ever attended school in the sample were also asked question about repetition and tabulating this shows that 24 per cent of children sampled have ever repeated and 76 per cent have not repeated any class. The drop out rate is about half the number of children who should join secondary school in the sample. Table 6 bears the descriptive statistics for children schooling variables

Table 6: Descriptive statistics for children schooling variables

Variable	Mean	Std. Dev.	Min	Max
Age child began school (std 1)	6.25	0.65	4	8
Resource work hours children spend on weekdays	0.58	0.53	0	4
Hours children work weekends	2.07	1.76	0	7
Evening study hours	1.77	0.84	0	5
Average number of children in a household	4.10	1.59	0	9
School type dummy=1 if public school	0.83	0.37	0	1
School type dummy=1 if private school	0.17	0.37	0	1
School attendance dummy(1=attending)	0.88	0.32	0	1
Dummy for lower primary(1=lower primary)	0.24	0.42	0	1
Dummy for pre unit(1=pre-unit)	0.02	0.21	0	1
Dummy for upper primary(1=upper primary)	0.55	0.50	0	1
Dummy for post primary(1=post primary)	0.19	0.40	0	1

Source: Field survey data 2007

The schooling variables reveal that 83 per cent of children in the sample were from public school and 17 per cent from private school. This indicates that majority of rural population are benefiting from the free primary education. On average, children spend 8 hours in school and an hour to collect resources mainly water after school. Children also spend on average one hour forty five minutes for private studies. 9 per cent of children who are involved in resource collection activities reported to be affected by the resource collection work and this are reflected by their inability to complete homework. This is also confirmed by the 9 per cent of children whose teachers' comments in their progress report indicate that the resource collection work was affecting their performance.

From Table 7 above 63 per cent of the school going children collect water while 41 % collect firewood. On average 59 per cent of the sampled school going children participate in either collection of water or firewood or both.

Table 7: Summary statistics for children collection activities

Variables	Mean	Std. Dev.	Max	Min
Water collection participation	0.63	0.48	0	1
Firewood collection participation	0.41	0.49	0	1
Resource work participation	0.59	0.49	0	1
Travel time firewood	98.61	91.20	0	360
Collection time firewood	66.37	51.44	0	300
Travel time water	22.68	22.37	2	150
Collection and queuing water time	38.71	42.18	3	240
Firewood total time	168.23	116.82	10	480
Water total time	61.48	60.62	5	390

Source: Field survey data 2007

Children spend 4 hours on average to collect resources where the highest share is for firewood with around 3 hours and water collection takes one hour. For water collection time queuing in the water sources takes around 40 minutes while the travel time takes around 20 min. this indicates that there is many people who collect water from the village tap which contributes the highest proportion of water time.

4.3.1 Results of Bivariate Probit Model of Resource Collection Work Participation and School Attendance

The first outcome of interest that we study is whether children are currently attending school and collecting resources. As this is a binary outcome, we use maximum-likelihood to estimate a bivariate probit model which will be followed by computing the marginal effects.

Table 8: Estimated Bivariate Probit Model

Number of observations 609
Iterations completed 3
Log likelihood function -402.70721
Wald test of rho =0: chi2 (1) = 4.79451 Prob > chi2 = 0.0286
Marginal effects after biprobit y = Pr (School attendance =1, child resource work=1) (predict) = 0.61169809

	School attendance			resource collection			Marginal effects		
Variables	Coefficient	Robust Std. Errors	P values	Coefficient	Robust Std. Error	P values	Marginal effects	Robust Std. Error	P values
Water minutes	-0.003	0.001	0.01	0.017	0.004	0.00	0.005	0.001	0.00
Girl child	0.135	0.167	0.42	0.369	0.137	0.01	0.131	0.046	0.01
age15to18	1.249	0.198	0.00	2.445	0.355	0.00	0.571	0.050	0.00
Mother resource work minutes	0.117	0.057	0.04	-0.080	0.050	0.11	-0.015	0.017	0.37
age6to14	2.948	0.250	0.00	2.582	0.390	0.00	0.858	0.046	0.00
Household size	-0.003	0.044	0.94	-0.016	0.040	0.69	-0.005	0.014	0.70
Post primary	0.310	0.291	0.29	1.208	0.294	0.00	0.341	0.071	0.00
Upper primary	-0.651	0.287	0.02	0.925	0.159	0.00	0.229	0.059	0.00
Head years of schooling	0.026	0.027	0.33	-0.035	0.026	0.181	-0.009	0.009	0.31
_cons	-1.193	0.495	0.02	-2.396	0.527	0.00			
athrho	0.279	0.126	0.029						
rho	0.272	0.118							

Source: Field survey data 2007

The discussion of the bivariate probit model marginal effects will not be decomposed to both direct and indirect effects, since the study analysed the data using Stata 9 which has no capacity to calculate the decomposed marginal effects. The bivariate probit results of resource collection work and school attendance by 609 children are provided in Table 8. The marginal effects presented below are for the conditional probability that the two events occurred. The correlation term (the rho. value (0.27)), summarizes the direction of correlation between the error terms in the two equations of resource work participation and school attendance, is positive and statistically significant. This suggests that the two choices are jointly determined. The positive significant sign indicates that these activities are positively related We also carried out a likelihood ratio test of the null hypothesis that ρ equals zero against the alternative that ρ does not equal zero. The test statistic, 4.79 is distributed as chi-squared with one degree of freedom under the null hypothesis. The value of 4.79 is statistically significant, so the null hypothesis is rejected.

The above results provide indications of those factors that positively influence the sampled children's likelihood of engaging in resource collection work as well as the determinants of school attendance. These results imply that age groups 6 to 14 years and 15 to 18 years significantly determine resource work participation and school attendance, based on their positive signs. Additionally, being in the age group 6 to 14 years increases the child's total marginal effect of combining participating in natural resource collection work and school attendance by about 86 per cent relative to those in age group 19 to 24 years. Those in age group 15 to 18 years increases the total effect of participating in resource collection and school attendance by 57 per cent relative to age group 19 to 24 years. In both age categories the total marginal effect is positive.

The level of children education was categorized into lower primary (standard 1 to 3), upper primary (Standard 4 to 8) and post primary school (Form 1 and above). Those in post primary variables have the expected positive sign of both participation in resource collection and schooling. Those children in upper primary are less likely to be attending school as the school attendance coefficient is negative, this may be due to high drop out

rate. Being in upper primary level will increase the positive total marginal effects of combining the two decisions by 23 per cent while post primary is by 34 per cent relative to those in lower primary. One of the reasons why the upper primary has a lower percentage than post secondary is due to the high drop out rate in the sampled region.

With the presence of a girl child in a household, signs for resource collection are positive and statistically significant, and being a girl increases the likelihood of combining resource collection and school attendance by 13 per cent relative to boys. The involvement of women in resource collection positively affects the likelihood of a child involvement in resource collection and negatively affects child involvements in resource collection. This indicates that adult involvement in resource collection will reduce the burden of children in resource collection. The household size negatively affects both resource collection and school attendance. Although household size is not significant the negative signs of household size affecting school attendance suggest that as households members increases the household asset base is constrained and this may lead to children not attending school due to poverty. Those who don't participate in school reduce the burden of those in school in a large households and thus negatively affecting child resource collection.

Collection time measured in minutes for water was estimated as the environmental variables. The water minutes negatively affect school attendance and they are statistically significant in determining the total marginal effect of school attendance and resource collection work. The marginal effects of the environmental variable is very low, for instance, a one minute increase in water minutes increases the total marginal effect of combining resource collection and school attendance by 1 per cent.

One major disadvantage of bivariate probit model is that it only shows that the decisions are correlated, corrects for the endogeneity but does not provide information about the direction of causality. To be able to establish the direction of causality that is, the effect of resource collection on school attendance an instrumental variable probit model was estimated and the IV probit results are reported in Table 9.

In the Instrumental variable probit model, the time children spend collecting water is used as instrument for resource collection which is used to correct for endogeneity.

Table 9: IV Probit results

Variables	Coefficients	Robust std. Err.	z	P values
School attendance				
Child resource work	-0 942	0 320	-2 950	0 003
Girl child	0 213	0 151	1 410	0.160
Age15to18	1 612	0 240	6 720	0 000
Mother resource work minutes	0 080	0.049	1 650	0 100
Age6to14	3 098	0 235	13 180	0.000
Household size	-0 013	0 041	-0 330	0.744
Post primary	0 601	0 267	2 250	0.025
Upper primary	-0.259	0 269	-0 960	0.335
Head years of schooling	0 013	0.024	0 560	0.573
_cons	-1 050	0 451	-2 330	0.020
Child resource work				
Girl child	0 098	0 035	2 850	0 004
Age 15 to 18	0 582	0 051	11.350	0 000
Mother resource work minutes	-0.022	0.010	-2.190	0.028
Age 6 to 14	0 606	0 045	13 550	0 000
Household size	-0 007	0 010	-0 710	0 479
Post primary	0 315	0 049	6 440	0 000
Upper primary	0 281	0 040	7 100	0 000
Head years of schooling	-0 008	0 006	-1 340	0 181
Water minutes	0 003	0 000	9 530	0 000
_cons	-0 032	0 098	-0 320	0 747
/lnsigma	-1.002	0.025	-39 730	0.000
/athrho	0 608	0.156	3 890	0.000
sigma	0 367	0 009		
rho	0 543	0 110		

Wald test of exogeneity (/athrho 0): chi2(1) = 15.17 Prob > chi2 = 0.0001
Number of observation=609
Source: Field survey data 2007

The significant Wald test for exogeneity indicates that we reject the null hypothesis, that there is no correlation between the errors in the schooling equation and the resource collection equation. The positive rho of 54 per cent indicates that the two decisions are

correlated. The school attendance is negatively affected by resource collection work as indicated by the negative significant resource collection coefficient. Although the household head years of schooling is not significant, it has the expected signs that is, the head education positively affect child school attendance and negatively on their resource collection work.

Household characteristics and household composition variables also affect the likelihood of a child attending school or doing resource collection work. The household size is insignificant but has a negative effect on both schooling and resource collection implying that children from large household are not likely to collect resources but can also negatively affect schooling due to factors such as poverty.

The high positive probit index of the age category of 6 to 14 years suggest that this is the age most likely to be attending school as compared to the age 15 to 18 years which has a lower probit index relative to those over 18 years of age. Due to the high drop out rate the probit index for a child being in upper primary is negative and insignificant while that in post secondary category probit index is positive and significant relative to those in lower primary category. The presence of women being involved in resource collection work positively increased school attendance and negatively determine the child involvement in resource collection especially in firewood collection work which takes more time compared to water collection.

4.3.2 Determinants of Children's School Performance

One variable is used to estimate school performance which is constructed from the collected information about last exam sat results which are averaged and any mark below the average of 306 marks out of 500 marks is labelled below average and is the dependent variable of the performance model. The results from the bivariate model are presented in appendix 1 (Table A1). The insignificant negative rho coefficient (-0.17) from the Bivariate probit suggests that participating natural resource collection work and school performances are not jointly decided. Therefore we estimated the univariate probit of

school performance and resource collection as one of the explanatory variable for 486 children who had performance and collection activities information.

Table 10: Probit model of school performance results

Number of observation=486
Iterations completed =4
log pseudolikelihood = -294.43067

variables	coefficients	Robust std error	P value	Marginal effects	Robust std Error	P-Value
Child resource work	-0 213	0 178	0 232	-0 081	0.067	0 232
Water minutes	0 001	0 001	0 645	0 000	0 001	0.645
Age	-0 116	0 115	0 317	-0 044	0 044	0.317
Age squared	0 005	0 005	0 285	0 002	0 002	0 285
Girl child	-0 145	0 123	0 237	-0 056	0 047	0 237
Mother resource work minutes	-0 071	0 044	0 107	-0 027	0 017	0 107
Household size	0 069	0 039	0 078	0 026	0.015	0 078
Post primary	1 284	0 345	0 000	0 388	0.070	0 000
Upper primary	0 196	0 204	0 337	0 075	0 078	0 337
Head years of schooling	-0 003	0 024	0 908	-0 001	0 009	0.908
Firewood minutes	0 001	0 001	0 342	0 000	0 000	0 342
Public school	0 727	0 175	0 000	0 283	0 066	0 000
_cons	0 032	0 713	0 964			

Source: Field survey data 2007

The results shows that as children progress to post secondary school they are likely to perform below the average mark as is expected since the curriculum content becomes complex. The results indicates that the type of school children attend is a major determinant of performance. the results shows that children in public schools are likely to perform below the average mark relative to those in private schools. The likelihood of a child being in post primary and performing poorly in school increases by 37 per cent relative to those in lower primary school.

Although the effect of participation in resources collection work is negative, it is not significant; the result may suggest that school performance is more related to the child's ability than to external pressure of resource participation work. This finding is also confirmed by Nankhuni and Findeis (2003) when they estimated determinants of school

progress using variables such as progress at the right class at the right age and progress in the senior primary school.

CHAPTER FIVE

5.0 Conclusions and Policy Recommendations

5.1 Conclusion

This study examines the links between natural resource collection work and children schooling in Kiambu District. The study was motivated by the growing concern about the anticipated negative effect of environmental degradation on human capital development. Our study uses data collected from 200 households using a detailed questionnaire. The sample had 609 children from Lari, Ndeiva and Kikuyu Divisions of Kiambu District. The descriptive statistics indicates that children are involved in both decisions of resource collection and school attendance.

The main study hypothesis is that; as resources becomes more scarce households will invest more time in collecting them and this will adversely affect the children's school attendance and performance. In order to correct for correlation that exist in the error terms of the resource collection equation and school attendance equation, the bivariate probit model was estimated. The results indicate a positive correlation between resource collection and school attendance. The instrumental variable probit was also estimated to correct for endogeneity of the two equations and also to indicate the direction of causality. The main findings are that children's school attendance and progress is negatively affected by scarcity of natural resources. Children's school attendance is affected through the increased work that results from scarcity of natural resources.

The school performance and resource collection model indicates a negative interlink however, the effects of resource collection works on performance were not significant which suggest that performance mostly depends on child's ability. There is a positive relationship between performance and type of school the child attends which is evident from the public schools dummy relative to private schools. Increased school attendance by children in public schools can be associated with the free primary education although the quality seems to have been compromised as evidence of lower school performance by

children in public schools relative to private schools.

5.2 Policy recommendation

From the research findings, there is need to reduce the child involvement in resource collection through several ways. First, children can stay longer in school studying during prep's time which will increase their chances of reading more and concentrating on school work. As children progress to the higher classes, they can also be encouraged to attend school even on Saturday morning to compensate for resource collection time. Secondly, increasing water supply in the area may reduce the time children spend queuing for water at the source of water. The water supply can be enhanced through tap water projects for the rural dwellers which will reduce time for fetching water and the cost of buying the water. Another policy that can be adapted for the areas with access to village tap is increase the number of village taps or community taps in the villages to a short distance from each other which will reduce the time children spend in queuing and travelling. There is also need to train and encourage communities on water harvesting technique to harvest rain water through roof catchments during the rainy seasons which can also be strengthened by building of storage tanks for the households. Management of existing water resources can be encouraged through water conservation measures.

The presence of women being involved in resource collection work positively increased school attendance implies that education of children can be enhanced even through adjustments such as a change in cultural attitudes towards encouraging men's involvement in resource collection activities.

To reduce the time children spend to collect firewood especially on weekends, the available alternatives of fuels for cooking should be improved. First, proper rules should be set on how to manage charcoal burning since its one of the causes of high deforestation rate in this country and a major substitute to firewood in the rural areas. Further more access to modern energy such as liquidated petroleum gas and solar energy,

improvised '*jikos*' could provide time for children to go to school or to spend time on school work and personal study which was revealed by this study to be on an average of one hour per day.

5.3 Areas of Further Research

There is need to carry out this study with more random experiments on the instrumental variables to be used for correcting endogeneity. The bivariate model can also be estimated using other econometrics packages such as Limdep which can decompose the marginal effects into direct and indirect effects. Information on household assets and income can be collected to estimate firewood demand function. Furthermore, the performance study can be estimated using panel data to control for other factors that affect child's performance and also to have a broader implication of environmental degradation on schooling. In addition, there still exists a need for research in this area of linking environment, schooling and poverty for the whole country, Kenya.

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Appendix 1

Table A1: bivariate model of resource collection work and school performance results

Variables	coefficients	Robust Std. Error	P value
Below average mark			
Water minutes	-0 000	0 001	0 932
age	-0 168	0 114	0 140
Age squared	0 007	0 005	0.117
Girl child	-0 155	0 122	0 206
Mother resource work minutes	-0.061	0 043	0.157
Household size	0 074	0 039	0 055
Post primary	1 218	0 343	0.000
Upper primary	0.179	0 203	0 378
Head years of schooling	-0 001	0 024	0 955
Firewood minutes	0 000	0 001	0 594
Public school	0 712	0.174	0 000
_cons	0.146	0 719	0 839
Child resource work			
Water minutes	0 099	0.025	0.000
age	1 646	0 303	0 000
Age squared	-0 079	0.015	0 000
Girl child	0.351	0 169	0 038
Mother resource work minutes	-0 129	0 058	0 027
Household size	-0.155	0 046	0 001
Post primary	2.435	0 753	0 001
Upper primary	0 205	0 240	0 394
Head years of schooling	-0 026	0.036	0 469
Firewood minutes	0 033	0.009	0 000
Public school	0.371	0 278	0 182
_cons	-7 844	1 628	0 000
/athrho	-0 180	0 156	0 251
rho	-0.178	0 152	
Wald test of rho=0:	chi2 (1) = 1.31792	Prob > chi2 = 0.2510	

Source: Field survey data 2007

Appendix 2

QUESTIONNAIRE FOR HOUSEHOLD SURVEY

HOUSEHOLD ID CODE _____

Date of survey: ___ /___ / 2007

Village: _____

Name of interviewer: _____

Introduction

Hello my name is..... and I am helping a student of the university of Nairobi, school of Economics to conduct a household survey on collection activities. Your participation will be highly appreciated. The survey will last for 30 minutes. All answers you provide are confidential.

A. Household Details

Name (see code) A1	Sex (see code) A2	Age(years) A3	Marital status(see code) A4	Highest level of education(see code) A5	Number of years in school A6	Relationship with head (see code) A7	Main Occupation (see code) A8

A1 -Make a complete list of all individuals who normally live and eat their meals together in this household, starting with the head of Household

A2 1-male 0-female

A4Monogamous Married =1, Polygamous Married =2, Living Together=3, Separated=4, Divorced=5, Widow or Widower =6, Never Married=7

A5 1=None 2=pre-unit 3=Primary 4=secondary 5=Post secondary 6=others

A7 Head=1, Spouse=2, Son=3, Daughter=4, Father/Mother=5, Sister/Brother=6, Grandchild=7, Other Relative (Specify)=8, Servant (Live-In)=9, Other Non-Relative (Specify)=10

A8 farming-1, Casual labour-2, Employed-3 Family business-4, self-employed-5, Student-6 none-7 others (specify)=8

B. Income Generation

What are the activities generating household income in cash and kind (list with approximate contribution to household):

- ☐ Agriculture: Average income _____ Kshs/ Month
- ☐ Firewood: Average income _____ Kshs/Month
- ☐ charcoal trading): Average income _____ Kshs/Month
- ☐ water trading : Average income _____ Kshs/Month
- ☐ Wage Labour: Average income _____ Kshs/ Month
- ☐ Employment: Average income _____ Kshs/ Month
- ☐ Family business: Average income _____ Kshs/ Month
- ☐ Other (explain): List activities _____ Average income _____ Kshs/ Month

C. Household Energy Use

What are the main sources of energy in your home?

Energy type C1	Yes/ No C2	Uses of the energy type C3	How often do you use energy type in C1 per week C4 see code	Do you buy the energy type in C1 Yes/ No C5	Quantity bought C6	Cost of the energy used per Month C7
Kerosene						
Firewood						
Charcoal						
Gas						
Electricity						
Others specify						

C4 1=daily, 2=sometimes, 3=2-3days a week, 4=4-6days a week, 5= Once a week

C6 for firewood quantity per trip and for charcoals quantity collected per week in local units

D. Sources of Resources

Do you buy firewood _____if yes how much in local units_____

If no,

Where do you collect firewood? Check all that apply:

☐ In Home garden (time taken (Both ways travel time plus collection time) ____hrs)

☐ Fallow lands, bare hills (time taken (Both ways travel time plus collection time) ____hrs)

☐ State Enterprise land / forest (Both ways travel time plus collection time) ____hrs)

☐ Other land (specify) (time taken (Both ways travel time plus collection time) ____hrs)

Where do you go to collect water?

☐ Village taps (Both ways travel time plus collection time) ____hrs)

☐ River (Both ways travel time plus collection time) ____hrs)

☐ Neighbours (Both ways travel time plus collection time) ____hrs)

☐ Own tap (Both ways travel time plus collection time) ____hrs)

☐ Others specify _____ (Both ways travel time plus collection time) ___ hrs)

E. Natural resources collection activities

Firewood collection

Household members E1	Do you collect firewood? E2-yes/no	Travel time (Both ways in minutes) E3	What is the average distance traveled to collect firewood (one way)? E4	Quantity per trip E5	Quantity unit E6	Collection Time (minutes) E7	Do you sell the firewood collected I 8	If yes in E8 how much? E9
1								
2								
3								
4								
5								
6								
7								
8								

F Water Collection and Purchase

Household members F1	Do you collect water for the family? Yes / No F2	How many times a day do you collect water? (F3 see code)	How many days in a week do you collect water F4	How far do you have to go for water during dry season? F5	How far do you have to go for water during rainy season? F6	Travel time (both ways in minutes) F7	Collection Time including time of queuing at the source (minutes) F8	Quantity of water collected per trip F9	If purchased, Price/20 litres buckets F10
1									
2									
3									
4									
5									
6									
7									
8									

F3 1=once, 2=twice, 3=3-4 times 4=sometimes, 4=more than 4 times

G What is the average time spent (in hours) per week on these Household Activities?

Household member G1	Agricultural activities G2	Cleaning G3	Laundry G4	Cooking G5	childcare G6	Others (specify) G7
1						
2						
3						
4						
5						
6						
7						
8						

H. Education and Collection activities by Children

Household children(arrange them according to their birth order) H1	Have you ever attended School? Yes/No H2	How old were you when you started school? H3	What class are you in or the highest class you have ever attended? H4	Have you ever repeated any class? H5	if yes in H5 which class? H6	Are you still in school? H7 If yes continue in H10 if No go to H8 and H9	if no which year did you complete or dropped out of school H8	What was the main reason for you to drop out of school? H9	are you in public=1 or private school=2 H10	Have you ever missed school in the past term to do household duties H11	If yes in G11 list the activities you do when you miss school See code H12
1											
2											
3											
4											
5											
6											
7											
8											

H9 1=lack of school fees 2=household work 3=firewood water collection 4= work to earn income
H12-activities 1=water collection, 2=firewood collection, 3=cooking, 4=childcare, 5=cleaning, 6= Agricultural activities, 7= Laundry

II. Education and Collection activities by Children

Do you combine schooling and collection of fire wood or water work? Yes=1 No=0 H13	If yes in G11 how many hours in a day do you collect water/firewood on weekdays? H14	How many hours do you collect water/firewood on the weekend? H15	How many hours do you go to school daily? H16	Do you collect firewood /water when going home from school? H17	Are you given home work in your school? H18	Does this firewood /water collection activity hider you from completing your homework? H19	How much time you spent on personal study at home? H20	Do you sit for division exams in your school H21	What was your total mark in the previous division exam H22	From your teachers continuous assessments does this resource work affect your school progress H23

Thank you