FOOD SECURITY AND POVERTY AMONG SMALL-SCALE FARMERS IN NYANDO DISTRICT, KENYA

BY

OLUOKO-ODINGO ALICE ATIENO

B.A. (Hons) and M.A. (University of Nairobi).

A Thesis Submitted to the University of Nairobi (Faculty of Arts) in fulfillment of the requirements for the Degree of Doctor of Philosophy in (Agricultural) Geography

2006

DECLARATION

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

OLUOKO-ODINGO ALICE ATIENO

This Thesis has been submitted for examination with our approval as the University Supervisors

PROF. ELLAS, H.O. AYIEMBA
Professor of Geography,
Department of Geography and Environmental Studies,
University of Nairobi

PROF. LABAN, A. OGALLO
Professor of Meteorology,
Department of Meteorology,
University of Nairobi

DEDICATION

First,

To All my Teachers from Kanyango Clan - Agwara -Nyandusi -Nduru - Pap-Nyadiel Primary Schools-Ng'iya Girls High School - University of Nairobi

Second,

To Prof. Richard Samson Odingo, for giving me inspiration, and in the process demonstrating that there is no conflict between a woman's pursuit of her right to education and marital obligations,

Third,

To our daughter Kristina Tatiana Nyasangare, who together with her generation has witnessed and borne the burden of escalating food insecurity and poverty.

ABSTRACT

This Study discusses Food Security and Poverty Issues with special reference to Small-scale Farmers in Nyando District of Kenya. The District suffers from problems of drought and frequent flooding, which negatively impact on agricultural activities. Low food crop production and inadequate cash among various households, make it incapable of benefiting from available food, which could be purchased from neighbouring districts like Kisumu and Kericho. The objectives of the research concentrated on establishing the influence of drought and floods on household food security, examining the socio-economic factors that influence household food security, examining how household population and health influence household food security, and; investigating the significance of poverty as an important aspect of food security among the small-scale farmers. The main research questions paused concern the influence of unfavourable weather on household food security, socio-economic constraints to household food security, the demographic and health factors influence on household food security, and the role played by household poverty on household food security. The formulated null hypotheses assumed no relationship between household food security and the occurrence of droughts and floods, land availability, household size and labour, family health and, distance to market, among other factors. The hypotheses were tested using various statistical techniques to establish what explains the rampant food insecurity and the prevalence of rural poverty in the study area.

The sampling frame comprised of small-scale households within Nyando District. The Locations sampled for this study were first stratified according to the existing agro-ecological zones, which varied from high to medium and to low agricultural potential areas. Using a sample size of 279 households, the first household was chosen randomly, and systematic random sampling used to select other households. The techniques of analysis included Multiple Correlation and Multiple Regression Analysis, Stepwise Multiple Regression Analysis, Principal Component Analysis, Factor Analysis and Cluster Analysis, which were selected on the basis of the characteristics of data dealt with and the relevance of each technique. The analysis

regarding household food security and climatic factors established that, although drought episodes frequently occur in the study area, they were not severe enough to result into total crop failures as opposed to floods, where six months of flooding resulted into total crop failure. During such periods of crop failures, various households depended on food purchases using income from ofT-farm employment, remittances from relatives, or Food-for-Work programmes, which were not always available, with most of the households having inadequate funds for food purchases. The findings of the analysis between household food security and socio-economic factors revealed that land availability (farm size and land cultivated), household size and labour, hired labour and, distance to the nearest market centre, all impact upon household food security. These factors contributed nearly 50 percent of the variation in household food security. The analysis concerning the demographic and health factors and household food security revealed that morbidity and mortality were inter-dependent and influence household food security both singularly and jointly. Further, household size and family health related issues constituted nearly 50 percent of the variations in household food production, and households having between 5 and 10 persons were found to be more productive than smaller household sizes.

The analyses using Principal Component Analysis, Cluster Analysis and Factor Analysis, in comparison with the results from regression analyses, prioritize farm size, family health and age of household head as principal components, determining the improvement of household food security and reduction of household poverty. Other conclusions emphasize the need to view household size as a resource rather than a burden, maintaining farm sizes to economic units, and the use of suitable inputs and appropriate technology. Further, in order to minimize the impact of droughts on household food security, drought resistant crops should be encouraged, while also prioritizing planning and management of floods. A minimum of farm size of 3 hectares is required per household in areas receiving unimodal rainfall patterns, with those areas having two cropping seasons, which require at least 1.5 hectares. A new definition of poverty is arrived at on the basis of food production and cash availability. Major recommendations emphasize the need to provide farmers with timely climatic data, incorporation of issues like age of household head and experience in farm work, weather fluctuations and farm size in food policies. Dual-purpose crops (referring to crops that qualify as both food and cash crops) are recommended together with affordable farm inputs among other recommendations for policy makers.

ACKNOWLEDGEMENT

I would like to acknowledge the contribution of different institutions and individuals towards the success of this Thesis. I would like to give special thanks to the University of Nairobi, Vice Chancellor (Prof. Magoha) for having granted the necessary assistance at the early stages of this work to enable me register for the Ph.D. I am very grateful to the Deans Committee for providing me with the initial funding to carry out the fieldwork, without which, the work could not have been completed in time. Similarly, I am sincerely thankful to the German Academic Exchange Service (DAAD) for their generosity, who came in handy with financial resources when the work was almost at the verge of stalling.

f am indebted to the former and current Chairman of Department of Geography and Environmental Studies (Dr.E. Irandu and Prof. E.H.O. Ayiemba) for their unparalleled and prompt support whenever they were called upon to act. Their commitment was critical in ensuring that the work-plan for this research was strictly and successfully followed.

I would like to deeply appreciate the contribution by my supervisors: Prof. E.H.O. Ayiemba and Prof. L.A. Ogallo, who have tirelessly and relentlessly worked hard with me, while going through the scripts in time and making necessary comments. I am, particularly, grateful for the advice, suggestions, and direction during the preparation of the proposal and writing of the thesis, and their assistance during the different stages of fieldwork and data analysis to ensure the accuracy of the results.

I am deeply grateful to Prof. R.S. Odingo for his words of wisdom right from the conceptualization of the idea of the research topic to the time of writing of the Thesis. I would like to thank Prof. F.F Ojany for his words of encouragement and Dr. Arungu-Olende for his advises, particularly on energy issues, and my colleagues in the Department, who from time to time inquired about my health, progress of the work, and offered encouragement, particularly, Miss Rego.

I would also like to acknowledge sincerely the Ministry of Education, for granting me the permission to proceed with fieldwork, and Ministry of Agriculture (Department of Food Security, particularly, Mrs. Onyango) for their support with materials and information regarding food security situation in the country. I would also like to thank Mr. Peter Oduko, Mr. Ombulo Otieno and Mr. Willis Adera (the officers at the Nyando District Headquarters (Population and Agriculture (Livestock and crops) Departments, specifically. My sincere thanks also go to different officers at the District Medical Office in Nyando, Dr. Diemo (Medical Officer of Health), Messrs David Owuor and Yuanita Hongo (District Clinical Officers) and Mr. David Wangila (Health Information Officer). I would also like to thank the officers at the Out-growers Scheme in Chemelil for their assistance.

My sincere appreciation also goes to Mrs. Caroline Kambona for her assistance during fieldwork, whenever I called upon her to assist and other college-mates, who challenged me to proceed with the programme quickly and provide a way forward for them, particularly, Mrs. Esther A. Obel and Mrs. Mediatrice Wangira. I am thankful too to the officers at IGAD Climate Prediction and Application Centre (ICPAC) who provided me with technical assistance whenever it was necessary. I am also grateful to Mrs. Agnes Andolo for the assistance during the initial stages of data processing and analysis, Mr. I. Ayuyo for the cartographic work, nephew Robert Owino for reading the work continuously and tirelessly, and my research assistants - Washington Yogo, Joab Onyango, Kay Ouma, Wyckliff Muganda, and Gordon, O. Oyoo.

I would like to express my sincere thanks to my husband Sammy, for the co-operation, support, understanding and availability during the various stages of the work. I am grateful to my daughter Kristina for providing the momentum for setting new goals in life, enduring difficult conditions during the fieldwork and friendship when the going was rough. Not to forget, my father Rev. Absalom Oluoko Aloo, and mother Benta Adhiambo Nyasangare, for the priceless foundation of life and aspirations, which they laid down for me.

TABLE OF CONTENTS

CHAPTER 3: BACKGROUND TO THE STUDY AREA

CHAPTER 4: RESEARCH METHODOLOGY

CHAPTER 5: CLIMATE AND FOOD SECURITY

CHAPTER 6: SOCIO-ECONOMIC FACTORS AND FOOD SECURITY

CHAPTER 7: THE EFFECT OF DEMOGRAPHIC AND HEALTH FACTORS ON FOOD SECURITY AND POVERTY

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER 1

BACKGROUND TO FOOD SECURITY AND POVERTY AMONG SMALL-SCALE FARMERS

In this introductory chapter, the relationship between food security and poverty globally is highlighted together with some of the methodologies that have been used in trying to deal with these problems. This is because it is impossible to divorce food availability from poverty eradication strategies. Secondly, some existing literature regarding food security and poverty situation in Africa is given in order to bring better understanding between these issues and development funding over the years. In terms of food security and poverty in Kenya, the relationship between agro-ecological zoning and food security/poverty status together with the effects of climatic and some socio-economic factors on existing poverty levels are also discussed. Additional issues included are resource allocation in the year 2004 to various needs and the relevance of multiple expenditure on education, among other basic needs.

1.1 FOOD SECURITY AND POVERTY PROBLEMS AND THE SYSTEM'S APPROACH ADOPTED

Food Security and poverty problems are now familiar concepts to a majority of researchers throughout the world, particularly among the developing countries, such as Kenya. Within the developing world, Africa, particularly Sub-Saharan Africa, is classified as one of the poorest regions associated with escalating food security problems, amidst high levels of poverty. Some of the factors contributing to this situation include limitations of soil and climate, and emphasis on export crops at the expense of food crops (in terms of research, infrastructure development, and marketing systems). Additional factors include over-reliance on food imports at the expense of local food crops and the neglect of small-scale food production. As long as a society is deficient in all its food needs, poverty is inevitable, since food insecurity is viewed as both a cause and a consequence of poverty (Eicher, 1986; Mellor, ***el al,*** 1987; Sanchez, ***el al,*** 2005).

In order to adequately address food insecurity, it would be simpler to deal with poverty, as food is just one of the basic needs required by an individual for a minimum healthy life. However, the problem of poverty among the developing countries has been viewed fundamentally as one of the aspects of economic development with emphasis being placed on overall economic growth, whereby rises in per capita incomes do not automatically benefit the majority of the target populations. Instead, even under the conditions of the so-called "growth" the absolute poor still suffer, and are hurt with both absolute and relative impoverishment at the same time. According to Sandbrook (1982), even if people received a given amount of income, it could not be used to eliminate poverty, as income cannot validly be divorced from its societal context. Such poverty is humiliating for the relatively deprived, while relative poverty can be as excruciating for its victims as absolute deprivation.

The high incidence of poverty has been attributed to the capitalist approach to development, which results in increasing income inequalities initially, which are later theorized to improve. Countries like Britain, which applied this method in the nineteenth (19^{th}) century and twentieth (20^{th}) century soon realized that there was actually no improvement in the inequality levels as was earlier envisaged. Such countries were forced to deal with the problem by increasing state responsibility for financing investment, education, and other non-consumptive expenses among the poor. Persistent poverty among the developing countries has been attributed to heavy external debt, inadequate capital and wanting technology, lack of liberalization and transparency in developed country markets, and declining official debt assistance. It is still uncertain to-date how much and for what period should development assistance be given to these countries to enable them escape poverty. Various scholars have suggested that for a country to have attained sustainable development, services, like water, food, health, shelter and energy, education and income must be prioritized in that order ((Sandrook. 1982, UNEP, 1999b).

There are several attempts that have been used, probably to put an end to the vice (agro-ecological zoning, livelihood zoning, household food economy, income accounting, and the basic needs approach)(IGAD-DMCN, 2002 and Ministry of Finance and Planning, 2000a and b). The results proved usefiil in planning for extension services, general early warning systems, and calculating the amount of cash needed to buy food per month among the poor households. However, it is still uncertain whether the information was adequate to solve problems of intra- and inter- household food availability, to establish the relevance of early warning systems to poor households, and the relationship between intra-household needs and the monetary values proposed in space and time. The Basic Needs Approach, which is a close variation of the methodology used in this study, although it states some of the most important intra-household basic needs, excluded the contribution of the individual factors to escalating poverty levels (Sanchez, ***el al,*** 2005, Ofosu, 1991, ILO, 1972, Kekovole, 1991, and Sandbrook, 1982). In the current study, it was decided to examine the actual contribution of various intra- and inter-household and regional determinants of poverty to individual household poverty levels in order to provide direction on what needs to be prioritized if poverty is to be ameliorated. This would provide material for comparison with other similar studies concerned with Food Security and Poverty.

The System's Approach adopted in the study normally assumes that a farm and therefore, a household, consists of a set of related sub-systems, which form a hierarchy of systems (Ruthenberg, 1980; Obara, 1983, and Oluoko, 1999). Such an approach allows an integrated study of issues to be discussed, and is particularly useful to Agricultural Geographers because the farm is a major decision-making point in any agricultural development, yet it is influenced by several other factors, both physical and human in nature. The approach has shown many interesting results on different issues on food security, for example, the simultaneous occurrence of droughts and floods in Nyando irrespective of the rainfall seasons in the area, problems of uneconomical land sub-divisions, and agriculturally suitable household sizes and family health. Additional issues include household vulnerability to food insecurity and poverty, which are priority areas for study if food security is to be achieved. All these issues have been examined in this study with a view to coming up with correct interpretation of the factors at play, which explain the high incidence of poverty and food insecurity in the study area.

1.2 FOOD SECURITY AND POVERTY IN AFRICA AND OTHER DEVELOPING COUNTRIES

In the case of Africa, (the world's largest continent, with a land area of nearly 30 million Km', with a wealth of natural resources - minerals, forests, wildlife and diverse biological diversity), a majority of the inhabitants of the continent wallow in poverty accompanied by skewed income patterns, despite these enormous resources. These characteristics are very synonymous with its past history of colonization and subsequent partition by the various European powers (Editors of Life, ***el al,*** 1961). Even after obtaining independence, a majority of African governments inherited, and continued to maintain centralized economic and sectoral institutions together with irrelevant development policies thus making Sub-Saharan Africa one of the poorest regions of the world. As a result, food crisis is ever prevalent in this continent and may continue to be so until a radical surgery is carried out on the existing development policies.

The African food crisis is long-term in nature, and has been building up for several decades, and while food production has declined, population has been increasing, leading to increases in poverty, with minimal resources being made available for food production. Yet the funds ear-marked for the poor never reach them, and seldom efforts are made to link further funding to the achievement made by those involved with the results, not to mention regular cost-benefit analysis aid allocation (Hancock, 1989 and Sandbrook, 1982). For example, while the Green Revolution of the 1970s resulted in a worldwide increase in per capita food production, Sub-Saharan Africa is the only region in the world that has seen a decrease in food production, with 22.5 million children malnourished in 1996-2001 records. Agricultural productivity also lags behind that of industrialized countries, partly due to poverty. Just to emphasize this. 1 hectare of farmland produces 2.5 tonnes of food in the United States of America but only between 300 and 500Kg in Africa (Google, 2006). The poverty reduces access to the necessary farm inputs.

On the other hand, Africa had the greatest percentage change in food crops consumed over the period (1996-2001), with a lower change in consumption of beef. The percentage change in population was also greatest in Africa (see Table 1.1, where values are given in Cereal Equivalents). Population growth in Sub-Saharan Africa is estimated to be 3 percent per year and the inability to match population growth with food production results in food insecurity for 40-50 percent of the people (Google, 2006). While the absolute poverty of the world dropped from 40 to 21 percent, Sub-Saharan Africa still remains the only region where the number of people, living in abject poverty has grown over the past 20 years. The absolute poverty has also risen from 42 percent to 47 percent in the period 1981-2001 (Google, 2004).

Table 1.1 Percentage Change in Food Consumed by World, Developing Countries, Asia, Africa and Population in the year 2004

Region	Total Food Consumption	Consumption of food crops	Consumption of Livestock Products	Population
World	154	146	152	102
Developing countries	311	201	404	133
Developed countries	56	51	55	35
Asia	363	189	638	122
Africa	205	242	172	194

Source: Modified from Rask, ***el al,*** 2005.

Scholars have suggested that any reduction on poverty in Africa would need to consider raising the productivity of small-scale farmers, creating employment for landless labourers, and encouraging more productive use of labour in public work programmes. The establishment of labour intensive industries - which rely on local materials and which meet local needs, is also necessary. In a study by Hancock (1989) and Sandbrook (1982), Kenya along with Zambia and Ghana, revealed the worst maldistribution of incomes among the poor and non-poor ((Hancock, 1989, UNEP, 1999b and Sandrook, 1982), suggesting that efforts to find lasting solutions to the poverty problem will not be easy. In Kenya, two ingredients are used in poverty mcasures-a relevant monetary indicator of well-being and a threshold or poverty line below which people will be classified as poor (CBS, 2005).

1.3 FOOD SECURITY AND POVERTY IN KENYA AND NYANDO DISTRICT

Kenya is a unique country with very varied ecosystems, ranging from arid and semi-arid lands, to savannas and alpine and mountain ecosystems, and it has always been assumed that food insecurity and poverty problems are only persistent within the agro-pastoral and pastoral areas. This is not always the case, as in addition to climate and weather extremes, problems of Structural Adjustment Programmes by donor countries and post harvest losses among others, affect man areas (Republic of Kenya, 2001a). Most of the poverty in Kenya is being blamed on Structural Adjustment Programmes (SAPs) of the 1990s - brought about by the World Bank and International Monetary Fund (IMF). It has, however, been stated that if poor countries cannot negotiate reformed international economic arrangements, they at least have it within their power to reconstitute their domestic priorities and institutions in order to avoid putting blame on others (Sandbrook, 1982).

In Kenya today, homogenous landscapes consisting of cash crops within the best and most productive agricultural land, and owned by a few individuals, emphasizes the inferior position given to food crop production to ensure food security. Secondly, the labour aristocrats continue to invest in capital-intensive projects like floriculture and air transport, which are used to maintain the GNP growth rates, while the poor continue to wallow in poverty. Thirdly, the provision of public services are polarized and are closely knitted with the existing political system, with non-participating areas completely lacking services of education, health, clean-water, environmental sanitation and public transport. Although increases in national incomes are intended to reach the poor, the strategy has not been successful in the country, just like many other developing countries, in spite of historically unprecedented average rates of growth throughout the sixties (Central Bureau of Statistics (CBS), 2004 and 2005, Monke, ***el al,*** 1989; Onchere, 1999; CBS, 1996a, Dache, 1989; Ministry of Finance and Planning, 2000a and b; Republic of Kenya, 1996a; Khaemba, 1992; Cherongony, 1995).

Although Kenya's agriculture and hence food security are highly weather dependent, the effective use of home-grown sectoral early warning systems- dealing with the various agro-ecological zones has not been adequately exploited. Such systems are intended to assist in identifying surplus, and deficit areas, in order to fill in the production gaps. The extreme climatic and weather events are common in many parts of the country and are associated with severe social and economic impacts such as famine, shortages of water, and energy. Other problems include shortages of many other basic needs, disease outbreaks, and disruption of trade, which are all aspects of poverty. Vulnerability to food insecurity in the country has been particularly attributed to population pressure and political interests in land ownership - leading to fragmentation of land holdings into small and inadequate units set aside for household food production. Additional factors are population growth, which has led to out-migration, and cultivation of marginal lands- susceptible to droughts and floods, environmental degradation, poor information dissemination, and poor marketing systems, unsuitable crop varieties (inappropriate technology), poor infrastructure, poor development goals, pre-election violence, persistent and frequent droughts, and poverty itself. (Jaetzold, ***el al,*** 1982, and IGAD-DMCN, 2002).

The food security outlook reports for the period between September to December 2005 predicted for example, the current fragile food security situation (ICPAC, 2005), which was supposed to continue upto December 2006 (ICPAC, 2006). See Figure 1.1 also for some of these details. Although there is still no in-country alternative system in place to verify the data from the World Food Programme, there is little doubt that the early warning system information is still not given the attention it deserves by the government for proper disaster preparedness, planning and management.

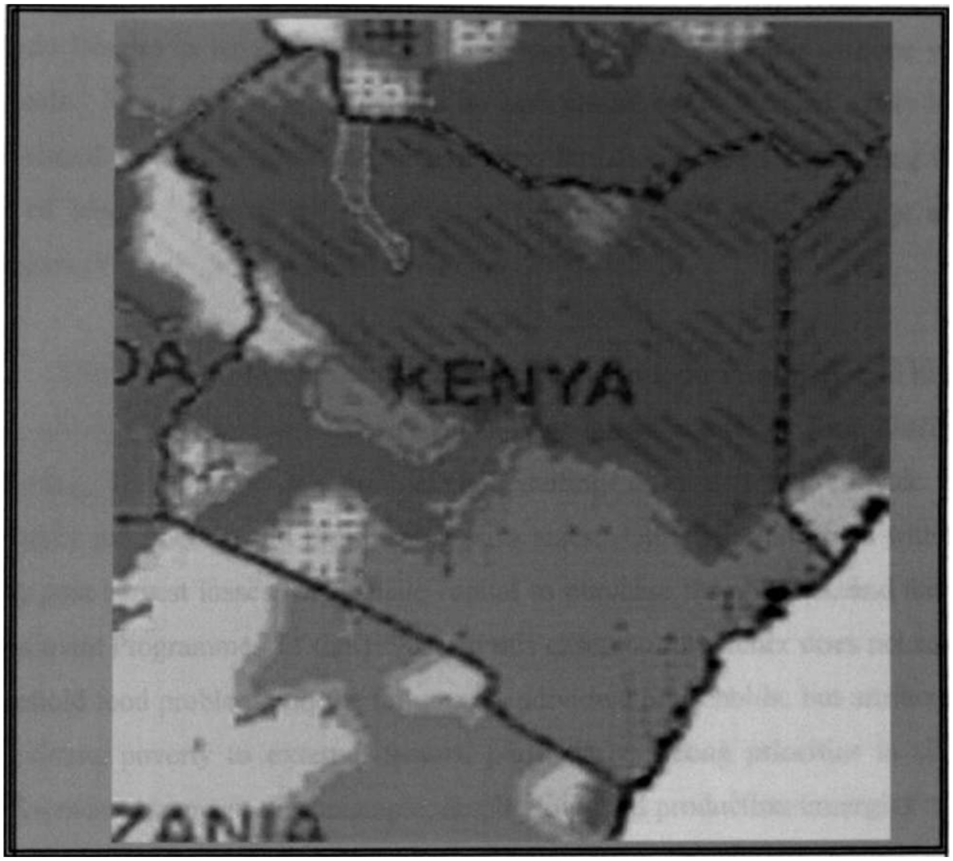
I

A study of the resource allocation to various sectors of development in Kenya in the year 2004 casts a lot of doubt on the possibility of ensuring that poverty reduction strategies remain fruitful. For example, the Economic Survey for the year 2005 (CBS, 2004 and 2005) indicates some of the achievements in the year 2004. The output was mainly due to the rise in output in agro-processing industries like sugar, milk, grain, milling, fish, tea, and oils. In addition, increases in employment were attributed to increases in credit to private sector and enhanced consumer demand for goods and services. Some of the issues that demand urgent consideration include, first, establishing if the stated increases in manufacturing are sustainable, given that agriculture is declining, along with the escalating oil prices and transportation costs, which are mandatory for secondary and tertiary development sectors. Secondly, the possibility of creating additional job opportunities, besides low levels of income, climatic hazards and declining economy appear to be non-existent. Thirdly, whether food security has been accorded the priority it deserves, and whether borrowing for consumption can still translate to development, is not clear from various government reports (Republic of Kenya, 1996a and b, and CBS-Statistical Abstracts).

The Central government recurrent and development expenditures towards poverty eradication in some of the sectors showed that education, health, labour and home affairs were allocated about Kenya shillings 86.0; 22.0; 1.0 and 2.0 billion, respectively. When examining the relationship between levels of education and poverty in Kenya, the same records clearly showed that, while 79.9 percent of Kenyans who attended school were still poor, 86.2 percent attended school and were non-poor. This type of data does not show clearly the relationship between poverty and levels of education in comparison with other factors like food production, health, and employment, among others. The parameters used in the analysis-marital status, gender, household size and age of household head - could assist in explaining vulnerability, but additional information is still needed if food insecurity and poverty are to be reduced.

Figure 1.1:

SATELLITE IMAGERY OF KENYA SHOWING F(X)I)
SECURITY SITUATION (JUNE-DECEMBER, 2006)



Humanitarian Emergency
Acute Food and Livelihood Crisis
Generally Food Secure
Chronically Food Insecure

<u>Source</u>: ICPAC, 2006

Even though Kenya used monetary values to emphasize poverty, many scholars concur that food security can only be achieved if other basic needs are taken into consideration (Sandbrook, 1982; UNEP, 1999; Ministry of Finance and Planning, 2000a and b; Sanchez, ***et al***, 2005; ILO, 1972 and Kekovole, 1991). The welfare monitoring surveys in Kenya mention infrastructure, access to health, education, productive assets and markets for goods and/ or labour as some of the needs of the poor which the Kenya Government has not met. While the methodology dwelt more on regional disparities and age/sex of household head, it missed out a reference to individual items - health, education, assets, infrastructure, markets and information on poverty. Further, although there is an outcry about population growth rates, the results in this study has shown that, Nyando District in Kenya is actually under-populated and unable to cope with labour demands. Low population figures for an agricultural country could easily lead to low agricultural production, hence food insecurity, due to high costs of existing labour, and lack of labour in some critical areas, added to the HIV/AIDS scourge and related problems (Ministry of Finance and Planning, 2000a and b).

Some of the external factors that contribute to food insecurity and high poverty levels among households in Kenya include poor infrastructure for food distribution and marketing, low food production levels resulting from extreme climatic conditions (droughts and floods), and diminishing farm sizes. Others are conflicts within pastoral areas, post harvest losses, inadequate capital to purchase farm inputs, and the Structural Adjustment Programmes of the 1990s. In this case, the researcher does not solely blame household food problems on the failures of individual households, but attributes some of the existing poverty to external factors, particularly, wrong priorities in allocation of development resources. For example, despite low food production emerging as a priority and education, health, drinking water and climatic shocks becoming secondary to poverty eradication strategies by 2015 (among the millennium development goals), more funding has been directed to primary school education, while hunger still remains a problem in Kenya. In addition, as education raises expectations and awareness of poverty status, relevant education must be accompanied with new job opportunities and fair acknowledgement of meritocracy.

Among the external factors contributing to food insecurity and poverty is drought. The devastating drought and famine responsible for many human deaths and countless livestock deaths has gone to underline the vulnerability of the country to natural disasters, in this case, drought. This research intends to show that in order to deal with food insecurity and poverty accordingly, both individual household resource allocations (within/intra-household determinants) and external variables (inter-household and regional determinants of poverty) must be considered. It is still uncertain whether, the direction taken, the efforts made, and enormous resources spent, will truly lead to elimination of poverty by 2015 as intended (Sanchez, ***el al***, 2005, Republic of Kenya, 1996b and 2001a). The experience with the current drought in 2006 indicates that the country is still unprepared to deal with such shocks.

Secondly, the UNEP and DMCN workshop on disaster preparedness and management, which allowed the participants to visit the victims of floods at Budalangi of Western Kenya and Nyando District of Nyanza provinces, respectively, was an eye opener to the researcher to the real suffering of humankind from the climatic calamities. Thirdly, having lived within a humble background, where tolerance levels to poverty are very high, added to some of the experiences gained from living in both developed and third world economies, the researcher did not doubt that the role of education in fighting poverty could be over-estimated. This formed the foundation for this research in order to unveil the myth characterizing food insecurity and poverty, precisely to establish causes and problems of poverty, and identify ways of dealing with this problem, as even the millennium development goals lacked the teeth to positively impact on the crisis.

Nyando District was one of the areas visited during the IGAD Climate Prediction and Applications Centre (ICPAC) workshop, but it was not classified as agro-pastoral or pastoral area, yet it experienced such high levels of human suffering, it was, therefore, natural to try and find out possible explanations. As stated earlier, Nyando District, being a medium potential area is one of the regions assumed to be free from food insecurity and poverty problems. Paradoxically, weather fluctuations, inadequate food reserves, and poor management of the existing resources, make food security attainment impossible even within the medium potential areas. Nyando District, therefore, is one of those medium potential areas, which could help in explaining that food security problems go beyond the semi-arid and arid areas, and could be more extensive in the country than it is estimated to be (Jactzold, ***el al,*** 1982 and Republic of Kenya, 1996a and b).

1.4 STATEMENT OF THE RESEARCH PROBLEM

Food security is a fundamental issue in Kenya just like in many other developing countries, as each countiy is charged with the task of feeding its people at all times irrespective of unfavourable weather conditions. This makes food security one of the major aspects of agricultural policy in the country. Food security is closely tied to poverty, as food insecure populations are also the poor, living as they do on less than 1 US dollars a day.

This study recognizes the close link between household food security and poverty, particularly among small-scale agriculturalists, who are normally associated with food security problems due to unfavourable weather patterns, lack of capital and labour, diminishing agricultural lands, and low agricultural productivity, among others. In order to address these issues, this study concentrates on four major factors: the climatic, socio-economic and demographic and health factors, that influence food security in Nyando. These four factors impact negatively on food security and should be addressed through relevant policies to improve household food security situation and eradicate poverty.

1.5 RESEARCH QUESTIONS

In order to focus on the research problems to be investigated, the following research questions will be used as guidelines:

- How does unfavourable weather influence household food security among small-scale farmers in Nyando?
- What are the socio-economic constraints to small-scale household food security in Nyando District?
- How does poverty influence household food security in Nyando District?
- What are the Demographic and Health factors influencing household food security?

- What arc the coping strategies?

1.6 RESEARCH OBJECTIVES

The general objective of the research is to investigate the factors that influence food security in Nyando District. Only four questions among the research questions have been used to formulate the specific objectives and, hence, the null hypotheses as, it was not possible to quantify the role of the government. The coping strategies are discussed together with other findings. The specific objectives are as follows:

- To study the influence of drought and floods on household food security in Nyando District.

- To examine the socio-economic factors that influence household food security, in the study area.

- To examine how household size and health influence household food security in the study area.

- To investigate the significance of household poverty as an important aspect of food security among the small-scale farms.

1.7 JUSTIFICATION OF THE STUDY

There is imbalance between the amount of food required for consumption (demand) and the amount of food produced (supply) in many parts of Kenya. Details of these are presented in chapter 2. This imbalance has resulted into problems of food security and poverty. Problems of population growth, low per capita incomes and unfavourable weather conditions alongside the finite agricultural land resources cause uncertainty in the future food production prospects. Food security is, therefore, an important study topic in Kenya, as the country, is faced with growing population, and uncertain food production situation due to socio-cconomic as well as environmental problems. The sector of the economy which, is at risk consists of smallholder farmers, accounting for 80 percent of the agricultural crop production in the country. These populations require new ways of growing more of their food in order to increase both food supplies and their incomes as the nation is primarily rural and heavily dependent on the agricultural economy (WRI, ***et al,*** 1996). These vulnerable groups further require attention to enable them to adapt to the expected adverse impacts of unfavourable weather conditions, characterized by the high frequencies of drought occurrence and floods, which often disrupt agricultural production. A study directed at the smallholder producers and dealing with food security will provide useful information for policy frameworks, to enable the government to regulate the sector and address food security problems and encourage sustainable development. Sustainable development is probably difficult to achieve in Kenya, and other developing countries without clear efforts to directly deal with poverty. Food security among smallholders can only be achieved when poverty is minimized, if not eradicated, and the processes of food crop production integrated with environmental conservation.

The study area (Nyando District) is however frequently plagued by the occurrence of perennial floods, which in the past did not receive adequate attention from the government but which recently have attracted great attention from the media. These floods that are sometimes followed by severe droughts are responsible for the rampant poverty in the area as noted by Nyaranga (2002) who called for urgent measures to end the menace. Peasants living in the area need encouragement to improve their household food security. Success with small-scale rice irrigation in Nyando District, for example, is a pointer to some of the initiatives, which could be taken by the government to rid the district of food insecurity. Even though the area is subject to floods, rainfall is not always reliable and the probability of receiving 1000mm per annum is low. The periods devoted to land preparation and planting are always plagued by rainfall uncertainty. Thus one of the key challenges to food security in Nyando District is climate extremes.

1.8 SCOPE AND LIMITATIONS

The study contains a discussion of the various relationships and inter-relationships of smallholder household food security and poverty. In the area of climatic issues and household food security the study has covered the impact of droughts and floods. The Socio-economic factors included in the research deal with land (farm size and farming systems), labour and capital/credit facilities, technology and government policy. Additional socio-economic factors include distances to the nearest service centres like markets, banks, primary schools and water. The demographic and health factors discussed include household size, age, migration, education, together with household morbidity and mortality. The sections on Poverty and household food security address issues like regional poverty (fieldwork observations and accessibility), including energy, inter- and intra- household poverty (gender, and education), and the nature of the vulnerable people. The study of food security is a vast undertaking and for this reason, not all the aspects could be treated equally in this study. Consequently, the focus of this study has been an attempt to understand household food production and consumption levels, and the extent of poverty in the Nyando District.

1.9 DEFINITION OF KEY CONCEPTS

Adaptation- is the ability to cope with the existing hitherto difficult situation.

Basic needs - are those needs that are essential for human survival (Sandbrook, 1982).

Development - is the structural formation, which takes the country from the "vicious cycle of poverty" to encompass improvements in education, health, productive capacity and income (Ofosu, 1991). Sectors such as agriculture, manufacturing, international trade and infrastructure play very important roles during this exercise.

Disaster - is a serious disruption of subsistence and normal functioning of a population causing widespread human, material or environmental losses, to such an extent that the affected society cannot subsist without outside intervention.

Drought - refers to a rainfall-induced shortage of some economic good brought about by inadequate or badly distributed rainfall.

Famine - refers to a period with acute shortage of food.

Food security - refers to access by all people at all times to enough food for an active and healthy life (World Bank, 1988a). A new definition of food security is provided at the end of this study. Households are considered food insecure if they cannot meet 100 percent of food requirements through food production, food purchased and food-for-work. Food production in this case refers to the amount of food in terms of cereals, produced within a household in order to attain food security.

Gross Domestic Product (GDP) - is the size of a nation's economy and it is measured annually (the value of all, final goods and services produced within the borders of a country). On the same note, **Gross National Product (GNP)** combines the GDP with net income from abroad (WRI, ***et al,*** 1996). **Purchasing Power Parity,** on the other hand, refers to how much of a common market basket of goods and services each currency, can purchase locally.The researcher would like to state that since alternative indices for measuring development in space and time are still lacking, in some parts of the thesis, these indices are still used to highlight some serious and relevant development issues. **Per capita** GDP and GNP, therefore, refer to average measure of resident's wellbeing.

Hazard - is a potentially threatening event, natural hazards include extreme events like drought, floods, epidemics and pests (DMCN-UNEP, 2004).

Household - is a unit of production, consumption and socialization feeding from family pot (Piwoz, 1985). **Household food production or food crop production** is the total number of bags or Kilograms of cereals produced annually by a household, while **Household labour** - refers to number of family members in full-time farm work. The **Household size,** on the other hand, refers to number of household/family members who are present in the household at least 50 percent in a year, under one household head and dependent on one piece of land.

Land-use - refers to the way land is divided for the various farm enterprises.

Mitigation- refers to actions taken, particularly to reduce vulnerability to a certain danger/risk. In this study the greatest danger is food insecurity and poverty.

Needy groups/Vulnerable people - are identified as those living in marginal agricultural areas (ASALs), smallholder agriculturalists, women and women headed households, children, indigenous populations, the landless and urban slum dwellers (Republic of Kenya, 2001; Intergovernmental Panel on Climate Change (IPCC), 2001; UNEP, 2001). In this study, the "vulnerable" dealt with are the smallholders, and a new definition of the vulnerable groups of people is also provided at the end of this thesis.

Poverty - The "poor" are the members of society who are unable to afford basic minimum needs of food, clothing, health, shelter and education. The overall poverty line for rural areas is Ksh. 1239 and Ksh. 2648 for urban areas (Ministry of Finance and Planning, 2000a and b). A new definition of poverty has been provided at the end of the thesis, since the definition above lack data on all the relevant household incomes and expenditures are valued at market rates. Further, only a few households studied had access to remittances and off-farm sources of income. **Absolute poverty line** is the minimum standard required of an individual to fulfil hie or her minimum recommended calorific requirement and basic non-food needs (CBS, 2005).

Risk - is predisposition to a certain danger, in this case, food insecurity and poverty. According to DMCN-UNEP (2004), risk is inclination of a population suffering a disaster.

Service accessibility - relative distance (either as absolute distance (Km) or with respect to time taken) to the nearest named services in the area.

Small-scale/Smallholder farmer - is a farmer whose access to agricultural land ranges between 0.2 and 12 hectares as defined by the Central Bureau of Statistics and the two definitions are assumed to have the same meaning in this thesis. A new group of small-scale farmers has been identified in this research.

Sustainable development- is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development, 1987).

Vulnerability - is the degree of loss that can result from the occurrence of a potentially damaging phenomenon, such as a drought, flood, or famine condition or propensity of damage by hazard and is determined by economic, social and physical context using human populations.

1.10 ORGANIZATION OF CHAPTERS

The first chapter is an introduction to the study topic, its relevance and objectives and hypotheses together with the study limitations. Chapter two contains information on literature reviewed during this study with respect to the relationships between food security and climate, social and economic issues, demography and health, poverty and relevant methodologies. The literature review process led to the identification of research gaps, which were used to justify the research and the theoretical and conceptual models adopted. Chapter three focuses on the characteristics of the study area and deals with the physical, socio-economic and demographic and health characteristics of the study area. Chapter four discusses sources of data and sampling processes, data processing and analytical methods, as well as hypothesis testing, and research limitations.

Chapter five, addresses the issue of Climate and household food security, where the impact of drought and floods on household food security and the results of hypothesis testing between the variables has been provided. Chapter six and seven deals with Socio-economic factors, **I** and **II,** respectively, which influence household food security in Nyando District. Such factors include availability of capital (either as land or cash), labour, technology, environment, government policy and the results of hypothesis testing between household food production and these factors. Chapter eight discusses the influence of demographic and health factors and household food security. This chapter, apart from the results of statistical analysis, also deals with issues touching on household size and age of household head, morbidity and mortality together with information on the impact of the two most important diseases in the study area - HIV/AIDS and Malaria. Chapter nine deals with poverty and household food security. The chapter contains information on the regional aspects of poverty (climatic issues and service accessibility), inter-household poverty (socio-economic and demographic variables), intra-household poverty (gender problems and education), and the results of Principal Component Analysis, Cluster Analysis and Factor Analysis. Chapter ten contains summary of findings, conclusions and recommendations.

CHAPTER 2:

LITERATURE REVIEW

2.1 INTRODUCTION

The chapter brings out the linkages between food security and poverty, in an effort to show how they are inter-related and inter-dependent in space and time. This is followed by an analysis of land use related issues among small-scale farmers (relationships) such as small-scale farming, crops grown, and agricultural production factors. Other areas covered in this literature review include the impact of physical and biological conditions, and the role of government policies on household food security.

2.2 FOOD SECURITY AND POVERTY

Sehmi (1993) and Eicher (1986) apart from stating that satisfaction of hunger is the first priority in terms of household food security, with nutritional issues being secondary, also pointed out that food security is one of the research gaps among other issues in agricultural research. Additional factors alongside food security included the need to carry out research in agriculture and to examine the performance of different development projects in a specified area while examining the constraints in the African agricultural sector and ways of overcoming such bottlenecks in order to improve yields. Other research areas mentioned were: the analysis of capital, credit facilities, agricultural constraints and their influence on maize production, national nutrition and consumption surveys which were shown as inputs into food policy analysis while consumption and nutrition studies were important for food security. Soil fertility, agricultural production constraints to provide the knowledge base for better strategies, programs and projects and water resources were recorded also as important research areas, in an effort to trace the roots of the food security problems linked to failure in policy.

Globally, FAO, 1987; Nana-Sinkam, 1995; UNCTAD, 1996 and UNDP (1997)- Human Development Report) have shown that per capita food production has been falling and household and national food security is at risk in many countries of the world. Projections of food security on a global scale also indicate that by the year 2025, Africa will only be able to feed 40 percent of its population. According to the various sources quoted above, poverty and food security are inter-dependent and inter-related and; both large-scale farms and smallholder/small-scale farm-sectors contribute towards the attainment of food security anywhere in the world. WRI (1996); Pearson and Greenwell (1980); Eicher (1986) and FAO (2001a and b) further stated that over 60 million people face food emergencies throughout the world at any given time due to national disasters/hazards as well as man-made disasters. Thirty percent of the total number of people who live in Eastern Africa (currently 18 million people) face food shortages, thus making it necessary to find ways of dealing with such a major economic and social problem.

The Global Environment Outlook 2000 study carried out jointly by UNEP (UNEP (1999b), FAO, 1996, and the World Resources Institute (WRI, ***et al,*** 1990) noted the inter-relationships between agriculture, poverty and environment. The work stated that over-harvesting of fuelwood contributes to the loss of biological diversity, which is a sign of environmental degradation. It was further observed that, poverty among rural people reinforces any existing trend towards environmental degradation by placing even greater stress on the natural resources. Additional studies noted that, poverty among Africa's poor is both a cause, and a consequence of accelerating soil degradation and declining agricultural activity, and attributed undernourishment in Africa to inaccessibility to food in some regions, uneven food distribution, and inability of the poor to afford food. Poverty line as defined by the World Bank is US $ 420 per capita in 1990 prices. For inter-country comparisons, people live below absolute poverty line if their incomes are under US$ 370 per capita (1985 prices) and, are considered extremely poor if their incomes are below USS 275 in Purchasing Power Parity (PPP). In Kenya, 60 percent of the rural population live below the poverty line, earning and living on less than 1 US dollar a day (USS 1/ day), with per capita income of USS 220 (less than that for Uganda and lower than the Sub-Saharan African average) (WRI, ***et al,*** 1990 and Ministry of Finance and Planning. 2000a and b).

The general decline in food security between 1960s and 1980s, particularly in Sub-Saharan Africa could have contributed to increased severity of poverty in the area. Other factors linked to food insecurity are international policies, which adversely affect the agricultural sector of developing countries. (UNEP. 1995 and 1999; FAO, 1996;

UNDP, 2000a, WRI, ***et al,*** 1996). These studies identified the inter-relationships between food security and poverty and showed that in Sub-Saharan Africa and South Asia, due to the problems of persistent poverty and high population growth, food security problems and undernutrition were relatively intractable. WRI, ***et al,*** (1996) report attributed wellbeing to life expectancy and mortality trends, and noted that food security was a necessity in order to address problems of global increases in human population alongside the required food, water and energy. Energy issues are, therefore, incorporated in the current research in order to examine to what extent it affects food security among smallholder farmers in the study area.

Nationally, Koske, 1999 and Republic of Kenya, 1996(b), itemized bottlenecks to food security in Kenya as follows: urbanization, imbalance between food supply and demand, food aid, food imports, population growth, degradation of the natural environment, and neglect of traditional agriculture, as factors limiting agricultural production. Other obstacles mentioned include minimal production of food crops to meet cash obligations, lack of access to agricultural credit, high costs of inputs, lack of infrastructure and storage facilities, lack of official marketing channels, isolated markets and lack of transport. The studies also noted the need to investigate resource availability in the rural areas that can be used to establish agro-based and allied industries, to enhance food security as food requirements generally exceed supply in Nyando.

The National Development Plan of Kenya (1997-2001); World Bank, 1990; Khaemba, 1992 and Cherongony, 1995) in their various studies showed that Kenya experiences both "transitory food insecurity" (arising from intermittent risks) and "chronic food insecurity" associated with poverty and the continuing inability of many households to meet their food requirements because of lack of purchasing power. These sources estimated that approximately 80 percent of Kenyans live in rural areas and depend on agriculture for livelihood. The two types of food insecurity are experienced in Kenya due to the bad economic situation facing the country resulting from Structural Adjustment Programmes (SAPs) brought about by World Bank and International Monetary Fund (IMF). Further, food security problems which, for along time were assumed to be problems of the low potential agricultural zones, are now increasingly prevalent even in the medium and high potential land areas of the country due to increases in population. Khaemba (1992) concluded that people in the medium potential areas could face temporary food insecurity if steps were not taken to avert the situation.

Sanchez, ***el al,*** (2005) in a study entitled "Halving hunger, it can be done" noted that poor and hungry people often face social and political exclusion as they have little access to education, health services and safe drinking water. The study also recorded that hunger reduction is a major part of poverty strategy as little progress can be made in reducing poverty as long as large numbers of people suffer from malnutrition. Three types of hunger were noted: Acute hunger (starvation that occurs during famines and disasters), Chronic hunger (due to constant or recurring lack of access to food of sufficient quantity and quality, often coupled with poor health and caring practices) and Hidden hunger (caused by lack of essential micro-nutrients - vitamins and minerals).

According to Google (2005a), rural areas in Africa are generally poorer than urban areas with rural women, particularly, women headed households being poorer than the male headed ones in terms of their food security, income, size of land cultivated, together with technology used. Poverty in Kenya is manifested in the form of hunger, illiteracy, lack of access to basic education, and to drinking water, minimum health facilities, and shelter. Nationally, the incidence of poverty in the year 2000 was 51 percent in the rural areas and 38 percent in the urban areas. Overall poverty was highest in Nyanza Province, where Nyando District is found. According to these sources, in Nyando district, between 60 to 70 percent of the population falls below poverty line (Central Bureau of Statistics (CBS), 2000a and b). In the year 2005, the poverty in the rural areas was 31 percent in Central province and 65 percent in Nyanza province, with mean poverty headcount index of 64.6 percent in Nyanza, representing the poorest province in Kenya (CBS, 2005).

2.3 LAND USE

Agricultural production is closely linked to the manner in which land is used. This is important due to its linkages to food deficits, labour and capital (Yotopoulos, 1967; UNEP, 1999b; Shah, 1980 and Republic of Kenya, 1996b). Yotopoulos emphasized in his studies that capital was essential in improving national food security in Less Developed Countries (LDCs). He carried out a detailed analysis of the factors of production (land, labour, capital) in Epirus in Greece by sampling both small-scale and large-scale farms and categorically urged researchers to attempt to account for the complicated interaction between different processes or branches of agricultural production in their production function. Among the issues that were noted as the cause of food deficits, are inequitable land distribution, poor farming methods, unfavourable weather conditions, lack of skilled-man-power, diminishing good agricultural land, falling crop yields, and emphasis on industrial crops at the expense of food crops. In addition, unfavourable land tenure and ownership systems have led to declining productivity on grazing lands, falling crop yields, and diminishing returns from water supplies (Laut, 1968; Yotoupolos, 1976 and UNEP, 1999). The data in the analysis were, farm production of various crops, income, land holding and assets, livestock, occupation, food consumption and expenditure, demography, education and the use of labour, among others, which gives suggestions on the kind of data that are necessary for use in the study of food security. Shah (1980) and Republic of Kenya (1996b) identified a study gap on the prices of various food commodities, including, those which are essential for appreciating the food security situation among rural populations. Some of the producer prices are given in the later chapters of this thesis, although they are not considered as major determinants of household food availability as most households depend on their own household food production.

Several factors (social and economic) influence agriculture such as market (price, distance to markets and cooperative societies/agencies); transport (road and rail), farm incomes, and type of enterprise (cost of inputs, size of farm, cost of returns and presence of livestock in the farm); labour (family and hired labour), mechanization and specialization on particular enterprises (Symons, 1968 and Schultz, 1964). Yotopoulos (1967) suggested that the gross value of agricultural production for each farm (household food crop production) be made the dependent variable, and only land used in crop production be included in production function, when dealing with such issues.

The role of small-scale farmers in agricultural production has been discussed by the United Nations Food and Agriculture Organization (FAO) (1970a; Wilson, 1972 and Egal, 1999) and problems they face were dealt with by Rampel, 1985 and UNEP, 1995. Smallholder food crop producers are heterogeneous with respect to percentage of area under crop, crop production and yield, or to ecological factors, agricultural systems, crop varieties, affliction with disease and pests, and effectiveness of crop processing (Traub, 1987). FAO, 1970a noted the role of smallholder food producers in maintaining food security and commented that subsistence economies which, have existed from the early 1960s could remain persistent temporally. For example, in Africa south of the Sahara, between 1962-1985, 62 percent of the total food consumed was from subsistence production providing 75 percent of the total food supply of the region in terms of calories and about 60 percent in terms of protein. Others are provision of better water supplies, production of traditional crops, provision of subsistence needs and provision of employment. Wilson (1972) also examined the possibilities of controlling the smallholder farm sizes without opposition from the smallholders in order to control further unofficial sub-division. This is because such sub-divisions may result into uneconomical units, or loss of titles, where farmers are not able to pay their debts, as such problems are ultimately linked to food insecurity and poverty.

Rampel (1985) pointed out the existence of a study gap for a system which would curb the concentration of land ownership together with agricultural support system designed to facilitate the advancement of smallholder farmers, in order to maximize yields per hectare. Problems cited by Rampel included land tenure system, food productivity, population pressure, low agricultural production, labour, and the little priority given to investments in agriculture. Additional problems noted includc privatization, degradation of environment and agrarian structures (UNEP, 1995). Among the smallholders, the crops most used are root crops (sweet potatoes, cassava, taro and yams), as well as tropical and subtropical grains (rice, maize and sorghum). In whatever combination, food produced should have the correct nutritional value (Atieno, 1988 and Buliro, 1974). Atieno (1988) identified a study gap in food production and maximization of yield as possible ways of increasing yield per hectare. The study after recommending a balanced diet for all, noted that if adequate balanced diets were to be assured, then the food produced or acquired had to make up the components of a balanced diet.

Kahr (1974) observed that among the crops grown for food, of all cereals (rice, wheat, rye, barley, oats, maize, sorghum and millet), wheat is the most preferred by people due to its special bread-baking properties, while rice forms the basic food for an important part of the human race. In discussing land use and crop varieties globally, FAO (1970b) noted that food security in a country is likely to be disadvantaged if the production of export crops is emphasized, since foreign exchange declines as a country becomes more dependent on export crops (as in many LDCs). The decline is due to the negative effects of this condition on prices. Further, except for limited number of cases, export crops to high-income countries can no longer serve as the same powerful stimulus for growth as in the past, unless, very substantial changes are made in production and trade policies of More Developed Countries (MDCs) to the benefit of Least/Less Developed Countries (LDCs).

Additional studies in Western Kenya on various crop combinations were carried out by Akech (1990), Kennedy (1989) and Obara (1983) in areas including, South Nyanza and Kano Plains of Nyando District respectively. The results showed that the most frequently occurring crops were maize, beans, and sugarcane which, were also the major users of land. In both normal and drought years non-sugarcane farmers grew more sorghum, millet and cassava (crops which were associated more with traditional diets in the region) in order to insure against potential losses of the maize crop in the year during drought episodes. In Kenya, maize has been studied more than any other cereal. For example, Kohlhepp (1986), Rwigema (1990), Cherongony (1995), Gerhart (1974), Ottichilo, ***et al,*** (1990), Ngugi (1987), Frohberg, ***et al,*** (1980), Odingo (1979), Burton (1932), Simango (1976), and Kariungi (1976) among others. These authors studied maize with respect to its ecological requirements, socio-economic problems, nutritional value and growth during the different phenological stages. The persistent problems of maize as noted by the Ministry of Agriculture (1969) over the decades despite the policy changes between 1969 to 1999 imply that Kenya can no longer rely on a single crop for food security. On the other hand, Kenya Economic Survey Report (1996a) while considering the spatial distribution pattern of both subsistence and cash crops, (maize, millet and pulses-peas, green grams, and beans) indicated that in recent years, food crops have received greater emphasis among the small-scale farmers throughout the country. Crops observations should be carried out comparatively when seeking to determine labour constraints and opportunity costs in terms of the neglect of competing crops (Okai, 1972).

As far as technology and land use are concerned, Natarajan, ***el al***, 1984; Traub, 1987; Brandt, 1985 and Laut, 1968 discussed land use and technology, and identified three areas which arc useful to this study, particularly among small-scale farmers. These are improved crop varieties, use of animate and inanimate machines, and fertilizers. They pointed out the existence of a study gap in the coordination of agricultural food technology and nutrition needs in the evolution of food grain varieties. Such varieties should possess the best possible attributes of production, utilization and nutrition as this interaction between technology, and nutrition plays a vital role in the food system. A research gap was pointed out in relation to market structure, estimates of food supplies, as well as demand for addressing declining food production levels in Black Africa. Other observations were that the current technologies in the production of new seeds faced certain limitations such as the high susceptibility of the final products to drought, pests, diseases and high demands on type of storage techniques adopted and recommendation was made for farmers to store food reserves.

The role of gender may also influence land use, as women must also carry out other duties besides farming. In Kenya, Pohl (2002) commented on the role played by women in acquiring energy, and noted that the demand for energy led to Kenyan women walking long distances while carrying heavy loads of firewood. Pohl also noted that on the outskirts of Nairobi, women walked upto 5 miles (8 kilometres) with a load weighing almost 65 pounds (30 kilogrammes (Kg)) on their head in order to reach the market and sell firewood. In western Kenya, such long journeys together with firewood gathering could take up to 8 hours on each occasion, thereby bringing a stiff competition between energy demand and food crop production requirement.

2.4 ECOLOGICAL FACTORS

The role of ecological factors in food security can be seen in the work of Miller (1974), and Ogallo, ***el al,*** (2003) who explained how ecological factors influence both agronomic activities together with socio-economic factors and which, impact upon household food security in an area. According to Ogallo, ***el al*** (2003) study in Uganda, climatic factors, realized as wet and dry spells (or floods and droughts), greatly influence agricultural production, and hence household food crop production. For example, these factors impact upon the availability of water for agricultural use, the spatial and temporal patterns of the spells, and the day to day agricultural activities (ploughing, planting, weeding, and fertilizer applications among others). Additional problems include water and wind erosion, grazing and farming patterns, and the occurrence and spread of many diseases and pests.

Weather, in particular, affects crops at various stages of their biological cycle and remain a factor throughout the entire production process, with extreme events (droughts and floods) resulting into food crop supply upheavals. Some of the floods and droughts that have created havoc include those related to short-term climate anomalies in East and Central Africa (Parry, 1988), and the recent Katrina hurricane, which flooded many cities and affected many areas in the southern United States of America, leading to 1100 human deaths, displacement of over 1 million people, and budgeted at US Dollar 200 billion (Google, 2005c).

Excess rainfall received in uplands and deficits in lowlands has contributed to flooding in some areas and drought in others. Some parts of the world therefore, receive more precipitation compared to others, so that crop developments are well adjusted to the seasonal rainy and drought episodes (Riehl, 1978; Griffiths, 1966; Chang', 1966 and Billings, 1970). While water loss normally takes place through evapotranspiration (Riehl, 1978; Chang', 1966; Billings, 1970; and Griffiths, 1966), above normal rainfall is associated with many floods. Such floods interrupt economic activities and create favourable crop disease environments, due to unplanned expansion of human settlements, and inadequate investment in basic agriculture without proper land use policy.

On the other hand, temperature, which is closely related to the partitioning of the earth's atmosphere into troposphere, stratosphere, mesospherc and thermosphcre, and the diurnal temperature changes has been studied (Riehl, 1978; Barry, ***el al,*** 1982; Allee, ***et al,*** 1951). Of great importance is the absolute temperature, which governs the speed of biological processes and physical reactions and heat loss through radiation. The relative temperature on organisms indicates the direction and rate of heat loss by other processes, such as conduction (Billings, 1970; and Griffiths, 1966).

Globally, the Intergovernmental Panel on Climate Change (IPCC) (2001) - a global institution responsible for assessing the research on the potential impacts of climate change, including various ecological and socio-economic aspects of agriculture, has had occasion to comment extensively on issues of food security. Studies by the IPCC established that, in terms of agriculture and food security globally, climate variability and climate change would impact upon crop yields, soil fertility and water resources as well as food prices. Recent aggregate studies also estimated, that the economic impacts on populations such as smallholder producers, and poor urban consumers, would result in lowering the incomes of vulnerable populations, as well as increasing the absolute number of people at risk of hunger. The study by IPCC underlined the importance of research in the area of food security, especially among the vulnerable groups such as smallholder farmers, who constitute a large percentage of the populations of the developing countries.

According to Camberlin, ***et al*** (2003), in much of the equatorial eastern Africa, with the exception of some high land areas close to Lake Victoria, most precipitation falls within two rainy seasons, the long-rains (March to May) and the short-rains (October to December). Each season coincides with the passage of the Inter-Tropical Convergence Zone (ITCZ), when it migrates from the Southern to the Northern Hemisphere and vice versa. Camberlin, ***et al*** (2003) also noted that in Kenya, 72 percent of the country receives less than 300mm of rainfall on average during the March-May rainy season. In this context, any fluctuations in the total rainfall amount, the inter-seasonal distribution of the rains, or the onset and termination of the season, may be difficult for farmers not only for the country, but also for the entire East African region.

Terramura (1986) and Titus, ***et al*** (1986) wrote on maize, wheat and rice together with additional effects of environmental degradation on food crop production. These studies pointed out a research gap on the impacts of global warming on crops such as maize among the developing countries, as the effects of global warming would be felt on both human health, and biodiversity. It was also noted that while commercial farmers were concerned about the impacts of future climate change on average conditions and average yields, smallholder farmers would be more concerned with changes in the probability of a severe drought that causes complete crop failure. These authors emphasized the importance of rice, wheat, and corn (maize group) among other edible plants as only 15 species of the 80,000 edible plants, which supply most of the food calories and three quarters of the protein to the world's population. Rice, wheat, and Maize supplied two-thirds of these calories and one-half of the protein.

The United Nations Convention to Combat Desertification (CCD)(1999) and the Climate Change Secretariat (UNFCCC) (1999a) underlined the fact that rainfall reliability (drought) has great influence on food security problems, poverty, and migration. The CCD (1999) proposed an integrated approach in addressing the physical, biological and socio-economic aspects of the processes of drought integrated with poverty eradication strategies to ensure food security, and recommended the incorporation of gender in such studies.

FAO (1982b) observed that in many areas, rainfall is not only insufficient but also highly erratic in pattern. Effective rainfall is further decreased in some areas by high rates of evapotranspiration. In these conditions droughts start gradually with below-normal rainfall for one or two years and this is followed by even a complete year without rain, in the right season. Such occurrences are usually enough for famine to set in. as food reserves are exhausted and no new crops are grown.

Drought affects both food and cash crops in areas where agriculture is practiced and therefore it contributes to the threat or occurrence of famine, (FAO, 1982b). Other effects of drought include reduced demand for non-food items in the shops as people spend most of their disposable income on food; the employing households in the informal sector minimize their obligations, and the destitutes become more dependent on wealthy households (Silitshena, 1987). Small-scale farmers cope with drought problems through purchase of food if available, sale of livestock and reliance on kinship ties to tide them over the difficult period. The poor households without cattle and those not cultivating their own land are most affected and when individual households cannot produce enough food for themselves, they can least afford to purchase from elsewhere (Odingo, 1987).

More intense rainfall could exacerbate flooding and soil erosion (Parry, 1990). According to Drought Monitoring Centre in Nairobi (DMCN)-UNEP (2004) report, flood prone areas of western Kenya are located around Lake Victoria Basin and cover an area of about 47,709 Km^2. The basin is made up of eight (8) catchments associated with rivers, Sio, Nzoia, Yala, Nyando, Sondu, Sondu-Miriu, Mara and Wenzao. According to this report the worst flooding cases usually occur at the mouths of most of these rivers, especially during the rainy season thus, causing damage to crops, livestock, infrastructure and human settlement. Nzoia and Nyando rivers are said to pose the greatest danger in that they drain very large low-lying plains that are also heavily populated before entering the Lake. Frequent flooding turn large shore lands into permanent swamps while also retarding development in the affected areas, as the populations affected must move out and leave their development activities for some time while they await floods to recede. The study area in Nyando District covers some of the flood prone areas under discussion.

Nyaranga (2002) and material included in the National Development Plan of Kenya (1997-2002) underlined the influence of rainfall, rainfall reliability and distribution on smallholder agricultural production in Nyanza Province, which are fundamental to understanding food security in the proposed area of study. Nyaranga attributed rampant poverty of the people in the area to adverse weather conditions (drought and floods). According to these reports, the Nyando Valley due to structure of the floor of the Nyanza Rift Valley is vulnerable to flooding by heavy rains some of which originates in the highland catchments, with the low lying areas forming a trough of low rainfall and poor rainfall reliability. He, therefore, called for urgent measures to check the menace of these floods and also pointed out the need to promote horticultural production using irrigation from the Lake Victoria waters.

Intensive agricultural production could be a threat to food security due to its link with soil erosion, ground water contamination, soil compaction and decline of natural fertility as well as destruction of traditional social systems (Fisher, ***el al,*** 1996). The World Resources Institute (WRI) (1996), Batiwala (1995), European Union (EU) and UNDP (1999) and EU and UNDP (2000a), UNEP (1987), WRI, ***el al,*** (1990), Eicher (1986) and FAO (1970b) have all suggested that although agricultural production is essential for attaining food security, its contribution to environmental degradation should be checked. WRI (1990), Eicher (1986) and FAO (1970b) recorded the effects of agricultural production on the biological diversity within the different types of environments-forests, rangelands, wetlands and other ecologically and economically fragile ecosystems. This is because cropland expansion would always be at the expense of rangelands, forests, wetlands and other areas that were both economically important and ecologically fragile. The studies pointed out a study gap on the influence of Desertification, salinization, water logging and soil erosion, on cropland. They recommended energy use in agricultural production due to its positive role in food production and employment generation which together impact positively on food security.

2.5 DEMOGRAPHIC AND HEALTH ISSUES

Sai (1997) and Olusanya (1985) noted that the total population, its distribution by age and sex, and the rate at which the population is expanding are essential in determining needs. This total population according to Thomas (1980) changes by the addition of births or in-migrants and the subtraction of deaths and out-migration. These researchers recorded that, since the end of the second-world war Africa's population has grown rapidly as a result of declining mortality. Olusanya estimated that by the end of the twentieth century, the Africa's population would have reached one billion.

CBS (2001a and b), and Jeffers (1978) stated that Kenya's greatest resource is her people. They further recorded that the absence of disease, illness and impairment is a necessary prerequisite for human wellbeing and the ability to perform productively on the job, in school and in the home. In Kenya, during the 1999 Census, a total of 28,686,607 people were enumerated and this revealed an increase of thirty-four (34) percent over the 1989 enumerated figure. Of this, 14,205,589 were males and 14,481,018 were females. According to the Ministry of Finance and Planning of Kenya, the country's population structure comprises a very high proportion of young people, where about 56 percent of the total population, is below 20 years. This population requires high annual investment in the social sectors on the basis of its structure, notably education and health, just to maintain minimum acceptable living standards. The highest level of education reached by most of the poor was primary school (63.1 percent) with majority of the poor depending largely on buying drugs from pharmacies or visiting public dispensaries when they fall sick. On the other hand, the non-poor households visit private doctors and dispensaries, hence affordability, illness and distance to the nearest medical facilities are the most crucial factors among the rural poor. However, rising human population should not be treated as a curse, for example, Ayiemba (2003) has clearly stated that human aggregate numbers could be changed into a resource on the basis of declining fertility in order to achieve sustainable development.

According to Ghansan (1972), Juma (1985) and CBS, ***et al***, (2004), health conditions within any country vary a great deal depending on the country's ecological and climatic conditions, socio-economic conditions, people's lifestyles, demographic parameters, environmental sanitation, nutritional status and other related factors. Further, the growth patterns of healthy and well-fed children are reflected in positive changes in their height and weight. These researchers emphasized that inadequate food supply, among other factors often leads to malnutrition, resulting in serious consequences on the physical and mental health and development of children. Ghansan (1972) recorded that apart from the quantitative aspects of family planning, qualitative aspects which mean more to an individual in the short run and to the nation in the long run, should educate people about the benefits of the programme and not to force them.

According to Njagi, ***et al*** (2004), Acquired Immune Deficiency Syndrome (AIDS) is caused by Human Immuno-Deficiency Virus (HIV) that weakens the immune system, making the body susceptible to, and unable to recover from other opportunistic diseases that lead to death through these secondary infections. HIV/AIDS is a serious public health and socio-economic problem in many countries around the world. The study noted that the most affected countries are found in Sub-Saharan Africa, especially those located in eastern, central and southern parts of the continent.

Paul (2004) reporting on a study by FAO on AIDS recorded that AIDS is not only a scourge that has been leading to an outburst of mortality in Africa (eight million persons killed within 15 years), but it carries serious consequences for food security and the breakdown of the social fabric. The disease is said to affect 26 percent of farm workers in Namibia, 23 percent in Botswana, 20 percent in Mozambique and 17 percent in Kenya. It contributes to increasing vulnerability of households by ruining their capacity for production in countries enduring food insecurity. The ill persons progressively become unable to work and even to communicate.

Republic of Kenya (2001a) recorded that close to 70 percent of people with HIV/AIDS live in Sub-Saharan Africa and the developing countries of Asia. It was also documented that HIV/AIDS is the second most serious development threat facing Africa after armed conflict. Kenya ranks among the highly affected countries in Africa with over 2.2 million people infected (about 16 percent of adult population). Peak ages of HIV/AIDS in Kenya are 25 to 29 for females and 30 to 34 for males. It was recorded that the total cost of AIDS to the country reached Ksh. 2 billion in the year 2000 and was projected to reach about Ksh. 5.5 billion by the year 2005.

According to Ogora (2004), the high levels of poverty and numbers of orphans out of HIV/AIDS related deaths are forcing minors to take early responsibilities of fending for their families. Ogora reported that children of school going ages were actively involved in providing cheap labour in rice plantations in Ahero and west Kano irrigation schemes during planting and harvesting.

As far as Malaria is concerned Njagi, ***el al*** (2004), noted that Malaria affects 20 million Kenyans annually. It is also estimated that children under five years of age die from direct consequences of Malaria infection. Further, pregnant women suffer severe aneamia and have a high likelihood of delivering infants with low birth weight. Many Kenyan households are affected by the financial hardships caused by malaria. Geographical differences in altitude, rainfall and humidity, all influence the malaria transmission patterns as they determine vector densities and intensity of biting by malarial mosquitoes. According to this study, Kenya is divided into four malaria ecozones, namely Stable malaria-Nyanza, Coast and Western provinces; Seasonal malaria - Central, Eastern and North Eastern provinces; Highlands prone to malaria epidemics - mainly in Rift valley province and some parts of Nyanza province; and Malaria free -Nairobi and some parts of Central province. Nyando district of Nyanza falls within the stable malaria ecozone, which makes the disease important in the current study on food security.

2.6 PREVIOUS FOOD SECURITY AND POVERTY SURVEYS

The purpose for conducting farm-related surveys differs from one researcher to another. For example, data on crop acreages and production assists farmers and other stakeholders in the pricing and marketing of the Final products and further ensuring stability on acreages planted and production as recorded by Ryerson, ***et al,*** (1979). Such sampling surveys produced data that could be projected to suit a large area, particularly, where it was impossible to study the entire population as also noted by Cruickshank, ***el al,*** (1970). In addition, when carrying out sampling surveys, errors were encountered by Maher, ***et al,*** (1980) who recorded that such errors were beyond the control of the researcher and could originate from the omission of certain variables or methodology adopted due to the assumptions of the models. Maher, ***et al*** (1980) experienced these errors in their research where they used LANDSAT Multi-Spectral Imagery for purposes of resource management. In addition to Remote Sensing techniques on agricultural study, Ryerson, ***et al*** (1979) also used Principal investigator approach, with student assistants, in order to collect information on crop type, most recent farm operation, weed coverage, crop colour, stage of growth, crop height, percent ground cover, and soil moisture conditions.

Hyde, ***et al,*** (1974) also observed a major research limitation as the inability to acquire the necessary data due to unavoidable circumstances in the process of data collection while studying crop competition in terms of land use. Hyde, ***et al*** (1974) noted data gaps on crop hectarages or production due to the existing inconsistencies in the available data together with continuous changes within the district boundaries. Additional observations by Hyde, ***et al*** showed that crop patterns like other geographical distributions were highly dynamic, leading him to use the index of concentration. A form of dualistic structure (referred to as primary and secondary zones of concentration) was distinguished - namely, the core and periphery areas respectively. This is to say that the zones of concentration of each crop overlap to a considerable degree and therefore it is unrealistic to apportion an area to one or other "staple food crop zone". The "intermediate zone" is, as a result, identified as a zone with several food crops, which make an important contribution to the total agricultural land use. This type of scenario is difficult to distinguish among the smallholder farmers, as previous studies within the study area noted the existence of inter-cropping.

Land cover analysis and crop inventories, as part of the studies in agricultural activity, have been carried out using Geographical Information Systems (GIS) and Remote Sensing methods in addition to other computer software packages (Maher ***el al*** 1980; Ryerson ***el al,*** 1979). Republic of Kenya, 1996 also applied concentration indices to examine crop concentration or inequalities in certain areas. Investigations on capital accumulation within farms have been done using Regression Analysis techniques, Linear Cobb-Douglas Functions and Input-Output models (Oluoko, 1999; Brandt, 1985; and Atieno, 1988). These investigations concentrate mainly on production/consumption patterns as well as savings, since capital is essential in financing the farming enterprises. The inter-dependence between capital and labour issues has led various scholars to handle them jointly. Other studies concentrated on population factors (particularly tradition), political situation, disease patterns, mortality and fertility, migration and gender which all influence the agricultural output leading to problems of malnutrition, hunger, disease and poverty (Elamass, 1997; Oluoko, 1995; Seckler, 1984; Blankhart, 1974; and Gerhart, 1974).

As far as poverty is concerned, various limitations have been isolated concerning the methodologies used in the analysis, for example, the use of calories and income levels as a measure of levels of poverty were found to provide inaccurate results as explained below. Sehmi (1993) recorded that proteins, fats and carbohydrates are normally burnt or oxidized in the body to provide the energy for the various activities of life and are often termed the "proximate principles", and together with water, form the main bulk of the foods. This means that the calorie, as an indicator of food-poverty may not be accurate as non-poor households who may have access to both protein and carbohydrates in their households may choose to eat inadequate amounts of food (due to certain reasons), and therefore, may still appear as food poor households. A geographical study, like the current research, is therefore required, at the grass-root level so that any ideas concerning food security are assessed, and the government merely required to provide resources according to the demand of each area, such as Nyando District. Similarly, the use of income levels may lead to misleading results as household food production is not always available in cash, while producer prices also vary in space and time. Therefore, it is not possible to give monetary values to all foods consumed within a household. On the basis of the above shortcomings, the current study has opted to using both household incomes and food production, particularly, cereals which form the bulk of the diet in the country and therefore, in Nyando District.

Secondly, when dealing with household food security, the emphasis should be laid upon the minimum food an individual household requires as almost all foods (proteins and carbohydrates in nature) contain all the required nutrients in varying proportions. This makes the issue of nutritional value of food or quality, secondary to food insecurity solutions. Thirdly, according to Sehmi (1993), food should supply numerous essential elements in adequate quantities to sustain life, as without it life cannot exist (or death prevails, which is the opposite of the origin). This means that even the food types that have been given little priority such as wild-fruits and wildlife, among others, could form major parts of food requirements in individual households. As in Kenya, unfortunately, some of the best agricultural lands are used for growing inedible flowers when many are dying of hunger. The two variables (household incomes and household food production levels) were, therefore, found to be extremely important if lasting solutions were to be found concerning food security problems (food insecurity).

According to the Basic Needs Approaches, certain minimum levels of private consumption are required like food, clothing, shelter, access to essential public services such as clean water, sanitation, public transport, and health and education facilities. Scholars (Sandrook, 1982, Ofosu, 1991, Kekovole, 199land ILO, 1972) have suggested that the approach should be aimed at achieving specific minimum standards of living among the poorest groups of the society. The Basic needs approach is one of the integrated approaches, which are considered to be of primary importance to development through employment creation, improved management of human resources, financial resources, and regional balance. Other factors include expansion in agricultural and industrial production, preservation and development of natural resources and improvement of public welfare. The sectors proposed for action include food security, health, education, water, housing, and transport and telecommunications.

Recently, the effects of anthropogenic activities (in the process of agricultural production) were noted to adversely affect the environmental system resulting in international forums directed at addressing the arising challenges. These challenges are: high energy demands, diminishing agricultural lands, food insecurity, environmental degradation, poverty and climate variability as well as climate change which affect the globe (IPCC, 2001; and UNEP, 2001 among others). These issues are discussed in many United Nations Conventions with minimal studies carried out at the micro-scale level. The Conventions emphasize the use of a systems approach in any analysis in order to encourage sustainable development. For example, Bohle, ***et al*** (1993) recommended the adoption of a system's approach to study vulnerability of certain disadvantaged groups to food crises. Oluoko (1999) also used this approach, where a purposive random sample of 80 smallholders was drawn from the population to study socio-economic problems of smallholder farmers. The study used techniques such as Analysis of Variance (ANOVA) and Multiple Regression (Stepwise and Enter methods) in the analysis. The proposed study will attempt to examine these current problems at micro-scale level among the vulnerable people. The above surveys discussed differ in design, purpose and methodology and, rely mostly on the decisions made by the researcher. Multivariate Statistical Techniques have, therefore, been used in this present study with measurements being carried out at all levels (nominal, Ordinal, interval and ratio scales) where applicable.

2.6.1 The Existing Climatic data and the Adopted Methodology

The influence of rainfall reliability on food security, poverty and human dynamics/migrations has been studied before (Climate Change Secretariat, 1999a), where poor rainfall reliability as a climatic factor was manifested either as drought/dry spells or floods/wet seasons (Miller, 1974 and Ogallo, 2003). By studying various seasons (months of rainfall occurrence/fluctuations), it was established that rainfall fluctuations, which affect total expected amounts of precipitation (inter-seasonal distribution of rains or the onset and termination of the season) expose farmers to food insecurity and poverty (Camberlin, ***et al,*** 2003). Further several studies have confirmed that the small-scale farmers/smallholder households among other poor households are the most affected (FAO, 1970a, Wilson, 1992, Egal, 1999, Traub, 1987, Rampel, 1985 and Nyaranga, **2002).**

As periods of droughts and floods result into depletion of food reserves (FAO, 1982), almost all the available resources are converted to food purchases among poor households (Silitshena, 1987). Minimal or no resources are, therefore, available to other basic needs of health, clothing, shelter, education and other livelihoods (Ofosu, 1991, Sandbrook, 1982 and WRI, ***el al,*** 1996). The severity of drought and flood episodes also impact differently on various crops, particularly, cereals, which supply two-thirds (2/3), and one-half (1/2) of the world's calories and proteins, respectively (Terramura, 1986 and Titus, ***el al,*** 1986). The Intergovernmental Panel on Climate Change (IPCC) (2001) recently recommended that in order to find lasting solutions to food insecurity, a systems approach that encompasses the climatic, socio-economic, demographic and health factors, together with relationships and inter-relationships is needed.

Some of the data dealt with by the scholars above included availability of water for agricultural use and agronomic practices (ploughing, planting, weeding, and fertilizer application, among others), in addition to spatial and temporal patterns of dry and wet spells. Other issues were emerging problems from the spells (water and wind erosion, grazing and farming patterns, and occurrence and spread of pests and diseases), crop yields, soil fertility, food prices and income levels, and the relationship between crop (cereals) failure and crop varieties. The above section has, therefore, justified the type of data collected and put in the analysis (in accordance with the first research objective and hypothesis), which form the basis for discussions in chapter four (4) of this thesis. Among the variables dealt with include, relationships between household food crop production and duration of droughts and floods, crop combinations and famine crops within different seasons. Additional issues are vulnerability to drought/floods, human dynamics and coping strategies.

In terms of methodology, issues relating to data collection on crop patterns, land covcr analysis and crop inventories used Regression and Correlation Analysis (Simple or Multiple), Input -output models or Linear Cobb-Douglas Functions, and the use of each method depends on data available and research interest (Maher, ***el al,*** 1980, Republic of Kenya, 1996, Oluoko, 1995, Brandt, 1985, Elamass, 1997, Oluoko, 1999, Seckler, 1984, Blankhart, 1974 and Atieno, 1988). A similar approach is used to incorporate data on production and consumption in space and time to the ones on drought and floods to enable joint analysis.

2.6.2 The Existing Socio-economic data and the Adopted Methodology

The relationships between land, labour and capital among small-scale/smallholder households had previously been studied (Yotopoulos, 1967, Symons, 1968. and Ruthenberg, 1980), while Sehmi (1993) and Eicher (1986) dealt with nutrition and household consumption related issues. These studies were carried out using data on performance of different projects in space and time, constraints to and reasons for such constraints on agriculture, together with ways of overcoming the bottlenecks. Additional data included the analysis of capital/credit facilities, influence of agricultural constraints on crop production, food policy, soil fertility, production and water availability.

Comparative analysis of lack of purchasing power among households and food security within the medium and high potential areas was studied by Republic of Kenya, 1996a, World Bank, 1990, Khaemba, 1992 and Cherongony, 1995. On the other hand. Sanchez, ***et al,*** (2005) discussed vulnerability to social and political exclusion due to minimal access to education, health services and drinking water. Data relating to famines, disasters, accessibility to food (in terms of quantity and quality) and health care was used. Poverty and its manifestations together with gender have been studied (Google, 2005b and Central Bureau of Statistics (CBS), 2000a and b), and the data used included income levels, farm sizes, technology, household food deficits, illiteracy/lack of access to basic education and drinking water, minimum health facilities and shelter. Terms like overall poverty line, absolute and relative poverty were elaborated on.

Monke, ***et al,*** (1989) used data relating to rate and pattern of economic growth, when dealing with government policy and stressed that food security, which is linked to staple food supplies, self-reliance, surplus generation (in terms of food and income), and markets or food prices in space and time must be part of any government policy. While Werner, ***et al,*** (1993) discussed decisions affecting small-scale farming households, the need to find law enforcement mechanisms to deal with food security issues was suggested by Metzer, 1981. On the other hand, Onchere (1999) and CBS (1996) having recommended that per capita incomes be made central in planning and implementation of the national policy, Dache (1989) and CBS **(1996b)** stated clearly that population data (household size, structure, and dynamics) must be added to such studies due to close relationship between population growth and food security. Apart from the GDP/GNP figures, additional data mentioned by the above studies comprise food security monitoring surveys, food shortages, imports, research and extension services, agricultural financing, veterinary services, environmental conservation, seed varieties and planting multiplication. Others are technology, agricultural trade (market prices, capital and infrastructure), processing/industry/energy, and land development/preparation and use.

On this basis, chapter five **(5)** has dealt with different data dealing with these issues of land, labour and capital such as farming systems/operations, sizes, production, consumption, surplus, yield and farm expenditures (Land availability characteristics, man-hours of work, and cost (labour), and crop sales, income from off-farm employment, distance to the nearest market, and banking centre (capital), and other livelihoods (energy source, clean source of water and primary schools). As agricultural production is very closely related to climate variability, the relationship between socio-economic factors and climate were discussed using information on land preparation by season, cost of renting/leasing (and leasing period) land, presence of livestock in the farm, cost of veterinary services, crop varieties and methods of tilling the land, wealth index and government policy, as stated in chapter **5** and **6** of this thesis.

As far as the methodologies used are concerned, Hyde, ***et al,*** (1974) studied land use through primary data collections (direct observations and interviews), while Ryerson, ***el al,*** (1979) used remote sensing and Geographic Information Systems (GIS) to deal with crop inventories and land cover analysis. The issues concerning labour (in terms of time spent on work per day/man-hours, were discussed by Palmer-Jones (1974) in establishing the profitability of the tea industry. In order to incorporate the physical factors into the analysis of socio-economic factors, Obara (1983) used the method to discuss cotton yields and constraints/problems. During the studies above, stratified random sampling methods were used to collect primary data on farms in order to establish even their profitability (Obara, 1983, and Cruickshank, ***et al,*** 1970).

2.6.3 The Existing Demographic and Health Data and the Adopted Methodology

Studies concerning the linkages between population and human resources and environment and development exist (World Commission on Environment and Development (WCED) (1987)), while issues related to sustainable development and demographic factors have also been examined (Ghansan, 1972; CBS, ***el al,*** 2004; Ayiemba, 2003; Juma, 1985; JefTers, 1978; Ministry of Finance and Planning, 2000b; and CBS, 2001). These authors integrated food security and poverty variables with the physical and socio-economic environmental factors together with demographic and health parameters. The data used included ecological and climatic data (disease, pests, weather and soil), socio-economic issues (people's lifestyles, environmental sanitation, nutritional status, food demand and supply), and demographic and health factors (population growth rates, and demand of services).

Sai (1987) and Olusanya (1985) linked the distribution of human populations by age and sex as the major determinant of needs in space and time. The relationship between food crop production and mortality and life-expectancy, particularly dealing with data relating to infant, child and crude death rates, life-expectancy at birth, nutrition, provision of medical services and food distribution networks was established (Suda (1991), Muganzi (1991), WRI, ***el al,*** (1996), Caldwell, ***el al,*** (1984). PSR1 (1990) and Ayiemba (2003) discussed population issues as structures and processes, while the reasons behind high population growth rates have also been studied (Okumu, 1991, Khasiani, 1991, PSRI, 1990, and Muganzi, 1991). The data used included birth and death rates, age and sex, migration, fertility, mortality and morbidity. While the attainment of food security is linked to provision of basic needs (Muganzi, 1991), the relationship between fertility, education, gender and household food crop production was also established (Suda, 1991; Thomas, 1980: Okumu, 1991; Ayiemba, 2003; Oduor-Otieno, 1991; and Khasiani, 1991). The data used related to basic needs (food, clothing, shelter, health care, and water supply), man-hours of farm work per day, food production levels, education, gender, household size and health. Other data included the number of children per woman and age of onset of child bearing, and agricultural labour, together with the quality and quantity of the labour. Studies also exist concerning issues relating to vulnerability to diseases, particularly, HIV/AIDS and Malaria (Ghasan, 1972; Juma. 1985; CBS, ***el al,*** 2004; Njagi, ***el al,*** 2004; Paul, 2004; Republic of Kenya, 2001a, and Ogora, 2004)

There is information also concerning the need to integrate demographic and health factors with socio-economic factors for planning purposes (Mbithi, 1991), and other issues (population pressure on agricultural lands and inter-linkages between fertility, household consumption and savings, and food security problems like famine) (Okumu, 1991; Khasiani, 1991; PSRI, 1990; Baldwin, 1975; and Sinha, ***et al,*** 1988). The data comprised of those relating to population structures and processes, health provision, political structure and government policy, production techniques and transportation of products. Additional data included shifts in the level of monetization of the economy, education levels, degradation of ecosystems, employment levels and opportunities, economic activities, gender and food availability.

Further, the linkages between migration, population growth and agricultural production were studied (Beaujeu-Gamier, 1978; Guery, du, 1978; Thomas, 1980; Khasiani, 1991; and PSRI, 1990). The data were concerned with the colonial history and agriculture, land tenure systems, human dynamics from and to agricultural regions, urbanization, distribution of natural resources and services, capital and employment opportunities. Additional variables included on going agricultural activities, labour, human morbidity and mortality, health care/life-expectancy, feeding habits, income levels, poverty, food distribution and malnutrition.

Other authors discussed issues relating to economic growth, income levels, labour, provision of basic needs and population factors (Ghansan, 1972; Juma, 1985; CBS, ***et al,*** 2004; and Mellor, ***et al,*** 1987). The data dealt with included dietary systems, family planning programs, household size, education and other livelihoods, capital, labour and farm inputs, government policy, basic needs (food, shelter, clothing, health care and water supply), household fertility, consumption and savings, economic activities and gender. Additional information exists concerning the relationship between population growth, labour availability and economic wellbeing (Ruthemberg, 1980; and Muganzi, 1991). The necessary data included population structure variables (size, distribution and biological composition), processes variables (fertility, morbidity, mortality and migration), with a System's Approach being proposed for such studies.

On this basis, the current study has used data relating to population structures (age and biological composition of household heads), and processes (morbidity, mortality and migration). Other data, for example those concerned with household size, indicate the current and future trends in population growth rates in space and time. Since these demographic and health factors are part and parcel of socio-economic factors, the previous statistical analytical techniques discussed for the socio-economic factors hold, and as elaborated in chapter 7 of this thesis.

2.6.4 The Existing data on Food Security and Poverty and the Adopted Methodology

The information concerning the role of agriculture in national development can be traced (Atieno, 1988), while data dealing with definitions of poverty are documented (Republic of Kenya, 2001a, Tiffen, ***et al***, 1994, Batiwalla, 1994, Ofosu, 1991, and Sandbrook, 1982) together with information relating to origin, indicators, and causes of poverty (James, 1982; Editors of Life, ***et al,*** 1961, Sanchez, ***et al,*** 2005; WRI, ***et al,*** 1996; Ofuso, 1991; WCED, 1987; Kekovole, 1991; Tiffen, ***et al,*** 1994; Batiwalla, 1994; and G8, 2005). The main type of data used is normally Gross National Product or Gross Domestic Product, per capita incomes and purchasing power parity.

Relationships between environmental factors (physical factors-climate, geomorphology and geology, biological factors-flora and fauna, socio-economic factors-effects of human activities on the natural environment) and food security and poverty are documented (Chang', 1969, Oluoko, 1996, Obara, 1986, Kokwaro, ***et al,*** 1998 and Kokwaro, 1972). In these studies a System's Approach was used (Obara. 1986, Oluoko, 1999, Ruthenberg, 1980, UNEP, 1995; IPCC, 2001 and Billings, 1966). The data dealt with were soils, insects, pests, diseases, relief and climate (temperature, moisture, sunlight, winds and evapotranspiration), infrastructure facilities (transport and marketing systems, urban development, and levels of industrialization). Other data comprised of vulnerability to food insecurity and poverty, land degradation, loss of biodiversity, pollution, energy sources and types, household incomes, crop production and availability of agricultural inputs. Additional studies exist on the linkages between climatic variability, loss of biodiversity, and land degradation and food security and poverty (Ogallo, 1989; Ogallo, ***et al,*** 1993; World Bank, 1997 and Billings, 1966). Further, there is adequate information regarding the relationships between crop production and abundance or scarcity of water, environment and crop yields (Billings, 1970; Griffiths, 1966; and Riehl, 1978), together with issues concerning rainfall amounts to crop production and yields (DMCN-UNEP, 2004).

Studies concerning the improvement of food security (socio-economic and demographic and health factors) are many (Republic of Kenya, 1996a; World Bank, 1989; Khacmba, 1992; and Cherongony, 1995), with other information on vulnerability to poverty and gender (Sanchez, ***el al,*** 2005 and Ministry of Finance and Planning 2000a and b). Some of the indicators of poverty used were variations in per capita incomes, life expectancy rates, imports and exports, GDP and GNP (for inter-country comparisons). Additional parameters included vulnerability to crises and hazards (like droughts and floods), insecure rights to land and other natural resources, inability to store produce after harvest, environmental degradation, and lack of stored surplus grain or cash. Other data used included lack or low levels of education, inadequate health care services, nutritional and income levels, employment opportunities, quality of shelter, disaster preparedness, quantity and quality of labour, and social inequity.

In addition to those methodologies used to handle climatic, socio-economic and demographic and health factors, Principal component Analysis, Factor Analysis, and Cluster Analysis have been applied (Dache, 1989; Harris, 1975; Camberlin, ***el al,*** 2003; Akech, 1990; Henshall, 1966a and 1996b; Hartigan, 1975; Google, 2005a and b; Anderberg, 1973; Mclain, ***et al,*** 1985 and Klastorin, 1983). Principal Component Analysis was used to study spatial and temporal characteristics of rainfall (Camberlin, ***el al,*** 2003), while Factor analysis was used to reduce the number of variables (Akech, 1990 and Henshall, 1966a). On the other hand, Cluster Analysis was used to detect groupings in data (Google, 2005a and b), as an explanatory tool (Hartigan, 1975), as a descriptive tool (Anderberg, 1973), and to organize data (Mclain, ***el al,*** 1975; Mecklein, 1986 and Klastorin, 1983).

On this basis, the current study has defined poverty in relation to regional/spatial issues (climatic shocks and accessibility to various essential services), inter-household variations (socio-economic and demographic and health factors), and intra-household disparities (gender and education). All these factors form the main ingredients needed in the understanding of poverty. The techniques are used for similar purposes in the current study, and this is shown in chapter 8 of this thesis. The next section elaborates on the type and sources of the data used in the current study.

2.7 RESEARCH GAPS

In a study by UNEP - Vulnerability Indices: Climate Change Impacts and Adaptation (UNEP (2001)), it was pointed out that there was a research gap on the vulnerable people at the district or province level. It was stated that such a study should emphasize the use of a conceptual framework, as the two approaches (the bottom-up and top-down international comparisons) which often have been used in the study of vulnerability have camouflaged the vulnerability of the local population. Hence, the relevance of the proposed vulnerability-study in Nyando District of Nyanza Province.

Several other research gaps and policy issues have been pointed out during literature review in order to strengthen smallholder agriculture and some of them have been used in the formulation of the objectives in the present research. Due to research limitations as expected in every study, other remaining gaps (national food imports and food aid, marketing structures and human diseases linked to food security apart from Malaria and AIDS), which will not be covered, would be recommended for further research by future scholars and policy-makers.

Specifically, research gaps, identified in the current study are education of smallholder farmers on new forms of energy production, as well as appropriate education methodology at different levels, and evolution and development of appropriate materials for mass communication. Other gaps are concerned with scientific and managerial capacity building for agricultural development in order to strengthen national agricultural research services, and development of local analytical capability for policy analysis (Eicher, 1986). Additional research areas include intensive and ongoing research programmes on agricultural production constraints, provision of knowledge base for better strategies, and programmes and projects together with supportive measures to adopt, where necessary, to relevant environmentally sound technologies and traditional methods of agriculture.

A number of recommendations have been made in the literature review particularly, to formulate policy on local food production, which takes into account sustainable development. More studies are required on poverty alleviation through increased incomes, access to food and other basic needs for all people in the economy. Such studies are also intended to address problems of marketing and prices. A comparative study within the high and low potential areas that aims at encouraging the productivity, health and nutrition of low income people and increasing their access to employment and productive assets together with promoting sustainable agricultural intensification and sound management of national resources was proposed. Such studies were to emphasize the areas with fragile soils and limited rainfall, as well as the pockets of widespread poverty where poor people are often found both in the high and low potential areas. Other areas requiring comparative analysis were:

- maize hectarages and hectarages of other crops using improved varieties, and the use of traditional seeds for policy issues for both large-scale and smallholder farms,
- study of incomes, consumption patterns, and savings among the rural agricultural groups and the urban poor,
- Cereal production and livestock production in the study area, and;
- Comparisons of food insecurity in the high potential areas and low potential areas.

Additional areas requiring attention were: short term production constraints, in order to prepare separate rainfed and irrigated agriculture, and livestock production strategies for different areas, and consumption and nutrition studies as far as food security is concerned. Economic analysis of smallholder farms is also necessary to examine the amount (degree of contribution in surplus generation for financing other basic needs) such as education and the existing infrastructure.

Investigations were also focussed on the possibility of credit facilities through the marketing organizations as done in cash crop production, as well as the effects of labour competition in smallholder agriculture between farm production and ofT-farm employment in the agro-based industries. Studies on malnutrition were noted to require planned and coordinated action by services of health, agriculture, education, social affairs and community development together with private institutions under the authority of central and local government. Even then, there were still data gaps on a malnutrition index among adults.

Coordination was needed between the areas of agriculture, food technology and nutrition needs to be reflected practically in the evolution of food grain varieties possessing the best attributes of production, utilization, and nutrition, because such interaction has a very crucial role to play in the food system. Lastly, field-focussed studies were found to be necessary in studying the linkages between women and different forms of energy use, especially, among the rural agricultural households, which predominantly depend on fuelwood for energy.

Other investigations were also required on the seasonal fluctuations of income among different population groups as well as health status of the farmer using multivariate statistical analysis.

The research gaps identified, portrayed agricultural geography as an inter-disciplinary subject, involving a number of scholars from community health, nutrition, meteorology, agricultural economics, religious studies, law, regional development and equitable distribution of resources, population studies, and other sub-disciplines. Therefore, the researchers need agricultural geography and Geography in particular, in order to come up with relevant solutions to local, national, regional and international problems. These inter-relationships have been summarized on the basis of their influence on the environment and the rising need for suitable development, especially, among the rural poor who depend on primary production as a source of livelihood. It is through these that the current research has attempted to relate the problems/issues of poverty, energy, environment, and food security among the vulnerable groups particularly the smallholder farmers as indicated in the topic of study. The inter-relationships characterizing the food crop production system command the use of a systems approach as a theoretical framework in the study in order to facilitate the discussion of the related factors that influence food crop production among the smallholder farmers in Nyando District of Nyanza Province-Kenya.

2.8 THEORETICAL FRAMEWORK MODEL

Three theoretical approaches have been applied in geographical research as a way of explaining vulnerability to food crisis and bringing about crisis management. The concept of "food availability decline" which is in line with Malthus (1798) approach, views food shortages as resulting from population increase which widens the gap between food production and food requirements. Secondly, the concept of "food entitlement decline" attributes famine not to limited/lack of food supply but rather to the lost ability of certain populations (entitlement) to produce, purchase or barter for food. A decline in entitlement occurs in the case of bad harvests, landlessness or unemployment in the face of rising food prices to provide income necessary to buy (usually available) food. This concept is recorded to be the most relevant in explaining the great famines of the last several decades. Lastly, the "crisis and conflict theories" view famine as a fairly short-term culmination point of long-term structural crisis. Seasons, contradictions, struggles and conflicts which are part of development of the global economic system, and which is characterized by crisis, polarization and manifested from local to global situations lead to structural weaknesses or inability, and thus to a rise in crisis-proneness.

The food availability decline attributes all food shortages to the imbalance between food production and population increases. It does not take into account the problems of diminishing farm sizes and environmental refugees. On the other hand, the food entitlement decline may include the food availability decline and crisis and conflict theories, though it is not well specified. The crisis and conflict theory also does not consider the effects of population increases. As a result, the theories complimcnt each other to bring a better understanding on real problrms of food crisis.

Nyando District has varying populations within different divisions, for exampole, Upper Nyakach division is said to be more populated than other areas like Muhoroni division. In such a case, the food availability decline may apply. The district also has squatters who occupied the district after 1992 land clashes, and such people have lost their ability to produce through landlessness, while also suffering from other problems of conflicts. As a result, the food entitlement decline and crisis and conflict theories both apply in the study of food security in Nyando district.

It is assumed that in developing countries such social conflicts (social restriction in access to productive resources, gender issues, destruction of natural resources or misjudged development policy) are occurring more frequently and strongly, and ultimately leading to the actual causes beyond the hunger problem. In this approach, the right to food is considered a basic human right. All the three concepts can be applied in studying, small-scale food crop production as a way of explanation. At the centre of food security debate is the availability of food at prices which the smallholder farmers such as those in Nyando can afford. Central Bureau of Statistics (2004) and (2005), however, have not given measures to ascertain that the right to food is achieved throughout the country. This underlined the fact that, governments have failed to understand the problem they are dealing with.

2.8.1 Conceptual and Operational Framework Models

According to conceptual framework model, there were several factors that influence household food security and poverty. Besides government policy, ecological and socio-economic factors impact upon household food surpluses and deficits resulting in household food security or poverty. These constructs have been illustrated in figures 2.1 and 2.2. Dependent variables were established to be food security and poverty and the independent variables, the decisions made by the government and the farmer, ecological factors, demographic and health factors, as well as socio-economic factors.

Food surpluses and deficits within each household were seen to be influenced by government policy, household food availability and ecological, socio-economic and demographic and health factors. The result is evidenced in household food security or poverty. In other words, households with food surpluses should have food security while those with food deficits result into poverty.

Household food availability was postulated as being directly influenced by the factors governing household food security. These factors were, first, access to food - mainly concerned with production; second, food availability- dealing with production and distribution and; third, quantity - mainly nutrition. These factors were also found to be impacted upon by the decisions made by the government and the farmer as well as by ecological, socio-economic and demographic and health factors. Small-scale household food availability depends on food production obtained from the family farm and food purchased using family income or remittances.

Ecological factors covered were drought, floods, soil productivity and crop diseases and pests. Socio-economic factors were farm size, food production, food consumption, capital, labour, education, food purchases, crop sales, service accessibility (proximity of household to clean water, urban centre, energy sources, market facilities and credit facilities), energy demand and use, food imports, food aid, marketing, research and technology. Demographic factors were family size and gender while health issues included family health, nutrition and malnutrition.

Figure 2.1:

Theoretical Framework Model: <u>The Relationship between Food security and Poverty and Land use factors, Fcological Factors, and Socio-economic</u> Factors

DECISIONS MADE BY THE GOVERNMENT AND DECISIONS MADE BY THE FARMER

FACTORS GOVERNING HOUSEHOLD FOOD SECURITY

T T

SMALL-SCALE HOUSEHOLD FOOD AVAILABILITY

GOVERNMENT POLICY

HOUSEHOLD FOOD BALANCE

FOOD SECURITY OR POVERTY

Ecological factors-Drought, Floods, Soil productivity. Crop diseases and pests, Land use factors- land tenure, land size. Socio-economic factors-Farm size. Food production. Food consumption, Capital,

Education, Food purchases, Crop sales. Service accessibility, Energy demand and use, food imports, Food aid. Marketing, research, technology, labour

Demographic factors-Family size & structure, gender

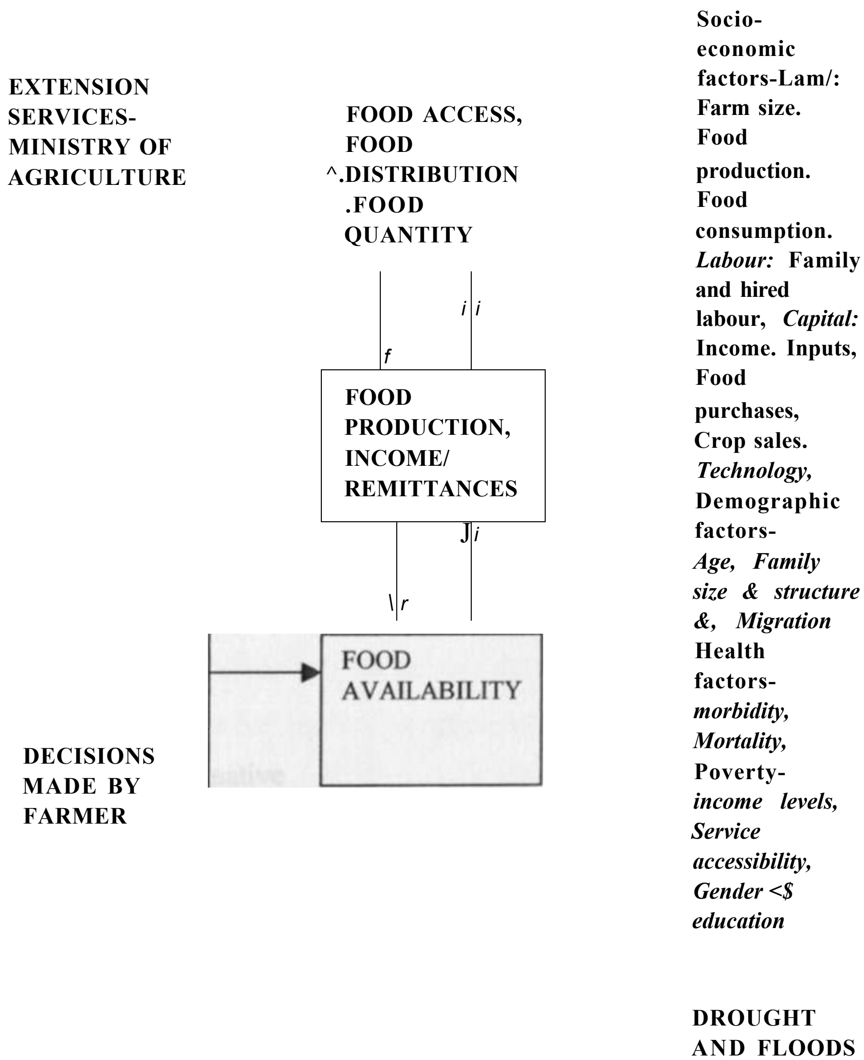
Health factors- mortality, morbidity, Malnutrition, ortsl XTiitritinn

ECOLOGICAL AND SOCIO-ECONOMIC FACTORS

Source: Researcher's design

Figure 2.2:

Operational Model: Relationship between Food Surpluses and Deficits and Kcological and Socio-economic Factors



Source: Researcher's design

2.9 RESEARCH HYPOTHESES

H_0: There is no relationship between food insecurity in Nyando and the occurrence of drought and floods in the District.

Hi: The Alternative

Ho: Household food security and economic factors (farm size, land cultivated, household labour, hired labour and distance to the nearest market centre) are not related.

Hi: The Alternative

Ho: There is no relationship between household food security and other socio-economic factors (years of farm operation, distance to the nearest - market centre, banking centre, primary school, clean source of water and firewood place).

Hi: The Alternative

H_0: Household food security and household demographic issues (Age of household head, I lousehold labour, and household size) are not related.

Hj: The Alternative

H_0: There is no relationship between household food security and household health (number of deceased persons and number of persons ill).

Hi: The Alternative

2.10 SUMMARY

Literature Review has shown that food security and poverty studies will always remain central in research due to persistent food security and poverty related problems, constraints to development of African agriculture and ways of overcoming such bottlenecks (need for analysis of capital and credit sources, nutrition and consumption levels). The prevalence of food insecurity in Africa and other developing countries is attributed to inaccessibility to food reserves or uneven food distribution and inability of the poor to afford food due to high food prices. Other bottlenecks include high population growth, chronic food insecurity and under nutrition. It is estimated that by 2015, Africa will only feed 40 percent of its inhabitants, with 30 percent of the 60 million people requiring food emergencies living in East Africa. As far as Kenya is concerned, eighty percent of Kenyans live in the rural areas and depend on agriculture for livelihood. The country experiences both chronic and transitory food insecurities, with 60 percent of the population living below the poverty line. The poverty is manifested in the form of hunger, illiteracy, lack of access to basic education and drinking water, minimum health facilities and shelter. Major bottlenecks to solving food security problems are high rates of urbanization, imbalance in food supply and demand, high population growth rate, degradation of the natural environment and neglect of traditional agriculture.

In terms of land use, agricultural production heavily relies on land allocation to various crops, which is also dependent upon the availability of labour, capital and demand. Several factors are held responsible for food deficits in Africa. These include:

- Inequitable land distribution and poor farming methods,
- Unfavourable weather conditions and lack of skilled-manpower,
- Diminishing good agricultural land and falling crop yields
- Emphasis on industrial crops at the expense of food crop, and unfavourable land tenure systems, leading to declining productivity on grazing lands, falling crop yields, and diminishing returns from water supplies.

Since small-scale fanners constitute the largest proportion of farmers in the rural areas, they also greatly influence land use patterns on the basis of common characteristics like small cropping areas, agricultural systems, and low levels of production, high vulnerability to climatic variability, disease and pests, crop varieties and processing.

On the other hand, the climatic factors whose effects are mainly felt among the poor and landless households influence the agronomic practices and socio-economic factors, and finally influencing household food security. Some of the climatic variability (maximized as droughts and floods) indices include availability or otherwise of water for agricultural use, the spatial and temporal patterns of the dry spells, daily agronomic activities- ploughing, planting, weeding, and fertilizer application, and water and wind erosion. Others are grazing and farming patterns, disease prevalences, soil fertility, crop yields and marketing, poverty, migration and food security, low demand for non-food items as most cash is used on food, less job opportunities in the informal sector, and many dependants within the non-poor households.

As far as demography and health factors are concerned, the main additions are related to additions of births and in-migrants, while subtraction is due to deaths and out-migration. Data on mortality is relevant in planning for investment in various sectors, with most researchers recommending that aggregate numbers be changed into a resource on the basis of fertility in order to achieve sustainable development. In terms of health, climatic factors, socio-economic conditions, peoples lifestyles, demographic parameters, environmental sanitation, nutritional status and other related factors all influence health conditions in a country together with food production levels.

Lastly, the Literature review, which was undertaken, summarizes the various methodologies that have been previously applied to improve food security and poverty related surveys in order to find proper direction for a more relevant approach in the current study. The section also assisted in identifying the data to be used in the development of the questionnaire for this study (Appendix 1) and as summarized in chapter 3 of the thesis. The different research gaps identified during Literature Review were briefly discussed in order to establish clearly the expected contribution of the current study in the field of knowledge. The process resulted into the design of the Conceptual Framework models presented in this thesis, to act as a guideline to areas of concentration in the present thesis as discussed in the various chapters.

CHAPTER 3

BACKGROUND TO THE STUDY AREA

3.1 INTRODUCTION

This chapter contains information concerning the various characteristics of the study area in terms of location, geology and soils, relief, agro-ecological zones, demography and health and other relevant socio-economic factors. This is particularly important to the study as sampling procedures were based on the distribution of these agro-ecological zones. Nyando district was chosen because the area suffers from frequent flooding and drought episodes, which require attention. The area is also a medium potential area, which is assumed to be food secure and yet it suffers from food insecurity so that results from the district can be used to address food insecurity problems in other similar areas. Thirdly, the researcher came from the area and this provided participatory approach to the study.

3.2 BACKGROUND TO THE STUDY AREA

3.2.1 Location/Site of the Study area

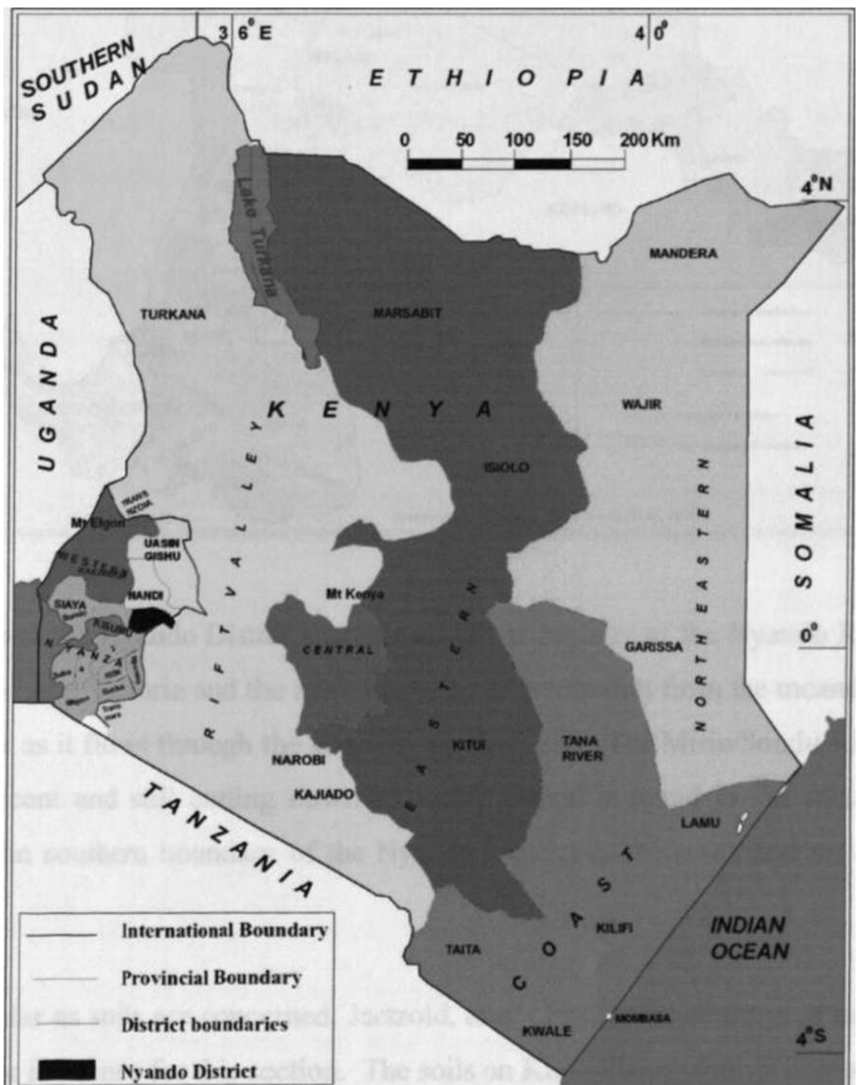
The District Development Plan of Nyando for the year 2002 to 2008 planning period (Republic of Kenya, 2001b) shows that Nyando District is one of the districts in Nyanza Province which was carved out of Kisumu District in 1998. It borders Kisumu District to the west, Nandi District to the north, Kericho District to the east and Rachuonyo District to the south. It lies between longitudes 34°4" east and 0°2" south. Nyando District covers a total land area of 1168 Km^2 and is divided into 5 administrative divisions, namely, Upper Nyakach, Lower Nyakach, Nyando, Miwani and Muhoroni divisions. See Figure 3.1, which shows the location of Nyando District in Kenya and Figure 3.2 showing the Nyando District administrative boundaries.

3.2.2 Geology and Soils of Nyando District

According to Saggerson (1952), Nyando District is dominated by the Nyanza Rift Valley with two escarpments, which have their origins in the Tinderet Volcanic massif astride the valley in the east. The Nyando Escarpment which, also forms the Songhor Valley in the east and represents the northern part of the escarpments to the Kisian/Nyahera escarpment. In the south, the southern escarpment stretches from Koru/Fort Teman area to include the Nyabondo escarpment of south Nyakach location. The floor of the Rift Valley is occupied by lacustrine sediments deposited by the formerly more extensive Lake Victoria during the end Tertiary to the Pleistocene Period.

Figure 3.1:

LOCATION OF NYANDO DISTRICT IN KENYA

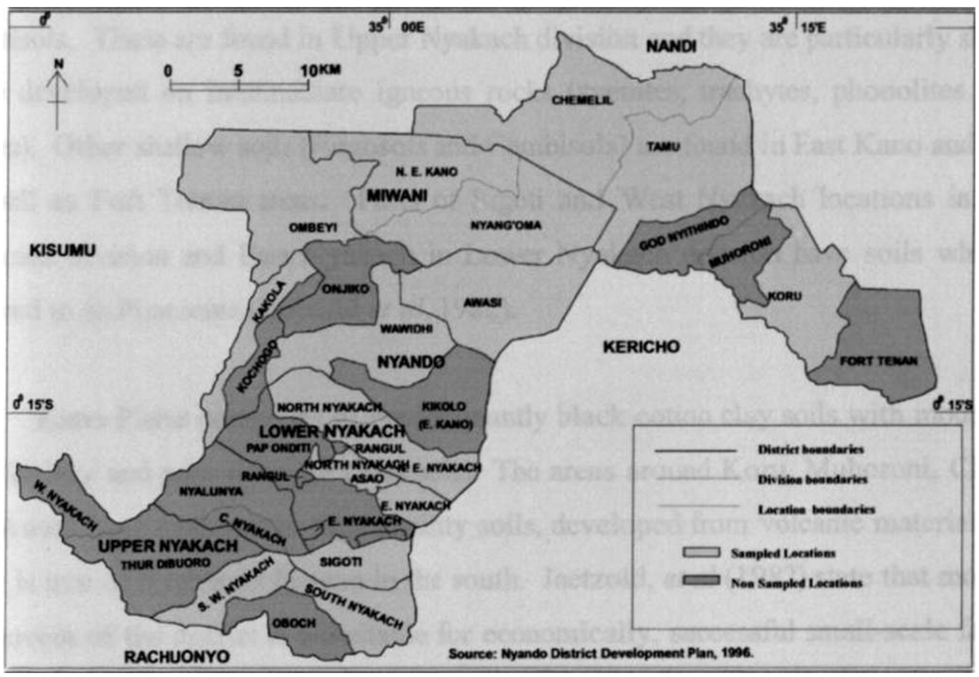


Source: Farm Management hand book of Kenya, 1985.

On the slopes of the Nyando escarpment are found colluvial/alluvial soils eroded from the escarpments, while the Koru/Fort Ternan and Awasi Plateau are occupied by volcanic cones contemporaneous with the Tinderet Volcanic Massif or Tertiary to Recent lava flows, which cap the Nyabondo Plateau in the south.

Figure 3.2:

NYANDO DISTRICT ADMINISTRATIVE BOUNDARIES AND SAMPLED LOCATIONS



The whole of the Nyando Distict is dominated by tributaries of the Nyando River which drains into Lake Victoria and the associated alluvial sediments from the meander systems of the river as it flows through the Kano/Nyakach Plains. The Miriu/Sondu River, which is more recent and still cutting down its valley floors, is found in the south where it occupies the southern boundary of the Nyando District in the south and west Nyakach locations.

As far as soils are concerned, Jaetzold, ***et al*** (1982) studied the area in detail and is the major reference for this section. The soils on Kano Plains (former lake sediments), occur in Awasi, Wawidhi, and Onjiko locations of Nyando division, and Nyang'oma in Miwani division. These soils have moderate to high fertility, but are subject to water logging. Such soils are said to be developed on alluvium from undifferentiated Basement System rocks (planosols, arenasols, solonetz, vertisols and fluvisols), which arc moderately well-drained to poorly drained, very dark grey to black, firm to very firm and could be sandy clay to loamy in nature. Similar soils are the ones scattered within Chemelil and Muhoroni divisions, and Koru and Fort Ternan locations.

The soils in Upper Nyakach (Nyabondo Plateau) and part of Chemelil and Tamu locations of Muhoroni division are variable in nature (well-drained, moderately deep to deep, dark red and friable clay among other characteristics refered to as Gleysols or Ferralsols. These are found in Upper Nyakach division and they are particularly shallow, were developed on intermediate igneous rocks (syenites, trachytes, phonolites among others). Other shallow soils (Regosols and Cambisols) are found in East Kano and Awasi as well as Fort Ternan areas. Parts of Sigoti and West Nyakach locations in Upper Nyakach division and East Nyakach in Lower Nyakach division have soils which are referred to as Phaezems (Jaetzold ***et al,*** 1982).

Kano Plains comprises of predominantly black cotton clay soils with moderate to low fertility and poor drainage (histosols). The areas around Koru, Muhoroni, Chemelil and Awasi have moderate to high fertility soils, developed from volcanic materials. The same is true of Nyabondo Plateau in the south. Jaetzold, ***et al*** (1982) state that more than 75 percent of the district is unsuitable for economically, successful small-scale farming. Extremely heavy soils combined with a warm climate, relatively low annual rainfall, and repeated flooding make farming a heavy burden. Figure 3.3 shows the distribution of soils in Nyando District, based on their fertility.

3.2.3 **Relief/Drainage**

Nyando District has three main topographical land formations namely, the hilly parts rising upto the foothills of the Tinderet volcano and trending westwards as the Nyando/ Nandi Escarpment, Nyabondo Plateau and part of the Nyanza Rift-Valley, the lowland area occupied by the Kano plains in Nyakach and Kano locations. The altitude varies from 1600 metres above sea level in Nyabondo Plateau down to 1100 metres above sea level along the Nyakach and Kano Plains. The District has two major rivers, Sondu Miriu, and Nyando rivers, and one gazetted forest, namely, the Koguta Forest that covers an area of 320.5 Hectares. Figure 3.4 shows variations in relief within the study area. The Nyando and Awach rivers are prone to flooding which has devastating effects on the people of the area. The rivers provide water for irrigation but this may be disrupted during floods.

Figure 33:

THE DISTRIBUTION OF SOILS IN NYANDO DISTRICT ON THE BASIS OF THEIR FERnUTY

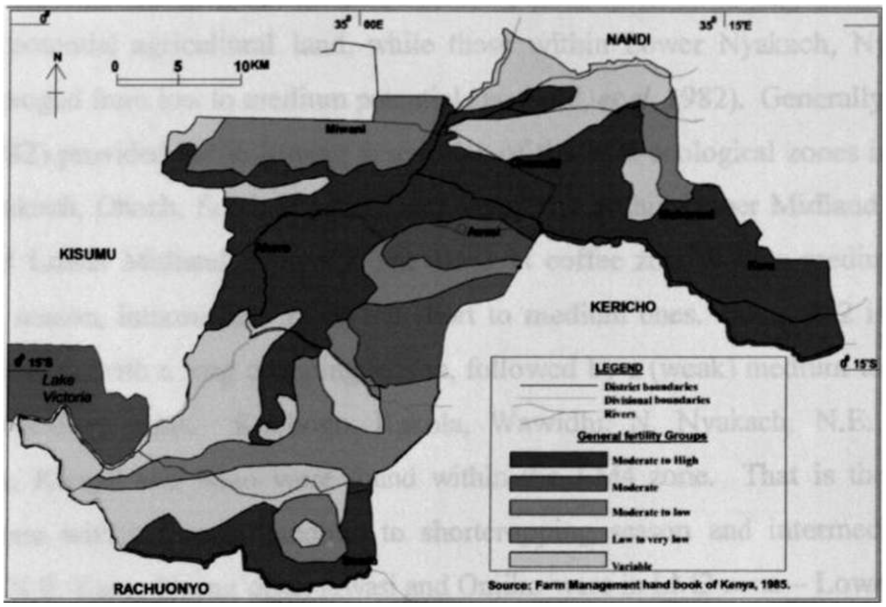
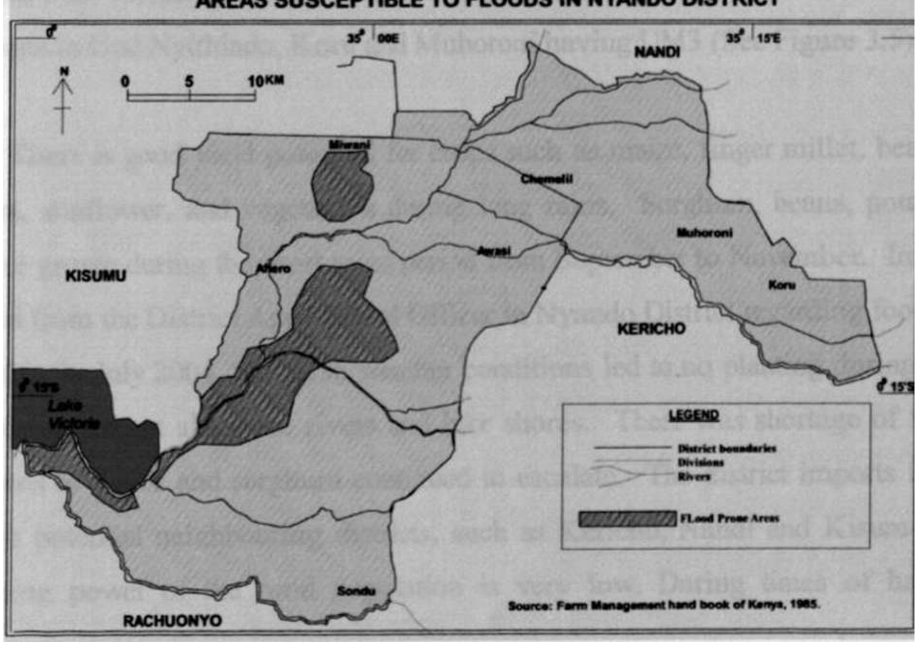


Figure 3.4:

AREAS SUSCEPTIBLE TO FLOODS IN NYANDO DISTRICT



3.2.4 Agro-climatic characteristics

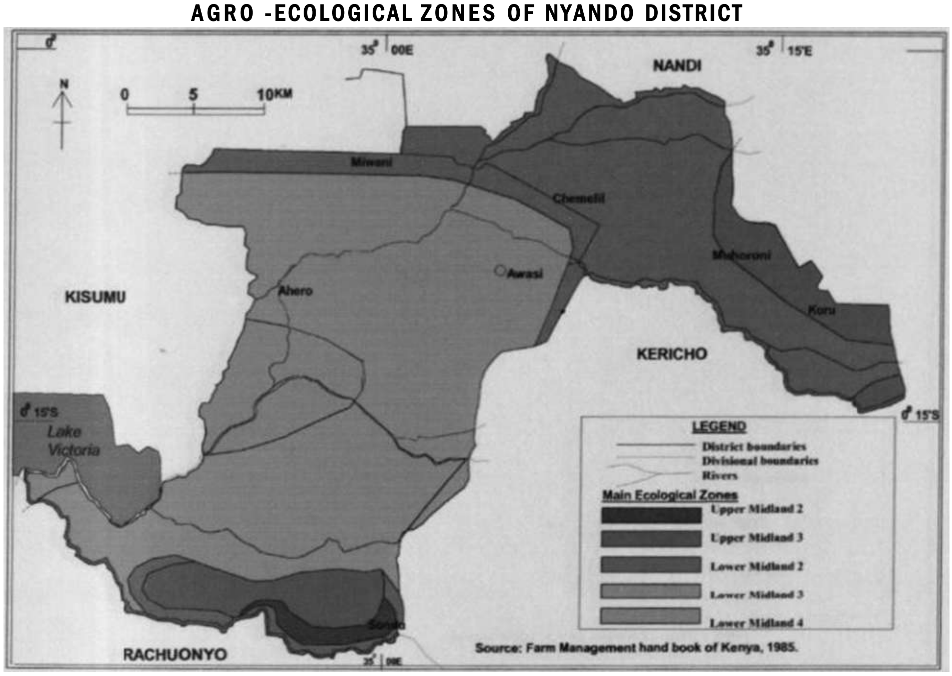
According to Jaetzold, ***et al*** (1982), the area receives bimodal rainfall with long rains received from March to May and short rains coming in September to November. Annual rainfall ranges between 1000mm to 1630mm with temperatures ranging between 20 degrees centigrade and 35 degrees centigrade.

Locations within Upper Nyakach and Muhoroni areas ranged from high to medium potential agricultural land, while those within Lower Nyakach, Nyando and Miwani ranged from low to medium potential (Jaetzold, ***el al,*** 1982). Generally, Jaetzold, ***et al,*** (1982) provided the following description of the agro-ecological zones in the area: S.W. Nyakach, Oboch, South Nyakach and Sigoti fall within Upper Midland 3 (UM3), UM2 and Lower Midland 2 (LM2). The UM3 is coffee zone with a medium to long cropping season, intermediate rains and short to medium ones. The LM2 is marginal sugarcane zone with a long cropping season, followed by a (weak) medium to short one and intermediate rains. Kochogo, Kakola, Wawidhi, N. Nyakach, N.E. Nyakach, Nyalunya, Rangul and Asao were found within the LM4 zone. That is the marginal cotton zone with a (weak) medium to shortcropping season and intermediate rains. Ombeyi, N.E. Kano, Nyang'oma, Awasi and Onjiko were in LM3 zone - Lower Midland cotton zone with a medium to long cropping season, intermediate rains, then followed by a (weak) short to very short rainy season. Chemelil, Tamu, God Nyithindo, Muhoroni, Koru and Fort-Teman are found within the Lower Midland 2 (LM2) with a small portion of the area in God Nyithindo, Koru and Muhoroni having UM3 (See Figure 3.5).

There is good yield potential for crops such as maize, finger millet, beans, sweet potatoes, sunflower, and vegetables during long rains. Sorghum, beans, potatoes, and fruits are grown during the short rains period from September to November. Information obtained from the District Agricultural Officer in Nyando District regarding food security shows that in July 2004, the harsh weather conditions led to no planting during the short rainy season except along the rivers and lake shores. There was shortage of foodstuffs and prices of maize and sorghum continued to escalate. The district imports food from the high potential neighbouring districts, such as Kericho, Nandi and Kisumu, but the purchasing power of the rural population is very low. During times of hardship in procuring food because of floods and drought, the government supports the population by a food for work scheme. In 2004 unfortunately, there was no such a scheme in operation. Figure 3.5 shows the various Agro-ecological zones.

Figure 3.5:

AGRO -ECOLOGICAL ZONES OF NYANDO DISTRICT



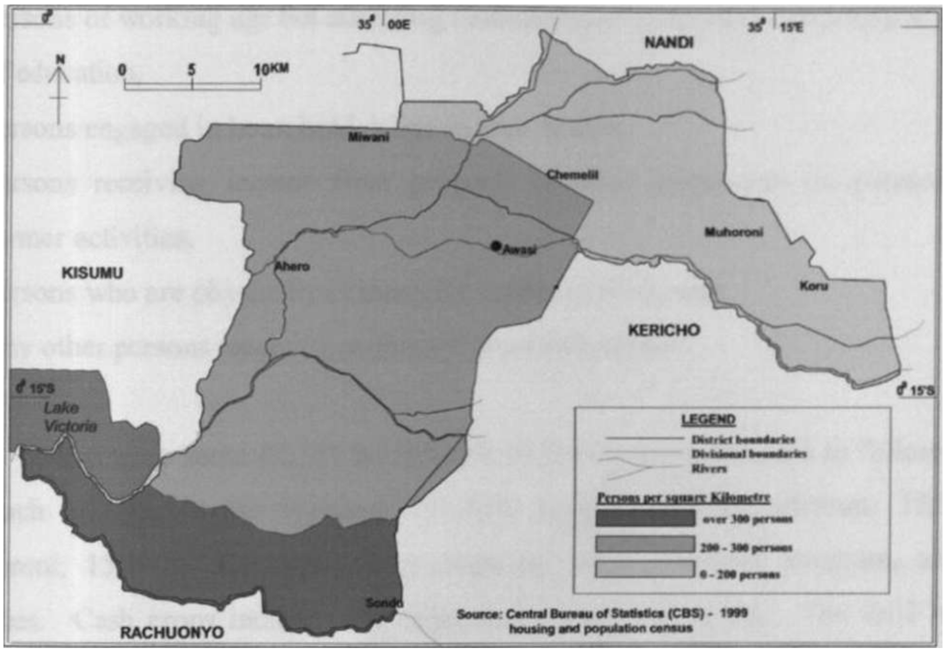
3.2.5 Demography and Health features

The District Development Plan (Republic of Kenya, 2001b) showed that, out of the five divisions, Upper Nyakach division had the highest population density of 368 persons per square kilometre, while Muhoroni had the lowest density of 190 persons per square kilometre in 1999. The population density is expected to rise to 500 and 255 persons per square kilometre in the two divisions respectively by the year 2008. Muhoroni has high agricultural potential and falls within the sugar-belt thus attracting many people. It is also the largest division in the area covering 334.8Km , which explains its low population density. The high population density in Upper Nyakach division is due to its small size of 176 square kilometres but also linked to its attraction as a high potential agricultural area. Other divisions have the following population densities per square kilometre: Miwani 257, Lower Nyakach 270 and Nyando 259 persons per square kilometre. These variations in density are given in Figure 3.6.

The Nyando District has a population growth rate of 3.4 percent. Rural population at the start of the plan period was **248,166.** There were four towns with a population of 83,971.

Figure 3.6:

POPULATION DENSITIES WITHIN THE STUDY AREA



Infant mortality rate is 89/1000 and under five mortality rate is 110/1000. Fertility rate stands at 5.8 and Male female sex ratio was 100:104. As far as gender is concerned, traditional land ownership and inheritance patterns continue to marginalize women and girls and prevent them from having access to, and control of productive resources such as land.

It has been further documented in Republic of Kenya (2001b) that a total of 125,348 persons, work in the agricultural sector. According to Baldwin (1975), the age 15 to 64 is the economically active age group and under 15 and over 64 is dependent on them. Labour force (economically active population), includes both employed and unemployed and the employed comprise all persons including family members who are normally engaged in some occupation or who for some reasons are temporarily absent from the family. This includes both full-time and part-time workers, the later being assumed to work a minimum period sufficiently high to exclude those, whose contributions are negligible. While the unemployed refer to all those persons who are not working, but who are seeking work for pay or profit (including those who have never worked before), the economically inactive population are those engaged in activities which do not contribute directly to the economic production of goods and services. These persons include:

(a) children not attending school,

(b) persons of working age but attending institutions of systematic instruction at any level of education,

(c) persons engaged in household duties in their homes,

(d) persons receiving income from property or other investment (in pensions) from former activities,

(e) persons who are physically or mentally unable to work, and;

(0 any other persons receiving public aid or private support.

There were some 68,371 households in the district distributed as follows: Upper Nyakach 14,092; Lower Nyakach, 11,149; Nyando, 14,029; Miwani, 13,982 and Muhoroni, 15,119. The main food crops are maize, cassava, sorghum, and sweet potatoes. Cash crops include rice, sugarcane, cotton and coffee. The total hectarage under food crops in the year 2000 was 182,000 hectares, while 240,000 hectares were under cash crops. There was 7,400 hectares, potential land for smallholder irrigation schemes, and 27,550 hectares available for non-irrigated agricultural expansion. The land carrying capacity is 1 livestock per hectare and the main livestock breed consists of Zebu cattle. About 83,700 persons work in the livestock sector in Nyando District (Kenya, 2001b).

Before discussing the population and food production figures, it is important to note that Nyando District was carved out recently from the former Kisumu District. Population figures are therefore based on the statistics regarding the area since 1969. These figures show that there has been a decrease in population of the area. Possible explanations for these decreases could be due to changes in boundaries, mortality, out-migration due to floods or errors in the census data resulting from data collection and/or processing. The population figures were used to examine whether population trends have been consistent with food crop production.

The Ahero District hospital was put under Nyando District in 1999 when the Medical Officer of Health office was established. Initially, the hospital was operating under Local authorities of Kisumu in 1960s and under Central government in 1970s. The District hospital is located in Ahero and not Awasi due to the availability of infrastructural services that were already existent in Ahero. Other related posts such as the District Clinical Officers and District Education and Information Officers were also created in 1999. It is as a result of these establishments that the information on health issues, were obtained from Ahero and not Awasi (the District headquarters) during fieldwork.

Most of the disease prevalence reduced from January 2005 to February 2005 with only diseases of the skin, pneumonia and eye infection increasing during the same period of time among the top ten diseases. The data does not show HIV/AIDS which, is related to diseases like those of the respiration and skin, diarrhoea and pneumonia. When these diseases were considered among the top ten diseases, HIV/AIDS-related disease prevalence would appear, as given in Table 3.1.

HIV/AIDS has become a major development challenge in Nyando due to the rising trend of infections which, rose from 19 percent in 1990 to 29.4 percent in 1999. The national prevalence rate is 14 percent. Cultural beliefs, poverty in the community, and stigmatisation of the affected/infected people, have been mentioned as hindrances to the control of HIV/AIDS in the district. The sugar industry in the district is suffering due to high medical bills for workers and frequent absenteeism due to illness. The disease lowers labour productivity and increases the cost of production.

3.2.6 Socio-economic characteristics

The Central Bureau of Statistics (CBS) (2003a) shows that pockets of poor communities were found in Ayucha sub-location of Nyando division, Kibigori sub-location of Muhoroni, and Gari sub-location of Upper Nyakach. Others were found in Agoro west and Awach sub-locations of Lower Nyakach division. The district accounts for between 0.8 to 1.6 percent to the country's poor with poverty incidence of between 50 to 70 percent. See Figure 3.7 for Poverty prevalence in Nyando District. About 54 to 63 percent of the households in the District were classified by the CBS as food poor. The household's own food production, provides only about 20 percent of the total household food requirements. The remaining 80 percent, is obtained through food purchases.

Table 3.1: Disease Prevalence among Households in Nyando District

Disease	January (2005)		February (20135)	
	Case	Prevalence	Case	Prevalence
Malaria	14122	46.75	13316	46.31
Diseases of the Respiration	4536	15.02	4304	14.97
Diseases of the Skin	2178	7.11	2188	7.61
Diarrhoeal diseases	2436	8.06	1935	6.73
Pneumonia	828	2.74	1118	3.89
Intestinal worms	723	2.39	659	2.29
Eye Infection	494	1.64	503	1.75
Rheumatism, joint pains	422	1.40	347	1.21
Ear Infection	400	1.32	359	1.25
Accidents	388	1.28	380	1.32
Others	3678	12.29	3643	12.67
Total	30205	100	28752	100

Source: Nyando District Medical Officer of Health.

CBS (2003a) further reports that rural self-employment, accounts for 10 percent while wage employment was 25 percent. There were 57,860 unemployed persons in the district in 1999. Urban self-employment was 10 percent and other forms of employment accounted for 3 percent. Labour force in the District was expected to reach 204,324 by the year 2008. In order to absorb the increasing labour force, there were plans to invest more in the productive sectors in the district such as the agricultural sector, fish industry and Jua-Kali industries.

3.2.7 External factors

Information obtained from the Ministry of Agriculture comprising of food security livelihood zones maps, indicated that the neighbouring districts like Nandi in the north and Kericho in the southeast were classified as food secure and Nyando District is therefore in a position to import food from these neighbouring districts. In terms of household food security, households with income or remittances from relatives in the major towns and work places could purchase food, which was always available at the local markets. It was the households without adequate incomes that were not in a position to afford to buy food even if it was available. Kisumu, the other neighbouring district is classified as a food deficit region although, it benefits from food imports from Uganda. Figure 3.8 shows the location of Nyando District, relative to the neighbouring Districts.

Figure 3.7:

POVERTY PREVALENCE IN NYANDO DISTRICT BY LOCATION

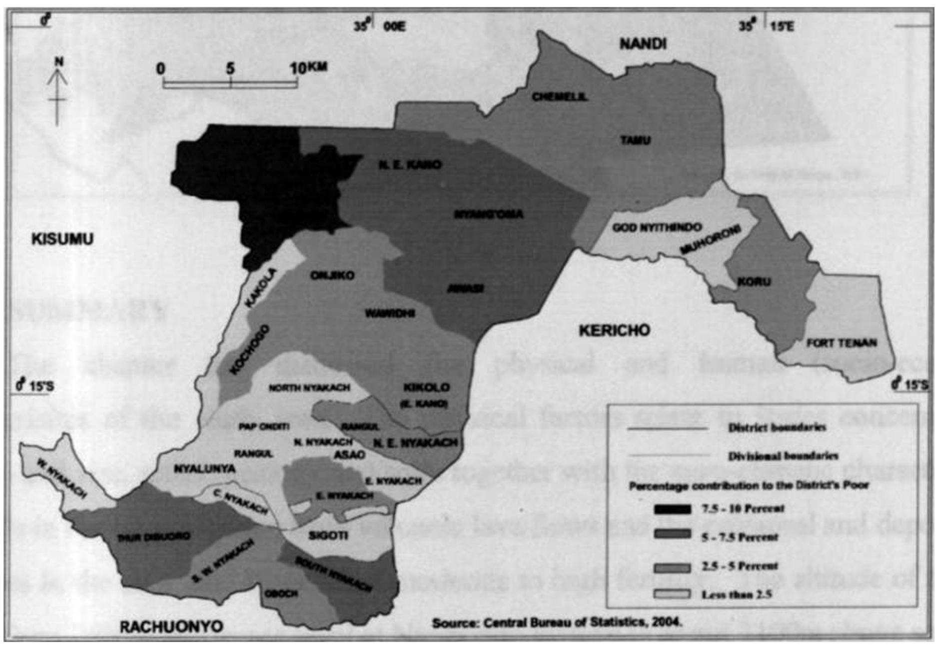
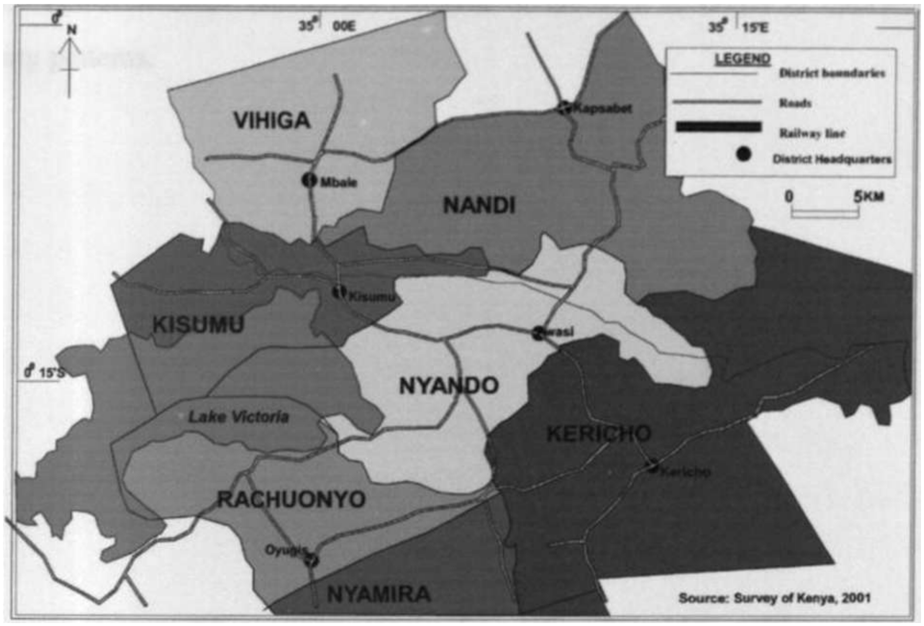


Figure 3.8:

LOCATION OF NYANDO DISTRICT IN RELATION TO THE NEIGHBOURING DISTRICTS



3.3 SUMMARY

The chapter has discussed the physical and human (socio-economic) characterisitcs of the study area. The physical factors relate to issues concerning the location and size, relief, geology and soils together with the agro-climatic characteristics. The soils in the area originate from volcanic lava flows and the erosional and depositional processes in the area, and range from moderate to high fertility. The altitude of the area ranges from 1600m above sea level at Nyabondo Plateau to about 1100m above sea level, at Kano Plains. The area receives bimodal type of rainfall with the long rains being received between March and May and the short rains arriving from September to November. The mean annual rainfall is between 1630mm and 1000mm.

The human characterisitcs discussed deal with demographic factors, health issues, levels of poverty, and agricultural production. There are 68,371 households in Nyando District, with annual population growth rate of 3.4 percent. Upper Nyakach division is the most populated with a density of 368 persons per square kilometre, compared to Muhoroni division, a density of 190 persons per square kilometre, the least populated. Malaria and HIV/AIDS related diseases still remain the most common in the area, and the district contributes between 0.8 and 1.6 percent to the country's poor. In terms of agriculture, coffee, sugarcane, rice, cotton are the main cash crops, while food crops include maize, finger millet, beans, sweet potatoes, sunflower and vegetables, among others. Harsh weather conditions existent in the area is noted to interfere with the cropping patterns.

CHAPTER 4

METHODS OF DATA COLLECTION AND ANALYSIS

4.1 INTRODUCTION

The main aim of this chapter is to provide a justification for the types of data used in the thesis, method of their collection, and statistical analytical techniques adopted in data analysis. The chapter explains the sources of the data collected, sampling frame and sampling design, preprocessing and processing procedures, together with the relevance of the analytical techniques used. Different challenges encountered during fieldwork and preparation of this thesis are also discussed, as these indirectly or directly influence the results obtained in the analysis.

4.2 SOURCES OF DATA

The use of both primary and secondary data sources in this study could not be avoided, as this is a geographical study, which deals with issues in relation to space and time. The primary data also assists in filling in the identified data gaps and supplements the secondary data in order to arrive at the expected results.

4.2.1 Primary data

Primary data were obtained from the field using questionnaires and interviews, general observations and recording, together with remote sensing technologies. Among those who have used questionnaires, Gregory (1970) suggested that they be used as a supplement to sampled studies. Both structured and unstructured questionnaires were used. The structured questionnaires were made open-ended to ensure that no relevant information is left out. Interviews were conducted with the Ministry of Agriculture officers, District Agricultural officer at Nyando, Ministry of Health officials at Nyando, Out-growers schemes, Sugar factories and farm households to ascertain that no vital relevant information was omitted in the study.

The questionnaires were used to collect data for both qualitative and quantitative analyses. The enumerator filled the questionnaire in order to aid the understanding of the questions and ensure accuracy.

In this study, the primary data required were, information relating to household food crop production (distribution and allocation of land parcels to different farming enterprises), food consumption and deficits/surpluses, incomes, education, age, transport, labour, and energy among other socio-economic parameters. Additional information concerning droughts and floods occurrences together with environmental conditions were also obtained.

Qualitative data was used to supplement primary data, and the data was obtained through focus group discussions in order to get different views from the community leaders, women, out-growers schemes, and policy makers on food security and poverty issues, and to find out their coping strategies.

4.2.2 Secondary data

Secondary data were obtained from different libraries. These libraries were the University libraries, the Ministry of Agriculture library, and United Nations Environmental Programme (UNEP) library, among others. Other additional sources of secondary data included topographical maps, and aerial photographs. These have been used to provide information on the study area, agro-ecological conditions, and other details of assistance to the research effort. Literature regarding previous studies on food security and related issues were sought from the various sources to be used in obtaining a comprehensive understanding of the study area and the study problem (Jaetzold, ***el al,*** 1982; Republic of Kenya, 2001b; CBS, 2003a and b and Information obtained from District Agricultural Officer in Nyando).

4.3 SAMPLING FRAME AND DESIGN

Before carrying out statistical analysis, the researcher usually faces the challenge of data acquisition and in the process, an individual would have to make decisions on the sampling frame, sample size and sampling techniques. Based on the literature review, simple random sampling (whether stratified or otherwise) received greater attention from different researchers (Elamass, 1997; Oluoko, 1995; 1999; Akech, 1990; Kennedy, 1989; Obara, 1983; Ryerson, ***el al*** 1979; Cruickshank, ***et al,*** 1970 and Schutz, 1964). The choice of the survey methods varied spatially, temporally as well as with individual decisions made by a researcher concerning the characteristics of the sampling population (Oluoko, 1999, Obara, 1983 and Shah, ***et al,*** 1980). All the issues have been taken into consideration prior to deciding on the most appropriate sampling approach to be used.

There were five divisions in Nyando District, namely, Upper Nyakach, Lower Nyakach, Nyando, Miwani and Muhoroni divisions. Within these divisions, there were locations as shown in Table 4.1.

Table 4.1: Divisions and Locations in Nyando District

Division	Locations
Upper Nyakach	West Nyakach, Thur Dibuoro, S.W. Nyakach, Oboch, S.Nyakach, and Sigoti
Lower Nyakach	Nyalunya, Central Nyakach, E. Nyakach, Rangul, Pap Onditi, North Nyakach, N.E. Nyakach and Asao/Asawo
Nyando	Kochogo, Kakola, Onjiko, Wawidhi, Kikoloye, Kano and Awasi
Miwani	Ombeyi, N.E. Kano and Nyang'oma
Muhoroni	Chemelil, Tamu, God Nyithindo, Muhoroni, Koru and Fort-Ternan

Source: District Development Plan of Nyando, 2001.

Systematic random sampling was used to select the locations for study after stratification according to agro-ecological zones, while the Sub-locations were randomly chosen. The first household was chosen randomly, thereafter, other households were chosen systematically. Printed papers numbered 1 to 9 were used to pick the k^{lh} sampling unit after which the next sample was selected. Strata or clusters were used primarily to ensure that different groups of the population were adequately represented in the sample. Sekaran (1984) noted that stratified random sampling involves a process of stratification or segregation, followed by random selection of subsets from each stratum. The population was first divided into mutually exclusive groups that were relevant, appropriate and meaningful in the context of the study. This process led to sampled locations and sub-locations given in Table 4.2 and 4.3, respectively.

Table 4.2: Locations chosen for Study

Location	Number of Households (1999 census)	Proportions
Upper Nyakach and Part of Muhoroni - High to Medium Potential Zones		
S.W. Nyakach	1332	
South Nyakach	3631	
Sigoti	1939	
Chemelil	3986	
Tamu	3154	
Koru	4212	
Total	18,254	39.67 Percent
Lower Nyakach and Part of Nyando - Medium Potential Zones		
Location	Number of Households (1999 Census)	Proportion
Ombeyi	4936	
N.E. Kano	4834	
Nyang'oma	4212	
Awasi	3144	
Total	17,126	37.21 Percent
Nyando and Lower Nvakach - Low to Medium Potential Zones		
Location	Number of I louseholds (1999 Census)	Proportion
Kakola	4273	
Wawidhi	1658	
N.E.Nyakach	2808	
North Nyakach	1147	
Asao/Asawo	755	
Total	10,641	23.12 Percent

Source: Systematic Random Sampling

Table 4.3: Sub-Locations Selected for Study

Location	Sub-location	Households	Proportions (%)	No. of Samples
S.W. Nyakach	West Kadiang'a	1332	7	20

S. Nyakach	East Kadiang'a	3631	19	53
Sigoti	Ramogi	627	3	8
Chemelil	West Songhor	1773	9	25
Tamu	God Abuoro	796	4	11
Koru	Koru	1084	6	17
Ombeyi	Kango	934	5	14
N.E. Kano	Kabar West	1042	6	17
Nyang'oma	Sidho East II	1484	8	22
Awasi	Ayucha	719	4	11
Kakola	Kakola (Ahero)	2174	12	34
Wawidhi	Ayweyo	893	5	14
N.E. Nyakach	Awach	723	4	11
N. Nyakach	Gem Rae	756	4	11
Asao	Lisana	755	4	11
Total		18,723		279

Source: Random Sampling

In order to find appropriate and adequate number of samples to be used for quantitative analysis, 1.5 percent of the total population was taken as the initial sample size, resulting into 279 questionnaires to be filled during the fieldwork. This sample was considered adequate due to the fact that, depending on the method of analysis, a sample size lying between 30 to 100 may be large enough to assume normalcy when other statistical conditions are observed (Clark, ***et al,*** 1986).

4.4 DATA ENTRY AND PROCESSING

This research has used both primary and secondary data. The secondary data were processed to provide figures for comparison with primary data obtained from the fieldwork and were not used for multivariate statistical analysis. The sections dealing with data entry and processing were, therefore, directed only at primary data collected through questionnaires among the various households. After selecting a sample, (a household), certain questions (attributes of food security) were administered to the respondent. Every answer obtained from respondents was recorded and each answer formed a variable during data entry. Mcneil, ***et al,*** (1975) defined a variable as any attribute which, may take on any of a range of numerical values. The collected data passed through different preparation stages/processes before it could be translated into useful information. It is these stages that are discussed below:

4.4.1 Data Entry

The major issues regarding data entry included:

(i) Laying of the structure

(ii) Entry of individual variables into a code sheet, and;

(iii) Printing out the results.

Before laying out the structure, the researcher had to sort out the questionnaires during fieldwork in order to decide on the variable numbers, variable labels, value labels, range (where necessary), and order of presentation (whether in a table form, just an individual item, or map). The items were first hand written and later keyed into the computer. The SPSS (Statistical Package for Social Scientists) software (version 9.0) was used in laying the structure. There were 279 questionnaires, as the questionnaires obtained during the pilot survey were not used in the analysis, with each questionnaire representing one household. The result was a 279 by 364 matrix A. This is to say that columns representing households ranged from 1 to 279 while rows representing the variables ranged from 1 to 364. It is on the basis of this matrix that descriptive statistics of frequencies, means and standard deviations were obtained using appropriate SPSS commands.

4.4.2 Data Processing

Using the matrix A discussed above, the researcher isolated variables with numerical values from string values so that they could be put into different kinds of analyses. In this case, variables with string values were analyzed using descriptive statistics (cross-tabulations and frequencies). On the other hand, the variables with numerical characteristics were also identified and put together in another table consisting only of numbers and their numerical values (Matrix B). It is from this table (Matrix B) that data dealing with different aspects of food security were picked out and grouped separately in their own files. For example, data dealing with climate issues, economic factors, social factors, demographic characteristics, health issues as well as poverty were put in separate tables. Only the households that gave all the required responses for each section of the questionnaire were selected as final sample size for a particular type of analysis. Next, all households (questionnaires) that did not have all the necessary data regarding the variables in question were removed from each table, leaving only the households that provided all the necessary information.

As far as climate and food security was concerned, the following data was used, duration (months) of drought and floods, months dependent on crop production and purchased food, and, total food production. There were separate tables for households experiencing floods and those experiencing droughts. The data were then subjected to Partial and Multiple Correlation analysis and Multiple Linear Regression analysis.

Four major socio-economic factors were used in this study, that is, land (household farm size), land cultivated the previous year, household labour, hired labour, distance to the nearest market, and years of farm operation. Other factors were concerned with proximity of households to various infrastructural facilities like schools, markets, banks and sources of fuel and water. Total household food (crop) production (mainly cereals) was the dependent variable in all the analyses.

Demographic issues comprised of age of household head (years), household size, and household labour. Health issues comprised of number of persons ill, and number of persons deceased within an individual household.

The last and most important part of the data in these analyses was the data that was used in Principal Component analysis, Factor Analysis and Cluster analysis. The data contained at least two variables from the various factors influencing household food security, that is to say, climatic factors, economic issues, social factors, demographic and health factors. First, Principal Component analysis (PCA) was carried out on this data, then Factor analysis (FA) and, lastly, Cluster analysis (CA) in order to identify and draw conclusions on the most important variables affecting household food security in Nyando District. The variables used in the analyses included: age (years), household size, farm size, years of farm operation, land cultivated the previous year, and total household food (or food crop) production. Other variables were: duration of drought, household labour, distance to the nearest market, distance to the nearest primary school, distance to the nearest health facility, number of deceased persons, and number of persons ill. There were other factors that the researcher would have liked to add to this table but a majority of the respondents did not provide all the required answers, hence, they were left out.

4.4.3 Data Presentation

Data presentation in the form of frequencies, either as frequency distributions/ tables or curves has been discussed by many authors (Blalock, 1979; Gupta, ***et al,*** 1998; Hammond, ***et al,*** 1978; Pritchard, 1984; and Spiegel, 1961). The use of either qualitative or quantitative maps and diagrams in the study of phenomena at various levels (nominal, ordinal and interval/ratio scales) is documented (Pritchard, 1984; McMaster, ***et al,*** 1989; Monkhouse, ***et al,*** 1963 and Birch, 1959). The type of data at hand determined the type of map or diagram to be used in presentation in order to enhance visual expression and interpretation of the original data collected. Such maps include the choropleth, the dot, the isopleth, isolines or flow-line maps, which assist in representing phenomena in space and time. On the other hand, when data was available but lacked spatial qualities, it was represented in the form of graphs (line, bar, pie, scatter, triangular or logarithmic graphs, among others.

The current study has used both continous and discontinous choropleth maps, for example to show variations in land use and flood prone areas, respectively. Linear patterns have been used to show waterways (rivers), administrative boundaries and roads, while symbols have been used to represent different categories of health facilities, in the study area. The choropleths, the isopleths and graphs (line, bar, pie and scatter) have been used to show spatial disparities and scores, respectively, where appropriate. Simple composite or multiple bar graphs (columnar or horizontal) have also been used. The food security outlook map in chapter one was presented using satelllite imagery.

4.5 STATISTICAL ANALYTICAL TECHNIQUES USED IN THE ANALYSIS

A number of statistical techniques and tools have been applied in solving different geographical problems existing in different agricultural landscapes, and is stated in the part dealing with data. These agricultural landscapes which, were the main concern in this study, resulted from human activity on the natural environment which was influenced by climatic conditions and soil types in the area. The physical factors interact with socio-economic factors to produce the various agricultural/farming systems (Werner, ***et al,*** 1993; Ruthenberg, 1980; and Laut, 1968).

The importance of statistical techniques in data acquisition, data analyses and data presentation, has been emphasized by many authors in different statistical literature. Though techniques have not been an end in themselves, they have served well as a means of, achieving quality, and removal of bias in analyses. The choice of different methods of data acquisition and processing is normally determined by the nature of data collected and the hypotheses to be tested. In this particular study, an attempt was made to select those techniques which, bring out the best in the data collected.

In order to deal with household food security and poverty, which is an inter-disciplinary subject, different types of analytical techniques were required at various stages of analysis with the aim of finding lasting solutions to the problems of food security and poverty in Nyando District. Such methods included:

- Multiple Correlation and Multiple Linear Regression analyses,
- Principal Component Analysis,
- Factor Analysis, and;
- Cluster analysis.

Although Remote Sensing and Geographical Information Systems (GIS) were supposed to be used for map preparation, there were some technicalities encountered, and therefore alternative packages like ArcCAD was used. The reasons for using a particular technique, its relevance in this study, and limitations together with ways of overcoming such limitations, are discussed in detail in the subsequent paragraphs.

4.5.1 Correlation and Regression Analyses

These are multivariate techniques used in statistical inferencing (Cole, ***et al,*** 1982 and Blalock, 1979). Correlation and regression analyses could be extended to include any number of interval scales, one of which could be taken as dependent variable and the remainder independent (Blalock (1979)).

4.5.2 Multiple Linear Regression Analysis

Multiple Linear Regression analysis was extensively used in this research as it is shown by previous researchers to be a useful technique of measuring multivariate statistical relationships. Quite often, geographical problems involve complex interacting variables. More than one independent variable was used against a single dependent variable (Clark, ***et al,*** 1986; Shan, ***et al,*** 1985; Blalock, 1979; Johnston, 1978). Multiple Linear Regression analysis using least Squares was applied in the analysis of farm labour, and ofTf-farm activities as well as economics of the various farm activities (e.g by Palmer-Jones, 1974 and Etherington, 1966). Chipeta (1972), in Malawi, used a form of Multiple Regression Analysis, referred to as the Model of Production and Distribution and recommended the model for use in other activities other than farming or any other commodity paid labour and for ordinary cooperation in farming after modification. Multiple Regression Analysis has limitations of multicollinearity, heteroscedacity and autocorrelation. The problems of multicollinearity, heteroscedacity and autocorrelation were overcome through careful consideration of the number of independent variables, limiting the chances of omission as indicated in the attached Questionnaire in Appendix 1, at the end of the thesis. However, it would also be important to note that no research is perfect due to data collection problems as noted by Schultz (1964). It should be noted that there are many ways of carrying out Multiple Regression Analysis, for example, the Enter Method and Stepwise Method, and in this study, both methods were applied.

4.5.3 Stepwise Multiple Regression Analysis

In order to eliminate multicollinearity that may exist among variables, Multiple Regression Analysis could be carried out in steps and the process referred to as Stepwise Multiple Regression Analysis. The method has previously been applied in studying many geographical problems such as the relationships between soil and crop, cotton yields, and yield problems (Obara, 1983, and Cruickshank, ***et al,*** 1970). The technique is a variation of Multiple Linear Regression Analysis, which provides a means of choosing independent variables, which will provide the best prediction possible with fewest explanatory variables. Cruickshank, ***et al*** (1970) collected farm survey data using a stratified random sample of 10 farms within lOKm radius to marketing and service centres in order to establish a 'bench-mark' relationship between the properties of the soil series and the economic returns to agriculture for statistical inference. Cruickshank used Stepwise Multiple Regression Analysis and Analysis of Variance. The relationship between any soil property and a gross margin was assumed to be significant if the regression coefficient was sufficiently different from zero with a confidence level above 95 percent. A similar confidence level was applied in this research.

Obara (1983) applied Stepwise Multiple Regression analysis technique in the study of geographical investigations of cotton yields. Obara noted that the method is useful in geographical investigations as a predictive tool for yield. It is a powerful variation of Multiple Linear Regression analysis, which, provides a means of choosing independent variables, and which provides the best prediction possible with fewest explanatory variables. In the present research, the technique was applied in examining other factors (physical or socio-economic in nature) which affect household food crop production. The variables discussed included increasing demand for energy, population growth, occurrence of floods or droughts, health of the farmer/family, and service accessibility. Additional parameters were education, food consumption patterns, land degradation, income levels, food production, family size, size of land, type of, and time of obtaining energy.

4.5.4 Principal Component Analysis, Factor Analysis, and Cluster Analysis

The above techniques have been used in this thesis for the purposes of summary/ reduction of data in order to draw conclusions concerning the variables under investigation and not for the purposes of hypothesis testing. According to Harris (1975), Principal Component Analysis (PCA) and Factor Analysis (FA) were used to examine within cluster variations while Cluster Analysis (CA) is useful in identifying differences between clusters. In other words, PCA and FA concentrate on relationships within a single set of variables. According to Harris (1975), both PCA and FA techniques could be used to reduce the dimensionality of the set of variables, to describe a set of variables in terms of their scores on a much smaller number of variables, with as little loss of information as possible. If the process is successful, then the new variables (components or factors) can be considered as providing a description of the "structure" of the original set of variables. In this thesis, PCA was used to isolate factors that influenced household food security in Nyando most among the climatic, socio-economic, demographic, and health factors. FA was applied in trying to find which variables determined the production of at least 700 Kilograms (Kg) of Cereals in a household. CA was useful after carrying out PCA in order to examine the differences between the clustered variables, by looking at the distances. The term distance, in this case, was a measure of similarity or dissimilarity. The differences between the clustered households, was also examined in order to understand the physical characteristics of their spatial locations.

4.5.5 Principal Component Analysis (PCA)

Google (2005a and b) gave several authors who have written about PCA (Congalton (1991), Davis (1986), Moore, ***et al***, (1993), Tabachnick (1989), Weslowsky (1976)). These authors stated that PCA involves a mathematical procedure that transforms number of (possibly) correlated variables into smaller number of uncorrelated variables called principal components. The first principal component acounts for as much of the variability in the data as possible, and each succeeding component accounts for as much as of the remaining variability as possible. Camberlin, ***el al,*** (2003) used PCA to study daily rainfall data from Kenya and north-eastern Tanzania and their results showed consistent rainfall variation over much of the region. Ogallo (1989) on the other hand applied another form of PCA to study the spatial and temporal characteristics of seasonal rainfall over East Africa during the period 1922 - 1983.

Harris (1975) noted that the new set of variables, derived from the original ones by PCA, were simply linear combinations of the original variables. The first principal component (PC) is the linear combination of the original variables whose sample variance is as large as possible. The second PC is that linear combination of the original variables, which has the largest possible sample variance. According to Harris, this process is continued until a total of P principal components have been extracted from the data with each successive PC accounting for as much of the variance in the original data as possible. The components are subject to the condition that scores on that PC be uncorrelated with scores on any of the preceding principal components.

Google (2005a and b) and Harris (1975) stated several advantages of PCA. fhese include:

(0 PCA is a powerful tool and is useful in data of high dimension where the luxury of graphical representation is not available,

(11) Once the patterns have been established, data can be compressed without much loss of information,

(iii) The technique can also be used in image compression,

(iv) Reduced labour involved in multiple regression analysis as condensed set of variables could then be used in all subsequent statistical analysis,

(v) The loss of power is minimal, especially when considering the multiple R of the components extracted, and;

(vi) The principal components are uncorrelated so as to limit duplication in our interpretations.

One major limitation of PCA was that there could be systematic errors encountered when extracting the principal components. This shortcoming was overcomed by performing also factor analysis to compare results as FA is known to have the ability to reduce the original pattern of inter-relationships from a relatively small number of factors, without the systematic error production.

4.5.6 Factor Analysis

The use of Factor Analysis in Geographical studies is well-documented (Akech, 1990; Obara, 1983; Henshall, 1966a and 1966b). Henshall (1966a) noted that geographers used Factor Analysis to study Agriculture and the rationale of its use is to achieve parsimony of description. The technique begins from a matrix of correlation coefficients showing inter-correlations between a set of the original variables.

The common factor accounts for the maximum of the variance among the variables, while the unique factor indicates the extent of which correlations with other variables in the set do not account for the total unit variance of the variables. The reference axis is usually rotated to an orthogonal position where they are uncorrelated in order to obtain the analysis. Henshall (1966b) gave variances associated with each of the factors, the contribution which each factor makes to explaining the total variance, and the correlations or loadings between the variables and factors as part of the explanation.

Obara (1983) proposed the use of factor analysis due to the following reasons:

(1) Factor analysis enables the reduction of original explanatory variables to a smaller possible collection of independent variables (factors) without any significant loss of information,

(ii) Factor analysis allows the researcher to handle sets of objects described by factor scores,

(iii) It is a useful tool in analyzing the dependence between explanatory variables and*

(iv) Factor analysis also reveals similarities between phenomena.

Akech (1990) after stating that results from Factor analysis technique could be used as input in further statistical analyses, for example in Multiple Regression Analysis, gave the following as some of the limitations of Factor Analysis:

(i) The method consists of very many different approaches that give different results,

(ii) The choice of the approaches during data analysis is often subjective, thus, limiting the comparability of factor results,

(iii) The interpretation of factor results may sometimes be invalid to the problem at hand, and;

(iv) The technique is mainly a descriptive tool and offers very little in explanation, especially when applied in problems with no existing theories.

In order to avoid many problems concerning these limitations listed above by Akech (1990), the current research uses Factor Analysis to reduce the number of principal components identified after carrying out principal component analysis. The aim was to establish which principal components, among those identified by PCA, were more influential in the production of at least 700 Kg of household food crop production (cereals) annually.

4.5.7 Cluster Analysis

According to Google (2005a and b), Cluster analysis (CA) is a multivariate procedure for detecting natural groupings in data. CA is an exploratory data analysis tool which aims at sorting different objects into groups in a way that the degree of association between two objects is maximal if they belong to the same group and minimal otherwise. Hartigan (1975) stated that like many other statistical procedures, CA methods were mostly used when there was no priori hypothesis with the research still being within the exploratory phases. The method has been applied in various fields: medicine, psychology, archeology, and anthropology.

Klastorin (1983) noted that clustering is important because it makes the organization and retrieval of information more efficient. However, cluster analysis always produces a classification, even if that classification is of little value to the user. Since clustering methods attempt to maximize the separation between clusters, the assumptions of the usual significance tests, parametric or non-parametric, are drastically violated.

Anderberg (1973) recommended that cluster analysis may be used with discriminant factor analysis. Anderberg noted that after multivariate data are collected, observations are grouped using cluster analysis and then discriminant analysis is applied in the resulting groups to describe the linear structure of the measures used in cluster analysis. In this research, discriminant analysis was not necessary as CA is just used to enable the spatial characteristics of the grouped households together with combination of factors that influence household food security to be identified. A dendrogram that clearly differentiates groups of objects will have small distances in the far branches of the tree and large differences in the near branches. A dendrogram in this case refers to a tree-like diagram that summarizes the process of clustering. Similar cases are joined by links whose position in the diagram is determined by the level of similarity between the cases.

The objects in the same cluster were given the same name, and objects were displayed in order that subtle differences may become more apparent by physically adjoining all objects in the same cluster. Data were summarized by referring to properties of the clusters rather than to properties of individual objects. The following are some of the shortcomings of cluster analysis:

(i) The classifications delivered are not significantly compelling to convince the experts, and;

(ii) The statistics themselves are not based on sound probability models and the results are poorly evaluated and unstable when evaluated.

The first shortcoming was overcome by carrying out other statistical analyses and hypotheses testing before cluster analysis. In other words, CA was just used to stress the outcome of various statistical procedures. The second limitation was overcome by combining cluster analysis with other probability models and statistical techniques.

4.5.8 Remote Sensing and Geographical Information Systems

As has been mentioned earlier, Remote sensing and Geographical Information Systems (GIS) technologies were other statistical tools that were supposed to be used to produce precise maps to aid understanding of the research results. Ogallo, ***et al*** (1993) applied cross-spectral analysis to study the relationships between the westerly/easterly Quasi Biennual Oscillation (QBO) phases as the basis for seasonal rainfall forecasting. Remote sensing is a tool for data input into GIS systems (Bernhardsen, 1992). In this research digital camera and aerial photographs were some of the remote sensing tools that were relevant in acquiring some of the data that were further intended for incorporation into GIS systems for map production. Sattelite imagery was also used to obtain some of the maps used in the thesis. However, due to inadequate trained manpower in the field of GIS, the technology could not be used and an available alternative (ArcCAD) was used to produce the maps presented in this thesis.

4.6 DATA ANALYSIS AND HYPOTHESIS TESTING

Harris (1975) recorded that multivariate statistics is an assessment of descriptive and inferential techniques that have been developed to handle situations where sets of variables are involved either as predictors or measures of performance. These multivariate statistical techniques provide rules for combining variables in an optimal way and also provide a solution to the multiple comparison problems (through the testing of null hypothesis).

According to Harris (1975) and Cole, ***et al,*** (1982), in the area of multivariate statistics, computational procedures are so lengthy as to make hand computations impractical for any but very small problems. Computer programmes are, therefore, designed for actual computations in order to handle problems that are probably encountered with real (primary) data. There were two shortcomings that have been recorded regarding the demand for computer programs. These were: one, it puts the researcher completely at the mercy of the computer programer(s) who wrote the program or adapted it to local computer systems; and two, it renders impossible an analytical approach to exploring the properties of a particular technique. The first shortcoming was avoided through systematic data processing procedures that enabled the data to be queried. The second problem was overcome by using a tested computer program like SPSS. For example, Harris proposed SPSS as one of the statistical programs useful for multivariate statistical analysis. In addition to SPSS, SYSTAT version 7.0, Microsoft Word and Microsoft Excel for windows XP have also been used in one way or another during data analyses procedures. For example, SPSS was used in the laying of the structure and obtaining descriptive analysis, Partial and Multiple Correlation analyses, Multiple Linear Regression analyses as well as Factor Analysis. SYSTAT was used to run Stepwise Multiple Linear Regression analysis, Principal Component Analysis and Cluster Analysis. After observing the requirements for individual statistical procedures, the appropriate null hypotheses were tested and then the results were interpreted. It was these procedures that have resulted into the production of this thesis and the conclusions made there from.

4.6.1 Hypothesis Testing

After the use of statistical analytical techniques, the null hypotheses formulated were tested in order to draw conclusions in the research. Individual null hypotheses were tested for each area examined in the thesis, this is to say, areas dealing with climate, economic issues, social factors, demographic and health factors. The null hypothesis was that there was no relationship between the above variables and household food security (p = P = 0). The null hypotheses were tested after regression analysis using the F statistic. This enabled generalizations from relatively small groups of individuals to other individuals (the population) with similar characteristics (McNeil, ***el al,*** (1975)).

The null hypotheses tested in this research were as follows:

1 **(a) There is no relationship between Household food security and drought occurrencc.**

(b) There is no relationship between household food security and flood occurrence.

2 **(a) Economic factors do not influence household food security.**

(b) There is no relationship betw een social factors and household food security.

3 **(a)Dcmographic factors do not influence household food security.**

(b) There is no relationship between health factors and household food security.

4 **There is no relationship between household food security and poverty.**

The null hypotheses were separated so that each category of variables could be examined. The statistical hypotheses for all the research hypotheses is that there is no difference in the population variances, which is tested by F statistic at 95 percent confidence interval. The results of the above processes are discussed in chapters Four (4), Five (5), Six (6), Seven (7) and eight (8) with summary of the conclusions and recommendations, being given in chapter nine.

4.7 RESEARCH LIMITATIONS

This study initially considered the wisdom of analyzing the efficiency of labour using the Cobb-Douglas Production Function (Yotoupolos, 1967), but this line of approach was discarded due to the many variables required in order to use this model. Secondly, the issue of efficiency of labour is already covered in the quantity and quality of household labour. Similarly, due to late availability of funds and envisaged problems of data collection for this research, some non-essential aspects were not covered in the research. These involved such topics as:

i) National food imports and food aid in years of food shortage,

ii) Detailed analysis of marketing structures on the national scale, and ;

iii) Human diseases linked to food security other than Malaria and HIV/AIDS

The issue of household food security is complicated and encompasses several factors that require proper investigations to enable detailed data analysis to be carried out, thus resulting into a lengthy questionnaire that took long to administer. The respondents were therefore requested to be a little patient in advance and in some cases allowed to recommend their free time when they could respond to the questions more effectively. Like many other researchers, in order to minimize costs of research, the pilot survey was limited to only 10 questionnaires. In some cases cross-sections were taken rather than visit individual areas to minimize the costs.

As far as the data collection was concerned, some respondents were illiterate and had problems articulating the responses to the questions that were addressed to them. This forced the interviewer to translate the questionnaire into a language that they could understand. This was common in Miwani, particularly, in Obumba village and also Muhoroni division. Educated people responded better to the questionnaires. Many farmers also do not keep records on crop production, labour costs, cultivation, weeding and harvesting. In addition, labour costs were paid for differently, both in kind and in cash and therefore were difficult to cost. Further, other respondents were either reluctant to respond to the questionnaires as a result of previous experiences with other researchers or were afraid to talk about HIV/AIDs. Some farmers also did not want to reveal their farm numbers. As a result, some sections of the questionnaire, was not answered by every respondent as expected. These were the reasons leading to fewer households selected for multivariate statistical analysis in each case.

Bad weather, particularly due to rainfall, interfered with data collection exercise in areas such as God Abuoro and Achego. The research had to be terminated until the rain subsides or the interviewer had to risk being rained on. Some of the farmers who could have been found in the farms, therefore, could not be interviewed. Ragged topography in Upper Nyakach division inhibited sampling in some areas, in addition to poor infrastructure towards the interior from the main road. Another problem experienced during the research was disorganization of the government offices, particularly, when the researcher was trying to have access to secondary data. This is because the District is newly created and the offices are scattered from Kisumu to Ahero to Boya through to Awasi, the District headquarters. The researcher had to persevere in order to overcome the obstacles during such moments.

The researcher would like to to state that due to limitations of software used in map production in this thesis, some maps might not be as clear as expected. In cases where such problems appear to be more serious, efforts have been made by the researcher to provide further explanation underneath the maps.

4.8 SUMMARY

The chapter has given a summary of the different types of data and methods of analysis that had been handled by different scholars in the area of food security and poverty, together with the relevant methodologies that could yield at least some reliable results. Existing data relating to climatic issues and food security and poverty include, information on rainfall reliability, human dynamics, smallholder households as some of the poorest households, diminishing resources during drought and flood episodes and their impacts on crops and man, and the role of cereals as food security staples. Regression and correlation analyses using a System's Approach emerged as one of the most relevant methodologies when dealing with these problems.

In terms of socio-economic data, the areas studied included data concerning the relationships and inter-relationships between these factors, climatic, demographic and health issues. Main areas dealt with issues on land, labour, capital, and nutritional status among households, together with constraints to agriculture, vulnerability to food security and poverty, and government policy. The relevance of using both primary and secondary data sources together with the use of various sampling techniques was stated.

Data is also available on the linkages between population and human resources, environment and development, and food security and poverty. Additional data dealt with population growth rates, structures, processes and the emphasis on the need to integrate the demographic and socio-economic as well as climatic data using a system's approach to address various problems. As the demographic and health factors arc inseparable with socio-economic issues, similar methodologies and data can be used to deal with the emerging challenges in the two areas of research.

The existing data regarding food security and poverty include the role of agriculture in national development, relationship between the natural and socio-economic environment and crop yields, ways of improving food security and vulnerability to poverty. The relevance of statistical methods like Principal Component analysis, Factor Analysis and Cluster analysis were also discussed.

In the current study, the primary sources of data included field interviews, focus group discussions, general observations and recording, while secondary data was obtained from different libraries for both qualitative and quantitative analyses. Systematic, simple and stratified random sampling techniques were used, where appropriate, to sample the studied locations, sub-locations and households with initial sample size of 279 households. The data was collected and processed manually and using various computer software. Different multivariate statistical analyses were applied (Multiple correlation and Multiple Linear Regression, Principal Component, Factor and Cluster Analysis). The choice, purpose, and expected results of each methodology were related to the recommendations of the previous research in terms of their success over alternative approaches. Chapter five, which follows the present one, deals with the first objective and the results of tested hypothesis between climatic factors and food security.

CHAPTER 5

CLIMATE AND FOOD SECURITY

5.1 INTRODUCTION

Among the Millennium Development Goals (Sanchez, ***et al,*** 2005), climatic shocks were among the five (5) major factors listed as responsible for causing hunger. Other factors were poverty, low food production, illiteracy of the mother, poor water, and sanitation and health facilities. In this Chapter, our major concern has been the climatic factors that influence household food security, particularly, droughts and floods. The three elements (temperature, rainfall and wind) are of particular importance to this study as the author assumed that all crops grown within Nyando District grow on the basis of the available sunlight and evapotranspiration levels, with only the three elements, varying spatially and temporally. Further, these three elements are also responsible for the development of crop pests and disease pathogens, which later destroy crops, while also interfering with sunlight and evapotranspiration not only in the study area, but also as witnessed in other parts of the world. The impacts of these elements are discussed in the subsequent paragraphs.

This chapter also attempts to characterize the link between weather and climate and food security in Nyando District. First, the relationships between climate variability and household food security and poverty are provided in order to explain how climate variability has been affecting agricultural production and its relevance in Nyando District. Secondly, an attempt is made to analyze statistically, the link between household food production and drought as well as floods using regression analysis and concentrating on household responses and characteristics to climatic factors. This is followed by detailed discussion of the spatial and temporal features of the impact of drought and floods in the study area. In the concluding parts of the chapter, remarks on drought and foods are brought together in the discussions.

The Correlation and Multiple Regression Analyses were aimed at investigating the existence of a relationship between climatic factors (drought and floods) on household food crop production, which also formed the basis for other discussions.

Droughts and floods came out as serious climate variability problems, and temperature and rainfall were isolated as being important weather elements that not only influenced household food security, but also controlled the effects of other weather elements like solar radiation and evapotranspiration, on crop production. Other issues addressed were the vulnerability of the sampled households to droughts and floods, impacts of such hazards, and coping strategies, with the summary section giving the research findings and conclusions drawn.

5.2 THE RELATIONSHIP BETWEEN CLIMATE VARIABILITY AND FOOD SECURITY AND POVERTY

Although crops are influenced by the biological factors (soils, insects, pests and diseases) and physical factors (relief and climate), it is the climate, which sets the limit for crop production (Grifiths, 1966). The main climatic elements in agriculture are temperature, moisture, sunlight, winds and evaporation and any crop grown must find suitable combinations of these within its own microclimate. These effects of climatic factors on agriculture has been discussed in detail by Chang' (1969) as shown earlier in the literature review. Commenting on drought, Hertsgaard (2004) puts it that if climate change is not moderated, more people will die in years to come either directly, through more destructive storms and droughts or indirectly through declines in food production and the spread of infectious diseases. Soil factors in Nyando District, were studied in detail by Obara(1983).

The issue of climate variability within the ecosystems, in this study, is linked to the farm system's approach, whereby the various enterprises within individual households are assumed to be inter-related and dependent on the existing environmental conditions. (Oluoko, 1996; Obara, 1983; and Ruthenberg, 1980). Environment, in this case, encompasses all the physical factors (climate, geomorphology and geology), biological factors (flora and fauna), and socio-economic factors (effects of human activity on the natural environment, such as transportation, agricultural crop production, urbanization and industrialization among others) (Billings, 1966). The system then becomes the pillar for sustainable development as it provides all services to the various ecosystems, both terrestrial and aquatic in nature (UNEP, 2001). The climate system of Nyando, is therefore, believed to emerge from the symbiotic relationship, between the aquatic and terrestrial ecosystems (IPCC, 2001), which is an interactive system of the atmosphere, the biosphere, the hydrosphere, and the cryosphere, together with the geological structure and, which respond to the solar radiation. The relationship results into temporal and spatial climatic variations, relative to the latitudes, distance to the sea, vegetation and topography, envisaged in the average weather (often in terms of mean and its variability are recorded). In this context, weather refers to the fluctuating state of the atmosphere, characterized by the temperature, wind, precipitation, clouds, solar radiation and evapotranspiration (IPCC, 2001).

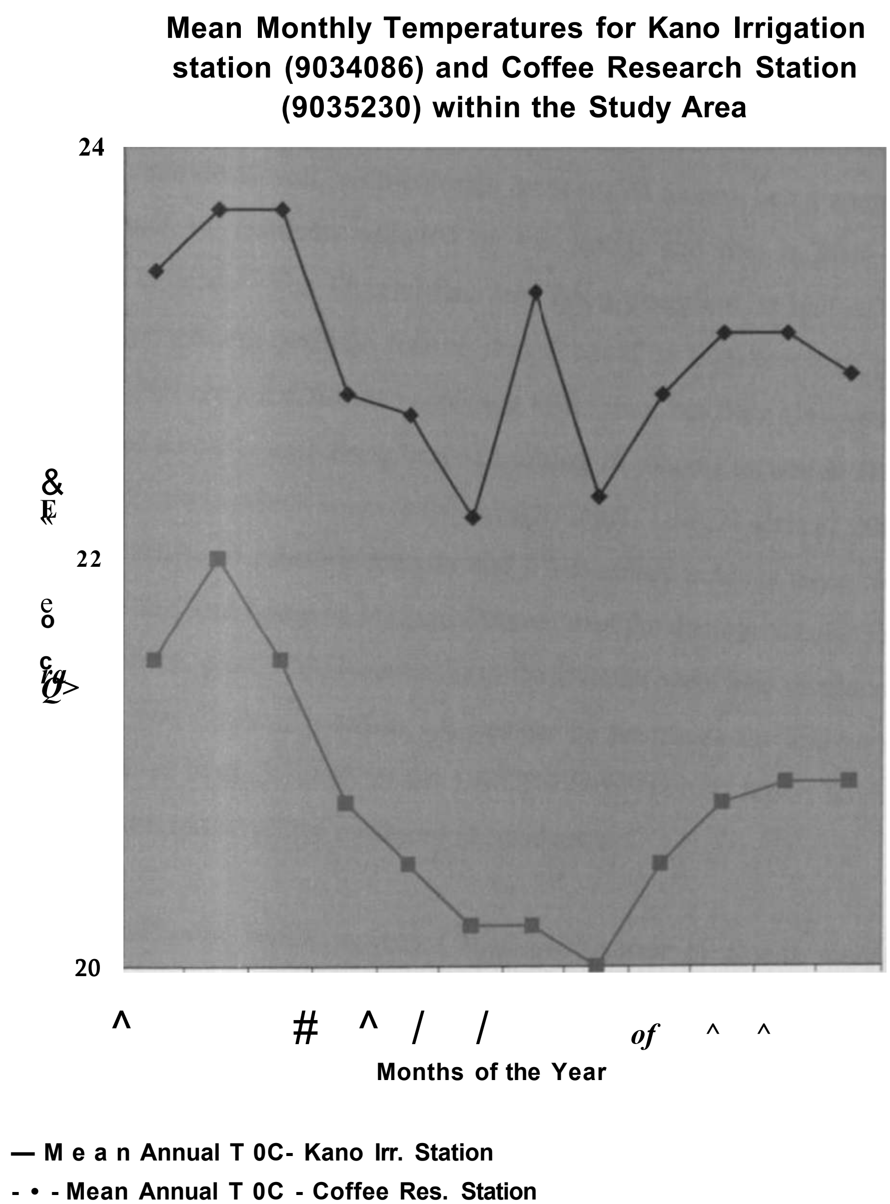
Although the DMCN-UNEP report attributes floods in Nyando to increased rainfall, the results of the current study revealed that, flooding in Nyando was mainly due to heavy rainfall within the catchment areas of major rivers (Nyando and Sondu Miriu), since both floods and droughts occurred simultaneously.

A knowledge of the difference between air and leaf temperature assists farmers in adopting protective measures, as frost often occurs before the air temperature in the instrument shelter drops to freezing point in the middle and high altitudes (Chang', 1969). There are two temperature-recording stations in the study area, namely, the Kano Irrigation (Lower Midland) and Coffee Research Station (Upper Midland) (Jaetzoid, ***et al,*** 1982), and Figure 5.1 provide the Temperature characterisitcs in Nyando District. Households in Nyando District suffer many losses whenever there is flooding in the area, resulting into severe household food security and poverty problems (DMCN-UNEP (2004) report.

As far as floods is concerned, Moyses dos Reis ***et al*** (1992) in Brazil, identified three different types of floods, namely,

- ordinary floods - small and reaching 3-4 metres,
- intermediate or extra-ordinary floods - regular and frequent, reaching 4-5.5 metres and supply the surface and sub-surface reservoirs, and;exceptional floods which are very frequent, with serious social and economic consequences (reaching 5.5-6 metres), including the submerge of pastures, and the reduction of dry rest areas. These may cause serious consequences due to the delayed water drainage.

Figure 5.1:



Source: Jaetzold, et al, 1985.

Moyses dos Reis suggested, therefore, that the high and low water marks should be used as essential signs to warn the people about the coming of droughts and floods. The researcher believes that Nyando District may have experienced at least one of the three types of floods at one time or the other, though no proper documentation is available to verify this fact.

DMCN-UNEP (2004) states that floods in Kenya in 1997-1998 sparked major emergency relief as hundreds of people lost their lives and thousands were displaced from their homes. The cost of floods was estimated to be US Dollars 1 million, apart from the damage they caused to the infrastructure. Agricultural reports on Nyando reported that in the year 2004, floods in Nyando District swept thousands of acres in Nyando, Miwani and Lower Nyakach divisions, exposing residents to extreme hunger and deprivation. Further, large tracks of land under rice, maize and beans (staple food of the locals) were destroyed, with colossal amounts of money being spent to evacuate and feed thousands of residents affected by the floods and this in turn, reduced Nyando people into beggars. The District has now been classified as one of those in Nyanza Province experiencing periodic famine, exacerbated by high levels of poverty prevalent in the area. Not only did floods contribute to famine, but they also resulted into deaths, destruction of property and disruption of learning in schools as was in Brazil. In the year 2005, according to various sources (Nyaranga, 2002; DMCN-UNEP, 2004 and Republic of Kenya, 2001a), 15 primary schools and 3 secondary schools were closed and nearly 7200 pupils were sent home in Nyando District, and the damage was estimated at Ksh. 60 million. Similarly, over 300 Households in the District were also displaced, and the most affected area was Ombeyi location. A number of proposals for finding solutions to the flood problem in Nyando such as the DMCN-UNEP (2004) report have been prepared since 1969 but these have not produced good results.

The fieldwork results revealed that areas prone to floods were also prone to droughts and poverty was one of the contributing factors to vulnerability to these calamities. On the other hand, (Nyaranga, 2002 and Agricultural Reports of Nyando for the year 2004) stated that major issues causing vulnerability to these flood hazards in study area include low-income levels, poor planning and management of agricultural farm lands. Additional factors include high population densities and inexperience of the community to cope with some flood risks as trade-off against beneficial services or goods. Studies carried out in Nyando (DMCN-UNEP, 2004), emphasized that vulnerability to floods occurred due to the following:

(a) lack of poorly, implemented flood management policies,

(b) lack of flood preparedness,

(c) poverty/health, education/human capacity,

(d) conflicts, unfocussed development plans and population dynamics,

(d) dependence or over-exploitation of natural resources,

(e) lack of flood mitigation strategies, and;

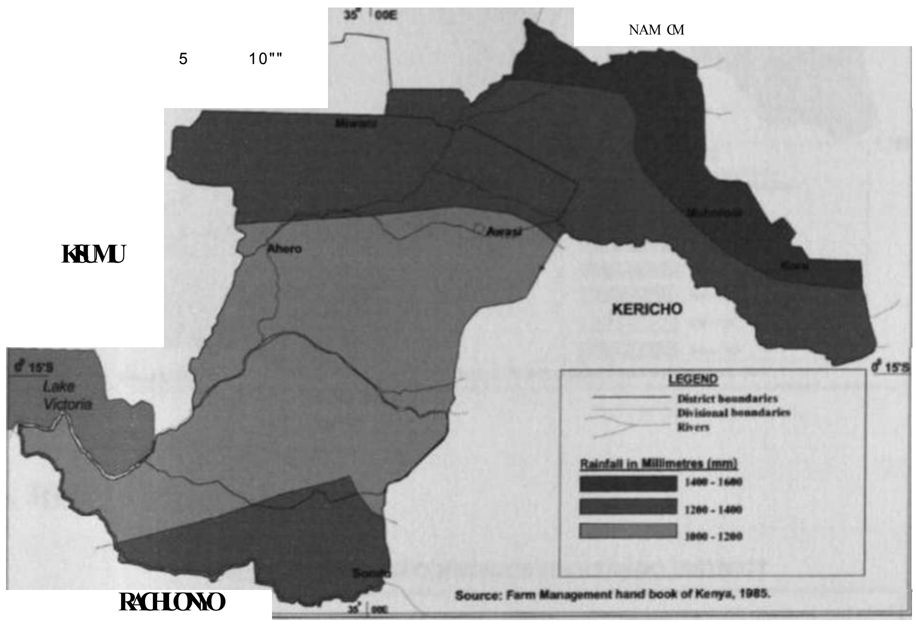
(f) building resilient human, economic and natural systems.

In contrast to floods such as those, which have taken place in Nyando District, drought conditions, which occur due to below normal rainfall exist when the amount of water needed for transpiration and direct evapotranspiration exceed the amount available in the soil, resulting into plant wilting and eventual death. There are three types of droughts, namely, permanent droughts, seasonal droughts and unexpected droughts (Chang', 1969 and Griffiths, 1966). Under permanent droughts, water must be applied for a crop to survive and therefore, this type of drought is not found in Nyando, the study area. Seasonal droughts occur regularly, for example, between July and August and December and January each year during which farmers try to make allowance for irrigation where appropriate. The most important type of drought in this research is the one due to the variations in rainfall pattern from the expected average, whereby, a long spell of dry weather finds the crop producer completely unprepared to irrigate, leading to a total loss of crop in question. It is on this basis that rainfall data relating to and required at various stages of crop development is collected in order to ascertain the likelihood that, given amounts of rain will fall at each stage, hence, justifying the use of such data in this part of the thesis. Some of the data concerning Nyando District has been provided in the section dealing with agro-climatic issues and food security and poverty.

There are about six rainfall stations in Nyando District, namely, Miwani (the Mill), Ahero, Kano Irrigation Station, Chemelil Plantations, Koru Mission, Koru Homalime Company, and Koru, Coffee Board Substation. According to Jaetzold, ***el al,*** (1982), the areas close to the lake (sugarcane zone-LM 1 and 2) receive less amount of rainfall. Water stress occurs after the second rains, which are feeble and not very reliable (450 - 600 mm) and therefore there is very little storage surplus for the real dry season with its peak in January. This can be seen for the rainfall figures for Miwani station. Towards the plain (the cotton and marginal cotton zone - LM 3 and 4) the reliability of the second rains becomes so low and they are also scattered, thus making the cultivation of the second annual crop difficult. It is also difficult to define the second growing season as will be seen in data obtained from the fieldwork. The Tea-CofTee Zone (UM 3) are very small and are found only in Upper Nyakach division. See figures 5.2 and 5.3 for the mean annual rainfall and rainfall reliability of the study area.

Figure 5.2:

MEAN ANNUAL RAINFALL IN NYANDO DISTRICT



Rainfall figures for the area show that Chemelil, Muhoroni, Koru, and Upper Nyakach areas receive between 1200mm and 1400mm of rainfall annually, though there is an element of uncertainty in the rainfall figures received. Lower Nyakach and Awasi areas receive between 1000mm and 1200mm of rainfall annually. It is this area that is prone to prolonged droughts in Nyando. First season rains, which are expected from end of February to July are 60 percent reliable. However, the reliability of the second season rains, which are expected between end of July and end of January need verification in order to ascertain the results of Jaetzold, ***el al,*** (1982) which give 60 percent reliability and the relationship with crop performance of the affected areas of the District.

Figure 53(a):

RELIABILITY OF FIRST RAINS IN NYANDO DISTRICT

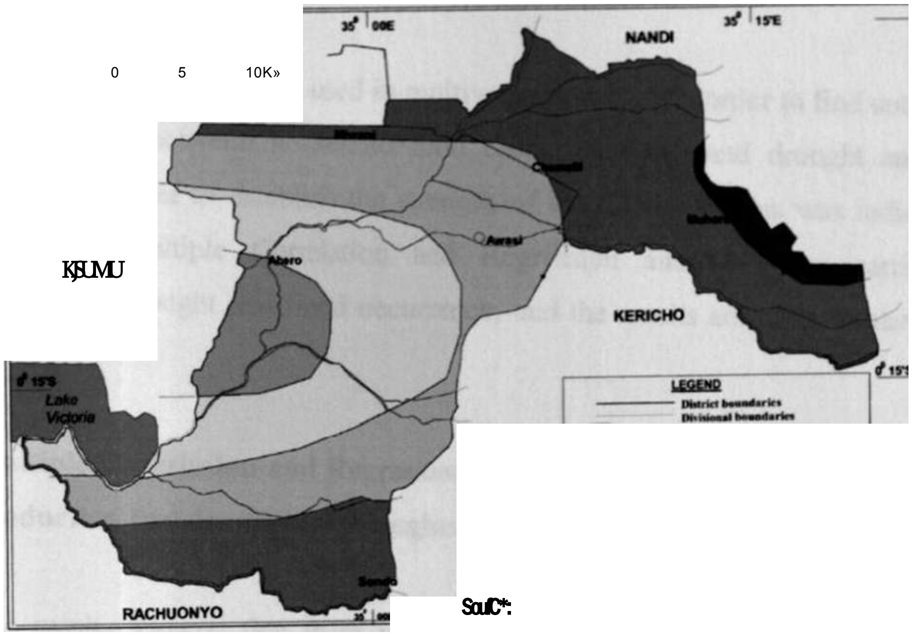
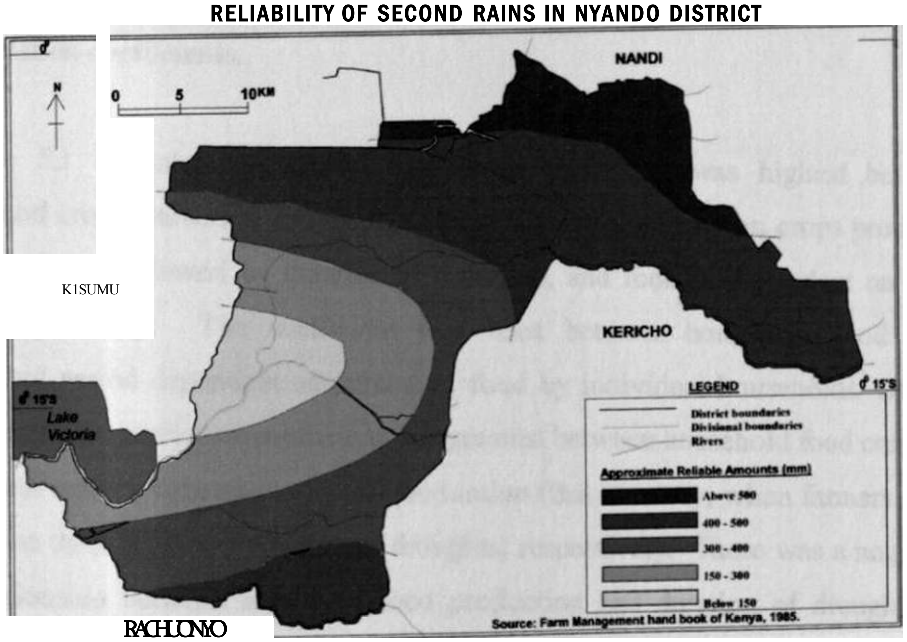


Figure 5.3(b):

RELIABILITY OF SECOND RAINS IN NYANDO DISTRICT



53 THE EFFECT OF CLIMATIC FACTORS ON HOUSEHOLD FOOD CROP PRODUCTION

Various households were used in multivariate analysis in order to find out if there was a relationship between household food crop production and drought and flood occurrence and further to establish the strength of the relationship as was indicated in chapter three. Multiple Correlation and Regression analyses were carried out independently for drought and flood occurrence, and the results are given in the rest of this chapter.

5.3.1 Multiple Correlation and Regression Analysis between household food crop production and duration of droughts

The results showed that there is a relationship between household food crop production (Y) and other independent variables (period dependent on crop production (Xi), period dependent on purchased food (X_2), and duration of drought (X_3), since no correlation coefficient was zero. These results are given in Table 5.1 of Multiple and Partial correlation coefficients.

Table 5.1 indicates that Partial correlation coefficient was highest between household food crop production and months when farmers depended on crops produced on their own farms followed by duration of droughts, and months dependent on crop purchases, respectively. The coefficient was least between household food crop production, and period dependent on purchased food by individual households. On the other hand, Multiple correlation coefficient was greatest between household food crop production, and months dependent on crop production (this is to say, when farmers used crops grown on their land) and duration of droughts, respectively. There was a negative multiple relationship between household food production and duration of droughts as well as months dependent on purchased food (when farmers had to purchase food). Only 89 households were able to answer all the questions relating to climate and household food security and poverty, therefore, the sample size in this analysis was **89.** The means and standard deviations of Xj, X_2, X_3, and Y were 3.0, 3**.9,** 2.3, and 2**.8;** and 1.6, 1.3, 1.0

and 2.4, respectively. The coefficients were significant at 0.05 significance level for household food crop production and months dependent on food production.

Table 5.1 Multiple and Partial correlation coefficients of Climatic Factors and Food Production

	Period/ Months dependent on crop production -X,	Period/ Months dependent on purchased food - x_2	Duration of droughts - X3	Total /Household food crop production - Y
X,	1.000	1=0.179 2=0.094	1 =-0.089 2=0.408	1=0.389 2=0.718
X_2		1.000	1=0.160 2=0.135	l=-0.195 2=0.067
X_3			1.000	1 =-0.150 2=0.159
Y				1.000

Source: Multiple Correlation Analysis (1 = Multiple correlation coefficient/Pearson correlation Coefficient and 2 = Partial correlation coefficient throughout the thesis)

Multiple linear Regression analysis results gave values for R (the Multiple Regression Coefficient), and R^2 as 0.223 and 0.050, respectively. The value for R^2 indicates that the independent variables entered in this analysis could explain upto 5 percent of the variations in household food crop production. The F statistic gave a value of 1.481,which was significant at 0.225 level of significance, slightly above, 0.05 confidence level as was intended in this research. This meant the research hypothesis of no relationship between months of flood and household food crop production could not be rejected so as to avoid the risks of type 1 and 2 errors. It was therefore, concluded that there could have been other factors (not enumerated) among the sampled households, which in addition to droughts affected food production. The Analysis of Variance (ANOVA) is shown in Table 5.2.

The resulting linear regression equation using standardized coefficients was:

$$\mathbf{Y = 4.371 + 0.058X, - 0.167X_2 - 0.122X_3}$$

All the t ratios in all the analyses in this thesis are provided in Appendix 2 at the end of the thesis. The equation revealed that there was a negative relationship between household food crop production and months dependent on purchased food as well as duration of droughts. There was however, a positive relationship between household tood crop production and months dependent on food crop production. This meant that whenever there was a good harvest or the absence of drought, in this case, most households depended on crop production without any need to buy extra food. The above relationships were, however, very minimal.

Table 5.2 Analysis of Variance (ANOVA)

Model	Sum of Squares	Degrees of freedom (df)	Mean square	F	Significance
1 Regression Residual Total	25.310 484.195 509.506	3 85 88	8.437 5.696	1.481	0.225

The partial regression scatter plot between duration of droughts and household food production showed another random association between points (-2, 2) and (1,2). The random association between the two points indicate that drought in this area does not lead to total crop failure, for example, 8 months of drought could lead to about 200Kg of household food cereal production and which was also equivalent to having a whole year of drought. It could be concluded that drought ***per se,*** is not a serious problem in this region, as some production could still be attained, which could be maximized using drought resistant crops. On the other hand, if these droughts were serious, then, there could be some households in the District whose household food crop production was 200Kg annually, as a result of farms located probably within Upper Nyakach or Muhoroni divisions and whose crop failures were independent of the lower zones.

53.2 Multiple Correlation and Regression Analysis between Household food production and duration of Floods

Table 5.3 gives the results obtained from correlation analysis. A two-tailed significance test was used, and according to Table 5.3, there was a direct relationship between household food crop production and all the independent variables (period dependent on crop production or household food purchases and duration of drought. The relationship was weakest between household food crop production and months dependent on crop production but was highest between household food crop production and months dependent on purchased food.

Table 5.3 Spatial Correlation Coefficients

	Months/ Period Dependent on Crop Production - X|	Months/ Period Dependent on Purchased food - x 2	Duration of Floods (months) - X3	Total crop production (Kg) - Y
XI	1=1.000	1 =-0.113 2=0.513	1=0.519 2=0.001	1=0.277 2=0.102
X2		1=1.000	1=0.0709 2=0.681	1 =-0.066 2P=0.702
X3			1.000	1=0.117 2=0.497
Y				1=1.000

Source: Correlation and Regression analysis

The correlation between food production and duration of floods was 0.5. The results revealed that during floods, most households depended on purchased food, and the intensity of the problem depended upon the state of the previous harvest and the availability of stored grain.

The Multiple correlation coefficients were highest for the relationship between household food crop production and months dependent on food crop production, though the association was quite weak. There was also a negative multiple relationship between household food crop production and months dependent on purchased food. This could be explained by the fact that, there was a very high positive multiple and partial correlation between duration of floods and months dependent on purchased food. Increased household food crop production, therefore, could be attained only in the absence of floods, which means no food purchases and mainly reliance on household food crop production. Among the three independent variables, duration of floods had the greatest control on household food crop production, with a multiple correlation coefficient of 0.5, as compared to other independent variables. The means and standard deviations for X], X_2, X_3, and Y were 1.8, 1.9,0.2, and 2.9, and; 2.8, 3.9, 1.1, and 3.1, respectively.

After carrying out Multiple Linear Regression Analysis, R, and R^2 values were 0.280 and 0.078, respectively. The variables entered into this analysis (period dependent on crop production and household food crop production and duration of floods) accounted for 7.8 percent of the variations in household food crop production. This means that the above variables are only responsible for about 8 percent of the variations in household food crop production. The Analysis of Variance results were as shown in Table 5.4.

Table 5.4 Analysis of Variance (ANOVA)

Model	Sum of Squares	Degrees of Freedom	Mean square	F	Significance
1 Regression Residual Total	22.444 263.862 286.306	3 32 35	7.481 8.246	0.907	0.448

Source: Regression Analysis

These results were, however, not significant at 0.05 significance level (or 95 percent confidence interval) as was intended during analysis. It was possible, therefore, that some households might have withheld some relevant data during the fieldwork. The resulting regression equation was:

$$\mathbf{Y = 2.44 + 0.29X, - 0.03X_2 - 0.03X_3}$$

The equation showed a positive relationship between household food crop production and months dependent on crop production and a negative relationship between household food crop production and the remaining variables. The research hypothesis of no relationship between duration of floods and household food crop production could not, therefore, be rejected in order to avoid both type I and type II errors. In conclusion, there was no evidence to enable the rejection of the null hypothesis. The partial regression plot for household food crop production against duration of floods showed a weak association between points (-0.4, -0.4) and (0.2, 4). The point (-0.4, -0.4) indicated that there were some farms in Nyando District which were not used for household food crop production (either they are permanently submerged in water or considered unsuitable by various households), and which might indicate a sign of degrading agricultural land in the region. In other words, about 6 months (6 out of 12 months) of floods led to a negative household food crop production whenever the farms were destroyed by floods, such that the floods resulted into a total crop failure on the affected farms, irrespective of land preparation activities. Further, when there was only about 2 months (point (0.2, 4)), of floods within the affected areas, it was possible to harvest upto 400Kg of household crop production. The weak association could be attributed to the spatial variations of the households selected for this particular type of analysis.

5.4 AGRO-CLIMATIC ISSUES, FOOD SECURITY AND POVERTY IN NYANDO DISTRICT

The rainfall data on the study area was obtained from Kenya Meteorological Department in Nairobi and compared with those found at the Agricultural Office in Nyando. The data was used in order to find out whether (a) drought actually occurs in the study area, (b) crops failed due to the late onset of rains/ poor rainfall distribution, or (c) due to the farmers' failure to carry out the agronomic activities in time. The researcher would have liked to use statistics for the year 2004 when the fieldwork was carried out, but this was not available. However, since the most important task was to verify if drought occurrence is real in the area, any statistics relating to Nyando and which is comparable to the records in the District Agricultural reports was considered appropriate. Although there were some irregularities on the data, the District Agricultural annual reports for the year 2000 blamed crop failures on poor distribution of rainfall just as the fieldwork results emphasized, as will be shown later in this chapter. Other reasons for crop failures were untimely, and poor agronomic practices, infestation of crops by weeds, pests and diseases, and lack of use of recorded farm inputs. Table 5.5 gives Rainfall figures for Miwani (station 9034009) for the year 2000. Similar Figures are represented in Figure 5.4.

According to this table, January, February, March, April, May, June, and August received below normal rainfall (which, also confirm the existence of drought episodes during the year). July rainfall was near normal (73.7 percent compared to 75 percent which represent normal rainfall). September, October, November and December received above normal rainfall, though there was no evidence of flooding as no percentage was greater or equal to 125, which indicates flooding.

Table 5.5 The 39- year period Mean monthly rainfall (L/T Mean) and Results of Rainfall recording for the year 2000 (R/fall) in station 9034009 - Miwani

Month	J	F	M	A	M	J	J	A	S	O	N	D
UY Mean (x)	155	157	283	480	480	206	179	200	256	254	314	169
R/fall(mm)-x	29	63	87	226	146	56	132	107	248	203	331	169
Percent (%)	19	40	31	46	30	27	74	49	97	80	105	92

Source: Kenya Meteorological Department, Nairobi.

(J,F,M,A,M,J,J,A,S,0,N,D refer to January, February, March, April, May, June, July, August, September, October, November and December, respectively.

Figure 5.4:

The 39-Year Long-term Mean Monthly (Blue) and Rainfall recording for the year 2000 (Red)

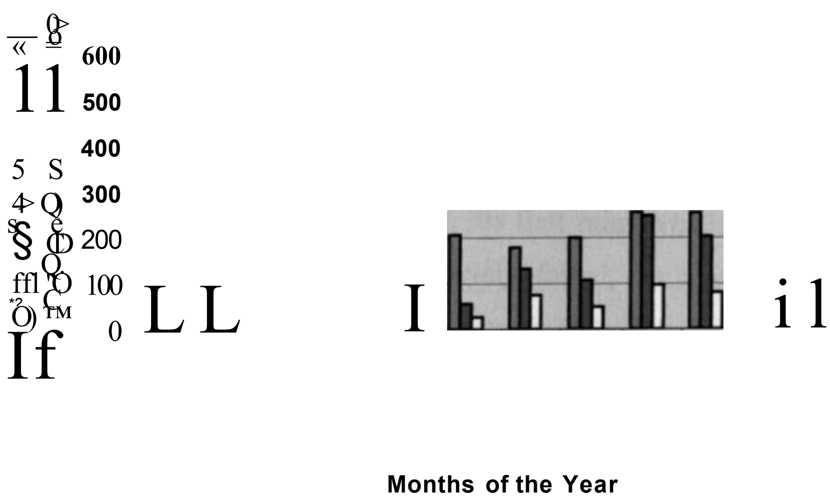


Table 5.5 has been selected as representing the greater part of Nyando District. It is the only station with over thirty years of continuous record for rainfall in the District. The Table contains Long-term monthly mean rainfall (mm), actual rainfall for the year 2000, and monthly percentage of the Long-term variation received in the year 2000. On the basis of this table, it can be concluded that all the months of the year expect to receive some rainfall, with the highest figures being recorded in March - May, and a secondary peak is observed from August to November. The variability of the amounts received for each month in any one year is brought out by figures for the year 2000, where the first six

months of the year were decidedly dry (percentages received ranging from a low of 19 to a high of 46) of the Long-term mean. The performance for the rest of the year was no better. The Table leads one to conclude that although rainfall may be expected throughout the year, the accompanying variability is such that crop failure due to inadequate rainfall during the main rains (March - May - August to November), may be expected in any one year. It is this state of affairs that justifies the need for irrigation for optimum crop performance, although in actual fact, only rice has benefited from irrigation, and sugar cane in a very limited area close to Chemelil. The incidence of agricultural drought may be observed particularly in those areas close to the lake, where the probability for receiving 300mm or higher during the short rains is low. When it comes to flood occurrence, the likelihood of floods to occur during the months of March, April and may during the long rains and during the short rains from September to November is self-evident. Furthermore, flood occurrence is more linked to heavy rain in the catchment areas of Nandi, Tinderet and Kericho for the Nyando River and Mau Forest and Kericho highlands in the case of the Sondu/Miriu for floods in Lower Nyakach.

The data on Table 5.5 further confirm that there were drought episodes during the year 2000 in Nyando District. Secondly, the first rains which have their onset between February and continued to July completely failed, so that both the seasonal and unexpected drought occurred between the months of January and February, and April and May, respectively, as the rainfall figures were all below normal. Thirdly, the second rains that start from July and continue to December were heavy and were above normal, though there was no evidence of floods in this particular year. These comparisons regarding the year 2000 can assist a reader in evaluating how reliable the fieldwork results are, when added also to the District Agricultural records for the year 2004, (year of fieldwork).

All households, which responded to the question concerning the onset of the long and short-rains were unanimous that the long rains season start in February and end in May. On the other hand, the short rains period begin from July and end in October. These responses were very close to what was stated by Jaetzold ***et al*** (1982) more than two decades ago. According to Jaetzold, the first rains (long rains) start on February and end in May as the farmers stated, but the second rains (short rains) onset mainly in August and end either in September or October. This meant that the long rains still have similar reliability as was about two decades ago while the second rains might have reduced in terms of reliability as was realized using the 39 year period rainfall records for Miwani.

According to the District Agricultural Reports for the year 2004, the year 2004 was not only unfavourable for Nyando District, but also for the entire country. This is because there were large records of crop failures together with flood occurrences as a result of failure, or untimely rainfall distribution, attributed to late onset of rains, which delayed the agronomic processes, with drought entirely destroying crops in certain localities. For example, between February and March, the onset of the long rains started by the third week of February and continued through March, with the highlands (Muhoroni and Upper Nyakach divisions) receiving adequate rainfall, while the lowlands (Nyando, Lower Nyakach and Miwani divisions) had inadequate rains. There was confusion on farm activities geared towards land preparation (ploughing, planting and weeding), as all the agronomic activities were taking place simultaneously depending on the onset of the rains in each division. According to the Fieldwork results and various Agricultural Reports for Nyando District, before the onset of droughts, various households were able to survive through consumption of root crops, or cooking bananas. Additional means of survival included selling vegetables, fruits or rice; with some church organizations providing food-for-work food relief, which in the year in question or as estimated at about 10 000 bags (90Kg sacks) of cereals.

Between April and May, both wet and dry periods were reported, with floods being experienced in the lower zones. A total of 3756 ha of crop area was reported as having been completely destroyed and waterlogged, due to floods occurring along water sources and where horticultural crops such as fruits and vegetables were planted. Crops planted in January were destroyed by floods, which also affected agronomic activities such as planting, and weeding. The flooding experienced in the lower zones was attributed to heavy rainfall, within the catchment areas, and not necessarily, heavy rainfall within the district, hence, simultaneous occurrence of both drought and floods. As a result, the various households within flood prone zones of Nyando, could not be solely held responsible for poor agronomic practices, as in this case, it was mainly a climatological problem. Further, there was an outbreak of Quelea Quelea birds, which damaged the cereals, in addition to tomato blight and wilt. As a result of the combined problems, food prices escalated, on the already available foodstuff, though few families could afford them due to their low purchasing power. Various households were therefore forced to depend upon root crops and fruits as sources of food and income together with relief food.

The June-July period of the same year witnessed continued escalation of food prices, particularly cereals like maize and sorghum, with most of the foodstuffs being imported from the neighbouring districts. On the other hand, there were high temperatures (greater than 30°C), without any rainfall with most field crops showing moisture stress. The destruction of maize fields during the April-May period reduced maize fields from 11,647 ha to 8736 ha, leading to reduced yields. Over 50 percent of the households experienced total crop failures, and although food-for-work supplements were available in June, they were not available in July, otherwise, other coping strategies, remained the same as was in the previous months. Diseases such as bacterial wilt, blight, black rot, greening disease in citrus, together with pests like aphids, boll-worm, diamond black moth, among others, were reported.

The agronomic practices during the January-July period of the year 2004 are summarized in Table 5.6. The table is an attempt to highlight the problems of drought and floods occurrences even during the main rainy season, at the peak of agricultural activities in Nyando District, which are accompanied by rising food prices. The simultaneous occurrence of drought and floods within the lower zones is an indication of the vulnerability of the respective households located in these areas.

5.5 VULNERABILITY TO DROUGHT AMONG SAMPLED HOUSEHOLDS

According to the fieldwork respondents, drought occurred in the areas shown in Table 5.7. The table is also illustrated in figure 5.5, showing Drought Occurrence in Nyando District.

Rainfall received during the Long Rains in Muhoroni (1) and Upper Nyakach (2) stations, the accompanying Agronomic practices, Drought/Flood episodes, and Cereal prices for the year 2004.

Month	Rainfall received in stations **1** and **2** (mm)/number of wet days	Agronomic activities	Drought/ Flood episodes	Cereal prices (Ksh.) per 2Kg tin for Maize **(1);** Millet **(2);** Sorghum **(3);** Rice **(4);** and Beans **(5)**
February	**1**-578/(24) **2-** 39/(2)	Land preparation	Drought	**1**-40; 2-90; 3-38; 4-140; 5-80
March	**1**-211/(21) 2-138/(5)	Land preparation/ Weeding	Drought	(No records)
April	**1**-802/(96) 2-184/(11)	Land preparation, and weeding	Floods	**1**-45; **2**-90; 3-52; **4**-120; 5-90
May	**1**-460/(32) 2-153/(14)	Land preparation, weeding and harvesting	Drought and Floods	**1**-45; **2**-200; 3-60; **4**-120; 5-80
June	**1**-212/(10) 2-26/(6)	Harvesting, sorting and storage	Drought and Floods	**1**-55; **2**-100; 3-60; **4**-120;5-80
July	**1**-0 2-46/(4)	Harvesting, land preparation and Rice management	Drought and Floods	**1**-40; 2-70; **3**-35; **4**-100; 5-80

Source: Ministry of Agriculture (2004) (U/Nyakach refer to Upper Nyakach division). 1 and 2 refer to Muhoroni and Upper Nyakach stations in column two and maize and millet prices in column five.

Table 5.7 shows that, Ombeyi and Awasi led in terms of drought occurrence with a percentage of 14.3. Asao/Asawo ranked third followed by Southwest Nyakach. Drought prevalence was, therefore, more common in Nyando, Miwani and Lower Nyakach divisions, as was stated also in the District Agricultural reports for the year 2004, and thus, confirm the earlier findings of Jaetzold ***et al*** (1982). The fieldwork data further indicated that some of these drought episodes lasted for a period exceeding one year as given in Figure 5.6.

According to Figure 5.6, the majority of drought episodes lasted for a period of three to five months (51.4 percent) with those taking less than three months ranking second. The sampled data also revealed that drought occurrence was an annual phenomenon (80. 3 percent).

Table 5.7 Percentage Drought Occurrence by Division and Location within the sampled areas

Division	Location	Percentage of Households reportedly affected by drought
	South WestNyakach	10.1
Upper Nyakach	South Nyakach	5.6
	Sigoti	6.1
	North East Nyakach	4.5
Lower Nyakach	North Nyakach	3.6
	Asao/Asawo	11.3
	Awasi	14.3
Nyando	Kakola-Ahero	2.4
	Wawidhi	
	Ombeyi	14.
Miwani	North East Kano	7.6
	Nyang'oma	3.6
	Koru	
Muhoroni	Chemelil	4.0
	Tamu	8.6

Source: Fieldwork data ("-" means no data)

Figure 5.5:

DROUGHT PERCEPTION BY HOUSE HOLDS IN NYANDO DISTRICT

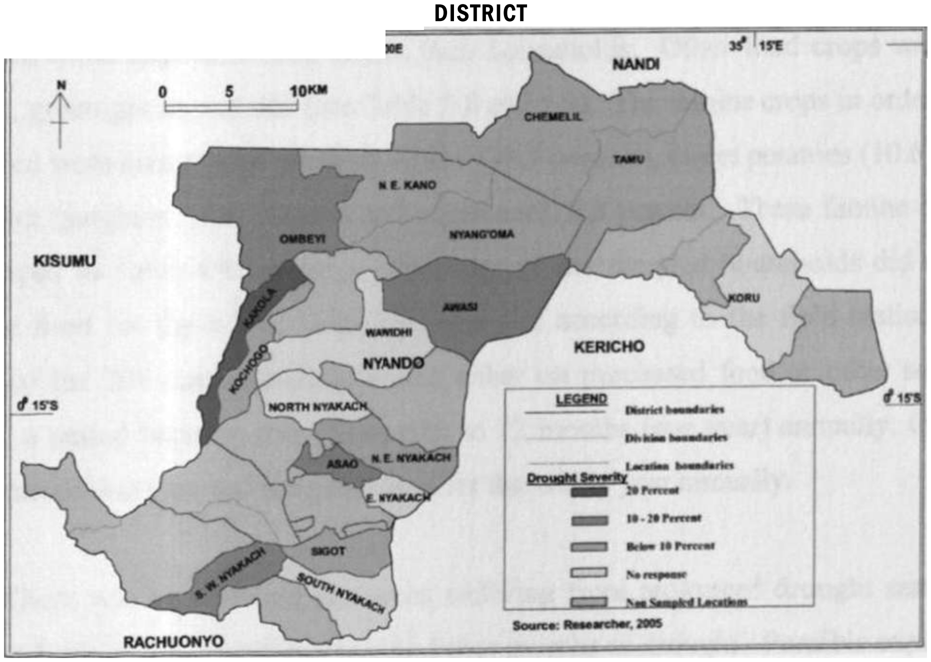
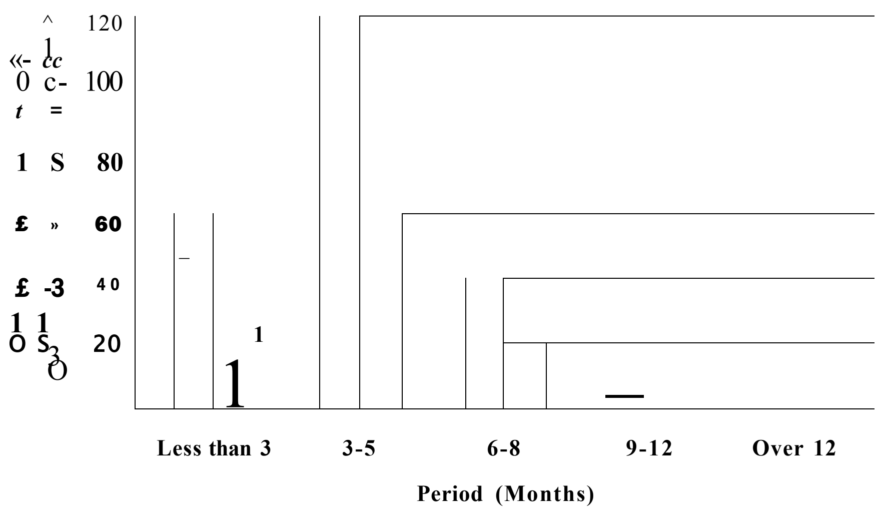


Figure 5.6:

Duration of Droughts in Nyando District



5.5.1 Vulnerability to drought and availability of household food and incomes among sampled households

During the dry season, over 89 percent of the respondents stated that maize crop is still the most important food within their households. Other food crops were sweet potatoes, green-grams and rice (see Table 5.8 and 5.9). The famine crops in order of their preference were maize (60.8 percent), Millet (21.7 percent), sweet potatoes (10.6 percent) and others (sorghum, rice, cassava and sugarcane), 6.8 percent. These famine crops are summarized in Table 4.9. A large percentage of the sampled households did not have adequate food for the whole year. For example, according to the field statistics, 53.1 percent of the 207 respondents depended either on purchased food or other sources of food for a period between five (5) months to 12 months (one year) annually. Only 26.1 percent stated that they had adequate food for the whole year annually.

There was no evidence that areas suffering from prolonged drought seasons had lower food production than those having fewer months of drought. Possible explanations could be that, either some respondents did not provide adequate data, or some data were missing, as the section dealing with agro-climatic issues clearly stated that the drought episodes were serious and frequently led to total crop failures. Secondly, the section on agro-climatic issues also revealed that, areas suffering from drought also experienced floods, which could mean that the afTected households might have had other farms elsewhere for household food production.

Table 5.8 Cereal Production within the drought prone areas of Nyando District

Area (Division and Location)	Total Food production in hundreds (00s) of Kg	Percentage number of days of drought occurrence
Upper Nyakach Division-		
S.W. Nyakach	38	10.1
S. Nyakach	41	5.6
Sigoti	38	6.1
Lower Nyakach Division-		
N.E. Nyakach	23	4.5
North Nyakach	2	3.6
Asao/Asawo	19	11.3
Nyando Division-		
Awasi	50	14.3
Kakola (Ahero)	16	7.6
Miwani Division-		
Ombeyi	75	14.3
N.E. Kano	35	7.6
Nyang'oma	15	3.6
Muhoroni Division-		
Chemelil	13	4.0
Tamu	25	8.6

Source: Fieldwork data

The field data also revealed that fewer crops were grown during the long rains than the short rains period, as the farmers were more certain about the reliability of the first rains, as compared to the second rains. This means that there is conflicting information concerning the reliability of the first and second rains according to the households in Nyando and Jaetzold, ***et al*** (1982). These differences of crops grown during the two seasons are summarized in Table 5.10.

Among the households that experienced drought, only 20.3 percent had access to credit facilities. The credit facilities were put to different uses such as buying farm inputs (33.3 percent), land cultivation (8.3 percent), food purchases (12.5 percent), paying school fees (37.5 percent) with unknown uses (others) constituting 8.3 percent also.

Famine Crop Combinations within the study Area

Division	Location	Crops Grown
Upper Nyakach	Sigoti	Maize & Cassava
	S.W. Nyakach	Maize, Sweet potatoes& Sorghum
	S.Nyakach	Maize, Sweet potatoes & Sorghum
Lower Nyakach	North Nyakach	Maize & Millet
	N.E. Nyakach	Maize, Millet & Sorghum
	Asao/Asawo	Maize, Millet & Sorghum
Nyando	Awasi	Maize, Sugarcane & Cassava
	Wawidhi	Maize
	Kakola	Maize
Miwani	Ombeyi	Maize & Sweet potatoes
	N.E. Kano	Maize & Sorghum
	Nyang'oma	Maize & Sweet potatoes
Muhoroni	Chemelil	Maize & Sweet potatoes
	Tamu	Maize, Cassava & Sweet potatoes
	Koru	Maize & Sweet potatoes

Source: Fieldwork data (See Figure 4.5 showing Famine Crop Combinations among the sampled Households)

These results meant that most households prioritize paying school fees and buying farm inputs using their credit facilities.

5.5.2 Vulnerability to drought, Human Dynamics and coping strategies

The available literature provided two different levels of coping with drought: the first one was by the individual himself and the second one by the government. Silitshena

(1987) stated that at the individual level, the following might take place as a response to mitigate the impacts of drought within the household:

(a) migration to areas with better food resources and grazing,

(b) social visits and fictitious kinship systems,

(c) rain-making,

(d) simple sharing of food,

(e) sale of livestock, and;

(f) migration to places of cash employment.

Table 5.10 Crops grown during Long and Short Rains Seasons

	Long Rains Period		Short Rains Period	
Crops Grown	Frequency	Percentage	Frequency	Percentage
Maize	189	84.4	65	40.4
Millet	24	10.7	18	11.2
Rice	6	2.7	3	1.9
Sorghum	3	1.3	3	1.9
Sugarcane	2	0.9	1	0.6
Sweet potatoes	0	-	24	14.9
Cassava	0	-	1	0.6
Vegetables-Onions/Tomatoes	0		42	26.1
Beans	0	-	4	2.5
	224	100	161	100

Source: Fieldwork data

Silitshena (1987) added that the government could participate in drought problems by providing relief to the affected people. This is done in order to:

- alleviate social distress and in order to avoid deaths from famine or thirst,
- conserve and improve the environment and long-term ecological viability of the economy,
- stabilize and improve the economy of the livestock sector,
- enable the crop sector of the economy to re-establish itself quickly after a drought,

- ensure financial stability of the country's banking institutions and of the government, and;
- minimize disruption to overall development and the development plan.

According to the above author, there were two types of relief, namely, livestock relief and human relief. Human drought relief consist of supplementary feeding of vulnerable groups, particularly, children, creation of employment for farmers in communal development projects, payment for preparing and improving the fields and provision of domestic water supplies and purchase of local food stuffs such as cattle and fish to feed the people. Although drought episodes have in the past been reported in Nyando, the researcher would like to state that the District does not suffer from extreme drought conditions to warrant all the above stated measures. Food - for -work programme, which is common in the area, was mostly implemented during floods, and is explained in detail in the section dealing with floods. This study has also established that drought episodes, in most cases, coincided with floods so that relief provided catered for the two misfortunes. Other qualitative informatioin were used to supplement quantitative data in the discussions.

As far as Nyando District is concerned, various households prioritized selling vegetables and fruits for extra income, using root crops to supplement family food requirements, and reliance on relief food programmes whenever available (Ministry of Agriculture, 2004). Such food relief programmes were either administered through the government, or Community Based Organizations (CBOs) like Non-governmental organizations, and / or including, Churches.

5.6 VULNERABILITY TO FLOODS AMONG SAMPLED HOUSEHOLDS IN NYANDO DISTRICT

The fieldwork results revealed that, flooding in Nyando, which in several occasions took place even during by droughts due to heavy rains within the upper catchments, was not necessarily as a result of rainfall distribution in Nyando District. The areas that were prone to flooding are shown in Table 5.11.

The data in Table 5.11 show that Ombeyi location suffers from flood occurrence more than other areas, followed by N.E. Kano and S. Nyakach locations, of Upper Nyakach division. As Ombeyi location also led in drought occurrence, the results confirmed that, areas prone to floods were also vulnerable to droughts. Among the households interviewed, 92.8 percent of the 105 respondents stated that they regularly experienced floods, with 95.2 percent mentioning that these floods occurred for a period less than one year, with 4.8 percent of the households experiencing floods for about 2 years. In terms of frequency, 94.4 percent of the respondents had floods annually and 4.4 percent of the sampled households had part of their farm permanently submerged in water.

5.7 VULNERABILITY TO FLOODS, AVAILABILITY OF HOUSEHOLD INCOMES AND COPING STRATEGIES IN NYANDO DISTRICT

The famine crops within the flood prone areas comprised maize, sorghum, millet, rice, sweet potatoes and cassava. During the short rains all the famine crops were grown together with vegetables (onions and tomatoes), and beans. Only seven (7) households sought and obtained credit facilities in the area, which were used to:

- buy farm inputs - 28 percent,
- assist in land preparation - 14.29 percent,
- buy extra food - 28 percent, and;
- pay school fees for children in school - 28 percent.

fable 5.11: Flood Occurrence in Nyando District among the Sampled Households

Division	Location	Observations	Percentage
Upper Nyakach	S.W. Nyakach	2	1.94
	W.Nyakach	14	13.6
	Sigoti	2	1.94
Lower Nyakach	N.E. Nyakach	4	3.88
	North Nyakach	8	7.7
	Asao	10	9.71
Nyando	Awasi		2.91
	Kakola (Ahero)		1.94
	Wawidhi		
Miwani	Ombeyi	36	34.95
	N.E. Kano	18	17.48
	Nyang'oma	4	3.88
Muhoroni	Koru		
	Chemelil		
	Tamu		

Source: Fieldwork data (Figure 5.6 shows Flood occurrence by Location among sampled households).

Among the 273 of the respondent household sizes within these flood prone areas, 93 percent had between one and seven persons, with a mean and standard deviation of 5 and 5.49 respectively. Within these regions prone to floods, the households were asked whether they would like to move to urban areas for off-farm employment or whether they would like to continue with crop production. About 94.1 percent households opted to continue with their food crop production with only a few people stating that they would like to move to towns for off-farm employment. This meant that any strategies aimed at assisting the victims must not be based on permanent relocation of vulnerable households if it is to succeed.

According to the fieldwork results, Lower Nyakach division (Asawo, North Nyakach and N.E. Nyakach locations) had the greatest number of households suffering from flood hazards. Miwani division (Ombeyi and N.E. Kano locations) was second while Upper Nyakach division (S. Nyakach and W. Nyakach) was third. See Figure 5.7, showing some of the remedies taken by the government to control flooding from one of the Rivers (Awach).

Figure 5.7:

Attempts to Control Flooding in River Awach/Asao, in Nyando District

5.8 SUMMARY

According to the Findings of this chapter, there are many effects of climatic elements such as temperature and rainfall on household food crop production, which combine and result into droughts and floods. The analysis of the fieldwork data has revealed that droughts and floods influence about 5 and 7.8 percent of household food crop production respectively. As a result, there could be other factors that are responsible for the remaining percentage of variability (87.2 percent), hence the need to investigate the contribution of other variables, as listed in the objectives of this research. The analysis further revealed that floods played a more important role than droughts in Nyando District, as six months of floods led to a total crop failure, while 8 months of drought (which was equal to one year of drought) still led to about 200Kg of household cereal production.

Drought occurrence was more widespread in the District, with Miwani leading in severity. However, the results suggested that, the effects of these droughts could be reduced by planting drought - resistant food crops, as they did not appear severe enough to result into total crop failures. As far as flood devastation was concerned, 29.8 percent of the people who experienced floods had parcels of land elsewhere. It was, therefore, possible that most people in flood prone areas do not put land susceptible to floods in meaningful food crop production to avoid destruction from floods, and this confirms the theory of possible degraded lands discussed earlier in this chapter. In addition, floods affected some areas in the District such as Miwani, Lower Nyakach and Upper Nyakach divisions, together with a small area of Nyando division.

In conclusion, in order to deal with floods in Nyando District, several measures will need to be undertaken:

- Advise the affected households to avoid settling in the flood plains and advise them to use them for short-lived crops, which provide additional income such as vegetables and fruits, whenever flooding subsides, as this would lead to minimal cereal crop losses.
- Extension services should be increased in the area to advice farmers on the forecasted weather patterns so that vulnerable households may take appropriate measures to avoid disaster, and where possible, convert the flood prone areas into grazing lands and rice cultivation, particularly, where the environmental conditions appear suitable for maturity.
- In order to achieve a target of at least 700Kg of household cereal harvest annually, each household should be advised to explore the possibility of getting land elsewhere, away from flood plains, through purchase or renting. On the other hand, the absentee landlords should also be encouraged to avail, their land for leasing so as to obtain additional income on otherwise idle lands.
- The government should also implement measures to prevent degradation of the catchments of Rivers such as Sondu Miriu and Nyando as earlier suggested by DMCN-UNEP (2004) report.
- A major feasibility study to address the problems of the entire L. Victoria region, particularly, among the riparian countries themselves should be prioritized to deal with flooding in the region and encourage suitable development.
- There is also need for proper use of policy to regulate human settlements in fragile ecosystems in order to avoid the adverse social and economic impacts and encourage relevant ecological impacts.

CHAPTER 6

SOCIO-ECONOMIC FACTORS AND FOOD SECURITY

6.1 INTRODUCTION

This chapter discusses the relationships between the main socio-economic factors (land, labour and capital) themselves, and how they impact on household food crop production, and hence, food security and poverty. It is assumed that any endeavour aimed at improving household food security automatically impacts positively on household poverty reduction strategies.

The chapter, therefore, deals with issues relating to the availability of production factors (land, labour and capital) within smallholder farming households, and their characteristics in space and time. These small-scale farming households obtain off-farm income from minimal crop sales, and off-farm employment, where necessary and some credit facilities from Community Based organizations within their reach. Fertilizers consume most of the funds allocated to farm inputs, and the emerging land uses together with the relationship between distance is discussed.

This chapter discusses the issues relating to household food crop production, consumption and surplus generation or food deficits, together with information on wealth index and technology. The chapter also includes the data analysis procedures and the reader should remember that for every summary of data, only the households that responded to all the relevant questions concerning a particular issue are used in quantitative analysis to allow more comprehensive comparison. The results of inferential statistical analyses (Correlation and Regression) given are then used to summarize the exact contribution of each of these factors on household food crop production and food security, to suggest possible remedial policies.

6.2 THE RELATIONSHIP BETWEEN LAND, LABOUR, CAPITAL AND FOOD PRODUCTION

According to Yotopoulos (1967), land is one of the major entries into the production function as it is theoretically inexhaustible (durability is infinite). Land enters the production process in the beginning of the period, renders its services, and is still intact at the end and ready to be employed again. Land use, therefore, refers to the actual and specific use to which the land surface is put in terms of inherent land use characteristics with emphasis on the vegetative covering or its lack (whether agricultural, silvicultural, industrial or urban (Symons, 1968 and Yotopoulos, 1967). In this study, the main concern is the agricultural land use within the study area.

Ruthenberg (1980) suggested a number of devices to spread risks, avoid storage losses, and ensure a constant supply of produce, based on consumer preferences that have been used. These are:

- diversification of production by growing a range of crops,
- the planting of a particular crop at different times over an extended period in order to ensure some production in either earlier or later period,
- the combination of different species in crop mixtures,
- the cultivation of small areas of especially reliable, though non-preferred crops (in this thesis, referred to as famine crops),
- employment of more resources for subsistence production than would normally be necessary in order to provide for a minimal production in the worst possible season, or,
- growing of some products for which their land or skills are not well adapted.

Another factor that determines the value of the net capital in this research is the distance to the market, which in addition to other factors also dictates the amount of household cash. Long distances require costs of transport to be incurred by carrying the agricultural produce using a vehicle or human carriage, such that the changes in distances would lead to similar changes in the final price of the commodity sold at the market.

A practical farmer, except for conditions of national emergency or to maintain fertility, aims at increasing costs only where income is likely to be increased by a greater amount (Symons, 1968). A household, therefore, concentrates on production with conducive market prices in order to obtain surplus, or personal income, to cover the domestic expenses. Production may be increased, by intensifying farming or increasing the amount of productive land as in order to raise increases in revenue above the marginal costs. Favourable climate, land, labour and cash availability were, therefore, some of the issues considered to ascertain that income comfortably exceeds the outlay. Mellor, ***et al*** (1987) studying agricultural production found out that among the small-scale farmers, capital primarily consists of hand tools, seed, and small quantities of fertilizer.

63 LAND USE AMONG SAMPLED HOUSEHOLDS

63.1 Availability of land and history of farming systems

Among the households studied, 72.2 percent (203 households) inherited the farm from their fathers with only 26.7 percent (75 respondents) buying their farms. Two households had rented land from relatives, while one was temporarily given (0.4 percent). About 61 percent had title deeds, while only 39.3 percent did not have title deeds. Farm operations in the above farms have been carried out for a period of between less than five years to over 50 years. The details are provided in table 6.1.

Table 6.1 elaborates that a majority of farm operations were between 10 to 19 years old (32.9 percent) (the period between the year 1986 and the year 1996). This was followed by those who have been operating the farm for less than 5 years (19.8 percent), or from the year 2000. The data also shows that some of the settlements have been there since independence. Out of the 202 respondents, about 92 households (45.5 percent) had sub-divided their land, with most sub-divisions taking place in Muhoroni division (45.7 percent). Upper Nyakach, Nyando, Miwani and Lower Nyakach divisions with 15.2 percent, 20.7 percent, 12.0 percent and 3.3 percent, respectively. Other fieldwork results revealed that a majority of the households in Nyando did not own much land (mainly between less than 0.43 to 0.85 Ha). See Table 6.2, which gives farm sizes, and yield obtained from the farms.

Table 6.2 revealed that only a small percentage of farmers engaged in meaningful farming (crop and livestock farming) due to inadequate land in the area with farm sizes of between 2.15 to 8.6 Ha, accounting for only 23.4 percent of the total. Crops grown for food include maize, rice, millet, beans, green grams, groundnuts, soya beans, sweet potatoes, sorghum and cassava. Coffee, tea, cotton, sugarcane, vegetables (tomatoes, onions, and kales) and fruits (paw paws, guavas, avocados among others) were grown for cash. The differences between acreage for food and cash crops are provided in Table 6.3. In Table 6.2 it can be seen that there were a total of 252, 260 and 69 households (questionnaires), which responded to the issues concerning farm size, crop performance, and land used for pasture, respectively.

Table 6.1 Years of Farm Operation after Land Acquisition

Division	Location	Years of Farm Operation/ HHd					
		Less than 5	10-19	20-29	30-39	40-50	Over 50
Upper Nyakach	S.W. Nyakach	8	3	8	6	1	2
	Sigoti	3	4	-	3	3	-
	S. Nyakach	–	1	2	4	4	-
Lower Nyakach	Asao	7	13	-	3	-	1
	N.E. Nyakach	5	10	-	3	3	-
	N. Nyakach	1	2	1	-	-	-
Nyando	Awasi	7	14	3	2	9	2
	Kakola	1	2	–	1	1	-
Miwani	Ombeyi	6	14	5	5	2	1
	N.E. Kano	7	9	2	-	1	-
	Nyang'oma	5	4	1	2	-	-
Muhoroni	Chemelil	1	2	1	1	5	-
	Tamu	-	7	18	10	4	-
	Koru	–	-	-	2	1	-
	Total	51	85	41	42	33	6
	Percentage	19.8	32.9	15.9	16.3	12.8	2.3

Source: Fieldwork data ("-" means no response in all the tables throughout the Thesis)

The reader should note that the households growing food crops may also be growing cash crops, so that the samples (households/questionnaires) 205 and 144 (in Table 6.3), added together give 349, which exceeds 279, the original sample size. Table 6.3 also indicates that food crops were grown in smaller farms than cash crops as over 90 percent of the households grew their food crops on farms between less than 0.43 and 8.6 hectares. The farms where cash crops were grown had averages of between 1.29 to over 8.6 hectares. Table 6.4 gives variations in land cultivated in the year 2003 among the sampled households by location and division.

Table 6.2 Farm sizes and Crop Performance

Item	Description	HHd	%
Farm size (Acres) where I Acre = 0.43 Hectares (Ha).	Less than 0.43	57	20.2
	0.43-0.86	73	25.9
	0.86-2.15	60	21.3
	2.15-4.3	51	18.1
	4.3 - 6.45	6	12.8
	6.45 - 8.6	2	0.9
	Over 8.6	3	1.1
	Total	252	100
Performance	Good	87	33.5
	Medium	91	35.0
	Poor	82	31.5
	Total	260	100
Land used for Pasture	Communal land	28	40.6
	Buying grazing land	10	14.5
	Less than 0.43 Ha	18	26.1
	0.43 - 1.72 Ha	8	11.6
	1.72-2.58 Ha	4	5.8
	0.58 - 3.01 Ha	1	1.4
	Total	69	100

Source: Fieldwork data (HHd and % refer to Number of households and percent, respectively throughout the Thesis)

Table 6.3 Acrcage used for Food crops and Cash crops

Acreage (Ha): 1 acre = 0.43 Ha	Food crops		Cash crops	
	HHd	%	HHd	%
Less than 0.43	115	56.1	-	-
0.43-1.29	71	34.6	56	49.1
1.29-2.15	15	7.3	30	28.3
2.15-4.3	4	2.0	12	10.3
4.3-6.45	.	-	10	8.8
6.45-8.6	-	-	5	4.4
8.6 and over	-	-	1	0.9
Total	205	100	144	100

Source: Fieldwork data

Over 40 percent of the sampled households have subdivided their land and this could be an explanation for the diminishing farm sizes seen in the study area. The data also highlight the need for the government to curb the practice if food security is to be achieved (See Figure 6.1 showing acreage per household among sampled households).

Tabic 6.4 Cultivated area by Division and Location in the year 2003

Division	Location	Area in Hectares **(Ha)**			
		0.43-1.25	**1.29-2.1**	**2.15-4.3**	**4.3-6.5**
Upper Nyakach	S.W. Nyakach	28	**1**	**1**	**1**
	Sigoti	10	**1**	**1**	-
	S.Nyakach	9	**I**	**1**	**1**
Lower Nyakach	Asao	22	2	-	**1**
	N.E. Nyakach	18	**1**	-	-
	N. Nyakach	8	-	-	-
Nvando	Awasi	39	5	**1**	-
	Kakola	5	**1**	-	-
Miwani	Ombeyi	33	**1**	**1**	-
	N.E. Kano	14	**1**	2	-
	Nyang'oma	4	**1**	-	-
Muhoroni	Chemelil	7	2	**1**	-
	Tamu	35	3	-	-
	Koru	1	4	-	-
Total		135	104	23	10

Source: Fieldwork data

Table 6.5 gives the number of households, which have subdivided their land versus those who have not. The table shows that a good number of households subdivided their land, particularly in Muhoroni area. While there were 272 households out of 279 households sampled, which gave information concerning the exact figures for their farms, as shown in Table 6.4 above. Table 6.5 shows that among the 211 households, 92 and 119 households have and have not subdivided their land, respectively.

For most households, land cultivated in the year 2003 was almost the same as the one cultivated in the year 2004, with only a few differences. Among the 97 households, which responded to the questionnaires regarding reasons contributing to the variations in land cultivated, the farmers noted the following as some of the reasons that led to changes in land cultivated within different years, and as shown in Figure 6.2:

Figure 6.1:

SPATIAL VARIATION OF FARM SIZES AMONG SAMPLED HOUSEHOLDS BY DIVISION.

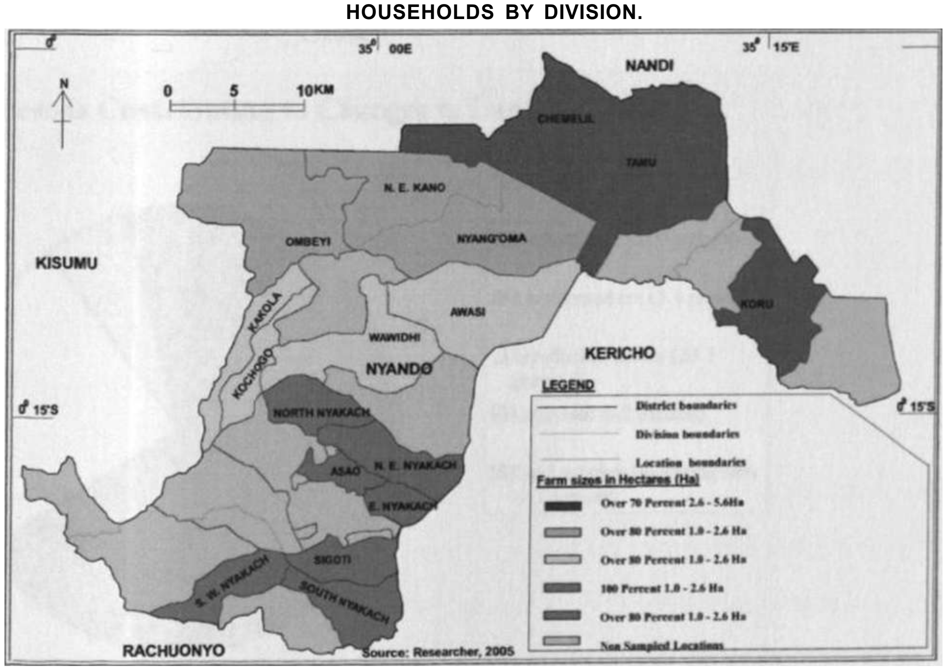


Table 6.S Land Subdivisions within the District

Division	HHds who have subdivided the land		HHds who have not subdivided the land	
	HHd	%	HHd	*

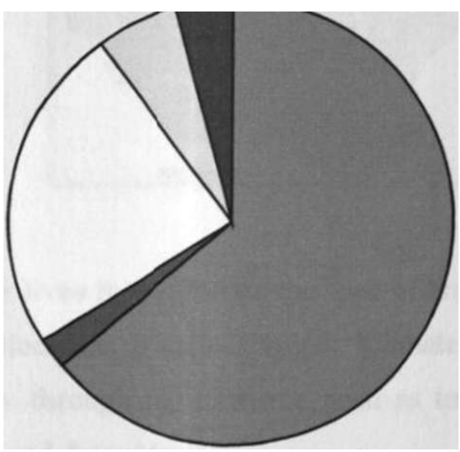
Upper Nyakach	14	15.2	40	37.4
Lower Nyakach	3	3.3	10	9.3
Nyando	19	20.7	8	7.5
Miwani	11	12.0	31	29.0
Muhoroni	45	48.9	18	16.8
Total	92	100	107	100
Percentage	46.2		53.8	

Source: Fieldwork data

Problems of lack of cash were noted in all the divisions. Insufficient labour was recorded in Upper Nyakach, Lower Nyakach, Muhoroni, and Miwani divisions, with the exception of Nyando division. Lower Nyakach and Miwani had some land leased out while some households in Miwani division had sold their land. Nyando, Muhoroni and Miwani divisions had some households which had subdivided their land among sons (refer to Figure 6.3 for the Spatial variations of the reasons leading to differences in land cultivated in the year 2003).

Figure 6.2:

Reasons Contributing to Changes in Land Cultivated



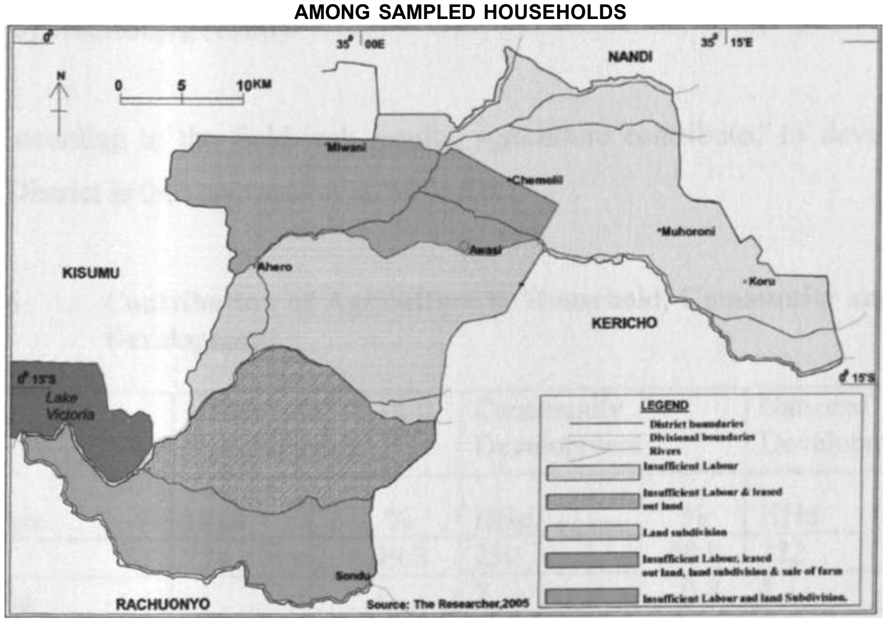
- Lack of cash (63.9 percent)
- I and leased out (2.1 percent I
- Insufficient labour (23.7 percent)
- I and sold (6.2 percent)
- Land subdivision among sons (4.1 percent)

6.3.2 The Relationship between Land use and the existing Climatic Conditions among Sampled Households

Farmers were also interviewed to state their reasons for choosing sites for particular crops and they gave responses such as suitable environmental conditions (79.3 percent), size of land available (17.5 percent), and whether or not it is grown by the people in the area. This meant that although climate issues ranked third in the above responses concerning reasons for inter-cropping and single strand, they provided the basis on which farmers start planning. When examining climatic issues and food security in chapter five, it was realized that climate, with respect to drought and floods did not significantly affect food security. However, according to the farmers, climate is one of the most important factors

Figure 6.3:

REASONS LEADING TO DIFFERENCES IN LAND CULTIVATED
AMONG SAMPLED HOUSEHOLDS



in their lives that influence the type of crups they grow within the household as well as land allocation to various crops. Climate therefore influences food security in Nyando directly through the elements such as temperature and rainfall, and indirectly due to floods and droughts.

The fieldwork results showed that average yields were generally low, and farmers need to be advised on which crops to grow that would produce high yields and which were also compatible with type of climate in the area. A study on the yields of various crop combinations in the area would be vital in order to ascertain that yield is improved using relevant extension services.

Among the problems mentioned by various households in Nyando, climate related problems were leading with 82 percent of the respondents. Other problems included high costs of inputs, lack of markets and / or low prices for agricultural commodities. These responses point out the fact that farmers (households) in Nyando spend more time worrying about the weather problems which frequently devastate them, and in the process ignore more important factors like those related to socio-economic issues. This study has therefore recommended extension services to the various households in the district in order to raise yield per unit area and obtain extra capital to re-invest in farming activities as noted by Ruthenberg (1980).

According to the fieldwork results, agriculture contributed to development in Nyando District in the ways shown in Table 6.6.

Table 6.6 Contribution of Agriculture to Household, Community and National Development

	Household Development		Community Development		National Development	
Response	HHd	%	HHd	%	HHd	%
Food	274	99.3	250	98.8	222	97.4
Clothing	-	-	2	0.8	3	1.3
Shelter	1	0.4	-	-	2	0.9
Savings	1	0.4	1	0.4	1	0.4
Total	276	100	253	100	228	100

Source: Fieldwork data

The table indicates that at the grass-root level, the role of agriculture as a source of economic development through savings was not appreciated, as less than one percent of the respondents considered agriculture as a major source of savings and other basic needs like clothing and shelter. The households mainly viewed agriculture as a source of food both at the local / grass-root/ household level and at the national level. Farmers therefore need to be encouraged to cultivate not only for household food security but also as a business capable of raising cash to their respective households.

Land preparation procedures, among sampled households, was closely related to the onset of the two rainy seasons and as given in Table 6.7. Table 6.7 show that land preparation was only taken seriously during long rains with minimal preparations taking place during short rains. It would be interesting to examine how these processes of land preparation within Nyando District influence household food crop production, as it did not form part of the objectives of the current study.

The farming activities included land preparation in January and February for long rains period and July/ August for second rains. Weeding during long rains begins in

Table 6.7 Land Preparation during Long and Short-rainy seasons

Activity	Land Preparation during Long rains		Land preparation during Short rains	
	No. of HHd	%	No. of HHd	%
Don't prepare land	-	-	142	72.8
Dig/Plough then plant	248	93.6	53	27.2
Dig twice then plant	1	0.3	-	-
Clear, Dig, Harrow, plant	14	5.3	-	-
Clear, dig, open trenches, plant	2	0.8	-	-
Total	265	100	195	100

Source: Fieldwork data.

February and ends in June, while for the second rains the weeding started in August and goes on probably until September. Harvesting was done during July and November/December period for the Long and Short rains, respectively. The major reasons for growing crops and for inter-cropping or single strand are given in Figure 6.4 and 6.5, respectively.

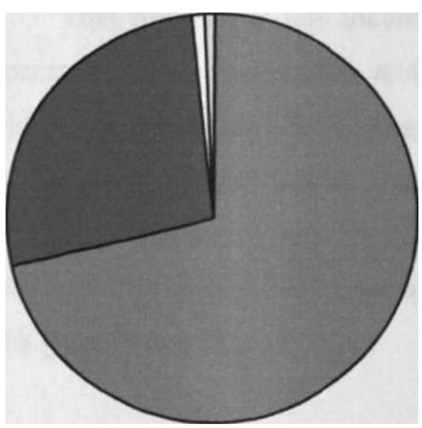
The above reasons for growing the particular crops mentioned together with the reasons for resorting to inter-cropping or single strand are all in line with what Ruthenberg (1980) stated as ways of spreading risks in order to ensure adequate supply of food. These reasons also give suggestions as to how the households rank problems relating to socio-economic factors, demographic factors, climatic and health issues as is summarized in the section dealing with research findings.

5.33 Land Productivity and Seasonal Variations in Production

The results of the analyses revealed that less land was cultivated during short rains (mean was 1.22 acres (0.5Ha)) as compared to long rains (where mean was 1.64 acres (0.7Ha)) period resulting into lower figures for production. The mean consumption during short rains was greater than that of long rains period. The Percentile values (25^{lh}, 50^{th} and 75^{th}) for consumption was the same for both seasons but appeared different for production during the long and short rains period with minimal crop sales during short rains period.

Figure 6.4:

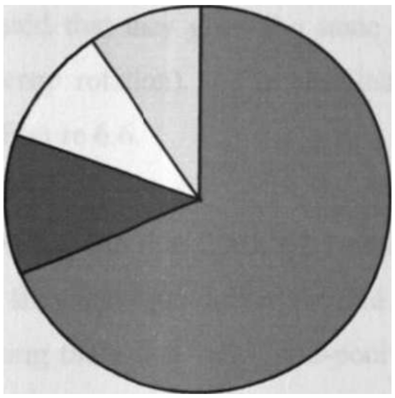
The Major Reasons for Growing certain Crops in Nyando District



- **Better Performance in the area (70.2 percent)**
- **Less Vulnerability to Pests and Diseases (26.6 percent)**
- **Recommended by neighbours or friends (1.2 percent)**
- **Recommended by the Government (0.8 percent)**

Figure 6.5:

The Major Reasons for Inter-cropping or Single strand



- **To Increase Yield (63.6 percent)**
- **Insure against Hunger (10.9 percent)**
- **Insure against Bad weather (9.3 percent)**
- **Better Nutrition (8.9 percent)**

This means that less income / capital or cash was available to be used in land preparation, labour acquisition and crop production during the long rains period. This could be the explanation for less capital indicated by households used to buy farm inputs, implements and to pay labour. Land cultivated during short rains was just about 1 acre (0.43 Ha) (60 percent) with about 17 percent of the land having an average of 2 acres (0.86Ha). Production was between 0 to 150 Kg with some extreme annual values of 5 500 Kg and 6 000 Kg.

The field results also showed that households in Nyando District diversified their crop and animal husbandry. Crops include both cash crops and food crops, though some crops such as maize, beans, rice, and millet fall within the two categories. Crops grown for food include maize, millet, rice, sweet potatoes, sorghum, and cassava in addition to fruits (avocados and guavas, among others) and vegetables (tomatoes, kales, onions and cabbages). Those grown for cash comprise of maize, sorghum, millet, rice, sugarcane, coffee, cotton and tea. Maize, sorghum, millet, sugarcane, and beans are grown during the long rains. Sorghum was grown in Upper Nyakach division, millet was grown in all divisions except Upper Nyakach division while rice and sugarcane were grown in

Miwani division. Figure 6.8 shows the Spatial Distribution of both Food and Cash Crops within the study area for the year 2004.

There were 148 households, which responded to the question requiring them to state whether they grow the same crops on the same piece of land. About 75.7 percent of this number said that they grow the same crops on the same piece of land (or they do not practice crop rotation). The remaining percentage changed crops due to the reasons given in Figure 6.6.

During the year 2003, 52.1 percent of the households sampled consumed all the food that they harvested before the end of the year. It was believed that these households were among those that were food-poor as is explained later in this chapter. About 80.9 percent of the respondents did not have adequate food for the whole year. This meant that the food self-sufficiency figures provided in the District Development Plan (50 percent) is probably lower than what is existing in the field. The field data also revealed that there was variation in land cultivated during the long and short rains, and these variations are given in table 6.8.

Figure 6.6:

Major Reasons for Practising Crop Rotation

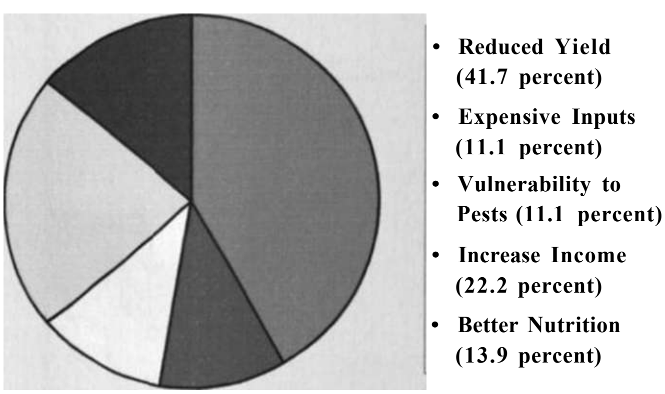


Table 6.8 Land Cultivated during Long and Short rains

Acreage in Hectares (Ha) - 1 acre = 0.43 Ha)	Long Rains Period		Short Rains Period	
	HHd	%	HHd	%
Less than 0.43	100	57.8	93	62.0
0.4 - 0.9	47	22.7	39	26.0
0.9 - 2.2	19	11.0	13	8.7
2.2-4.3	4	2.3	4	2.7
4.3 - 6.5	2	1.2	1	0.7
6.5 - 8.6	1	0.6	-	-
Total	173	100	150	100

Source Fieldwork data

Table 6.8 shows that more land was put into use during long rains than short rains with the majority of the households still cultivating farms of sizes between 0.43 to 0.86 Hectares (88 percent). The suitability of land for agricultural usage was in accordance with what had been stated earlier by Jaetzold, ***et al,*** (1982) who classified the land in Nyando District as mainly medium to low potential, with about 27.1 percent, 52.3 percent and 20. 6 percent, of the households stating that the land was well suited, moderately suited and marginal, respectively, to agricultural usage. Figure 6.7 shows the cost of renting land within the study area.

Figure 6.7:

COST OF RENTING LAND WITHIN THE STUDY AREA

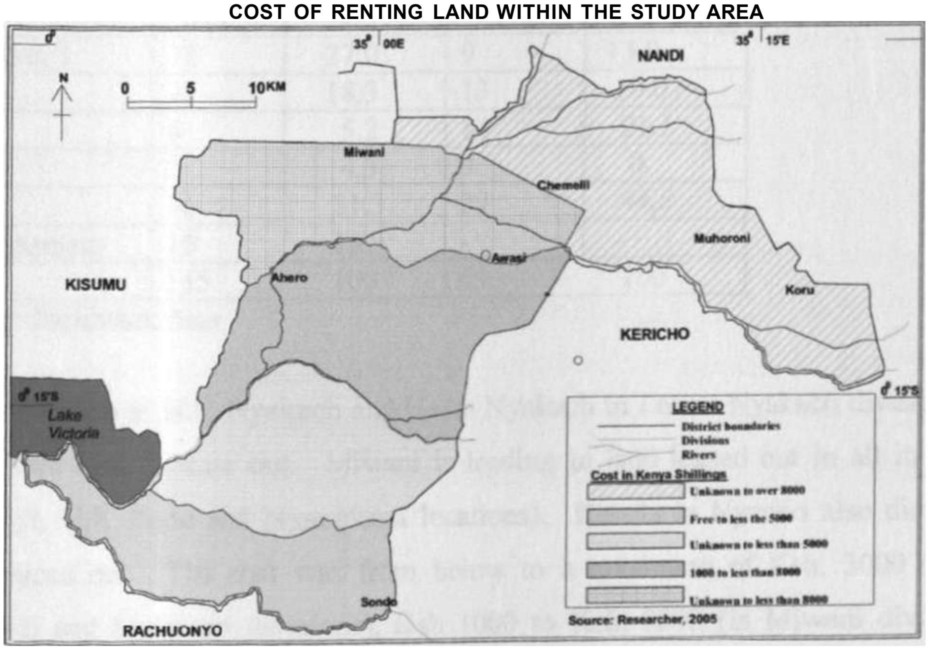


Figure 6.7 shows that land was cheapest in Lower Nyakach and this could be attributed to large portions of the division, which fall under low potential agricultural lands. The farmers rated the yield from rented land as good (60.4 percent of the households), to medium (34.0 percent) and low (5.8 percent). About 86 percent of the respondents stated that land was always available for renting and the renting, period together with the leasing period are as shown in Table 6.9.

When the different ranges were considered and the renting period, the cost of renting land per year was about Ksh. 1285. Seasonal lease period varied from January to any month up to December. This means that it is almost impossible to rent land within the flood prone areas as some of the floods stayed on for a period over 6 months.

A majority of the households, which leased out land, were found in Miwani division, Muhoroni division and S.W. Nyakach in Upper Nyakach division.

Table 6.9 Land Renting and Leasing Period

Period (Years)	Temporary Land Acquisition		Land Leased out	
	HHd	%	HHd	%
Less than 1	31	27.0	9	13.9
1-2	21	18.3	13	20.0
2-3	6	5.2	14	21.5
3-4	5	4.3	0	0
5-6	36	31.3	29	44.6
By agreement	16	13.9	-	-
Total	115	100	69	100

Source: Fieldwork data

Locations such as N.E. Nyakach and North Nyakach in Lower Nyakach division did not have extra land to lease out. Miwani is leading in land leased out in all its locations (Ombeyi, N.E. Kano and Nyang'oma locations). Kakola in Nyando also did not have land leased out. The cost was from below to a maximum of Ksh. 3000 (in Upper Nyakach and Muhoroni divisions), Ksh 1000 to Ksh. 8000 (in Miwani division) and between Ksh. 1000 to Ksh. 2000 (in Lower Nyakach and Nyando divisions). During the long rains period, the acreage planted, and yield were as shown in Table 6.10 The table indicates that as farms increased in size (beyond 2.15 hectares), yield decreased drastically. An explanation could be that there were fewer large farms in the area or production in the smaller farms were more efficient and hence more productive.

Table 6.10 Acrcagc and Yield during Long rains

	Yield	
Farm size in Hectares (Ha)	Kg/Acre	Kg/Ha
Less than 0.43	1180	2776.5
0.43 - 0.86	173.3	407.8
1.29-2.15	31.4	73.9
2.58 - 4.3	1.25	2.9
4.73 - 6.45	.	-
6.88 - 8.6	0.56	1.2

Source: Fieldwork data

6.3.4 Presence of Livestock among sampled Households

According to Mellor ***et al*** (1987), nearly all farm households maintain poultry and small ruminants, and in some cases, cattle as easily liquidated forms of savings, insurance, and income. Mellor stated that potential technical complimentarities between livestock raising and cropping were rarely achieved as livestock largely forage away from the farm resulting in loses of most of the manure. Mellor's study emphasized that livestock plays a much more diverse role on small-scale farms than in commercial farm situations as they are used for draft power, for domestic milk and meat, as a cash source for security in bad times, and to fulfill social customs.

During the field study it was found that 77.2 percent of the 276 respondents had livestock or poultry on their farms (213 households), and only 18.2 percent did not keep livestock on their farms and grazing was carried out on communal land due to land shortage. Some of the livestock attendants walked up to 7 kilometres (Km) to graze cattle. Table 6.11 gives the number of livestock per household, type of livestock and breed.

Table 6.11 Number of livestock, type and breed

Item	HHd/Percentage	
	HHd	%
Number of livestock - 1-3	61	56.0
4-5	32	29.4
6-10	15	13.8
11-15	1	0.9
Type of Livestock - Cattle	199	97.5
Sheep	5	2.5
Livestock breeds - Local	39	90.7
Hybrids	3	7.0
Mixed breeds	1	2.3
Breed Names - Zebu	3	30.0
Friesian	4	60.0
Jersey	2	20.0

Source: Fieldwork data

Table 6.11 shows that cattle were the most common type of livestock kept particularly in those households having local breeds. Although the government was trying to improve the quality of livestock among farmers in Nyando by introducing better yielding grade cows, it could be seen that this action had not however produced expected results, among the households studied.

The research further revealed that most households depended on communal land for grazing (40.6 percent) while an equally large percentage also bought grazing land (14 percent) with 26.1 percent and 11.6 percent of the grazing land being 0.43 Hectares and 0.86 to 1.29 Hectares, respectively. Most households provided their own household labour for livestock keeping (67.5 percent), and children and hired labour contributed 16.7 percent and 14.8 percent of labour, respectively. Labour comprised of activities such as grazing/ feeding and providing water to the animals. Approximately 63 percent, 28 percent and 9.1 percent walked less than 1 kilometre, 2 to 3 kilometres and 4 to 7 kilometres to watering points, respectively. Most of the communal land for grazing was located less than 1 kilometre from individual households studied (61.5 percent) with 38.4 percent being located 2 to 7 kilometres away.

Several households also stated that they had poultry in their farms but it was impossible to count all the poultry. Both poultry and cattle contributed towards the family food needs through meat (61.0 percent), milk (27.1 percent) and income (11.9 percent). The 77.8 percent of the households used veterinary services in the farm at a cost shown in Table 6.12. Mellor ***et al*** (1987) proposed that in order to avoid land and labour competition, feed production should use slack land or idle labour resources to prepare feed by harvesting, conserving and enhancing of maize residues. Additional propositions included increasing fodder from more densely planted maize, encouraging young fodder crops planted to mature, and allowing fodder crops inter-cropping into maize without compromising the maize yield.

Only 11 households sold their manure with 90.8 percent of the sampled households producing manure on their farms. Among the households that sold manure, the cost varied from less than Ksh. 100 (81.8 percent) to Ksh. 200 (18.2 percent) without stating the measurements.

Table 6.12 Cost of veterinary services among sampled households

Cost (Ksh.)	Number of Households	Percentage
Less than 1000	82	67.2
1001 -3000	31	25.4
3001 - 5000	1	0.8
Depends on disease	8	6.6
Total	122	100

Source: Fieldwork data

6.4 AVAILABILITY OF LABOUR AND ITS COSTS

Labour is one of the three major factors of production and during fieldwork it was realized that a majority of households used household members (family members) as full-time labour providers in their farms. The number of household members, which participated in farm work together with the activities performed and compensation given are provided in Table 6.13. The table (Table 6.13) also indicates that most households had at least 1 to 3 persons in full-time farm work (66.8 percent), mostly employed to carry out weeding (66.2 percent) and they were compensated with food. Monetary payments were limited to only 22.2 percent of the households out of a total of 45 respondents. The statistics in Table 6.13 show that most households did not employ permanent labour. For example, in this study the hired labour comprised of only 5 males and 2 females. Temporary labour was preferred and consisted of 51 percent males and 49 percent females. Most hired labour was in the age-group 15-19 (teenagers), probably, due to the fact that the age coincides with the time when the teenagers completed their primary education and when some of them dropped out of school, and resorted to any employment opportunity to cater for their financial needs.

The table (Table 6.13) gives different values for households, which responded to particular questions, hence the variations in sample sizes. For example, 238, 247, 89, 39 and 90 households out of 279 in the sample responded to questions relating to number of full-time family members in farm work, use of hired labour, type of crop labour hired for, labour in man-hours a day and wage paid per day, respectively.

Table 6.13 Full-time household members in Farm work and Hired labour

Item	Description	HHd	Percentage
Number of full-time family members in farm work	1-3	159	66.8
	4-6	72	30.3
	7-10	7	2.9
	Total	238	100
Type of Activity	Slashing	6	2.6
	Digging/Ploughing	45	19.7
	Planting	20	8.8
	Weeding	151	66.2
	Harvesting	3	1.3
	Others	3	1.3
	Total	228	100
Type of compensation	Food	35	77.8
	Money	10	22.2
	Total	45	100
Use Hired Labor	Yes	126	51
	No	121	49
	Total	247	100
Number of Permanent labour (male)	One	2	40
	Two	3	60
	Total	5	100
Age of permanent labour (male)	25-29	1	25
	30-34	1	25
	35-39	1	25
	40-44	1	25
	Total	4	100

Number of permanent labour (Female)	1	3	100
Age of permanent labour (female)	30-34	3	100
Number of temporary labour (male)	1- 2 3 - 4 5 - 6 7 - 8 Total	42 7 3 1 53	79.3 13.2 5.7 1.9 100
Age of temporary labour (male)	10-14 15-19 20-24 30-34 35-39 60 and above Total	1 14 11 1 8 3 39	2.6 35.9 28.2 2.6 20.5 7.7 100
Number of temporary labour (female)	1 - 2 3 - 4 5 - 6 7 - 8 Total	37 9 4 1 51	72.5 17.6 7.8 2.0 100
Age of temporary labour (female)	1 - 19 20-24 25-29 30-34 35-39 40-49 Total	17 7 4 9 2 1 40	42.5 17.5 10.0 22.5 5.0 2.5 100
Type of crop labour hired for	Food crops Cash crops Other Total	45 25 19 89	50.6 28.1 21.3 100
Labour in man-hours per day	1 - 2 3 - 4 5 - 6 Total	26 12 1 39	66.6 30.7 2.6 100

Source: Fieldwork data

The labour was mainly hired for food crop production (50.6 percent) with only 28.1 percent hiring labour for cash crop production. A majority of households worked for 1 to 4 hours a day, mainly earning a wage of between less than Ksh. 1000 to Ksh. 2000 (85.6 percent). Additional results from the fieldwork concerning seasonal use of labour indicated that most labour is hired during the long rains season (79.7 percent) with only 36.5 percent of the households which hired labour, selling some of their crops.

Chisholm, ***et al,*** (1973) stated that most small-scale farmers sell some of their produce not to raise capital but to meet their pressing needs. As many households did not keep records on the costs incurred during cash crop production and as evidenced during fieldwork, it was not possible to evaluate whether the costs incurred when hiring labour was profitable.

Mellor, ***el al,*** (1987) observed that in Sub-Saharan Africa, non labour cash expenditures in manual systems without chemical inputs were low, generally less than US dollars 5 (Ksh. 380 at the rate of Ksh. 76 to the dollar) per hectare (Ksh. 161.5 /acre). In areas where hired labour was common, however, cash expenditures could be as high as US Dollars 20 (Ksh. 1520 to US Dollars 60 (Ksh. 4560) per hectare (Ksh. 646 to Ksh. 1938 per acre). Labour input per unit area, primarily from family sources, in that study ranged from 350 to 1200 hours per hectare, (148.8 to 510 hours per acre) varying as a function of crop, population density, and length of cropping season. Periods of peak labour input generally correspond with planting and weeding, when timeliness could critically affect potential yields. Such Labour requirements of different crops and classes of livestock vary immensely. For example, rice paddy or wet rice is said to absorb over 4000 man-hours per hectare (1700 man-hours per acre) or the work of two people for 313 days per year for roughly 6 and one-half hours per day (Symons, 1968). If labour input continues to be increased, however, diminishing returns will eventually extend to the point where the marginal return of labour is zero. The labour inputs range from 1400 to 2500 man-hours (including female labour) per hectare per year (595 per acre to 1062.5 per acre); and apparently above this limit, additional labour inputs yield no returns.

Symons stressed that very low marginal productivity of labour could only be tolerated where labour is not hired, unless wage rates were to be correspondingly low. Yotopoulos (1967) further recommended that farm employment statistics, whether they refer to aggregate or to the micro-levcl, must often contain inferences derived from more easily observable data, like the agricultural population, the size of the agricultural labour force, or the labour available for the agricultural employment. As far as the family farm was concerned (micro-level), in order to estimate the labour employment, the following were required:

(a) the total family labour supply,

(b) family non-labour supply,

(c) family farm labour supply (labour available), and;

(d) the labour input (labour demand), where labour is measured either as man-days or man-hours.

The researcher would like to state that within the African society, it is difficult to refer to anyone as economically inactive in agriculture as most people work until death irrespective of illness, age, house duties, previous employment or public aid. As a result this study has used the age - group between 15 and 60 for the purposes of emphasizing issues of unemployment and underemployment among studied households. Table 6.14 shows the relationship between household size and labour.

The data showed that the total number of household members present does not determine the number of people in farm work (see Table 6.14 for more details). This could be due to the presence of children in a household, available off-farm employment opportunities, illness or just unemployment. It was also the household size of between 1 to 10 persons that hired most labour. As household size increased from 11 to 20 persons, fewer people were engaged in farm work, say, 1 to 6 people, and accounting for 22 and 20 male and female hired labour, respectively. The households with indications of unemployment constituted 35 percent of the sampled households.

Table 6.14 **Influence of household size on Labour**

Total number of household members present	Number of full-time household members in farm work/HHd					Number of Hired labour (male)	Number of hired labour (female)
	1-2	3-4	5-6	7-8	9-9		
1 -5	67	55	18	2	2	30	25
6-10	20	28	12	1	0	17	18
11-15	6	6	0	0	0	5	2
16-20	4	0	1	0	0	2	2
21 -25	0	0	0	0	0	0	0
26-30	0	1	0	0	0	0	0
Over 30	0	0	0	1	1	1	1
Total	97	90	31	4	3	55	49

Source: Fieldwork data

The fieldwork results shown on Table 6.13 indicate that there were signs of underemployment in the region as most household members present worked for 1 to 4 hours with the majority of the people working for only 1 to 2 hours a day. In this case, the researcher considers any work done for less than 6 man-hours a day as under-employment. Within the large households, the household members barely worked for even an hour. There were, therefore, signs of both unemployment and underemployment as the mean age, median and mode of the respondents was falling between 20 and 60 years (82.4 percent) with children and teenagers constituting only 16.8 percent of the sampled population. This also indicated that wages were expensive given that most of the household head did have other sources of income apart from farming. It was difficult to relate household size with household labour (man-hours/ man-days) and wage paid in Kenya Shillings per household. The age groups of sampled households: 1-10, 16-20, 21-60 and above were 2.3, 9.2, 82.4 and 0.8 percent, respectively, out of 131 respondents.

Table 6.15 shows that Lower Nyakach, Nyando and Muhoroni divisions had more household members (7 to 8 members) in farm work, who also worked for longer hours (3 to 5 hours a day) compared to other divisions where people worked for short times. While Miwani division did not have data for household sizes of 7 to 8 persons, the duration of time worked was the same as the one for Lower Nyakach, Nyando, and Muhoroni divisions. Most of the people in Upper Nyakach division also worked only for 1 to 2 hours per day. Many households hired labour for cash crops and Lower Nyakach was leading, while Nyando division led in hired labour for food crops. This could be attributed to the Nyando District headquarters, which are located within the division, and which, creates other off-farm activities which are easily accessible.

Table 6.15 Labour Characteristics and distribution within the study area

Division	No. of HH members in farm-work/HHd					Hired labour/ HHd		Crop type labour hired for/HHd		Duration of labour/HHd		
	1-2	**3-4**	5-6	7-8	**9-10**	**M**	**F**	Cash	**Food**	**1-2**	**3-4**	5-6
Upper Nyakach	34	12	2	0	0	20	18	5	0	2	0	0
Lower Nyakach	10	24	9	2	1	3	1	16	0	15	1	0
Nvando	9	20	9	2	1	18	63	7	12	2	1	1
Muhoroni	20	29	8	0	1	19	5	8	3	**1**	4	0
Miwani	29	12	5			16	13	9	10	6	6	0
Total	102	97	33	4	3	76	100	45	25	26	12	1

Source: Fielc work data (M = Male, F = Female, and No. = Nurnber)

6.5 SOURCES OF HOUSEHOLD CASH INCOMES/EXPENDITURES

6.5.1 Income from cash crop sales

The cash crops grown included coffee, tea, sugarcane, groundnuts, beans, fruits and vegetables (kales and tomatoes), as stated in the earlier chapters. Sugarcane farmers (53.5 percent) in the District were more than other cash crop farmers growing coffee and tea, beans, and other cash crops which accounted for 21.5, 4.9, and 20.2 percent, respectively (see Table 6.16 for more details). The spatial distribution of these cash crops is provided in Table 6.16 and Figure 6.8.

Table 6.16 Spatial Distribution of Cash crops within the Study area

Division	Cash crops	HHd	Percentage
Upper Nyakach	Coffee and/or Tea	26	81.3
	Sugarcane	2	6.3
	Beans	2	6.3
	Groundnuts	1	3.1
	Vegetables	1	3.1
	Total	32	100
Lower Nyakach	Sugarcane	1	33.3
	Rice	2	66.7
	Total	3	100
Nyando	Coffee and/or Tea	1	2.8
	Sugarcane	26	72.2
	Rice	6	16.7
	Groundnuts	2	5.6
	Cotton	1	2.8
	Total	36	100
Muhoroni	Coffee and /or Tea	2	4.9
	Sugarcane	35	85.4
	Beans	3	7.3
	Cotton	1	2.4
	Total	41	100
Miwani	Coffee and /or Tea	2	6.3
	Sugarcane	13	40.6
	Beans	2	6.3
	Rice	10	31.3
	Groundnuts	4	12.5
	Vegetables	1	3.1
	Total	32	100

Source: Fieldwork data

Figure 6.8:

SPATIAL DISTRIBUTION OF FOOD AND CASH CROPS AMONG SAMPLED HOUSE HOLDS

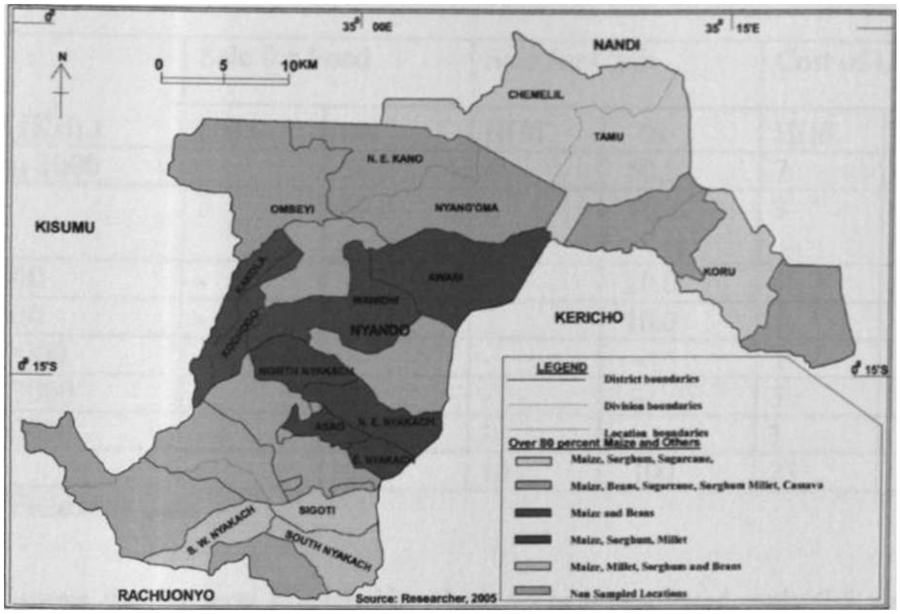


Table 6.16 shows that Miwani division is leading in the number of households growing cash crops followed by Upper Nyakach division. It is therefore questionable whether cash crop production brings prosperity as intended or food deficits as is witnessed within this region. Nyando division was found to be the poorest in terms of cash crop production. Over 70 percent of the households stated that the cash crops performed well, 26.3 percent and 3.4 percent stated performance as medium and poor, respectively. Among households that were sampled, a few farmers (only 23 households) were able to sell their crop for cash. Other farmers either did not sell any crop or sold in exchange for food. Table 6.17 gives the values in Kenya shillings (Ksh.) of the crops sold for food and for cash. The table shows that most households in Nyando District are mainly subsistence farmers, whose costs of labour were difficult to evaluate. Whittlesey (1936) defined a subsistence farmers as " A farmer who grows his crops or raises his animals and only sells what is left over, or what is forced to part with by emergencies". Symons (1968) went further to give various definitions of subsistence farmers and which were used to decide on the definition used in this study.

Table 6.17, shows that there is no connection between the cost of labour and cash obtained, which could be used for savings and future capital in the farm.

Table 6.17 Crop sales for food and cash Incomes and Cost of Labour among Sampled Households

	Sale for Food		Sale for Cash		Cost of Labour	
Amount (Ksh.)	HHd	%	HHd	%	HHd	%
Less than 1000	3	50.0	6	60.0	7	30.4
1000 - 2000	3	50.0	1	10.0	3	13.0
2001-3000	-	-	2	20.0	4	17.4
3001-6000	-		1	10.0	1	4.3
6001- 10000	-	-		-	2	8.7
10001-20000	-	-	-	-	3	13.0
20001-50000	-	_		-	3	13.0
Total	6	100	10	100	23	100

Source: Fieldwork data

Among the farmers/ households which were interviewed, only 7.8 percent sold some of their crops with the remaining percentage stating that they consumed all their farm produce during the long rains season (48.9 percent). Very few households had any food to store or sell for income, with only 18 households (18.4 percent) selling some of their produce for money. It was not clear whether the crops were sold to buy other types of food to fill production gaps within various households or due to other reasons. As an area of further study, it would be interesting to examine household production, consumption, sales, storage and reasons for sale so as to find out whether the money was used for buying food or savings. The fieldwork results revealed that it was the households with excess of production over consumption that were able to store food, particularly, among the households with less than 10 persons. Production did not match consumption among households with more than 12 persons as the mean, mode, median, and sum of consumption statistics all exceeded the production statistics.

This was an indication that the majority of households did not have adequate food and therefore, could not sell their crops for extra income. The standard deviations and range statistics show that there was more variability on production than consumption. In addition, all the percentiles showed shortage of production over consumption. A majority of households had 4 persons each with a mean of about 5 persons. There were 1477 persons living on 1343 acres (570.8 Ha) of land, showing a density of about 1 person per 0.39 hectares, which is too small for any meaningful food crop production. Symons

(1968) suggested that such small farms must be worked more intensively than large farms it their owners or tenants were to obtain reasonable incomes. Additional details regarding the influence of household size on household food security are provided in chapter Seven on demographic and health issues among sampled households. The number of bags stored (51.1 percent) or sold does not match or relate to excess of production over consumption.

6.5.2 Income from off-farm employment

During the fieldwork, households were also interviewed whether they had other sources of income apart from farming (off-farm employment/remittances). Table 6.18 shows that a majority of the households only had between Ksh. 1000 to 3000 annually as income from off-farm employment or remittances. This was barely enough for the household needs, particularly when other issues of health and education among other household requirements, were all considered.

Table 6.18 Income from off-farm employment / remittances

Income (Ksh.)	HHd	%
1000-2000	24	47.1
2001-3000	14	27.5
3001-5000	6	11.8
5001- 10000	2	4.0
10001-20000	3	6.0
20000 and over	2	4.0
Total	51	100

Source: Fieldwork data

6.5.3 Cost of inputs for food and cash crops

The cost of inputs for food and cash crops were as shown in Table 6.19, which elaborates that only 20.7 percent of the households (19 households out of 92 respondents) used inputs in their farm, and where input referred mostly to cost of fertilizer used.

Among the households that had title deeds (153 households) or 54.8 percent of the sampled households, only 7.8 percent had used their title deeds to acquire a loan. The

Tabic 6.19 Cost of Inputs used in the land cultivated in the year 2004

Total Cost (Ksh.)	Input for Food crops		Input for cash crops	
	HHd	%	HHd	%
Less than 1000	8	42.1	12	16.4
1001 -2000	2	10.5	11	15.1
2001 - 3000	2	10.5	10	13.7
3001 -5000	2	10.5	5	6.8
5001 - 10000	3	15.8	10	13.7
10001 -20000	1	5.3	7	9.7
20001 - 30000	0	0	12	16.4
30001 and over	1	5.3	6	8.2
Total	19	100	73	100

Source: Fieldwork data.

loan acquired in Kenya shillings and the percentages of households which obtained the loans were 1000-20000 (20.0 percent), 10001 - 20000 (70.0 percent) and 20001 - 100000 (10.0 percent). Only ten households had acquired loans. In both cash crop production and food crop production, the farmers used inputs. The details concerning the costs of inputs for food crops, production, consumption, and inputs together with the cost of farm storage facilities are dealt with in detail in the section dealing with Household production, Consumption and Surplus of production. It is believed that the farm storage facilities included the costs of pesticides used to preserve the crops.

6.5.4 Distance to the nearest market Centre

Distance to the nearest market centre is one of the factors that influenced capital of a household either by time spent on the way or by costs incurred during transportation of goods and the final price obtained. According to Obara (1983) the cotton plucked (during the time of his research) was mainly carried by individual farmers themselves to the buying centres and, such road problems are still persistent in the area. Special interests in road development are, therefore, necessary in order to encourage communication even during wet days, as poor infrastructure was one of the bottlenecks to agricultural development. The study revealed that Nyando households bought cereals from market (97.2 percent) and neighbour (2.8 percent). Chisolm, ***el al,*** (1972) gave an example of Africa as one of the areas where there is a close relationship between commercial agriculture and transport facilities, whereby transport facilities such as good railway and road networks have stimulated growth in commercial crop areas and caused little impact among small-scale farmers. Chisolm, ***et al*** emphasized that provision of transport and banking facilities have profound effects in agricultural development and gave an example of Malacca, Malaya where 83 percent of the subsistence farmers borrowed money annually and mainly for consumption. The farmers paid exorbitant interest rates to the shopkeepers who lent them money, as a result of unproductive agricultural activities, which subjected them to poverty.

The fieldwork results revealed that the households, which sold their crops, did so within the village (37 percent) and market (63.1 percent), hence showing the distance to the market as important in determining the household capital. The mode of transport used was walking (44.8 percent), Bicylce (17.8 percent), Vehicle (14.9 percent), handcart (9.5 percent) and unspecified means (13.5 percent). The variations in distances to the market centres and banking centres are provided in Table 6.20.

Table 6.20 indicates that S.W. Nyakach, Ombeyi and Awasi locations have the highest concentration of markets (they are more accessible as the markets and banks are located between 1 to 4 Km.). Some parts of Awasi location are still remote (with banks located between 31 to 50 Km.). Tamu location is least accessible in terms of markets and this goes for the entire Muhoroni division. The majority of the banking centres were still located quite a long distance from households (from 1 to over 50 Km away). This situation discourages household savings for future capital generation and establishment of off-farm employment.

Nyando District is well endowed with natural resources such as favourable climatic conditions, fertile soils and water resources. All it requires is improvement in transport facilities in order to encourage the development of other growth regions (centres) within the district to attract market and banking facilities. Chisolm, ***et al*** (1972) suggested that if there are good natural resources, or transport facilities, such growth regions would develop more rapidly, and would attract new industries. The greater the profitability of such a growth region the better its ability to attract capital, while the free trade and improved communications within the area allow the marketing of manufactured products to the peripherals. Uniform availability of resources within the District, should be explored for development in order to curb out-migration and undercutting of other established industries.

In considering the distance to market centres in relation to the costs of a 90Kg bag of either maize, millet, sorghum or rice, the areas with distances extremes like Koru location, Ombeyi and Awasi locations also had price extremes ranging from Ksh. 800 to about Ksh. 3200 per bag. However, most locations have accessible markets located from less than one Kilometre (within the residential area) to 4 Km away as was seen in the results. This could also be explained by the fact that during sampling process, access routes are needed and inaccessible/remote areas may not get as much attention as intended.

Table 6.20 Distance to the nearest Market centre and Banking Centre among Sampled Households

Division	Location	**Distance to the nearest Market centre (M) and Banking Centre (B) (Km)/ Number of Households**															
		0 - 1		2-4		S-10		1-20		21-30		31-40		41-50		jver 50	
		M	**B**	**M**	**B**	**M**	**B**	**M**	**B**	**M**	**B**	**M**	**B**	**M**	**B**	**M**	**B**
Upper Nyakach	S.W. Nyakach-	24	1	6	0	1	0	0	15	0	0	0	1	0	8	0	0
	Sigoti-	6	0	7	0	2	1	0	0	0	0	0	3	0	0	0	3
	S. Nvakach-	10	2	2	0	2	1	1	0	0	0	0	0	0	*1*	0	0
Lower Nyakach	Asawo-	14	1	7	2	2	1	0	0	0	1	0	11	1	10	0	1
	N.E. Nyakach-	8	0	10	2	2	0	0	0	0	0	0	9	0	8	0	0
	N.Nyakach-	4	0	4	1	0	0	0	0	0	0	0	4	0	1	0	0
Nyando	Awasi-	20	16	27	1<	0	0	0	0	0	6	0	3	0	1	0	0
	Kakola-	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Miwani	Ombeyi-	22	2	6	1	9	18	0	0	0	1	0	0	0	0	0	0
	N.E.Kano-	15	0	2	2	0	13	0	4	0	0	0	0	0	0	0	0
	Nyang'oma-	5	0	7	7	0	5	0	1	0	2	0	0	0	2	0	0
Muhoroni	Chemelil-	2	0	6	0	2	3	0	0	0	0	0	0	0	0	0	0
	Tamu-	6	1	15	4	18	21	0	0	0	0	0	1	0	0	0	0
	Koru	3	0	0	1	0	0	0	12	0	0	0	1	0	0	0	0
	Total	14f	2<	99	39	3	3 63	1	32	0	10	0	33	1	32	0	0

Source: Fieldwork data

6.5.5 Community Development participation

Community Development Organizations or Community Based organizations (CBO) may act as sources of income for various households, particularly when they encourage household savings and sharing of dividends as well as assisting in marketing of farm produce. Those in the study area include co-operative agencies, self-help groups. Welfare Associations, producer boards and government bodies, which carry similar functions. Community development participation may consume household income and time of the farmer, especially when it is involved with development projects such as building of schools, churches, and other services within a community. The main aim of incorporating these Community Development groups in this research, was to assess whether the individual households benefited enough from them to justify the time and cash spent on them.

According to the fieldwork data, 39.8 percent of the sampled households participated in Community development programmes. Upper Nyakach division was leading with 37.8 percent of the respondents participating in Community Development programmes. Miwani division came second, with 26.6 percent, then Muhoroni, Lower Nyakach and Nyando divisions with 17.1 percent, 15.3 percent and 7.2 percent, respectively. There were different types of projects the households participated in, for example some households in Upper Nyakach participated in agroforestry projects and farmers associations, as shown in Table 6.21.

Table 6.21 Types of Community Based Organizations among sampled households

Division	TvDe of eroun r>articipat<id in /HHd/ percent							
	Agroforestry		**School/church Const.**		**Farmers' Ass.**		**Food security Rel.**	
	HHd	%	HHd	%	HHd	%	HHd	%
Upper Nyakach	20	18	0	0	22	19.8	0	0
Lower Nyakach	5	4.5	0	0	12	10.8	0	0
Nyando	2	1.8	1	0.9	5	4.5	0	0
Muhoroni	2	1.8	1	0.9	16	14.4	0	0
Miwani	8	1.2	2	1.8	13	11.7	1	0.9
Total	37	33.3	4	3.6	69	62.2	1	0.9

Related, respectively)

Table 6.21 also indicates that more households participated in Farmers' Associations in all the divisions, but individual study of these associations was not done and it is later recommend for the further study. Agroforestry was the second most popular community development activity. Only one household in Miwani division participated in a Community based organization dealing with food security programmes. The researcher would like to emphasize that since food security is central to development, all Community Development groups should be made to include a programme or more on food security among its members.

When examining the cost incurred annually by various households on Community development activities, the raw data from the field showed that the lowest cost was Ksh. 200 (as identified in Muhoroni division) and the maximum was Ksh. 34,000 (which was found in Upper Nyakach division and where there were Agroforestry programmes and Farmers' Associations). In the Upper Nyakach case some households were obviously investing in agro-forestry activities for their own benefit. Other recorded costs were as follows: from less than Ksh. 1000 to Ksh. 3000 (84.3 percent), between Ksh. 3001 and Ksh. 5000 (13 percent) and between Ksh. 5001 and Ksh. 30000 (2.7 percent). Spatially, Upper Nyakach had expenditures ranging from Ksh. 1001 to over Ksh. 30,000, while Lower Nyakach, Nyando, Muhoroni and Miwani divisions had expenditures ranging from less than Ksh. 1000 to Ksh. 3000, Ksh. 5000, Ksh. 20,000 and Ksh. 30,000, respectively. The data showed that majority of households (65.9 percent) spent between Ksh. 1001 and Ksh. 3000 annually, and yet many households lacked income to buy extra food.

Among the households which participated in the development groups, the households which were engaged in Farmers Associations (54 percent) had remarkable performance in terms of production followed by those who participated in agroforestry activities (30.2 percent), particularly, when comparing group work and household food crop production. This study did not however quantify the strength of the relationship between production, cash and time spent on these community development groups together with the returns as the available data did not satisfy the requirements of a normal distribution. As a result, such a detailed enquiry has been recommended for further study.

6.6 COST OF FARM INPUTS, CROP PRODUCTION AND GOVERNMENT PRODUCER PRICES

The fieldwork results revealed that most households do not keep records of the amount of money they spend on the farm implements like hoes and slashers/pangas among other implements, and storage facilities, pesticides and renovations/constructions, particularly, on food crops (see Table 6.22). Table 6.23, on the other hand, provides some data on cash crop production, consumption, cost of inputs, and surplus together with cost of farm implements and storage facilities. Comparisons are later made between the amount received by farmers on the farm products sold, and the prevailing producer prices given by the government to find out if the two are consistent.

Table 6.22 Cost of inputs, Production, Consumption, Surplus of production and Cost of farm implements and storage for Food Crops

Item	Description	HHd	%
Cost of inputs (Ksh.)	Less than 1000	6	4.9
	1000-3000	53	43.4
	3001-6000	40	32.8
	6001-20000	17	13.9
	20001-50000	5	4.1
	50001 and over	1	0.8
	Total	122	100
Food crop production (bags)	1-2.9	87	56.1
	3-4.9	35	22.5
	5-6.9	20	12.9
	7-9.9	12	7.7
	Over 10	1	0.6
	Total	155	100
Food crop Consumption (bags)	1-2.9	29	18.4
	3-4.9	12	7.6
	5-6.9	7	4.4
	7-9.9	1	0.6
	10 and over	-	-
	Consumed all	109	69.0
	Total	158	100

Food Production Surplus (bags)	1-2.9 3-4.9 5-6.9 7-9.9 10 and over No surplus Total	14 2 2 - 1 5 24	58.3 8.4 8.4 - 4.2 20.8 100
Cost of farm implements and storage facilities (Ksh.)	Less than 1000 1000-3000 3001 - 6000 6001 -20000 20001 -50000 50001 and over Total	9 3 5 2 1 - 20	45.0 15.0 25.0 10.0 5.0 - 100

Source: Fieldwork data (I bag = 90Kg throughout the Thesis)

Table 6.23 Cost of inputs, production, consumption, surplus, and cost of farm implements and storage facilities for cash crops

Item	Description	HHd	Percentage
Cost of inputs	Less than 1000 1000-5000 5001 - 10000 10001 -20000 20001 -30000 30001 and over Total	3 35 10 7 12 6 73	4.2 47.9 13.7 9.6 16.4 8.2 100
Cash crop production (bags)	1-2.9 3-4.9 5-6.9 7-9.9 10 and over Total	17 14 20 1 6 58	29.3 24.1 34.5 1.7 10.3 100
Cash crop consumption (bags)	1-2.9 3-4.9 5-6.9 7-9.9 10 and over Total	22 2 3 3 2 32	68.8 6.3 9.4 9.4 6.3 100
Production Surplus (bags) after consumption	1-2.9 3-4.9 5-6.9 7-9.9 10 and over Total	11 4 4 2 5 26	42.3 15.4 15.4 7.6 19.2 100
Cost of farm implements and storage facilities (Ksh.)	Less than 1000 1000-5000 5001 - 10000	1 4 2	11.1 44.4 22.2

	10001 -20000 20001 - 30000 Total	1 1 9	11.1 11.1 100

Source: Fieldwork data

Table 6.23 elaborates that even though some crops were grown for cash, they were also consumed within the household. The data on cash crops indicates that these dual-purpose crops apart from maize include rice, beans and groundnuts. These were found to be very important crops, particularly when dealing with food security, and therefore they required greater attention. Very few households had surplus food to sell, for example, there were only 26 households which recorded surpluses. The section of farm implements and storage facilities also indicated that they were very expensive and were beyond the reach of most farmers. Such issues demand the assistance by the government to farmers in terms of loans so as to subsidize some of the farming costs. Descriptive statistical analysis on the fieldwork data led to the calculation of the means (Ksh.3332.41 and 10,364.02) and standard deviations (Ksh. 3671.63 and 8056.45) for cost of inputs, and farm implements and storage facilities, respectively.

According to the Central Bureau of Statistics (Statistical Abstract, 2004), the producer prices of some of the crops grown in Nyando were given in Table 7.3, and taking an example of maize, using the 90 Kg bag (used during fieldwork), and assuming that one of the crops mentioned was maize. The returns, therefore, obtained for maize in 2003 will be as provided in Table 6.25, where 100 Kg of maize was costing Ksh. 1189.50. When comparing the two tables (Table 6.24 and 6.25), it was observed that at least 7.5 bags of maize (675 Kg) were required to offset the cost of production before any profits could be made on production. With persistent crop failures due to adverse weather conditions and destruction from wild life, among other calamities, it is questionable whether subsistence farming in the District could be transformed into an economical enterprise with surplus income for savings.

Table 6.24 Average producer prices between 1998 and 2003 for some cash crops per 100Kg in Kenya Shillings

Crop	1998	2000	2001	2002	2003	2004
Maize	1284.4	1449.4	1359.8	1034.0	1189.5	_
Paddy Rice	1598.0	2832.3	2624.5	1605.9	1615.3	
Sugarcane	173.0	173.0	201.5	201.5	180.0	·
Cotton seed	2096.0	2100	1910.4	1800	1729.6	2107.4
Clean coffee	25718.0	15632.2	11508.7	11776.1	11962.9	9729.2
Tea	13300.0	12500.0	1523.0	13089.0	11638.7	11792.5

Source: Central Bureau of Statistics, 2004

Schultz (1964) suggested that in such cases, where the producer prices could not settle all the costs incurred during production process, emphasis should be placed on ways of increasing the yield to improve the farmers' income.

Table 6.25 Estimated Average Prices of Maize for a given size of Production

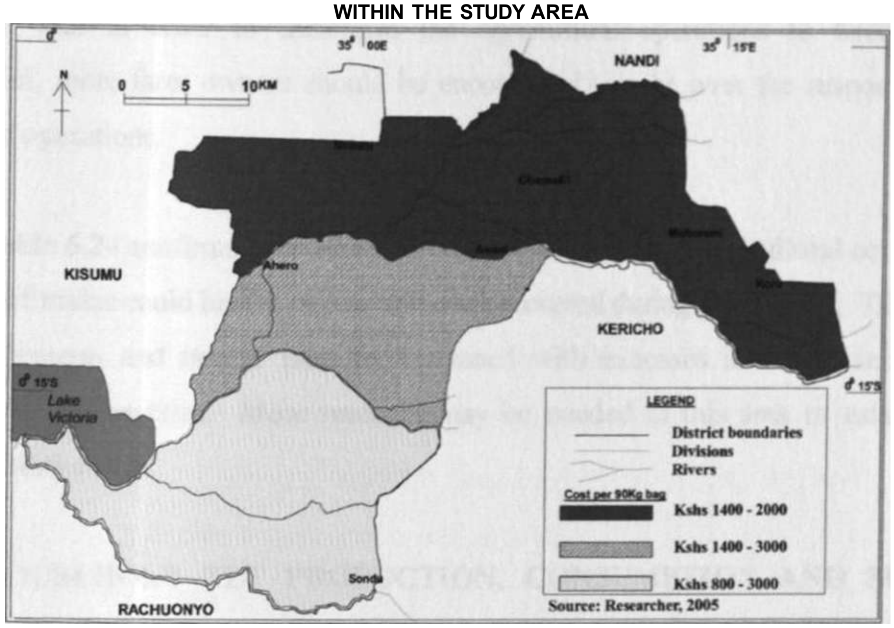
Average Surplus (bags)	Average surplus (Kg)	Total cost/income (Ksh.)
1.5	135	1605.83
3.5	315	3746.93
5.5	495	5888.03
7.5	675	8029.13
9.5	855	10170.23
10	900	10705.5

Source: Obtained from table 6.13

According to the fieldwork results, the cost of a 90Kg bag of cereals varied from one division to another, with maize costing more than millet and sorghum. For example, for Upper Nyakach and Lower Nyakach and Nyando divisions the cost was between Ksh. 1400 and Ksh. 2000 with Nyando division having costs ranging from Ksh. 1400 to Ksh. 3000. Miwani and Muhoroni divisions had between Ksh. 800 to Ksh.3000. The cereal crops grown included maize, millet and sorghum. See Figure 6.9, which give the Spatial Variations of Cost of one-90Kg bag of cereal among Sampled Households.

Figure 6.9:

VARIATIONS IN COST OF ONE- 90KG BAG OF CEREALS WITHIN THE STUDY AREA



The cost of a 90Kg bag of cereal was between Ksh. 1600 and 2000 (70.7 percent of the respondents) and this was particularly uniform in all the divisions with majority of households mentioning Ksh. 1600 as the modal figure. About 22.8 percent of the respondents stated a cost of between Ksh. 1400 and Ksh. 1500 with the majority in this group mentioning Ksh. 1400 as the average cost, particularly in Upper Nyakach, Miwani, and Muhoroni divisions. The households did not tell the price of individual cereals, but as stated earlier, it could be maize millet, rice or sorghum. According to government prices given earlier, the prices for maize and rice were Ksh. 1189.5 and Ksh. 1615.3 (Table 7.3). The prices mentioned during fieldwork were on the higher side for maize as most people spent an average of Ksh. 1400.

When comparing the farm size and households which bought inputs together with prices, a majority of those who bought inputs had farm sizes between 1 to 10 acres (0.425 to 4.25 ha), with a cost of between less than Ksh. 1000 and Ksh. 30 000. The hectarage from 4.7 to 12.8 hectares had only one household, which had bought a farm input costing between Ksh. 20 000 to Ksh. 30 000. An explanation could be that not many households had large pieces of land or this could be attributed to the predominance of absentee landlords. Schultz (1964) described such landlords as insufficiently informed, unsuccessful in developing the necessary incentives, and delegating responsibility for decisions and failing farm tenancy reforms geared towards their operations. Schultz suggested that in order to transform the agricultural operations to become more meaningful, more farm owners should be encouraged to take over the responsibility of their farm operations.

Table 6.24 confirms that there is a problem of pricing of agricultural commodities as prices of maize could hardly pay for the costs incurred during production. The costs of farm implements and storage facilities increased with increases in farm sizes for farm sizes below 4.7 hectares. More research may be needed in this area to establish any existing relationship.

6.7 HOUSEHOLD NET PRODUCTION, CONSUMPTION AND SURPLUS GENERATION

There was poor recording or lack of proper records on food consumption within households and the amount of surplus, as only a few households responded on this matter. A more worrying situation was those households, which consumed everything (69.0 percent), and this could be the figure referring to the households, which were food-poor as will be discussed later in the thesis. The Central Bureau of Statistics (2003a) stated that about 54 to 64 percent of the households in Nyando District are food poor, which was slightly lower than what the research has shown, the details on poverty are discussed in the section of poverty and food security. Among those households that were recorded during the fieldwork, as having consumed all their produce, Miwani and Nyando divisions were leading with 37.2 percent and 32.7 percent, respectively. The figures for Upper Nyakach, Lower Nyakach and Muhoroni divisions were 20.9, 2.7 and 7.4 percent, respectively. Among the households that produced food crops, production and consumption were as provided in Table 6.26.

Table 6.26 Production, Consumption and Surplus for food crops among the sampled households

Number of 90Kg-bags	Production		Consumption		Surplus	
	HHd	%	HHd	%	HHd	%
1 -2.9	87	56.1	29	18.4	14	58.3
3-4.9	35	22.5	12	7.6	2	8.4
5-6.9	20	12.9	7	4.4	2	8.4
7-8.9	4	2.6	I	0.6	-	-
9-9.9	5	3.2	-	-	-	_
10 and over	1	0.6		-	1	4.2
All	3	1.9	109	69.0	5	20.8
Total	155		158		24	

Source: Fieldwork data

According to Table 6.26, only 24 households out of 155 respondents, which responded to this particular question obtained surpluses from their production in the year 2003 (15.5 percent) with 69.0 percent having consumed all what they produced. A majority of the households also produced just about 1 to 2 bags and this was irrespective of the household size. Additional data regarding household consumption and production of different crops are provided in Table 6.27.

Table 6.27 Types of Food Crops Consumed among Sampled Households together with Annual Household Food crop Production and Consumption

Production/ Consumption in Kg.	Number of Households consuming				Household Production		Household Consumption	
	Maize	Sorghum	Millet	Beans	HHd	Percent	HHd	Percent
Less than 100					-	-		
100-200	18	0	7	0	87	56.1	29	18.4
201 - 400	9	0	2	0	35	22.5	12	7.6
401 - 600	6	0	0	0	20	12.9	7	4.4
601 - 1000					7	4.5	-	-
1001 - 1200					6	3.9	-	-
All	87	1	2	2	-	-	110	69.0
	120	1	11	2	155	100	158	100

Source: Fieldwork data

The statistics through observations of various histograms revealed that in order to make Nyando District at least 75 percent food secure, each household would require a minimum of 700 kg of cereals annually (about 8 bags), which is linked to the third quartile or 75th percentile (the mode). Or in order to make the district at least 56 percent food secure (the mean consumption), each household required about 560 Kg of cereals (about 6.2 bags) annually.

The statistics on production suggested that at the moment, 75 percent of the people in Nyando District produced about 400 Kg (4.4 bags) of cereals annually with one-half of the people producing 290 Kg annually. Standard deviation, range and variance were all greater in production than consumption, and which meant that greater variability existed in production as compared to consumption. These data meant that in order to improve household food crop production in Nyando District, the most important step to begin with should be aimed at equalizing the means and standard deviations of production and consumption. This could be done by increasing household food crop production through intensive cultivation or raising the household income so that various households would buy the extra food requirements to fill in the production gap and make the district at least 76 percent food secure. Furthermore, having the sum of production as about 45,000 Kg and consumption at approximately 88,400 Kg, shows that there is a shortage of 43,400 Kg among 158 households, which responded to this particular question. There was a total of 68,371 households in the entire Nyando District and 46,021 households within the sampled locations. Using the shortage above for 158 households, and referring it to the entire sample population of 46,021 households, there was a shortage of 12,641,211 Kg (or 14,045.9 ninety (90) Kg bags). The entire district, which consists of 68,371 households, would then have a shortage of 208,670.98 bags (20,867,098 Kg) on condition that the sample statistics were best estimates of the population parameters. The figure is more than double what was proposed by the Ministry of Agriculture (2004) reports, which was only 10 000 within the flood prone areas. The descriptive statistics relating to production, consumption and farm size (both in acres and hectares) are provided in Table 6.28.

Table 6.28 Statistics relating to Production and Consumption on Sample Farms

Statistic	Production	Consumption	Farm size (Acres)	Farm size (Ha)
Mean	290	559	4.73	2.01
Median	200	700	3.00	1.30
Mode	100	700	1.00	0.43
Standard deviation	242	233	4.14	1.76
Variance	584	541	17.16	7.29
Range	1100	700	27.00	11.48
Minimum	100	100	1.00	0.43
Maximum	1200	800	28.00	11.90
Sum	45000	88400	1343	570.78
Percentiles	25"'-100 50^{th} - 200 75th - 400	25^{th} - 400 50^{th} - 700 75^{th} - 700	25^{m}-2.00 so^.oo 75^{th}-2.98	25^{m}-0.85 50^{th}-1.28 75^{th}-2.98

Source: Fieldwork data

There was a positive correlation between household food crop production and farm size, which meant that the size of land contributes to the limited amount of food produced within the households and which does not relate well with consumption demands. A possible way of increasing the household food production would be to raise the mean of 2 hectares to tally with the third quartile (75^{th} percentile) at about 3 hectares. Given that the mode for household consumption is 700 Kg (which tallies with the third quartile or 75^{th} percentile) and the mean is 559 Kg, by raising the minimum farm size to 3 ha, the study area would automatically become 75 percent food secure. The data regarding farm sizes, production and yield are provided in table 6.29.

Table 7.8 shows that for farms of acreage between 0.43 to 1.29 hectares, the yield was about 176.5 Kg per hectare. Yield was between 88.2 Kg per hectare and 187.5 Kg 436 Kg per hectare for farms of 1.72 to 2.58 hectares. In this research, the main concern was to find out how a majority of households (65 percent), having between 0.43 to 1.3 hectares of land, with a mode of 0.43 hectares could raise their production in order to achieve food security.

Table 6.29 Farm size, Production and Yield

Farm size (Ha)	Average Farm size (Ha)	Production (in hundreds of Kg) and Yield (Kg/ha)							
		Average Prod. 1.5		3.5		7.5			10
		Prod. 1 - 2		3 - 4		5 - 10			over 10
		HHd	Yield	HHd	Yield	HHd	Yield	-IHc	Yield
0.43-1.29	0.86	70	174.4	16	407	11	872.1	0	1162.8
1.72-2.58	1.72	11	87.2	9	203.5	5	436.0	0	581.4
3.01-3.87	3.44	7	43.7	4	101.9	2	218.1	0	290.7
4.3-5.16	4.73	4	31.6	7	74.0	3	158.6	1	210.7
	Total HHd	93		36		21		1	

Source: Fieldwork data (Prod, refers to Household Food crop Production)

The data on production suggested that each household required a minimum of 3 hectares in order to match consumption with production. The yield which, ranged from 176.5 Kg/ha (Kilogrammes per hectare) to 882.4 Kg/ha needs to be increased for extra food production. In this case, although the type of cereals dealt with were not indicated, the alternative is to increase yields per unit hectare, which appear to be too low in the study area on all crops grown. For example, Acland (1971) gave average yields for some of the crops grown in Kenya before the improvement of crop varieties and agronomic practices, as given in Table 6.30, and which exceeded the observed yield in Nyando District among the sampled households.

Table 6.30 Average yields of some crops grown in Kenya and Nyando

Crop	Biological Name	Average Yield (Kg/Ha)
Maize	***Zea mays***	1100- 1350
Rice	***Oryza saliva***	5000 - 5700
Sorghum	***Sorghum vulgare***	550- 1700
Finger Millet	***Eleusine coracana***	450 - 900
Green grams	***Vigna aureus and V. mungo***	200 - 450

Source: Compiled from J.D Acland (1971)

The Table shows that whatever the cereal that the households in Nyando were growing according to fieldwork, the yields were still lower for maize and rice with exception of sorghum, finger millet and green grams.

6.8 LEVEL OF TECHNOLOGY AND WEALTH INDEX AMONG SAMPLED HOUSEHOLDS

Replacement of labour by machinery occurs when a farmer considers that investment in machinery, taking into account capital changes and depreciation, will increase profits through reduction in labour costs. Areas that could not previously be cultivated for technical reasons are then put into productive use with the improved and specialized machinery. Schultz (1964) suggested that where human labour is cheap relative to the price of other agricultural factors, a household farm may be efficient with a small garden-type tractor. On the other hand, when human labour is relatively dear, a household farm may be efficient with a combination of two or even three tractors that differ in size and type. The question is how many small-scale/ smallholder farmers could afford a tractor despite the high costs of human labour?

Mellor, ***et al,*** (1987) proposed that small - scale farming households should be the focal point of technology generation and extension development, as they play a critical role in increasing agricultural production and recommended productive, low-cost innovations, focus on food requirements, risk aversion, profit and reliability of crops. Symons (1968) also observed that the history of Agriculture has been a succession of examples of the extension of cultivation with improved tools, from the introduction of the first light plough, to its successors in heavier and more efficient plough, to horse-drawn implements, and eventually to mechanically powered machines. Symons grouped the effects of mechanization of agricultural operations as displacement of labour and extending the range of practical operations.

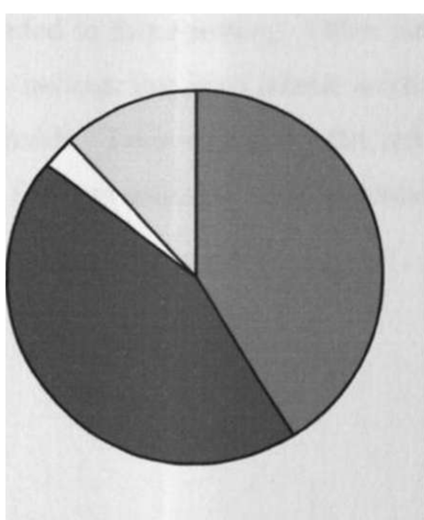
Mellor ***et al*** (1987) added other areas of technological change as irrigation, other forms of land and water management, mechanization, genetic improvement and the use of chemical inputs. Among the sampled households, only 35 households irrigated their farms with about 35.7 percent of the households using personal watering cans (may be for irrigation of vegetables). The life span of the watering cans lay between less than 5 years (25 percent) to over 20 years (16.7 percent). There were 33.3 percent and 16. 7 percent of the equipment, respectively, which lasted for periods between 5 and 20 years and 11 and 20 years respectively. Approximately 16.7 percent of those who practiced irrigation and owned watering cans stated that they had not spent any cash in maintenance. Fifty percent and 23.7 percent of the households, which practiced irrigation, had spent between Ksh. 100 and Ksh. 200, or Ksh. 500 and Ksh. 700.

The 64.3 percent who did not use watering cans used other methods of irrigation, which did not require specified equipment, and such methods as provided in Figure 6.10, with about 37.5 percent and 62.5 percent of the total of those practising irrigation using consistent supply and intermittent supply, respectively.

The household irrigation schemes were spread out in all the divisions in Nyando District, with many households being found in Upper Nyakach and Miwani divisions. Lower Nyakach, Nyando and Muhoroni divisions had the same number of households practising irrigation. Diversion with field storage and diversion without field storage were used in Lower Nyakach and Nyando divisions, while the above methods together with pumped surface flow were mentioned in Muhoroni and Miwani divisions.

Figure 6.10

Other Methods of Irrigation Apart from Watering Cans



- **Diversion with Field Storage (41.2 percent)**
- **Diversion without Field Storage (44.1 percent)**
- **Pumped well without Field Storage (2.9 percent)**
- **Pumped Surface Flow (11.9 percent)**

About 75 percent (187 households) had tried hybrid seeds and the type of seeds were as given in Table 6.31. This study did not attempt to compare the use of these hybrid seeds with the traditional ones. However, one major shortcoming of these improved seeds was that they compelled the farmer to buy seed each planting time irrespective of whether the money was available or not.

Table 6.31 Type of Seeds used among Households within the study area

Type of seed	HHd	%
Pioneer	90	48.1
513	34	18.2
511	51	27.3
512	3	1.6
Maseno cobber	5	2.7
614	2	1.1
Senando	2	1.1
Total	187	100

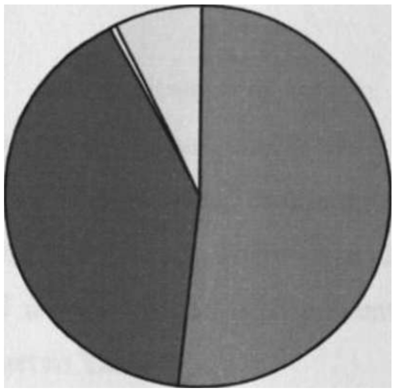
Source: Fieldwork data

The farm tools included slashers, pangas, and tractor. The methods shown in Figure 6.11 were used when tilling the land among 274 respondents.

The crops were harvested by use of machinery (1.2 percent), by hand (90.7 percent), and use of group labour (7.3 percent) among the 259 households which, responded to this question. Other methods not specified comprised 0.88 percent. The results indicate that hand labour was more popular in crop harvesting among the sampled households. Table 6.32 gives the variation in farm sizes in hectares with the method of tilling the land among sampled households.

Figure 6.11:

Methods used when Tilling the Land among Sampled Households



- **Use of Household Hand Labour (51.5 percent)**
- **Ox-plough (40 percent)**
- **Tractor (0.4 percent)**
- **Other (7.6 percent)**

Table 6.32 Variation in farm size with Methods of tilling the land

Farm size Hectares	HHd using household hand labour	HHd using Ox-plough	HHd using tractor	Other
0.43-1.29	83	53	1	6
1.72-2.58	19	25	0	5
3.01 -3.87	10	13	0	2
4.3-5.16	24	16	0	6
5.59 - 6.45	5	0	0	0
6.88 - 7.74	1	0	0	1
Over 7.74	1	0	0	0
Total	140	109	1	20

Source: Fieldwork data

According to Table 6.32, there was no increased use of ox-plough and tractor with increasing farm sizes, while many farms were tilled using household hand labour and tractor. Hand labour is also the one commonly used in crop harvesting. Spatially, the use of hand labour was more common in all the divisions, followed by the use of ox-plough, while tractor was used in Nyando division. Crop harvesting using machinery was carried out in Lower Nyakach, Muhoroni and Miwani divisions, otherwise hand labour was the mode (235 out of 259 households). Group labour was not available in Lower Nyakach but existed in all the other divisions. About 45.7 percent of the households out of 150 households used pesticides in their farms with 31.1 percent using Ambush as pesticide. Out of a total of 62 households, 59.7 percent harvested their crops, shelled them, dried and stored them. The crops were preserved either by drying in the sun, putting pesticides and storing or just drying in the sun and storing without putting pesticides.

As indicators of wealth, the following tools and equipment were mentioned among sampled households as stated in Figure 6.12. The Figure shows that a majority of the households owned ox-plough and radio, and this included temporary as well as semi-permanent houses. There were also a few wealthy farmers who owned all the materials used in wealth index (0.8 percent). Spatially, these wealth indices were distributed as shown in Table 6.33.

Table 633 Spatial Distribution of wealth among sampled households

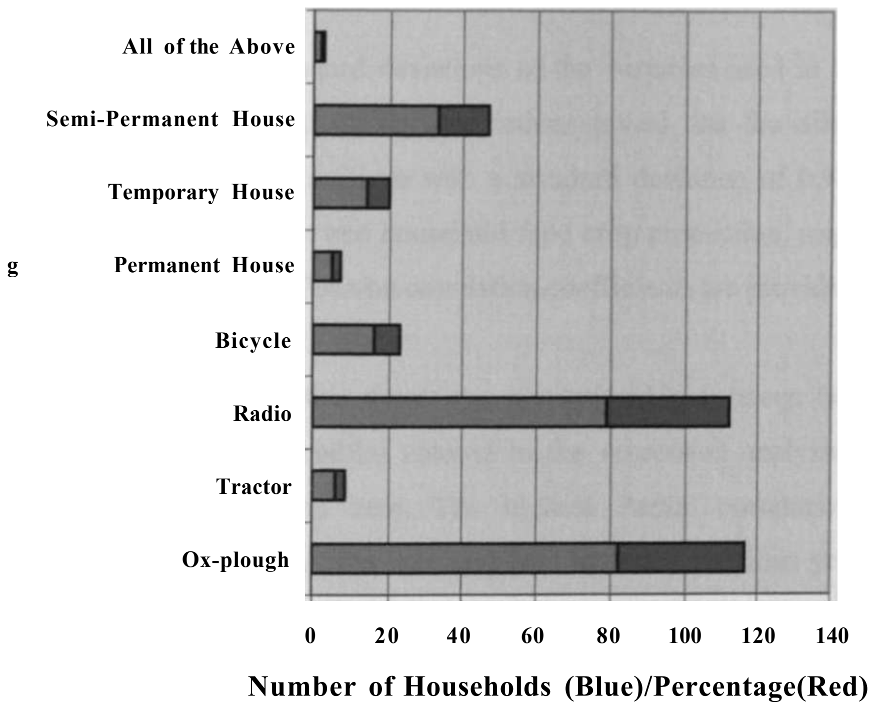
	Number of households with:							
Division	Ox-plough	Tractor	Radio	Bicycle	P/house	T&S/house	All	Total
Upper Nyakach	21	2	17	1	1	5	2	49
Lower Nyakach	13	1	30	1	-	1	0	46
Muhoroni	17	3	9	3	2	5	0	39
Nyando	15	0	2	5	1	25	0	48
Miwani	16	0	21	6	1	12	0	56
Total	82	6	79	16	5	47	2	238

Temporary and /or Semi-permanent houses, respectively).

Table 6.33 reveals that Upper Nyakach was leading in the wealth index followed by Muhoroni division, particularly when equipment like tractor, ox-plough, permanent house and all the items were considered. When comparing also the ownership of radios and

Figure 6.12:

Wealth Index Among Sampled Households



semi-permanent houses, then, Lower Nyakach and Miwani divisions were third and fourth respectively. Nyando division had mainly semi-permanent structures.

6.9 MULTIPLE CORRELATION AND REGRESSION ANALYSIS BETWEEN SOCIO-ECONOMIC FACTORS AND HOUSEHOLD FOOD SECURITY

As stated earlier in Chapter three, the **socio**-economic variables used in the analysis include farm size, land cultivated the previous year, household labour, distance to the nearest market centre and hired labour. The other **socio**-economic factors used in the analysis were, years of farm operation, distance to the nearest banking centre, distance to the nearest clean source of water, and distance to the nearest firewood place. The dependent variable in both cases was total food crop production.

6.9.1 Correlation and Linear Regression Analysis between Socio-economic Factors and Household Food security

The mean and standard deviations of the variables used in the analysis were as shown in Table 6.34. The standard deviations reveal that the distance to the nearest market centre was nearly uniform with a standard deviation of 0.98, followed by land cultivated the previous year and household food crop production, respectively. The table of Partial coefficients and Pearson correlation coefficients are provided in Table 6.35.

The Table shows that there was a relationship between household food crop production and all the variables entered in the regression analysis since no Multiple correlation coefficient was zero. The highest Partial correlation existed between household food crop production and land cultivated the previous year, with low partial correlation between food crop production and household labour, farm size and distance to the nearest market, respectively.

Table 6.34 Means and Standard deviations of the variables for economic factors and household food security

Variable	Mean	Standard deviation
Farm size (X|)	4.03	3.57
Land cultivated (X2)	2.17	1.77
Household labour (X3)	3.07	2.20
Distance to market centre (X4)	3.10	0.98
Hired labour (X5)	2.97	2.69
Household Food crop Production (Y)	2.52	1.94

Source: Fieldwork data analysis

The Pearson's correlation coefficient (Multiple correlation coefficient) was highest between household food crop production and household labour, farm size and distance to the nearest market centre respectively, with a negative multiple correlation existing between household food crop production and land cultivated the previous year. R and R~ values were 0.74 and 0.55, respectively, and which revealed that the economic factors could be used to explain 55 percent of the variations in food crop production in accordance to this analysis. See Analysis of Variance (ANOVA) (Table 6.36). The results from Multiple linear regression are later verified using stepwise Multiple

Table 6.35 Partial and Pearson Correlation coefficients between Major Socio-economic factors and Household food production

	Farm size (X_1)	Land cultivated (X_2)	Household labour (X_3)	Distance to market OQ	Hired labour (Xs)	Household food crop Production (Y)
X,	1-1.00 2- -	0.57 0.00	0.38 0.04	-0.17 0.39	0.14 0.48	0.47 0.01
X_2		1-1.00 2--	0.14 0.46	0.11 0.56	-0.06 0.76	-0.03 0.89
X_3			1-1.00 2--	0.12 0.54	0.46 0.01	0.52 0.00
X4				1-1.00 2--	-0.19 0.33	0.46 0.01
X_5					1-1.00 2--	0.26 0.17
Y						1-1.00 2--

Source: Fieldwork data analysis. 1 and 2 refer to Partial and Multiple Correlation coefficients, respectively, also for Tables 7.19 and 8.8, while '—' means not necessary.

regression, which is known to provide better prediction and also provides the contribution of the different variables to the variations seen in household food crop production.

Table 6.36 ANOVA between Economic Factors and Household Food Production

Model	Sum of Squares	Degrees of freedom	Mean square	F
Regression	57.784	5	11.557	5.837
Residual	47.457	24	1.98	
Total	105.241	29		

While calculated value of F was 5.837, F critical ($F_{(5>24)}$) was 2.62 and since the calculated value of F was greater than the critical value of F, the null hypothesis of no relationship between economic factors and food crop production was rejected. A conclusion was then made that economic factors greatly influence household food crop production and. are even more important than the climatic factors as discussed in Chapter five, leading to the equation below:

$$Y = 3J1 + 0.45X, - 0\text{-}31X2 + 0.38X_3 - 0.32X, - 0.5X_S$$

The equation indicates that there is a negative relationship between household food crop production and land cultivated, distance to the nearest market centre and hired labour. This shows an area, which requires policy strategies in order to improve household food crop production, and particularly directed to absentee landlords with large farms not necessarily used in crop production as they are engaged in off-farm employment. The government, therefore, must find ways of giving incentives to such households to enable them develop their land. The distance to nearest market could be an internal factor, (due to the size of the farm itself) or external as a result of inaccessibility of market centres. As far as hired labour was concerned, the analysis revealed that hired labour did not work long enough to pay for the costs incurred.

The association between predicted value of production and the actual (observed) value was random between the points (0,0) and (4,6) and this meant that the regression equation would yield better results within the range covered by the points.

The stepwise multiple regression was carried out in order to examine in detail, which factors would yield best results in terms of prediction, and after performing a series of steps, values of R, R^2 and F arrived at were as given in Table 6.37. The remaining variables left in the equation were Xj, X2, and X3, resulting in the equation:

Y = 1.55 + 0.47Xi - 0.31X2 + OJ9X3.

Tabic 6.37 Results from Stepwise Multiple Regression Analysis

Step	Variable Entered % contr.	R	R_2	F	Sig.
1	X_3 27	0.52	0.27	9.91	0.004
2	X4 10	0.61	0.37	4.28	0.05
3	X, 7	0.66	0.44	2.84	0.10
4	X_2 5	0.70	0.49	2.55	0.12

Source: Fieldwork data analysis (% Contr. refers to percentage contrination to the variation in Household food crop production)

The equation indicates that there is a negative relationship between land cultivated the previous year (X_2) and household food crop production while a positive relationship existed between household food crop production and farm size and household labour. According to these results, household labour accounted for 27 percent of the variation in household food crop production (the highest). A similar result was also arrived at using multiple regression analysis, though the percentage contribution could not be determined.

The number of family/household members in farm work together with distance to the nearest market accounted for 37 percent of the variation in household food crop production (distance to the market centre accounted for (37-27 percent = 10 percent of the variation). The joint effect of farm size (Xi), land cultivated the previous year (X_2), household labour (X_3), and distance to the nearest market centre (X_4) was 49 percent of the variation, with variable X_5 (hired labour) being removed from the equation. The socio-economic factors, in this analysis, therefore contributed 49 percent of the variation in household food crop production among the sampled households. The best prediction equation (Y) accounted for 46 percent of the variation in production, leaving hired labour to account for only 3 percent of the variation in household food crop production. The remaining 51 percent could be attributed to other factors such as other social, climatic, demographic and health factors and internal factors within production itself, which also influence household food crop production. Since climatic factors (drought and floods) already accounted for 12.8 percent of the variation, other social, demographic and health factors and internal factors could be held responsible for the remaining 38.2 percent of the variations in household food crop production.

The Analysis of Variance Table after stepwise Multiple Linear Regression was as shown in Table 6.38.

Table 6.38 ANOVA **Table for Stepwise Multiple Linear Regression Analysis**

Source	Sum of squares	Degrees of freedom	Mean square	F	Probability
Regression Residual	51.587 53.655	4 25	12.897 2.146	6.01	0.002

Since calculated F (6.01) was still greater than critical F ($F_{(4^\wedge 5)}$) which was equal to (2.76), the null hypothesis of no relationship was rejected and a conclusion was drawn that economic factors have impact on household food crop production, hence household food security.

6.9.2 Partial and Multiple Correlation and Regression Analysis between Other Socio-economic Factors and Household Food crop Production

The null hypothesis to be tested was that there was no relationship between the social factors and household food production. The table of partial correlation coefficient and Pearson correlation coefficient, which provide individual associations between household food crop production and each variable and multiple correlation (Table 6.40) and the table of the mean and standard deviation (Table 6.39) are given below.

Table 739 Standard deviations and Means of variables entered in the analysis between other socio-economic factors and Household food crop

Variable	Mean	Standard Deviation
Years of farm operation (Xi)	2.42	1.25
Distance to the nearest market (X2)	3.01	1.45
Distance to the banking centre (X3)	5.76	2.30
Distance to primary school (X4)	2.58	1.19
Distance to clean source of water (X5)	2.49	1.55
Distance to firewood place (X6)	1.77	1.13
Household food crop production (Y)	2.93	2.64

Source: Fieldwork data analysis

Table 6.40 Table of Partial and Multiple Correlation Coefficient between Social factors and Household food production

	X,	X_2	X_3	X4	X_5	X*	Y
X,	1-1.00 2—	-0.25 0.02	-0.18 0.11	0.62 0.35	0.99 0.37	-0.02 0.88	0.09 0.40
X_2		1-1.00 2--	0.19 0.08	0.35 0.00	0.73 0.51	0.31 0.78	-0.01 0.93
X_3			1-1.00 2--	-0.11 0.33	-0.08 0.48	-0.02 0.88	0.02 0.88
X4				1-1.00 2--	0.12 0.28	0.32 0.00	-0.23 0.04
X_5					1-1.00 2--	0.06 0.60	-0.29 0.01
X6						1-1.00 2--	-0.03 0.79
Y							1-1.00 2--

Source: Correlation and Regression analysis ('--' means not necessary).

Years of farm operation, distance to the nearest banking centre and distance to the nearest clean source of water were first, second and third highest in terms of direct correlation with production (Y), while X_2, $X4$, X_5 and X* had negative multiple correlation with household food crop production. Table 6.19 also shows that all the variables were related to food crop production with the weakest correlation existing between production and distance to the nearest market centre, banking centre and nearest place of firewood, respectively among these variables. The values for R and R^2 were 0.403 and 0.162, respectively, which meant that these factors entered in this analysis could explain 16 percent of the variations in household food crop production. Since the distance to the nearest market centre already accounted for 10 percent of the variation in household food crop production, other factors in this analysis can be said to be responsible for only 6 percent of the variations in household food crop production. The ANOVA table is given in Table 6.41.

Table 6.41 ANOVA between Other Socio-economic Factors and Household food crop production

Source	Sum of squares	Degrees of freedom	Mean square		Significance
Regression	92.959	**6**	15.493	2.450	0.32
Residual	480.607	76	6.324		
Total	573.566	82			

Source: Fieldwork data analysis

The calculated value of F (2.450) was greater than F critical ($F_{(6\cdot 7}6)$ = 2.17)) and the null hypothesis of no relationship was rejected and it was concluded that social factors influence household food crop production, resulting in the equation:

$$\mathbf{Y = 3.97 + 0.17X, + 0.16X2 - 0.04X_3 - 0.28X_4 - 0.29X_S + 0.08X«}$$

The above analyses, revealed that socio-economic factors contribute 46 percent plus 6 percent (52 percent) of the variation in household food crop production and are therefore very important in determining household food security.

6.93 Summary of Analyses on Socio-economic Factors and household Food Production, Food security and Poverty

The economic and social factors are inter-related and almost inseparable, such that the researcher decided to discuss them in one chapter to simplify the interpretation of the results, using household production levels. It was assumed that any factor that influences household food production positively or negatively will also influence household food security and poverty reduction strategies in a similar manner. The descriptive and inferential statistical analyses were used to serve specific purposes in order to achieve all the predefined research objectives. The main socio-economic factors discussed were farm size, household labour, land cultivated, distance to markets and hired labour. The other socio-economic factors included years of farm operation (which is linked to farmer's experience and effectiveness of extension services) and accessibility of services (infrastructural services) to various households.

The results of the Multiple Regression Analysis between household food production and socio-economic factors revealed that availability of land and household labour positively impacted on household food production, and hence household food security. Secondly, land cultivated each season, hired labour and distance to the nearest markets negatively impacted upon household food crop production, hence household food security. Procedures of stepwise Multiple Regression Analyses were used to isolate the contribution of individual factors on household food crop production and also to produce the best prediction equation, which resulted into removal of hired labour as a minor factor. These economic factors accounted for 49 percent of the variations in household food crop production as follows: (household labour (27 percent), distance to the nearest market (10 percent), farm size and land cultivated (9 percent), and hired labor (3 percent).

Among other socio-economic factors, years of farm operation (experience and effectiveness of extension service), easy access to market and firewood (access to sources of energy) impacted positively on household food crop production. On the other hand inaccessibility of market and banking facilities, primary schools and clean water sources impacted negatively on household food crop production. Since distance (whether accessibility or inaccessibility) already accounted to 10 percent of the variations in household food crop production, the remaining problems of service inaccessibility or under-development in regional infrastructure could be attributed to 6 percent (of the 16 percent variation of social factors) on household food crop production.

The socio-economic factors in this research, (problems of diminishing lands, inadequate labour and cash incomes (capital), farmer's and extension services, and infrastructure (roads, easy access to markets and banking centres, primary schools and clean sources of water) were responsible for 55 percent of the variations on household food production. These factors are, therefore, very important and must be considered seriously if household food security is to be improved and poverty eradicated.

6.10 SUMMARY

The spatial and temporal issues relating to land, labour and capital together with the existing inter-relationships have been discussed. Some of the information included concern emerging issues of envisaged land use patterns, relationships between markets and labour, availability of other related farming variables like crop varieties, and frequent land sub-divisions.

As far as labour is concerned, sources of labour, agronomic activities commanding such labour, characteristics and compensation for the labour are discussed. In terms of capital, the main sources of capital among the small-scale farming households were cash crop sales and off-farm employment opportunities. Some of the cash crops that generated the capital included coffee, tea, sugarcane, groundnuts, beans, fruits, and kales, with sugarcane being the dominant crop. It is doubtable whether cash crop farming among the small-scale farmers within the high agricultural density areas can translate to prosperity and eliminate food insecurity within the individual households.

Only a few households had off-farm sources of income, with the majority of the people getting barely enough to cater for all their household needs, particularly, the non-food items of health, clothing and shelter. Although these off-farm opportunities provided additional cash incomes to various households, they consumed time for agricultural production, and therefore, competed with household food crop production. Fertilizer was the most expensive and common input on which various households spent their cash, with more cash crops receiving fertilizer applications compared to food crops. The issues relating to markets and distance discussed also emphasized the fact that provision of good transport and banking facilities have profound effects on agricultural development, with Awasi and Fort-Ternan locations emerging as the least accessible in the district.

Most farms in Nyando District were inherited and some have been in operation for over 50 years, while problems of labour and cash greatly influence the amount of land cultivated by individual households annually. Family labour and temporary labour within the age group 15 to 19 were the most preferred among households, and, conversely, increases in household size impacted negatively on household food production. Hired labour was expensive and yet there were signs of both unemployment and under employment. Only a few households had surplus production over consumption for sale and few households with off-farm employment earned mainly between Ksh. 1000 and Ksh. 3000, which were barely enough to meet all the household needs.

While the suitability of land to agricultural production was mainly medium, minimal farm sizes were cultivated during the short rains period, leading to inadequate cash to buy inputs during land preparation for the long rains period. Hand labour and ox-plough were therefore more common in terms of land preparation, with a few households irrigating their land through diversion of water (for rice production) and using water cans to irrigate vegetables. Ox-plough and radio were the most common wealth indicators. After appropriate statistical analyses, it has been concluded in this section that **socio**-economic factors impact greatly on household food security and, hence, household poverty as they account for over 45 percent of the variations in household food crop production.

CHAPTER 7

DEMOGRAPHIC, HEALTH FACTORS, FOOD SECURITY AND POVERTY

7.1 INTRODUCTION

The demographic and health factors impact household food security in terms of labour (both quantity and quality), and are therefore, part of the socio-economic factors. The inter-dependence between the physical environment (climate and weather fluctuations) and the human environment (socio-economic environment) using a Systems' Approach automatically encompasses the demographic and health issues, which together play a decisive part in unravelling food security issues. This chapter begins by discussing the existing inter-relationships before specifically addressing issues, directly related to household demography and health. The demographic factors dealt with include household size, education and migration, while the health factors include morbidity, mortality and access to health care services. As stated earlier in chapter five, it is assumed in this chapter that any issue which negates any endeavours aimed at increasing household food crop production, automatically impacts negatively on household food security and poverty alleviation strategies.

The first section, which deals with the effects of demographic factors on household food security aims at finding out the following:

- Whether trends in population growth are comparable with required increases in food crop production in Nyando District,
- How household size affects farm size, household food crop production, and cash incomes, agricultural labour force, levels of education, and human dynamics,
- The connection between age of household head, household size, food crop production and household food consumption patterns, and;
- The correlation and regression results between the above variables and household food crop production.

The second section, which discusses health issues and household food security and poverty, elaborates on the effects of morbidity, mortality and the impact of

HIV/AIDS and Malaria ^particular, on household food crop production. The correlation and regression analyses are later used to establish the statistical significance of each of these vanables on household food crop production. The combined effect of both factors 1S lakT Presented in order to aid understanding, show the linkage with physical environment and socio-economic variables, and emphasize the importance of these variables in household food security and poverty. The main concern is the actual number of deaths within the household, irrespective of age, as death is assumed to produce physical removal of labour supplier or result in emotional stress within the concerned household, which also interferes with food crop production.

7.2 THE LINKAGES BETWEEN DEMOGRAPHIC FACTORS, PHYSICAL ENVIRONMENTAL FACTORS AND SOCIO-ECONOMIC FACTORS AND FOOD SECURITY AND POVERTY

Demography views population as comprising the study of populations as, structures and processes, whereby the structural elements include its size, its distribution and its biological composition. The processes, which operate within any population system, are fertility, mortality and migration (PSRI, 1990 and Ayiemba, 2003). Population growth may occur due to high birth rates, and moderate, or even high, death rates, and mass immigration or out-migration among others. The effect of this population growth on labour supply and economic well being differ depending on the reasons underlying the growth (PSRI, 1990; Okumu, 1991; Khasiani, 1991; and Muganzi, 1991). According to these authors, the demographic and health issues could be dealt with along three different lines of thought like population growth, migration, and morbidity or mortality. Muganzi (1991), particularly, proposed the use of a Systems' Approach when dealing with the demographic and health factors and food crop production in order to enhance agricultural productivity (due to the close link between these factors and the physical environment). This is because, apart from the socio-economic factors discussed in chapter five and six, the demographic and health factors are also needed to determme socio-economic development in which food security is central (Ruthernberg, 1980; Symons, 1968; Jaetzold, ***et al,*** 1982, and Muganzi, 1991).

The demographic and health issues are inseparable from socio-economic factors, as both are necessary for planning purposes. For example, Mbithi (1991) listed several of these factors that need to be considered while planning as changes in fertility, mortality, education, provision of public health, class and political structure and government organization. Others were production techniques, transportation of products and infrastructural services, distribution, sale or organization of production services, and shifts in the level of monetization of the economy. These variables vary spatially and temporally, and in this thesis, the issues dealing with transportation, sale and types of inputs and outputs, as well as cash flows and role of government, have been discussed in the section dealing with the impact of socio-economic factors on household food security and poverty.

73 THE RELATIONSHIP BETWEEN POPULATION DISTRIBUTION AND FOOD CROP PRODUCTION WITHIN THE STUDY AREA

There were difficulties in obtaining the population in Nyando District, as the District still heavily relies on Kisumu from which it was carved out as stated in Chapter two. The available population figures show that for some time, the population was decreasing and then it began to increase again from 1989 onwards as given in Figure 8.1.

Figure 7.1 reveals that during the 1969, 1989 and 1999 censuses, females were more than males and the growth rates were as provided in Figure 8.2, whereby the period between 1969 - 1999 witnessed a decrease in population, while that between 1999 and 2005 showed increased projections and growth rates.

According to Figure 7.2, the population growth rate for the period 1999 to 2003 was given as 2.5 percent, which was slightly lower than what was given in the Nyando District Development Plan (as 3.4 percent) at the beginning of planning period of 2003 to 2008. The District Agricultural Office gave the growth rate for the year 2005 as 3.8 percent, which was lower than what is calculated above (4.8 percent) for the period between 2003 to 2005, thus showing some inconsistency in the data available.

Figure 7.1s

Estimated population of the Study Area between 1969-1999

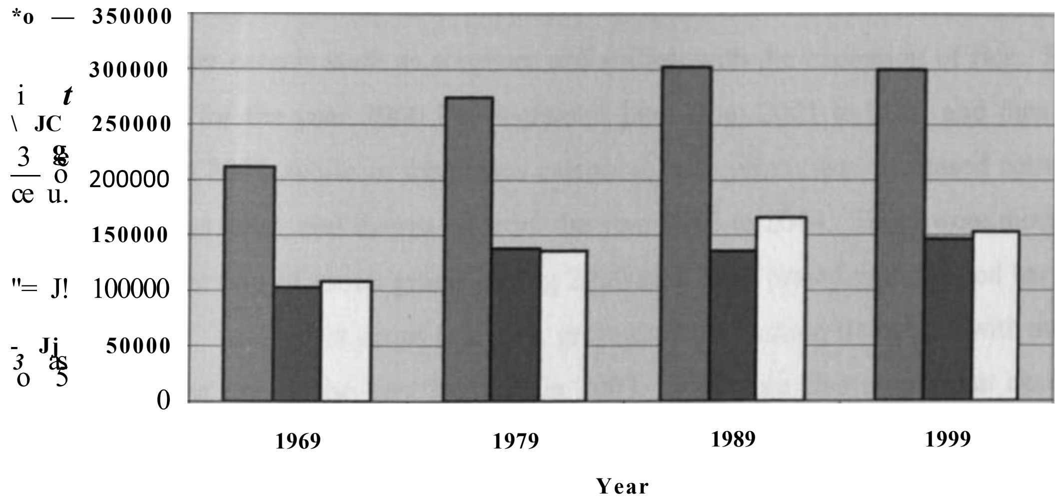
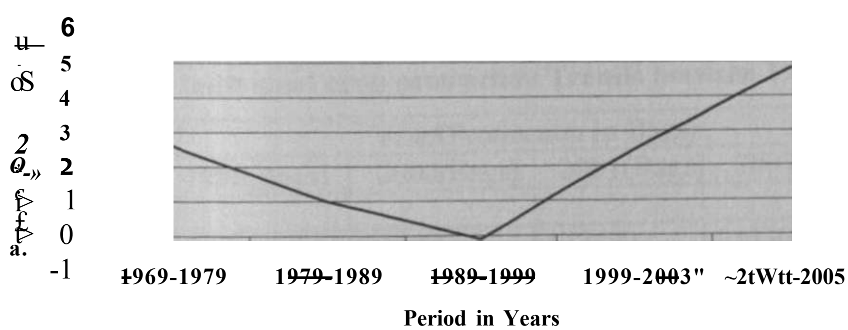


Figure 7.2:

Growth Rate (Percentage)



The available information on food crop production for the years 1980, 2000, 2001, 2003 and 2004 were used to establish whether food production has been increasing or decreasing at the same rate as the population growth. There was, however, no population data for the period extending beyond 1999 to compare with these crop production figures, except for the projected growth rates.

According to Table 7.1 crop production trends for the period 1980 to 2004, has been fluctuating over the years, with increases in maize production occurring between the year 1980 and 2000. Another remarkable increase in maize production occurred between the years 2001 and 2003 but later decreased in 2004 and a similar trend could be observed for other cereals such as sorghum and millet, with the exception of rice. Rice had high yields for the year 2000 but decreased later from 2001 to 2003 and then the trend went up in 2004, while in the pulses category, bean production increased between the year 1980 and 2001, and decreased from the year 2003 to 2004. There were minimal changes in production of green grams during 2000 and 2003 period with a good harvest realized in 2004. In the root crops category, groundnut production fluctuated with sweet potatoes attaining one of the best harvests in 2003. The table also shows that cassava could do well in the area as indicated in the year 2001, though no production records were available for the production periods of 2003 and 2004 for comparison purposes. Generally, there was a decrease in production of most crops in the year 2004 except for rice, green grams, cowpeas and groundnuts. These variations in food crop production trends alongside population growth rates are given in Figure 7.3 showing population growth alongside food crop production. In cases where population data was missing for a particular year, the previous year's data was used, where applicable.

Table 7.1 Individual crop production Trends between 1980 and 2004

	Year/(Production in Bags)				
Crops	1980(Bags)	2000(Bags)	2001(Bags	2003(Bags)	2004(Bags)
Cereals					
Maize	6510	129259	177472	233300	138810
Sorghum	1968.9	42070	56360	84025	50192
Millet	496	172	80	87.5	114
Rice	–	51648	44982	32175	81964
Pulses					
Beans	3425	12190	12285	10140	9755
Green grams	1525	865	856	858	7210
Cow peas	–	5350	3750	754	10390
Tubers/ Root crops					
Groundnuts	3730	2470	-	3970	4354
Sweet Potatoe«	700	5660	4320	72555.6	32222.2
Cassava	-	6400	13600	-	-

Source: Compiled from Kisumu and Nyando District Annual Reports 1978 to2004

Figure 7.3:

Per capita Cereal Production (Bags)

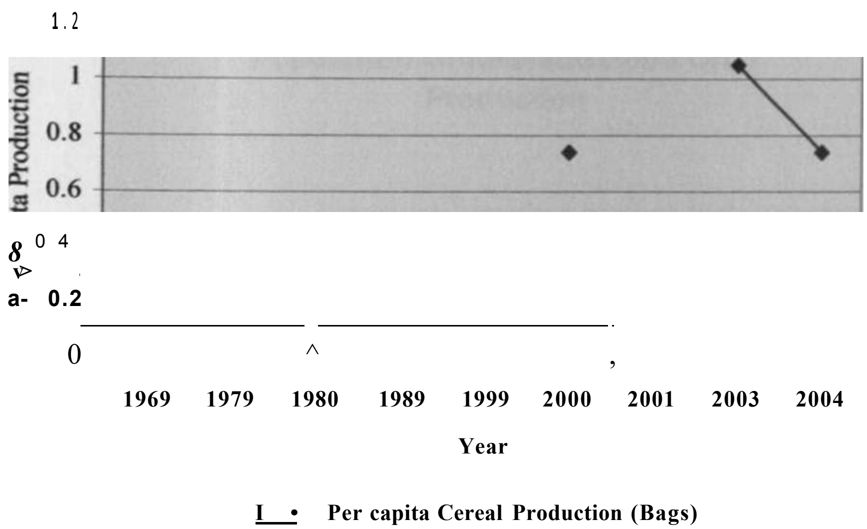
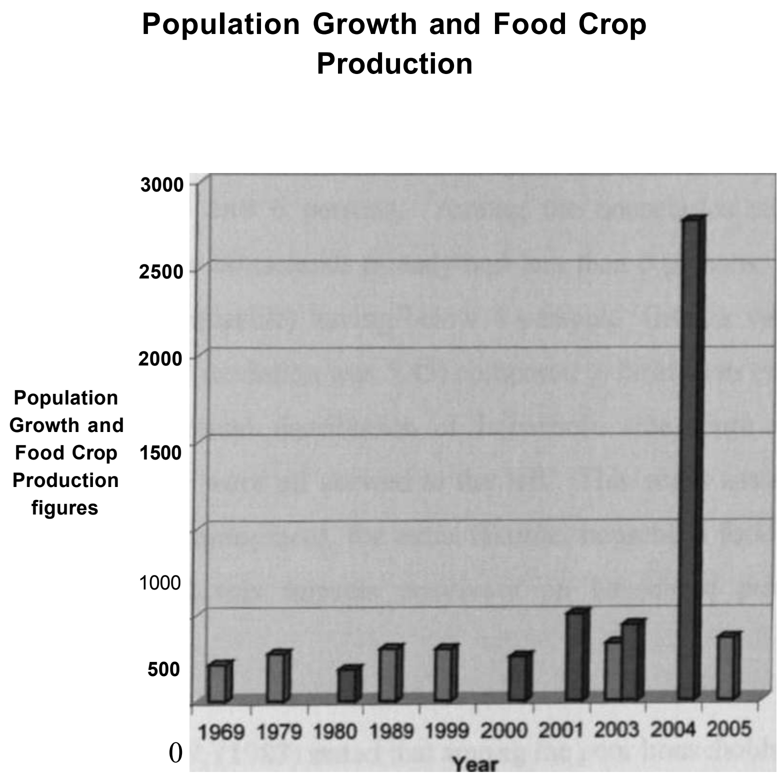


Figure 7.3 shows that production in the study area for the period 1980 to 2004 was very low (less than 1.2 bags) and well below the expected 6.4 bags (as stated in Chapter seven), hence the perpetual food insecurity in the area. Figure 7.4 elaborates on lack of precision and reliability of the existing data. These data were obtained and compiled from the population Census and District Annual Reports. Secondly, the year 2004, which was supposed to be accompanied by food shortage, in this case shows a bumper harvest, which is not true.

7.4 THE EFFECT OF HOUSEHOLD SIZE ON FOOD CROP PRODUCTION AND CASH INCOMES

Among the sampled households, there were family members who were present most time of the year and who depended on household food crop production for their survival besides minimal donations or remittances from outside. These were the persons considered relevant in terms of household food crop production. The reader should note that the definition of a household size in this study was referring to the number of people being sustained by a particular farm, irrespective of the number of wives. The majority oi the households had from two to seven members, with a few having between seven to

Figure 7.4:



(•Total Population (in 'POOS') •Total Cereal Production in f0008) of 90-Kg Bags]

between 15 hectares and 20 hectares with the majority of the sampled households having between one and less than 5 hectares. According to the fieldwork data, 55 percent of the 279 sampled households stated that they did not have adequate food for all household members with only 45 percent having adequate food for the household members. This showed a more serious situation than what was recorded in the Nyando District Development Plan (as Nyando District being 50 percent food sufficient (Republic of Kenya, 2001b).

In trying to find out how household size influences cash incomes within the household, the fieldwork results revealed that the households of 4 to 6 persons were the ones that were able to sell more of their crops (51.8 percent) and store some of their produce (52.1 percent). The households having 1 to 3 persons sold and stored only 22.5 percent and 6.8 percent, respectively. The percentage for stored and sold produce reduced for households having 7 persons and above. These statistics suggest that smaller households do not produce enough, may be due to the problem of labour shortage. Sales and crop surpluses reduced within the household from over 7 persons and this meant that in order to increase household income, it would be realistic to limit the size of a household to between 4 and 6 persons. Among the households studied in Nyando District, 75 percent of the households already had less than 6 persons, with one-third of the population (the first quartile) having below 4 persons. Greater variation existed in household sizes (standard deviation was 5.45) compared to farm sizes (standard deviation was 4.14). The statistical distribution of household size, farm size, production, consumption and storage were all skewed to the left. This study assumes that through crop sales or off-farm employment, for extra income, household food crop production could be improved and this impacts positively on household poverty eradication strategies.

Sinha, ***et al,*** (1988) stated that among the poor households, in this case, the small-scale farmers, there is famine, not because of unavailability of food in the market, but because of lack of purchasing power. Capital within such households mainly consists of hand tools, seeds, and small quantities of fertilizer, while non-labour cash expenditures in manual systems without chemical inputs are low. In cases where the incomes are slightly higher, such incomes, without incentives from the government (in providing infrastructure and accessibility of various services), might not necessarily lead to the acquisition of all the basic needs (Muganzi, 1991; Ghansan, 1972; Juma, 1985; CBS, ***et al,*** 2004; and Mellor, ***et al,*** 1987). Ghansan (1972) advised most of these authors that, although family planning programmes may benefit both individuals, by enabling parents to maintain smaller families, feed their children well on balanced diets, provide for their education and have extra funds to spend on the modem conveniences of life, it still must be done in line with the demands of economic growth.

. **Spatial variation** of-these **variables** showed **that** more bags of food crops were sold ,n uPPer **Nyakach followed** by Miwani divisions while Nyando divisions sold the least, art of fa explanation for sales in Upper Nyakach and Miwani divisions is due to the existence of better weather conditions (medium to high potential zones) as both areas had cash **crops** such **as coffee** and tea in the case of Upper Nyakach division, and sugarcane m Miwani division. It **was** possible that the households that were able to store some cereals and sold **some were** the ones having cash crops.

7-5 THE RELATIONSHIP BETWEEN HOUSEHOLD SIZE, FARM SIZE AND AVAILABILITY OF AGRICULTURAL LABOUR FORCE

In assessing the size of land per household and the number of full-time family/ household members in farm work/ household labour, the results revealed that land did not influence the number of full-time household members in farm work. In any case, the number of full-time household members in farm work reduced drastically as the household size increased. The first explanation could be the issue of absentee landlords who own large pieces of land but are also engaged in other off-farm employment elsewhere. Secondly, a majority of the sampled households had smaller farms of from 0.43 to 2.15 hectares with only a few having farm sizes greater than 2.6 hectares. These are shown in Table 7.2.

Table 7.2 Size of farm and number of full-time household members in farm work

	Household members in farm-work/ HHd				
Size of Farm (Ha)	1-2	3-4	5-6	7-8	9-10
0.43 - 2.2		63	19	3	2
2.6 - 4.3	23	27	10	1	1
4.7-6.5	2	5	2	0	0
6.9-8.6	1	1	0	0	0
9.0-10.7	0	0	0	0	0
11.2-12.9	1	0	1	0	0
Total (HHd)	101	96	32	4	3

Source: Fieldwork data

The mean, median and mode of the farm sizes were 2.0 hectares, respectively with a sum of 577.5 hectares. A majority of the farms fell below 4.3 hectares and this explains why increases in farm sizes were not accompanied by similar increases in household members in farm work.

The spatial variations were as provided in Table 7.3 together with Figure 7.4, which, shows that Muhoroni and Miwani divisions had larger farms compared to other divisions. Lower Nyakach had the smallest farms ranging from 0.43 to 1.3 ha and 3 to 3.8 ha.

Table 73: Spatial variations of farm sizes by Division among sampled households

Division	Farm size (hectares) /HHd								
	0.43-1.29	1.29-2.58	2.58-3.87	3.87-5.16	5.16-6.45	6.45-7.74	7.74-10.32	10.32-11.61	11.61 & above
Upper Nyakach	29	15	7	2	1	0	0	1	0
Lower Nyakach	44	2	1	0	0	0	0	0	0
Nyando	35	8	4	2	0	1	0	0	1
Muhoroni	9	10	6	40	0	1	1	0	0
Miwani	35	16	7	4	1	0	0	0	0
Total	152	51	25	48	2	2	1	1	1

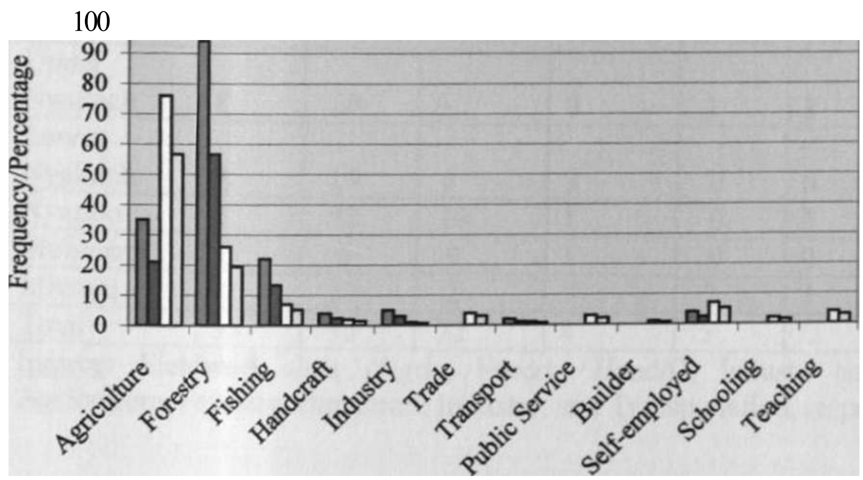
Source: Fieldwork data

The data show that Muhoroni division had more households with larger farms (greater than 2 ha) compared to other divisions, with farms in Lower Nyakach division being the smallest.

Not all the household population present most of the year was involved in farm work, as fieldwork results revealed that only 56.7 percent participated in agricultural activities, hence food production. This meant that potential agricultural labour in the rural areas were now looking for other opportunities of work away from agriculture, and hence food production, due to problems of unfavourable weather, lack of inputs, diminishing agricultural lands, and introduction of secondary activities in the rural areas. Within this group, 28.3 percent were permanently employed, 58.4 percent were temporarily employed while 11.4 percent were seasonally employed. The people that were permanently employed had to find other sources of labour for their household food production, while those employed temporarily failed to maximize their food production (due to divided attention between food production and other activities). Figure 7.5 below shows other occupations apart from farming, household members present and the household head participated in.

Figure 7.5:

Off-Farm Opportunities in the Study Area



Type of Employment

- **HHd Heads in the occupation**
- **Percent**
- **HHd members present in the occupation**
- **Percent**

According to Figure 8.5, all the eighty percent (80%) of the people in the rural areas were not all engaged in agricultural production, as was recorded in the Kenya National Development Plan (Republic of Kenya, 2001a). Labour competition between food crop production and other primary and secondary activities shows that some farms could be lying idle or were under-worked for food production, with those engaged in trading performing worst in agriculture and related activities. The occupations besides farming among sampled households are given in Table 7.4, which could be the reason for short time allocated to farming activities, as indicated in Table 7.5.

Table 7.5 indicates that people in locations such as Asawo and North Nyakach in Lower Nyakach division, Awasi and Kakola locations (Nyando division), Ombeyi in Miwani and Tamu and Koru locations in Muhoroni division worked for longer hours than the other locations. Figure 8.6 shows the variations in the Duration of time worked in the farms among sampled households by location.

Table 7.4 Occupations Apart from Farming among Sampled Households

Division	Occupation Apart from Farming/HHd						
	Agric.	Forest.	Fishery	Hand/C	Indust.	Transp.	Self employed
Upper Nyakach	8	20	6	0	3	1	1
Lower Nyakach	9	19	4	2	0	0	0
Nyando	4	22	10	1	0	0	0
Muhoroni	3	6	0	1	0	0	1
Miwani	11	27	2	-	2	1	2
Total	35	94	22	4	5	2	4

Source: Field work <ata (Agric, Forest., Hand/C, Indust., and Transp. Refer to Agriculture, Forestry, Handcraft, Industry, and Transportation, respectively)

Table 7.5 Spatial **Characteristics of full-time Household members in farm work among Sampled Households**

Division	Location	Number of full-time household members in farm work/HHd		
		1-2	3-4	5-6
Upper Nyakach	S.W. Nyakach	17	7	0
	Sigoti	11	2	0
	S.Nyakach	4	5	1
Lower Nyakach	Asawo	7	9	5
	N.E. Nyakach	5	9	4
	N. Nyakach	2	3	-
Nyando	Awasi	10	20	10
	Kakola	1	2	1
Miwani	Ombeyi	15	10	5
	N.E. Kano	12	2	0
	Nyang'oma	4	5	0
Muhoroni	Chemelil	2	6	2
	Tamu	11	16	6
	Koru	1	1	0

Total	102	97	33

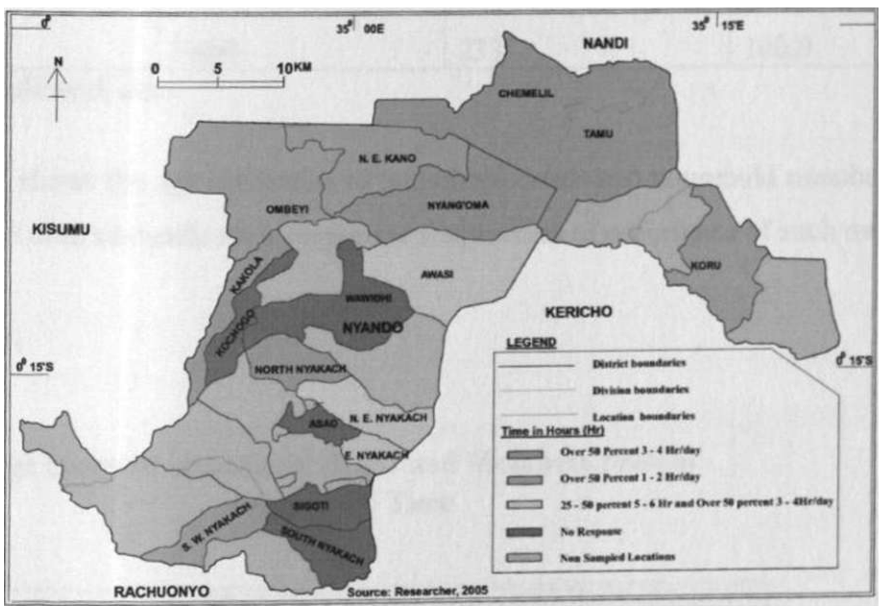
Source: Fieldwork data

7.5.1 Age Structure, Household size, and Household Food Consumption

Regarding whether they eat three meals in a day, 73.0 percent of the sampled households said that they had breakfast everyday. Other results were as shown in Table 7.6.

Figure 7.6:

DURATION OF NME WORKED PER DAY AMONG SAMPLED HOUSEHOLDS BY LOCATION



The table shows that a few households had three meals in a day with most of the respondents taking supper more seriously. These statistics also require that malnutrition studies be carried out in the area in order to examine how these patterns on meals influence household size and health. Secondly, the various households need to be educated on how to plan their meals so that they reap the best benefits from them as the data indicates lack of information on this matter, for example, taking supper more seriously than breakfast.

Table 7.6 Percentages of the Households who Eat Three Meals in a day

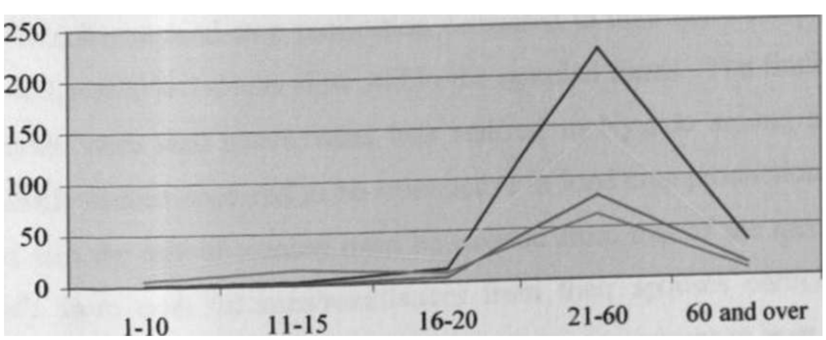
Type of Meal	Response	HHd	%
Breakfast	Eat Breakfast Do not eat Breakfast Total	203 75 278	73.0 27.0 100.0
Lunch	Eat Lunch Do not Eat Lunch Total	177 88 265	66.8 33.2 100.0
Supper	Eat Supper Do not eat Supper Total	193 40 233	82.8 17.2 100.0

Source: Fieldwork data.

Figure 7.7 shows the age categories of household heads and household members present most of the time alongside their respective frequencies of occurrence of such members.

Figure 7.7:

Age group of Household Heads and Members present most of the Time



Age Group

— Frequency of HHd Heads   Percentage of HHd Head
Frequency of HHd members — Percentage of HHd members

Figure 7.7 reveals that, some households were headed by children belonging to school going age, such as the ages between 1 to 15 and probably 16-20 years. For example, one of the children in the age category 1-10 years was eight (8) years old. These could be the households headed by orphans whose parents might have died because of various reasons relating to their health condition, as will be discussed in the section dealing with health issues in this chapter. The children household heads had the responsibility offending for themselves just as their parents would do if they were alive. The Figure also shows that most of the household members present were in the age-group 21-60 years. This could be because this is the time when primary and secondary school going children might have finished their education, while men also acquired wives. It is important to question whether these children headed households could engage in serious food production and encourage household food security. Results on food production among the different age groups revealed that between the ages 11 to 20, food crop production was minimal (mainly one-90Kg bag). However, production was higher within the age category of 21 to 60 and reduced for the age group of 60 years and above.

As far as sex of members present most of the time was concerned, 51.7 percent of the household heads were male while 47.2 percent were female. However, among the farmers interviewed, only 31.3 percent were male with female comprising 46.2 percent. This means that women still regard men as their household heads even if they were absent from home. It also meant that women play a more important role in farm activities, hence food crop production compared to their male companions, as they were the ones available for interview within the sampled farms. The findings of Suda (1991), however, were well above what was realized in Nyando among sampled households. Although women appeared to be more active in food crop production activities, it did not mean that the role of women must be isolated from that of the men as the women also benefit from cash incomes/remittances from their spouses participating in non-farm activities. Among the household members that were present at least fifty (50) percent of the year, 64.9 percent were male while only 30.2 percent were female (when all the age groups were included).

7.5.2 Levels of Education

Education level of household members is among the most important characteristics of the household because it is associated with reproductive behaviour, family and community health, and use of contraceptives(El-Zanaty, ***el al,*** 200land Suda, 1991).

When examining education alongside food production within individual households, families with primary school education performed better in terms of production. They obtained more bags of cereals from their land in a year, compared to those with secondary, and university education, as they were full-time available for agricultural work. Conversely, the worst performance was observed among the farmers who had university education, who recorded poor performance, possibly attributed to participation in off-farm activities along side agricultural food crop production. The interference with agricultural production resulting from availability of off-farm activities in the rural areas is an impact of migration policy aimed at discouraging movement into large urban centres (as discussed in the section on human dynamics). This policy, therefore, needs to include agricultural production so as not to interfere with household food production and food availability. On this basis, the government should enact legislation that allows even those in off-farm employment to participate adequately in food crop production to improve individual and regional household food security, for example by encouraging them to lease out their land while they are assisted to participate in agricultural production. Among the farmers interviewed, 52.7 percent attained primary school education, while 34.7 percent reached secondary school. Other percentages were as follows: A-level (9.0 percent), College/Technical training (2.7 Percent), and University (0.9 percent).

The observations by Okumu, (1991) and Khasiani (1991) showed that population pressure due to high fertility and lack of access to agricultural lands has led to constraints in the provision of services such as:

- health care and education,
- degradation of environmental ecosystems, and;
- unemployment and underemployment, which all aggravate household poverty problems.

Mother words, attainment of household food security, which is directly linked to poverty eradication, can only be achieved when the basic needs of food, shelter, clothing, health care an<i water are adequately available to the vulnerable groups of people to meet their needs (Muganzi, 1991). Households/ families with a large numbers of children are likely to be less able to save, and as a result, the level of investment is likely to be lower (Baldwin (1975). Thus, fertility affects household consumption and savings through the number of dependent children, while increased income, on the other hand, is associated with the level of education, economic activity, and the status and occupations of women within a household. It is further argued that increased savings may also induce parents to have additional children (PSRI, 1990).

While commenting on education, Suda (1991) recorded that on the average, women spend about 20 percent more hours than men in cropping activities, with the bulk of labour being in food crop production (Suda, 1991). These authors stressed that when you educate a woman, you educate a whole nation, and when you educate a man, you educate an individual, due to the advantages achieved in educating women such as reduced family size, better health care, expanded labour force, and improvement of education in other sectors. Household population for purposes of this research is limited to the number of persons present within a household (at least 50 percent in a year), without dwelling on other fertility indices such as number of children per woman and onset of child bearing (Thomas, 1980; Okumu, 1991, and Ayiemba, 2003). Education, on the other hand is viewed as a necessity in providing agricultural labour within the household, needed for household food crop production in terms of quality and quantity (Oduor-Otieno, 1991 and Khasiani, 1991). Comparisons will be made between men and women in the section dealing with gender problems to investigate if the findings of Suda (1991) apply to Nyando District.

7.53 Human Dynamics

As far as human dynamics are concerned, out of a total of 158 respondents, 93.2 percent stated that they would like to continue with agriculture and food production, while only 6.8 percent preferred to move to town to look for off-farm employment. The household heads who preferred moving to town and abandon food production, were those whose food production endeavours were not successful, particularly, where best production was about three (3) bags per year (barely enough for family needs).

The household members who were absent most of the time were important in food security analysis, as they were the ones who occasionally remitted some financial assistance to their respective families. The fieldwork data revealed that Kisumu town attracted most of the absent population (56 percent), followed by Nairobi (28.2 percent). Kericho town was third, followed by Chemelil town. A small number of people were attracted to places like Kisii, United States of America, Homabay, Nakuru, Kijabe, Mumias, Migori, Awendo or Kakamega.

Those household members absent most of the time visited their homes occasionally (85.2 percent), during weekends (7.4 percent), or during holidays. A large percentage of households were recorded as being absent due to employment commitments, and other reasons shown in Figure 7.8.

Figure 7.8:

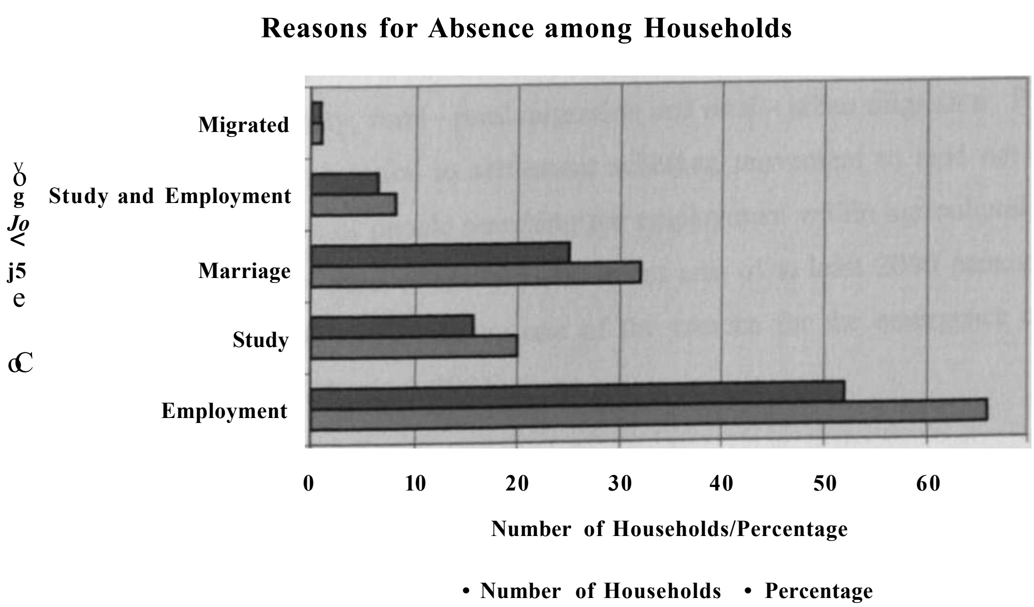


Figure 7.8 gives both evidence of rural to rural migration, particularly, among those who migrated or married in other rural areas. Secondly, rural to urban migration could also be seen among household members who were either moving out for employment or study. As stated in the earlier paragraphs, these movements interfered with individual and regional household food production. It was on this basis that the government enacted a policy to curb out-migration in the rural areas, through the provision of services and employment opportunities locally, so as to make large urban areas less attractive as destination areas (Muganzi, 1991). This study has, revealed that proper planning needs to be carried out both by the government and individual households, with the aim of improving food security, if proper food crop production is to take place alongside ofT-farm employment.

Migration is another demographic factor, which has been shown to interfere with household agricultural production, both within the source and destination areas (Beaujeu-Garnier, 1978; Guery, du, 1978; Thomas, 1980 and Khasiani, 1991). According to Khasiani (1991), the problem of migration started with the colonial government, which alienated high potential agricultural land from the so called native Africans, and introduced private land tenure system to replace communal ownership with individual ownership, thus reducing access to land by native Africans. Two types of migration were identified in Kenya, namely, rural - rural migration and rural - urban migration. Rural to rural migration entails migration to settlement schemes, movement to land not owned (squatters), and migration of people searching for employment within agricultural farms. The urban centre, in this case, refers to a settlement area of at least 2000 persons, with landlessness or near lawlessness being one of the reasons for the emergence of such centres (CBS, 1969 and Khasiani, 1991).

Beaujeu-Garnier (1978) mentioned dissatisfaction as one of the primary causes of migration. Whether migration takes place over long distances or short, or it involves a few households or several millions of individuals, it ends in all cases by transforming both the area of origin and the area of reception. Beaujeu-Garnier also listed some consequences to migration, such as,

- Consequence in space and numbers, where the reception areas absorb people hungrily, the towns expand, the countryside fills-up and new land areas are opened up, statistics change and there is increased density. Conversely, the source areas see their population diminishing, their towns vegetating, their countryside emptying and their fields going to waste.
- Demographic consequencces, affecting both the ratio and the pyramid,
- Biological consequences, reflected in the demographic character of the populations in terms of health,
- Other problems of contact, emphasized in racial, linguistics and religious differences among others,
- Capital conditions, accompanied with direct and indirect consequences, and;
- Economic repercussions.

Suggestions from Guerry, du (1978) could be used to discourage such migration through,

- Land redistribution accompanied by extension services and infrastructure development,
- Assistance to small-scale farmers with credit facilities and the minimum size of land controlled to avoid uneconomical units, while too large areas among small-scale farmers inhibit communication,
- Modifications of the pricing systems of the agricultural products to serve as an incentive to allow surplus generation of capital for reinvestment,
- Modification of land tenure systems, creation of employment opportunities and labour intensive agricultural activities to supplement family incomes,
- Creation of growth nuclei in the rural areas, stocked with good medical facilities and development possibilities, and;
- Removal of disparities between rural and urban areas.

The Correlation and Regression Analysis, which follows this section below assists in explaining how household size, age and household labour can influence household food crop production.

7.6 MULTIPLE CORRELATION AND REGRESSION ANALYSIS BETWEEN DEMOGRAPHIC FACTORS AND HOUSEHOLD FOOD CROP PRODUCTION

The variables used in this analysis comprised of, the total number of family/Household members present (household size/X|), Age of household head /X_2), and Number of full-time household members in farm work (household labour/X_3) with the dependent variable being total household food crop production (Y). The null hypothesis was that there is no relationship between the above demographic factors and household food crop production and hence, household food security. The Means and standard deviations of these variables are given in Table 7.7 and Multiple Correlation Coefficients in Table 7.8.

There were 122 households in this analysis, with the results revealing that the greatest variability existed in age of household heads and household size, respectively. The partial correlation coefficient was highest between household food crop production

Table 7.7 Mean and Standard deviation of variables used in Multiple Correlation and Regression analysis

Variable	Mean	Standard Deviation
X,	5.69	4.70
X_2	4.57	6.36
X_3	2.94	1.70
Y	2.86	2.40

Source: Descriptive Analysis

Table 7.8 Partial and Multiple Correlation Coefficients

	Household size **(Xi)**	Age of household head **(X_2)**	Household labour **(X_3)**	Household food crop Production **(Y)**
X,	1-1.**00** 2--	-0.03 0.71	0.22 0.01	0.18 0.05
X_2		1- 1.**00** 2- -	-0.06 0.54	0.26 **0.00**
X_3			1- 1.**00**	0.02

			2- -	0.83
Y				1- 1.00 2- -

details

and household labour (0.83), which still emphasized the importance of labour in food crop production. The partial correlation coefficient between household food crop production and age of household head was zero, which meant that there was no direct relationship between the two variables. The multiple correlation coefficients between the variables used in the analysis and household food crop production indicated weak relationships with the value for R and R^2 being 0.323 and 0.105, respectively. This means that the demographic factors used in this analysis could explain up to 10.5 percent of the variations in household food crop production (See Table 7.9 - The ANOVA).

The resulting equation was:

Y = 1.85 - 1.88X, + 0.27X2 - O.oix3,

and since the calculated value of F (4.595) was greater than F critical CF(3,ii8) = 2.68) at 0.05 level of significance, the null hypothesis of no relationship was rejected and

Table 7.9 ANOVA Table between Demographic factors and Household food Production

Model	Sum of Squares	Degrees of freedom	Mean square	F
Regression Residual Total	76.843 657.788 734.631	3 118 121	25.614 5.574	4.595

conclusion drawn that there is a significant relationship between demographic factors and household food production, hence household food security.

The equation revealed a negative multiple correlation between household food crop production and household labour. The scatter plot between observed values of production and predicted values (see Figure 7.9 and 7.10) also revealed that the prediction was probably more accurate for values between points {(-1,1) and (-1,8)} and

{(2,1) and (2,8)}. The partial regression plot between total production and number of full-time family members in farm work and total number of household members present showed a relationship between points {(-2,-2) and (-2,6)} and {(-2,-2) and (2,6)}; and {(-5,-2) and 5,4)} and {(10,-2) and (10,4)}, respectively, where household food crop production was the dependent variable (See Figure 7.11). The values of production were in hundreds of Kilograms. This means that having no household members in farm work impacts negatively on food crop production, and the researcher believes that the intensity of the problem varies with the household size. The negative production at (-5,-2) could mean that large household sizes which do not participate in farm work may suffer from hunger problems which are associated with farm land degradation problems. In addition, so long as there were at least two persons in full-time farm work, it was possible to achieve a production of up to 600 Kgs (as seen at point (2,6)).

As far as household size and household labour was concerned, the household size should not exceed 10 as the increases in household size ceases to positively influence household food crop production, with minimal increases in food production after the household size exceeds five. Similarly a small household size impacted negatively and very strongly on household crop food production, which meant that in order to maximize

Figure 7.9:

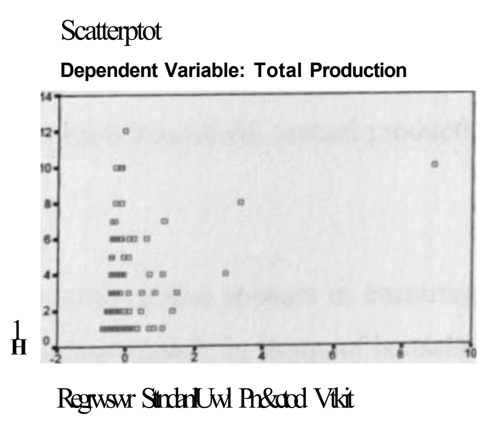


Figure 7.10:

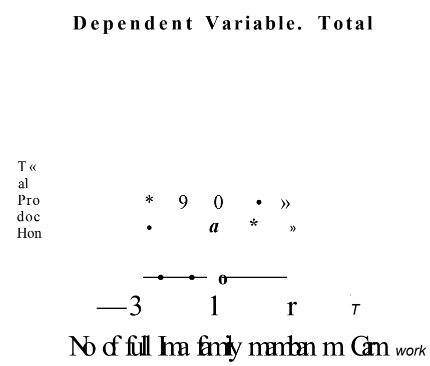
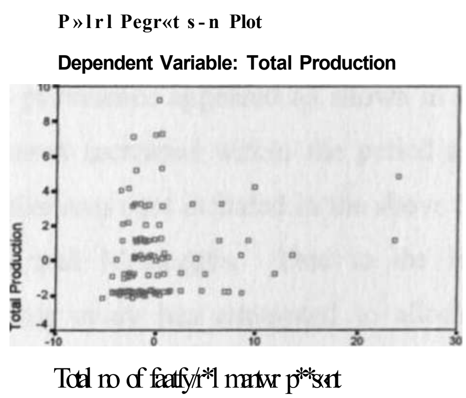


Figure 7.11:



household food crop production, the household size should lie between 5 and less than 10 with at least two persons engaged in full-time farm work. This is to say, with between 5 and less than 10 people within each household, annual production varied from 100Kg to 400Kg.

Although the government's position appears to encourage small household sizes, studies have shown that population growth, in terms of household food crop production, among subsistence households (dependent on agriculture) may require more labour in order to produce adequate food for the household (Chaudhury, 1989; Krishnaji, 1989; and Irfan, 1989).

7.7 THE EFFECT OF HOUSEHOLD HEALTH (MORBIDITY AND MORTALITY) ON HOUSEHOLD FOOD CROP PRODUCTION

During fieldwork, different questions were posed to fanners concerning health and food security. For example, some of the questions investigated how farmers were able to cope with farm operations during illness or death within the household. The responses were examined alongside food crop production in order to establish whether health issues impacted upon household food crop production. Other variables discussed included the impact of Malaria and HIV/AIDS on food security.

As stated earlier in Chapter two, based on fieldwork results, most disease prevalences reduced from January 2005 to February 2005 with only diseases of the skin, pneumonia, and eye infection increasing during the same period of time among the top ten diseases. HIV/AIDS prevalence appeared as shown in Figure 7.12, which revealed that HIV/AIDS related cases increased within the period among the top ten diseases. Other HIV/AIDS related diseases (not included in the above table) were Typhoid, Herpes zoster, Karposi sarcoma and Meningitis. Due to the importance of Malaria and HIV/AIDS in Nyando, this study has attempted to allocate more space for further discussion at the end of this section. The above disease occurrences have resulted in a life expectancy of between 48 and 49 years in Nyando (Republic of Kenya, 2001a).

7.7.1 The Effect of Household Morbidity on Household Food Security and Poverty

According to the fieldwork results, 22.1 percent of the farmers responded that they had been admitted to hospital in the last one year for the following lengths of time:

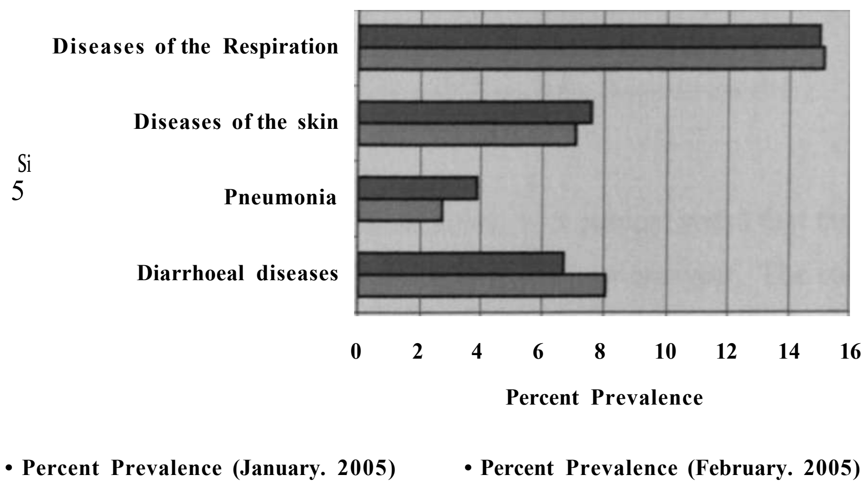
- less than one week (29.7 percent),
- exactly one week (32.4 percent) and;
- over seven days (37.96 percent).

Table 7.10 and Figure 7.13, therefore, provide disease prevalences obtained during fieldwork together with how farmers were able to cope with their farm operation needs alongside illness, respectively.

Generally, in case the fanner was not ill, but merely unwell as the majority of the responses stated (78.5 percent), 14.3 percent of them still went to hospital, 83.0 percent

Figure 7.12:

Estimated HIV/AIDS Related Disease Prevalence between .January and February, 2005



bought medicines from chemists while 1.4 percent just ignored the sickness. These results suggest that most farmers preferred to buy medicines, and this could be attributed to too much time required and difficulty encountered in order to access medical services in different hospitals. It is therefore, important for the government to advise rural households and medical personnel concerned, to ascertain that chemists do not store expired or irrelevant drugs, as a precaution against the use of such ineffective drugs.

Table 7.10 Disease Prevalence among Sampled Households

Disease	Case	Prevalence
Malaria	44	33.6
HIV/AIDs related (Pneumonia, Herpes zoster, Tuberculosis, weight-loss, restlessness, Typhoid, Diarrhoeal diseases, Respiratory tract infections)	40	30.5
Other long-term illnesses (Diabetes, High blood pressure, Sickle cell aneamia, Cancer, Paralysis,	30	22.9

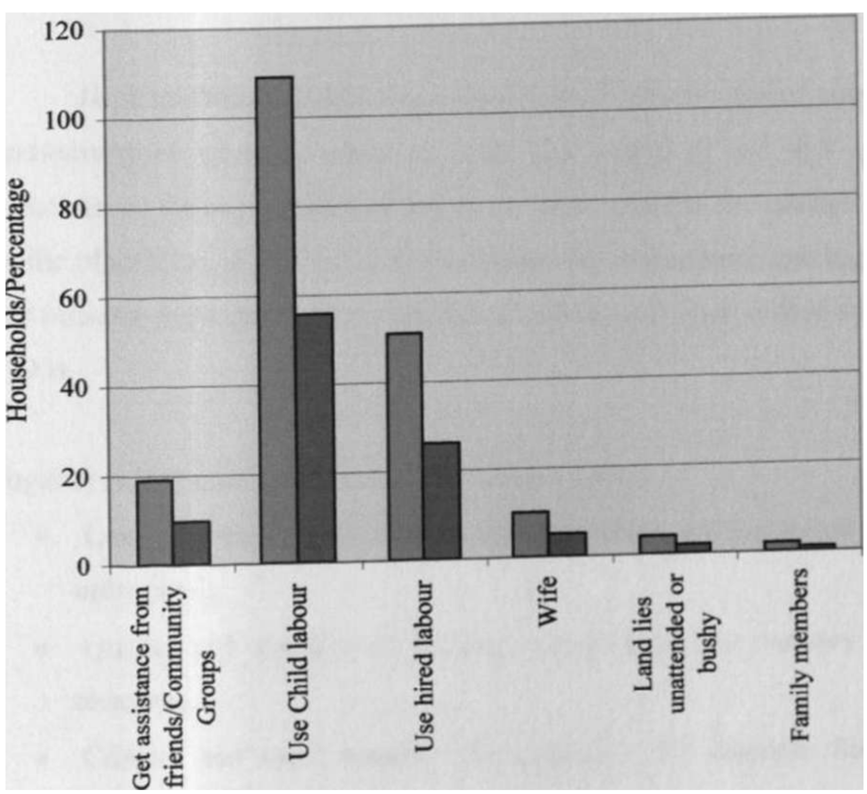
Tetanus, Lumber spondilosis		
Accidents, found dead/unknown, stroke, Bleeding to death, and congenital sickness	17	13.0
Total	131	

Source: Fieldwork data.

Out of the total of 89 households, 92.1 percent stated that they had a sick relative, who was sick in hospital and recovered in the past one year. The cost of treatment varied from Ksh. 1000 to over Ksh. 40 000. These results are tabulated in the Table 7.11.

Figure 7.13:

Ways of Coping During Illness



Coping Strategies

• Number of Households •Percentage

The demographic factors are closely linked to the health issues as PSRJ recorded that increases in household income, which raises the level of education and improves the nutrition and living conditions, greatly reduces the rate of household morbidity and mortality. The World Health Organization recognizes health problems within the developing countries and attributes them to harsh environmental conditions, low levels of income and shortages of well-trained personnel, particularly in the rural areas (Muganzi, 1991). Similar environmental conditions have also been blamed for food shortages due to problems associated with food distribution, resulting into malnutrition among other diseases. For example, research has shown that, the most common diseases in Kenya are infectious, parasitic and diseases of the respiratory system. The prevalence of these diseases is linked to lack of adequate health facilities necessary for increasing socio-economic development, to stop immunizable diseases like Tuberculosis (TB), Measles and Polio from causing health problems. Others are problems of low agricultural productivity and poverty, which lead to malnutrition and poor feeding habits within households (Njagi, ***et al,*** 2004; Ogora, 2004 and Muganzi, 1991).

High morbidity within a household affects the volume of output by reducing the productivity of workers, while its level and trends by sex and age, provide useful indicators on the requirement of health services, capacity for savings and labour quality. On the other hand, mortality decline increases the labour force, but higher life expectancy may increase expenditures for retirement facilities and other related social benefits (PSRJ (1990).

Muganzi (1991) associated mortality in Kenya with:

- Low incomes, which lead to feeding infants on traditional foods deficient or unhygienic,
- Quality and quantity of housing, which determine sanitary and public health measures,
- Climate and local weather fluctuations (for example floods and droughts discussed in chapter 4),
- Unequal distribution of agricultural land and its ownership and accessibility, which is related to household food crop production, consumption and incomes, and;

- External factors - referring to political systems, an efficient transport and communication system for transportation of goods and other essential products, and environment-free disease causing vectors.

Table 7.11 shows that for income levels below Ksh. 20,000, percentage cost of treatment exceeds percentage cost of income, except for the category between Ksh. 1000 to Ksh. 2000. According to the table, most households had income levels of between Ksh. 1000 to Ksh. 2000 per month, while most illnesses cost less than Ksh. 1000 to treat. The table (Table 7.11) also emphasizes that the majority of households earned between Ksh. 1000 to Ksh.2000 and they spent nearly Ksh. 1000 on treatment, leaving barely enough cash for other household basic needs such as food and clothing. These were the households that might require government assistance if they were to cope with food shortages experienced during droughts and floods and become food secure.

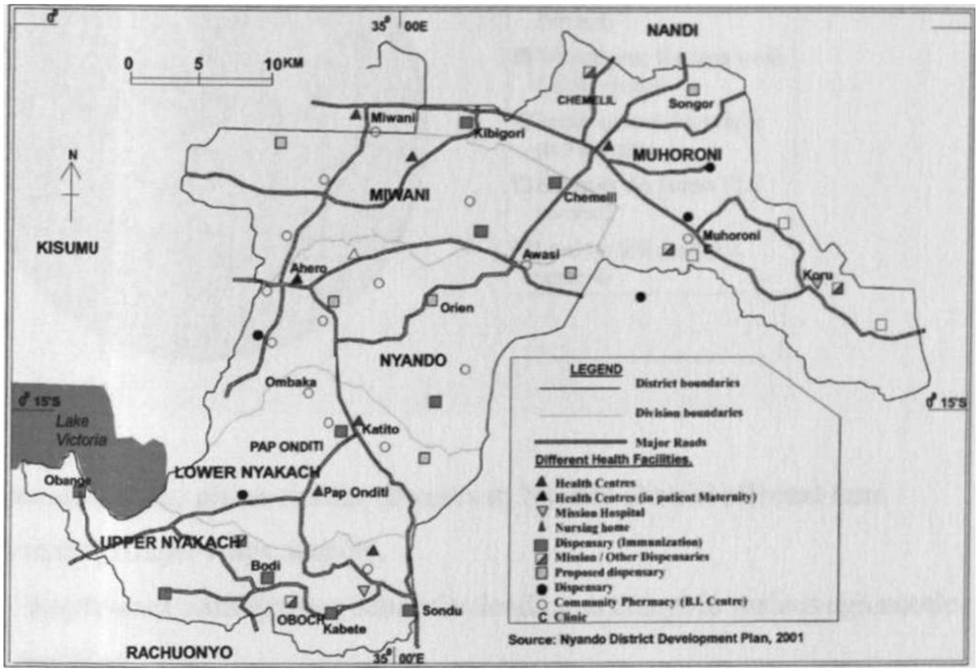
Table 7.11 Cost of Health care among Sampled Households

Cost of Health care in Kenya Shillings.	Percentage cost of treatment within the category	Percentage Income levels within the category
Below 1000	33.3	-
1000-2000	13.6	74.5
2000-3000	10.6	5.9
3000-4000	9.1	5.9
4000-5000	4.5	2.0
5000-6000	4.5	2.0
6000-10000	13.6	2.0
10000-20000	7.6	4.0
20000-30000	1.5	2.0
Over 30000	1.5	2.0
Total	100	100

Source: Fieldwork data (See Figure 6.6 for more details).

Figure 7.14:

SPATIAL DISTRIBUTION OF HEALTH FACILITIES IN THE STUDY AREA

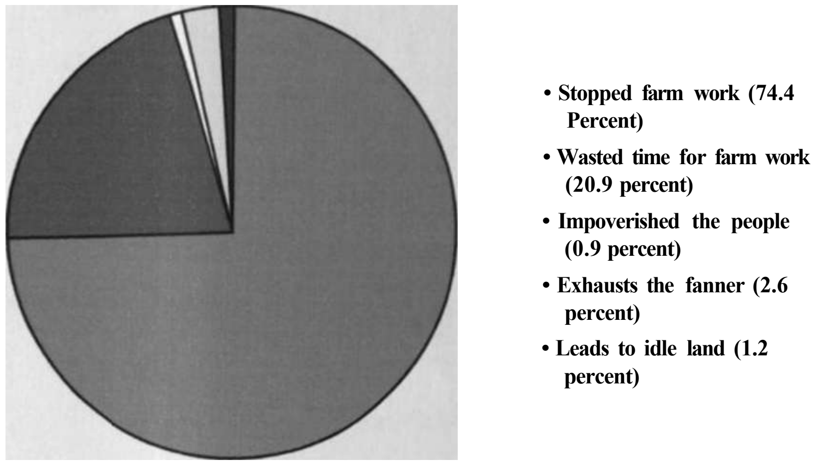


Three major sources of income contributed immensely towards payment of health care within the sampled households. These included employment (providing 40.0 percent of the cash required), cooperative societies (providing 30.9 percent) and remittances from relatives (contributing 23.6 percent), which support indirectly, the contribution of absent household members in maintaining household food security. The main disease symptoms various households suffered from included high fever (50.8 percent), herpes (1.5 percent), scabies (1.5 percent) and others (pregnancy complications, pain in the ears, coughs, tooth ache, vomiting, and burns) (44.6 percent).

Fieldwork results revealed that, the different diseases affected farm operations as shown in Figure 7.15.

Figure 7.15

Effects of Human diseases on Farm Operations



According to the above results, diseases in Nyando District affected farm operations in three major ways, namely,

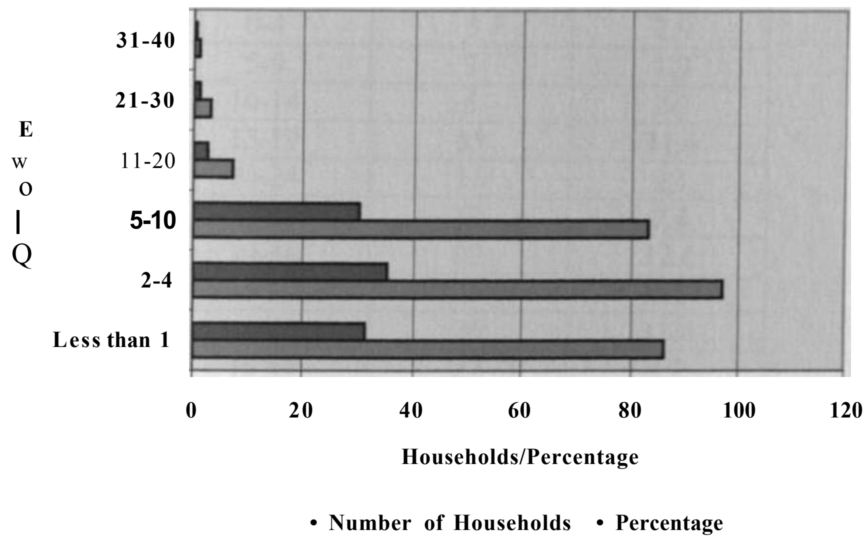
- interference with farming schedules leading to delays in various agronomic practices,
- contribution to the creation of idle land, and;
- causing poverty.

Poverty in this case is caused by lack of cash (spent on treatment), lack of food (due to uncultivated land during illness), and therefore, lack of other basic needs. This means that provision of household food security is a prerequisite for poverty eradication strategies, and this will be discussed in detail in chapter 9.

Figure 7.16 gives information on the accessibility of health facilities in the area of study which show that health facilities were quite accessible for most of the households in the area of study (66.1 percent of households could easily access medical care). However, 33.9 percent of the households still required consideration, as all life is important. Most households were located 5 to over 30 Kilometres from health facilities. More health facilities were, therefore still needed in the area for affordable and accessible health care service delivery. Refer also to Figure 7.14 for more details.

Figure 7.16:

Location of Health Facilities in the Study Area



7.7.2 Effect of Household Mortality on Household Food Security and Poverty among Sampled Households

Among the households interviewed, 72.3 percent had relatives who had passed away in the last one year. The relatives/deceased referred to in this study were parents, spouses, children, siblings, or aunts/uncles, nephews/nieces or cousins. About 83.0 percent of the respondents had had a deceased relative coming from the nuclear family, while the remaining percentage had the deceased coming from the extended family. Deaths by age of the deceased from both the nuclear and the extended family interfered with farm operations. Table 7.12 indicates that most of the deaths occurred within the age groups 15 to 19 and 30 to 34, respectively and it could be assumed that these were probably the sensitive ages for marriage among the youth in the rural areas of Nyando District. This probably, exposed them to various infectious diseases, besides Malaria and other congenital diseases.

Table 7.12 Ages of the Deceased among Sampled Households

Age (Years)	HHd	%
0-4	5	2.9
5-9	3	1.7
10-14	5	2.9
15-19	55	31.4
20-24	16	9.1
25-29	13	7.4
30-34	22	12.6
35-39	9	5.1
40-44	20	11.4
45-49	22	1.2
50-54	9	5.1
55-59	1	0.6
60 and over	15	8.6
Total	175	100

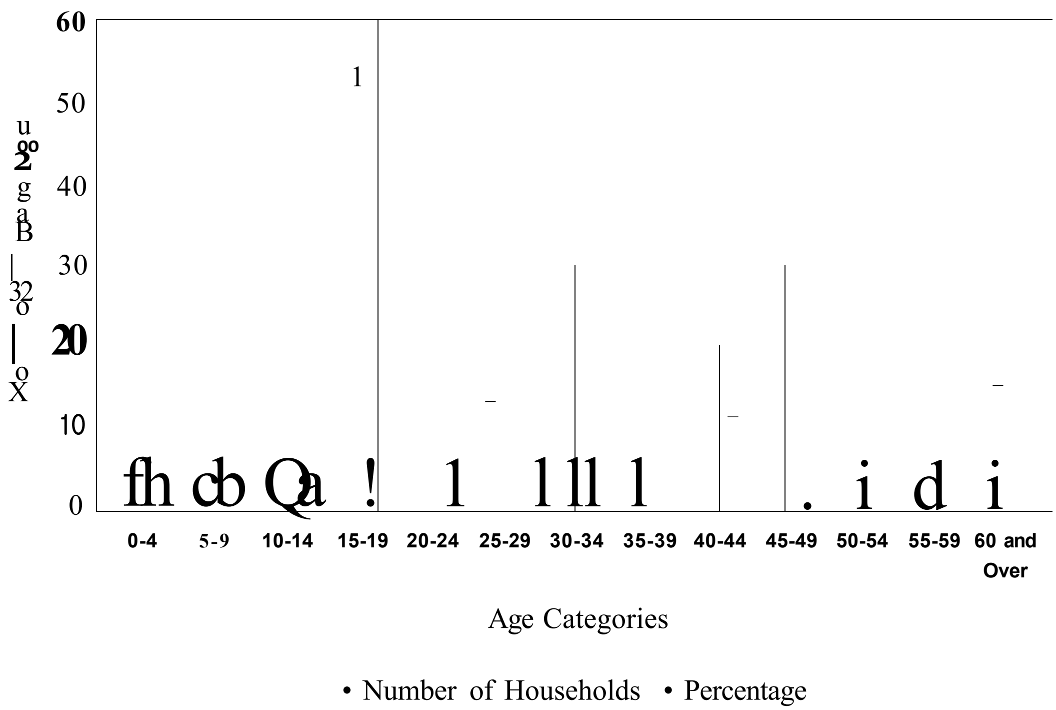
Source: Fieldwork data

See also Figure 7.17 showing the deceased within the different age categories.

During the fieldwork, the major symptoms of the diseases emerged as high fever, cough, and swelling feet, with most of the respondents stating that they were left with the responsibility of all the household needs of their departed relatives. Table 7.13 provides information on the causes of death for the households which had their relatives deceased, which shows that most deaths occurred due to HIV/AIDS related causes followed by Malaria, while ***Chira*** resulted in death of only 8 persons. The inhabitants of the area believed that the people suffering from ***chira*** lost weight like those suffering from HIV/AIDS but the diagnosis was negative against the HIV virus as the disease is mainly associated with violation of traditional norms, which result into a curse and finally, death sometimes. The disease ***(chira)*** is closely linked with the plagues given in James (1982).

Figure 7.17:

The Deceased within Different Age Categories



The researcher would like to state that scientifically, it is almost impossible to differentiate and isolate the symptoms of the three diseases (HIV/AIDS, Malaria and ***Chira).*** It was therefore possible that the combined effect of the three diseases was the one responsible for the high mortality associated with HIV/AIDS and Malaria.

According to Suda (1991) and Muganzi (1991), the infant and child mortality rates, and crude death rates have been declining over the years, leading to the increases in life expectancy at birth. The decrease in these mortality indices is attributed to better nutrition, provision of medical services, parental care (through education) and general improvement in living conditions of the people), and improvement in food distribution to rural areas using access roads. Life expectancy is an important indicator of social

Table 7.13 **Major Causes of Death among Households**

Disease	Cases	Prevalence
HIV/AIDS related (TB, Typhoid, Stomach ^problems. Pneumonia. RTD	65	47.8
Malaria	31	22.8
Long-term illnesses(cancer, old age, lumber spondilosis, diabetes, paralysis, epilepsy, asthma)	16	11.8
Other diseases (unknown, accident, allergy, mob justice, over-bleeding, aneamia	16	11.8
Chira	8	5.9

<u>Source</u>: Fieldwork

progress in both developed and developing nations, and availability of food within the different households is part of progress which household mortality creates a drawback on (WRI ***et al,*** 1996). For example, Caldwell ***et al*** (1984) recorded that the decline in infant mortality, coupled with the rise in expectation of life at birth to 50, resulted from many changes in Indian society, such as,

- the decline in epidemic diseases (for example plague and small pox) while Malaria and Cholera accounted for only a small percentage of deaths, and;
- availability of means other than the older systems of family and community assistance, to off-set malnutrition and starvation, for example, government providing food during drought and famines, remittances from relatives and more equal distribution of food within the family.

7.73 Effect of Malaria and HIV/AIDS on Household Food Security and poverty

Roberts (1974) defined Malaria as a systematic disease, acute, sometimes severe and often chronic, characterized by shaking, chills, rapidly rising temperature and a palpable spleen and after an interval free of fever, the cycle is repeated either daily or every third day. Data obtained from District Office of Health in Nyando District revealed that Malaria was the first cause of morbidity in Nyando District among children and adults due to floods, which frequently occurred in the area. In these flood prone areas malaria prevalence was over 60 percent, particularly, among sampled households in

Sango area of Lower Nyakach Division. These data emphasized that Malaria cases ranked first with a percentage prevalence of 33.6 followed by HIV/AIDS, which had a percentage prevalence of 30.5.

On the other hand, at the time of carrying out the baseline survey by the District Health Office in Nyando, HIV/AIDS prevalence was estimated to be between 24 and 25 percent, with bed occupancy of 60 percent HIV/AIDS. Among those admitted, over 70 percent were suffering from tuberculosis (TB) at some stage. These figures were slightly lower than what was available in the records at Ahero (the Nyando District Hospital), which were 46.31 percent for Malaria and 33.20 percent for HIV/AIDS. These variations point out the inconsistencies in data available within the study area.

The available data at the District office in Nyando also shows that HIV/AIDS prevalence ranked highest in Miwani, Nyando and Lower Nyakach Divisions, respectively, with an estimated 40,000 people affected. During the fieldwork, many households in Muhoroni (Songhor East) had many households, which mentioned the prevalence of TB within the household, with two to three additional sick children. The high prevalence of TB which, is also a HIV/AIDS related disease, could also be attributed to poor ventilated housing structures. The sampled households in Nyando District referred to the disease as ***"Two maduong***and signs of graves were very prominent within the homesteads, particularly, in Kabong'o area. Some of the sampled households in Upper Nyakach were unwilling to talk about HIV/AIDS, while some of the residents in the area also preferred to move to urban areas to escape ***"chira".*** Although ***Chira*** is real and existed long before HIV/AIDS within this particular community, one possible explanation for this willingness to move to towns could be as a result of overpopulation in the area resulting into several uneconomical pieces of agricultural land.

Information obtained from the District Officer of Health gave three major reasons contributing to the changes in prevalence for Malaria and HIV/AIDS, namely,

- Failure to report the cases as some of the information officers had not or did not deliver their statistics by the time information was being completed,
- Migration as a result of small scale businesses in the area which keep changing venues, and;

- Inadequate personnel required in carrying out data collection exercise.

According to the District Officer of Health in Nyando, these two diseases (Malaria and HIV/AIDS) affected food security in various ways, such as,

- Interference with farm operations during hospital admissions,
- Contributes to unproductive hours or minimal farm work when the farmer is sick or ill and has to walk to hospital,
- Cash that could have been used as farm input is diverted to buying drugs and paying for health services,
- Any mortality resulting from the diseases results in over two weeks mourning period when no farm work is done within the bereaved household, and;
- Employees in off-farm employment who normally assist with capital for farming also seek permission from work, to mourn their dead relatives.

Although malnutrition has declined in the District due to education of mothers (by Health Officials, Community Health Workers and other Community Based Organizations), poverty was still a menace and was stated as also responsible for aneamia problems among the people of Nyando. Other Non-governmental Organizations that help address issues dealing with Malaria and HIV/AIDS within the area of study was private clinics and Community-based Nutrition Programmes.

7.7.4 The Results of Multiple Correlation and Regression Analyses between Household food production and Health issues

There were two explanatory variables used in the analysis (number of deceased persons (Xi) and number of ill Persons (X_2). The dependent variable was household food crop production - (Y) as was in other previous analyses. The mean and standard deviation of each of these variables (X|, X_2 and Y) were 1.22 and 0.42; 1.14 and 0.35; and 2.43 and 1.86, respectively. The Partial and Multiple Correlation coefficients are provided in Table 7.14.

According to the results, there was a relationship between household food crop production and the two independent variables, Xi and X_2. The partial correlation coefficients were higher between number of ill persons and household production than between number of deceased persons and production, which was nearly zero (0.01).

Table 7.14 Partial and Pearson correlation coefficients between Health issues and Household food crop Production

	Number of deceased Persons (Xj)	Number of Persons ill (X_2)	Household food crop Production (Kg) (Y)
X,	1-1.00 2--	0.18 0.30	0.45 0.01
X_2		1- 1.00 2- -	0.12 0.47
Y			1- 1.00 2- -

Source: Multiple Correlation and Multiple Regression analyses

However, there was a high multiple correlation between production and number of persons deceased, which meant that death affected food production in combination with other factors, in this case, the number of ill persons, as that illness could be mental/ psychological, emotional or physical infirmity as defined by Muganzi (1991). The values of R and R^2 were 0.45 and 0.20, respectively, explaining that health issues could explain up to 20 percent of the variations in household food production. The ANOVA results are given in Table 7.15. The researcher would like to state that the 20 percent explained by the health factors were already accounted for within the socio-economic issues, due to the issue of inter-dependence between these variables among smallholder farmers.

Calculated value of F (4.315) exceeded F critical (F ^) = 3.23), leading to the decision to reject the null hypothesis of no relationship. The resulting equation was

Y = -0.23 + 0.04X, + 0.44X2,

ANOVA Results between Health issues and Household food crop Production

Model	Sum of squares	Degrees of freedom	Mean square	F	Significance
Regression	25.32	2	12.66	4.315	0.021
Residual	99.761	34	2.934		
Total	125.081	36			

7.8 DISCUSSION OF FINDINGS BETWEEN DEMOGRAPHIC AND HEALTH FACTORS AND HOUSEHOLD FOOD SECURITY AND POVERTY

It is important to remember that since socio-economic factors already included demographic and health factors, which accounted for 55 percent of the variance in household food crop production, land and capital, therefore, could be responsible for approximately 14.8 percent of the variance. The results show the importance of labour (in term of quantity and quality) within the small-scale farms. Earlier findings in chapter four and six revealed that the climatic and socio-economic factors accounted for 12.8 and 55 percent of the variance in household food production, respectively (67.8 percent in total, of which 30.2 percent are attributed to demographic and health factors). The rest of the variations (33.8 percent) could be linked to other factors not investigated as shown in figure 2.1 (Conceptual Framework model). These include issues related to soil quality, education, government policy, energy demand and use, research and marketing, gender, technology, nutrition and malnutrition, and, food imports and food aid. Additional variables revealed during fieldwork were environmental degradation, damage from wildlife, and production itself (for example, resulting from bad seed). This study has however, covered the qualitative impacts of government policy and decisions made by farmer (religion, and taste preference), education, energy demand and use, marketing, gender, and technology (as in chapter nine), of which, the impact of gender could be the least problematic. All these factors are important when discussing household food security as they control the decisions made by the farmer.

Secondly, this chapter has revealed the major causes of poverty among the small- scale farmers, which are particularly linked to the health of the household, and accounting for a large proportion of household food crop production. It is therefore, important that these farmers are, provided with a proper health scheme, to take care of their health and reduce the costs incurred during treatment, before any poverty reduction strategies could succeed. These issues relating to household poverty are discussed in chapter eight.

7.9 SUMMARY

This chapter has highlighted several issues that are crucial in the understanding of household food security in Nyando District. The qualitative and quantitative analyses in the chapter assisted in isolating the contribution of labour issues among socio-economic factors in terms of quantity (demography) and quality (health), in terms of their influence on household food crop production.

The results from the analysis of demographic factors revealed that the district could be less than 50 percent food secure as opposed to what was reported in the District Development Plan (Republic of Kenya, 2001b), with households having two persons or more experiencing more serious food problems. In addition, the size of farm (lying below 4.3 ha) did not influence the number of household members participating in household food crop production. Off-farm activities like fishery, forestry, handcraft, transportation among others, competed for the existing household labour, resulting into various households doing farm work for only 1 to 4 hours in a day. The age group 21 to 60 was the most productive in terms of food crop production, with women participating more in farm work than men, though they still relied upon remittances (necessary in providing capital for farm operations) from their spouses, and supper emerging as the most preferred meal.

Off-farm employment also impacted on household food production, through migration, where educated people were engaged in other off-farm activities elsewhere, leaving mostly those with primary school education on the land. Migration within the study area was characterized by both rural to rural and rural to urban movements, though most households clearly stated that they still preferred to continue with household food crop production. The search for well paying employment, study, marriage and a combination of any two or more of these needs were shown to be responsible for the migration among sampled households. Large households sizes (more than 10 persons) or small ones (less than 5 persons) proved less productive in terms of household food crop production, while households of between 5 and 10 persons, with at least 2 full-time family members engaged in farm work showing greater success. The above demographic factors could explain upto 10.2 percent of the variations in household food crop production.

In terms of health, several diseases, among them HIV/AIDS and Malaria contributed to disease prevalence in Nyando District. The various health problems affected household labour during illness and death, and cash incomes spent during such occasions deprived household food crop production of valuable capital, particularly among the small-scale farmers, resulting into food and cash poverty. Mortality was highest within the age groups 15-19 and 30-34 years, and the researcher assumed that this could be linked to marital practices, exposing these age groups to infectious diseases among other diseases (common malaria, congenital/long term and accidents) and HIV and AIDS. The health factors accounted for 20 percent of the variation in household food crop production so that the combined effect of demographic and health factors contributed 30.2 percent of the total variation in household food crop production. This chapter, has revealed the fact that no poverty reduction strategies can succeed, unless, the issue of household food security is dealt with.

CHAPTFR A

POVERTY AND HOUSEHOLD FOOD SECURITY

8.1 INTRODUCTION

The assumptions of the previous chapters such as a System's Approach and the relationships between household poverty and food security still hold true for this chapter. This chapter begins by providing some of the causes of poverty revealed through tieldwork analyses, and these are then linked to available literature on causes, indices and definitions of poverty. This was done in order to find a more appropriate definition of household poverty, on the basis of levels of household food crop production. All households that satisfied the definition in respect of food security were termed vulnerable households to food insecurity.

The adopted definition of poverty enabled the researcher to categorize determinants of poverty within the study area into three classes, namely; regional determinants of household poverty, inter-household determinants of household poverty (among household poverty) and intra-household poverty (within household poverty). The regional determinants are related to the influence of environmental factors on households (whether poor or non-poor household) such as climate, infrastructure and energy services. The inter-household determinants are factors that lead to segregation of households either as poor or non-poor, such as the availability of household land, labour, and capital, age, household size/fertility and migration, and household morbidity and mortality. The intra-household issues impact upon the quality and quantity of household labour and include issues related to gender and education.

The last section of the chapter presents the results of Principal Component Analysis (PCA), Cluster Analysis (CA) and Factor Analysis (FA), which were found to be suitable for summarizing the findings of chapter four, six and seven. These analyses enabled the researcher to verify the contribution of each individual item discussed (whether climatic, socio-economic, or demographic and health related in order to prioritize more serious factors), in the context of poverty and food security.

8.2 CAUSES, INDICES AND DEFINITIONS OF POVERTY

Throughout this thesis, the researcher has emphasized the fact that due to the close association between food security and household poverty (both as a cause or alleviation strategy), any efforts directed at improving household food security automatically impact positively on household strategies directed at reducing poverty. This assumption, on the basis of the systems approach applied in this research, holds true even for this chapter, except that the chapter concentrates on explaining how different factors within a household (climate, socio-economic, demographic and health) interact to influence individual household poverty levels in space and time.

For example, the analysis in chapter 5 revealed that weather (climate) did not discriminate between poor and non-poor households as all the vulnerable households succumbed to the climate related calamities, whenever they occurred. Secondly, while the non-poor households may use cash, probably from off-farm employment, to purchase food, the poor households continued to suffer from famine, unless external forces (like Food-Aid Personnel) intervened. Similarly, the analysis in Chapter seven and chapter eight, revealed that lack of household food security is both a cause and a consequence of household poverty, and without attaining household food security, poverty will still continue to be a problem to the vulnerable households. Some of the causes of household poverty identified in chapter seven and eight were:

- Lack of cash (due to monies spent on other claimants such as treatment),
- Lack of food (due to failure to cultivate idle land as a result of family sickness or death), and;
- Lack of other basic needs (which are also strongly dependent on the availability of food and cash within individual households). These causes may also be manifestations of poverty.

The findings led to the grouping of household poverty into three categories, regional determinants, inter-household, and intra-household determinants of poverty. The regional parameters that influence poverty within the study area emerged as climate (drought and floods), accessibility to services like markets, banks, schools, source of water, health facilities, industry, and even sources of energy. The factors that determined within household poverty were issues relating to gender and education. Where, regional determinants referred to factors that affect both poor and non-poor households in a particular area, the among/between household (Inter-household) issues were specific to individual households and led to the segregation of households as either poor or non-poor. The within household determinants of poverty were intra-household problems, and are subject to the decision-making sources, processes and consequences within a particular household, which impact upon the quality and quantity of household labour.

One of the tasks to be performed by this research is to provide a new definition of poverty and in order to carry out this exercise, some of the literature dealing with causes, indices and definitions of poverty have been consulted before arriving at the research definition. According to Sanchez, ***et al,*** (2005), poverty indicators vary in space and time, and hungry people are highly vulnerable to crises and hazards (caused by natural disasters such as major droughts and floods, or by man-made disasters like wars). Hie hazards may include factors like insecure rights to land and other natural resources, inability to store produce after harvest, environmental degradation, lack of income-generating opportunities, and poor health among others. The issues underlined by Sanchez, ***et al*** (2005) included the regional determinants of poverty (droughts, floods, wars/conflicts, and environmental degradation) inter-household (among household) determinants (lack of stored grain/surplus production or cash) and intra-household (within household) determinants, like insecure rights to land and other wealth indicators. The regional determinants of poverty referred to in this study include problems of the natural environment (like climate, and destructive wildlife among others), and availability of services (service accessibility), at a distance short enough, to encourage commuting, sale of products, and investment in off-farm employment.

Republic of Kenya (2000a)-report on poverty in Kenya (which uses a combination of the Cost-of -Basic Needs Approach and Food-Energy Intake method), defined the poor as "those members of the society who are unable to afford minimum basic human needs, comprised of food and non-food items". The overall poverty line/ absolute poor in the rural areas was set at those whose expenditures on food items was below Ksh.927 per month, while expenditures on non-food items was below Ksh.312 per month. The hard core poor (most vulnerable) spent less than Ksh. 927 for both food and non-tood items. This definition could not be used in the current study area due to several reasons, namely:

- Variations in prices of food relative to the adjacent districts and urban areas,
- Existence of climatic hazards (droughts and floods) in the area, which easily aggravate food availability and pricing problems,
- Many other types of food stuffs (not included in existing records) in the area like termites, and wild food (fruits and animals) and whose nutritional value (in terms of calories) has not been verified,
- The role of fish, as a major dietary foodstuff (relative to price fluctuations and species varieties) whose documentation is still wanting,
- Most households relied on food produced from household farms and only bought to fill the household food deficits, and,
- The fact that poverty could be a psychological problem, as some people take eating as a hobby, irrespective of any work done.

As a result, this study has laid emphasis on the differences between:

- Discussions in terms of overall poverty /regional poverty, which is related to environmental conditions (climatic variations and inaccessibility of an area), and which may positively or negatively influence household food crop production, (both within the food poor and non-food poor households) but the affected households have no control over them.
- Food poor and non-food poor households (where food poor are referred to as households with food deficits, whereby the level of consumption exceeds production), as this accommodates even those with psychological disorders, variations in dietary items, costs of food and calories consumed. Non-food poor households refer to those households with production surpluses or whose food crop production exceed household food consumption in the study area.
- Households producing less than 700Kg or about 8 bags of cereals annually compared to other households, which provides a benchmark for setting policy frameworks to check household food security and reduce/eliminate poverty.

The researcher's view is in line with Tiffen, ***et al,*** (1994), who traced the origin of poverty in Kenya from 1963 to the 1990s and attributed it to lack of food security. According to Tiffen, ***et al*** (1994), poverty, no-education, and low levels of education, and inadequate health care services were identified as major constraints to social and economic development. On the basis of research findings, the researcher summarized the causes of poverty into 3 categories:

- **Regional determinants of poverty as consisting of spatial distribution of poverty indicators in relation to climate and service accessibility,**
- Poverty among households (Inter-household poverty), which discuss the variations among households concerning socio-economic issues and demographic and health factors in relation to poverty, and;
- Poverty within households (Intra-household poverty), which deal with decision-making in a household (the issues of gender and education) in order to explain how individual household problems of poverty could lead to inequalities among households and possibly, to the regional inequalities.

The researcher's perception was in agreement with Batiwalla (1994) who suggested that since food security represents an important component of poverty reduction, it could be measured through nutritional levels, health and education status, income and employment, or quality of shelter. This is because it is the poor who pay much higher prices for their energy services, than any other group in the society. Sanchez, ***et al,*** (2005) and G8 (2005)-Gleneagles Communique - also reiterated the importance of food security, education, health care, and disaster preparedness, as key to poverty alleviation in the Millennium Development Goals. The price was measured in terms of time and labour, economic, health, and social inequity. This is why this study has attempted to bring together all these issues based on the fieldwork results in comparison with those done in a comparable developing country (India) in order to bring a better understanding into the subject.

On the other hand, UNDP/BCPR, ***et al,*** (2004) also listed three causes of poverty as:

- Economically related (due to low economic growth, debt burden, natural resource -based economies),
- Situational (poor infrastructural facilities, or environmental degradation), social (over population and resource management, inadequate social services e.g. fresh water, markets, credit facilities; education, HIV/AIDS), and;
- Political (political instability and conflict).

The studies quoted above show that poverty alleviation and /or reduction is impossible without, first ensuring household food security. Secondly, both the physical environmental conditions (climatic shocks and vegetation/wildlife) and the human environmental conditions (socio-economic, demographic and health) contribute to poverty levels from grass root (household level) to the national levels. Thirdly, it is inaccurate to deal with other basic needs without, first, ensuring household food security, as food is life. On this basis, the study has not defined poverty, just in terms of calories needed per person per day, or amount of cash as given by the government of Kenya (Republic of Kenya, 2000a), but also in terms of household food production, which contributes a big percentage of household food requirements.

The study, therefore, defines household poverty as "lack of or inadequate food (in terms of quality and quantity) or its cash equivalent within a particular household, and aggravated by minimal or lack of other basic needs". The basic needs referred to include clothing, shelter, health care, education and other livelihoods. These are the households which are vulnerable to food insecurity problems and which need assistance. This definition encompasses all the situational/regional or spatial issues (climatic shocks, and availability of services), inter-household variations (socio-economic and demographic and health factors) and intra-household disparities (gender and education), as all the important ingredients required in the understanding of poverty.

The regional aspects allowed the researcher to discuss the variations in the study area in relation to the existing physical environmental conditions (agro-ecological zones) and availability of services, which required well-developed infrastructure (accessibility, through roads to markets, banking facilities, or primary schools and energy sources). The among household variations (inter-household variables) enabled comparison of different households, with respect to availability of land, labour and capital (socio-economic factors), age of household head, household size/ fertility and migration (demographic factors), and; morbidity and mortality (health issues). The within-household variations (intra-household issues) dealt with include gender (in relation to access to certain determinants/indices of wealth) and education.

8-3 REGIONAL DETERMINANTS OF HOUSEHOLD POVERTY

This research has shown that there are different food security problems in the district ranging from climate, socio-economic, demographic, and health throughout the district. The details have been discussed in four different categories, namely; climate related, those related to other environmental factors (wildlife and vegetation, among others), those related to infrastructure (in terms of distances between households and service centres), and those related to availability of energy.

8-3-1 Climate

Within Nyando District, the study area, drought occurrence was shown to be responsible for the reduction of food crop production due to late planting, bad timing of rains, poor choice of crops, and untimely land preparation, though these drought episodes did not jeopardize farm operations immensely. For example, Ombeyi and Awasi locations (in Miwani and Nyando divisions) ranked first in terms of drought severity, with Asawo and West Nyakach locations (in Lower Nyakach and Upper Nyakach divisions, respectively) ranking second and third, respectively (refer to Table 5.7 for more details). As far as household food crop production was concerned, Ombeyi location (Miwani division), Awasi location (Nyando division), Sigoti and S.W. Nyakach (Upper Nyakach division) and N.E. Kano location (Miwani division) ranked first, second, third and fourth, respectively (see Table 5.8). Although it could be possible that more of the farmers questioned responded in these areas than other locations, to the questions posed by the researcher, a more reliable conclusion would be that drought occurrences in Nyando were not severe enough to result into total crop failure, as was earlier stated in chapter 5 of this thesis.

Flooding was observed in Miwani, Upper Nyakach and Lower Nyakach, and it was related to amounts of rainfall received in each area. In terms of flooding, locations such as Ombeyi, N.E. Kano, W.Nyakach and Asawo ranked first, second, third and fourth, respectively (refer to Table 5.11). Within the drought and flood-prone areas, Upper Nyakach division still ranked second in terms of household food crop production with Miwani (Ombeyi location) leading. It was also stated that households susceptible to flooding could have additional farms, which they failed to disclose for more reliable household food crop production to reduce the impacts of flooding among the affected households.

However, the researcher would not like to underestimate the impacts of drought and flooding in Nyando district, as apart from losses in property, the floods had caused serious losses in human life and livestock numbers. It would be more appropriate for mechanisms, which can deal with these disasters to be installed, either through storage of large volumes of surplus produce or promoting relevant crops like rice to take advantage of hitherto dangerous water from flooding. Such endeavours would minimize food insecurity in the area and instead promote poverty reduction.

8.3.2 Situational / Other Environmental Factors

The situational/ environmental factors deal with individual divisions within Nyando district, as problems are either division or location specific. In relation to agro-ecological zones, some parts of Upper Nyakach (Sondu - Nyabondo area), Muhoroni (Koru- God Nyithindo-Chemelil area) fall under upper midland 3 (UM 3) ecological zone, with most of the other areas lying within the lower midland 2 and 3, except for Asawo areas of Lower Nyakach, which was within the lower midland 4 (refer to Figure 3.5). These variations limited the type of crops, which could be grown within these areas. For example, coffee and dairy farming were found in Upper Nyakach and Muhoroni areas, sugarcane farming within Nyando division, Miwani and Muhoroni, with rice farming was found in Lower Nyakach, Miwani and Nyando divisions. Secondly, problems of sugarcane farming were, shown to be, almost uniform throughout the district such as delays in payments, and high costs of inputs, frustrated farmers and made it difficult to benefit from this crop. Thirdly, the presence of many HIV/AIDS orphans and widows indicated that much of the development funds were being directed towards the fight against the scourge, hence reducing funds required for other development claimants such as roads, markets, banks, schools, tap-water, and health facilities. Fourthly, landlessness and/or lack of title deeds meant that such households could not cultivate their land also because they lacked credit facilities necessary for serious farm operations, particularly, among the poor households.

In Muhoroni division, most households interviewed consisted of immigrants who worked in the sugar plantations, as cane cutters or kept small farms in "no man's land" (squatters), with the area between Awasi in Nyando and Muhoroni division having a few of smallholder rice growers. These immigrants earn upto Ksh. 300 per day and many even live in rented houses, within the nucleus estate around Muhoroni factory, holding land under various systems, though land tenure was, considered beyond the scope of the current study.

As far as Miwani division was concerned, apart from problems of excessive and inadequate rainfall (climatic), several other challenges existed, such as;

- Lack of capital to develop land,
- Lack of extension service,
- Lack of irrigation facilities (to enable them irrigate their land),
- Low levels of education (due to availability of cheap labour in sugarcane plantations),
- High concentration of orphans and widows,
- Idle lands,
- Lack of medical facilities, and;
- Unemployment, drug abuse and prostitution.

Signs of malnutrition among children could also be seen in Obumba village, though, malnutrition did not form part of objectives of this study. Outgrowers (schemes associated with prosperity and benefiting from the services rendered by the Chemelil Sugar Company Ltd), operated in the area using a cooperative society targeting farmers (See Figure 8.1 and 8.2), with between 0.43 and 0.86 hectares of their land under sugarcane.

Various households in Nyando division of Nyando District (between Ahero and Awasi) had (one-half to two hectares of land under sugarcane) depending on the suitability of the land, with suitable sugarcane soils ending just before Boya on the way to Kisumu along the Kericho- Kisumu road. These households which grew sugarcane were part of the Chemelil Sugar Company Limited Outgrowers Scheme. The area consisted of black cotton soil, with diminishing farm sizes within the flood plain, which was densely populated. Larger units of land which were waterlogged, (used for grazing) have been

Figure 8.1: Mixture of Maize and Sugarcane Farms in small Farm-sizes

Figure 8.2: Inter-cropping of Sugarcane with Maize

under this particular use since independence, which means that such areas had not been incorporated into meaningful food crop production to improve household food security in order to fight poverty. Nyando division also had high concentrations of widows and orphans (about 6 to 15) per household. Some of the widows were not participating in land cultivation because they had not gone through the cleansing process after the loss of a spouse- the so-called inheritance, while many households were found to be landless. Such widows had to buy cereals from season to season and many households, in the Wang'aya area, were recorded as complaining of lack of title deeds and minimal food relief. Minimal, in this case, was referring to 4Kg of maize, IKg of beans and one-half litre of cooking oil for duties performed.

In the Kano areas bordering Lower Nyakach division, the Ayweyo area (which is assumed to be lying below the lake level) is susceptible to frequent flooding by Awach and Nyabende (a tributary into the lake) rivers with water coming from adjacent hills (see Figure 8.3). The Awach area has successful small-scale rice irrigation scheme through the assistance of the Lake Basin Development Authority (L.B.D.A.), and such projects need to be encouraged as they promote household food security and poverty reduction. The existence of Acacia spp. (A. xanthophloea and A. drepanolobium) in the area indicate the low and variable annual rainfall (about 1000mm), considered inadequate for sustaining consistent household food crop production, or food insecurity. The low rainfall continues to Agoro area - the semi -arid belt of the lake, which is also susceptible to drought and flooding episodes alternately, which demand disaster management strategies to be put in place, and, the ecological divide forms the beginning of Upper Nyakach division.

Upper Nyakach division is ecologically different from the other divisions with more fertile soils. The areas between Sondu to Nyabondo/Oboch and between Anding'o Bware to Apoko are essentially high potential, while the area between Anding'o to Apoko and Opanga are low potential. There is a thriving brick making small-scale industry in the area using clay soils, which generate quite good incomes for participating households. In addition, problems, of hippopotamus in Sango Rota were mentioned, which destroy crops around the Miriu delta. Additional problems included flooding, prevalence of East Coast Fever among animals, (with minimal veterinary services) and Malaria among human populations. Monkeys and baboons also destroy crops, added to problems of human theft, dogs, diminishing farm sizes and lack of water in the area. Though some households had dairy animals, others lacked capital (to develop individual irrigation

Figure 8.3: **Efforts made** on **the River Channel to avert** Flooding

activities and develop coffee), and also lacked title deeds, which were stated as contributing to poverty levels. Sigoti area has benefited from electricity supply and Food-for-Work programmes operating in some of the areas provided about 2Kg of maize, which was considered inadequate by households with food needs.

8.3.3 Infrastructure

Service accessibility, as used in this research, refers to the distance (in absolute terms or time taken) to reach the nearest service centre. Such services include clean source of water, health care, schools, market centre, banking centre/ area, which are directly related to the existing infrastructure and road connectivity. Due to the variations in types, demand and use, energy, related issues were discussed separately.

Distance as a factor determining the access to various services, either in absolute terms as in kilometre traveled or as time taken (in hours) to reach a destination, was discussed in detail by the Central Bureau of Statistics (2001c). It influences levels of education, health care delivery, access to safe drinking water, and distance to the nearest industry, which is also a major source of market for agricultural products. Ministry of

Finance and Planning (2000a) also recorded that access to safe water varies with poverty status and locality, and households may take between 10 to 29 minutes to collect water during the dry season.

The fieldwork results revealed that primary schools, sources of water and places for fetching firewood were more accessible, as they were found close enough to many households, though the quality of the water did not form part of this study. However, the most important areas, such as banking centre, market centre and industry, which are necessary for provision of off-farm employment and marketing of agricultural products were least accessible. Readily available data from Machakos district, with some similar ecological conditions like Nyando District was compared with data available from the fieldwork. Table 8.1 gives the distances between households and various service centres, with the figures for Machakos and Kenya ranging from 0 to 2 Km while those for Nyando ranged from 0 to 4 Kilometre. The percentages given when, subtracted from 100 percent provided the percentages of service centres located beyond 4 Km in Nyando District.

Table 8.1 Accessibility of services among sampled households

Service centre	Percentage of households within 0 to 2/4 Km from the centre		
	Nyando	Machakos	National
Primary school	87.7	71.3	75.6
Source of water	93.7	83.3	88.1
Market	61.2	30	41
Banking centre	12.8	17.6	21.3
Place of entertainment	42.8	53.5	67.4
Industry	6.95	-	-
Health facility	38.8	-	-
Firewood place	97.9	-	:

Source: Fieldwork data and Tiffen ***et al*** (1994).

Locations such as S.W. Nyakach, Ombeyi and Awasi had the highest concentrations of markets. Tamu was the least **accessible** location, or Muhoroni division in general. Accessibility to markets, industries, banking centres, schools, health facilities, and sources of clean water need to be prioritized if regional poverty was to be reduced though increased incomes. The incomes could be obtained directly through sale of crops or off-farm employment (in the presence of good health and education) in order to maintain household food security.

The problem of accessibility of these services led to a production of 1 to 2 bags of cereals irrespective of household size, with 69.0 percent of the households producing less than what they consumed. This could be the group/households who were food poor, with the remaining percentage referring to non-poor households. The figure (69.0 percent) was above what is given by the Central Bureau of Statistics (2003a) concerning food poverty in Nyando District, (which was as between 54 and 64 percent). Among the households which consumed all the food they produced, Miwani, Nyando, Upper Nyakach, Lower Nyakach and Muhoroni percentages were 37.2, 32.7, 20.9, 2.7, and 6.4 percent, respectively, though the term "all" was not specified, but it was assumed that such households had very serious food deficits. Diminishing farm sizes contributed to the increasing inadequacy of food production, particularly, where population densities were high, such as Upper Nyakach, and Nyando divisions (refer to pages 256 to 258).

83.4 Energy Types, Use and Demand

The demand for energy in food crop production was already discussed in chapter 7, and this present section is mainly dealing with the role of energy in poverty alleviation strategies. According to Goldemberg, e/ ***al,*** (1995) provision of energy is central to socio-economic development (or better life and improved standards of living) as energy aids access to jobs, food, health services, education, housing, running water, and sewerage. In this case, energy services include illumination, comfortable indoor climate, refrigerated storage, transportation, appropriate temperatures for cooking and materials among others. It should be remembered that, although demand and use of energy is necessary for eliminating poverty, overuse of fossil fuel related sources of energy (due to rapid population growth and urbanization) has also been blamed for losses in agricultural production resulting from problems of environmental degradation (IPCC, 2001).

For example, Ndey-Isatou (1995) stated that, along with clearing land for agriculture, wood fuel consumption has drastically reduced forest and contributed to degradation problems such as ecological instability, loss of agricultural production, desertification, climate change and loss of biodiversity. Detailed discussions of these problems are, however, considered beyond the scope of the current study. Google (2005c) attributed the negative effects of desertification, deforestation and soil erosion to increases in poverty, which in-turn threatened the environment as the farmers lacked alternative sources of energy.

The G8 (2005)- Gleneagles Communique-, which emphasized the importance of energy, reiterated that provision of secure, reliable and affordable energy sources is a fundamental agenda for development and stability, hence showing how external forces (like policy) can be influenced to impact favourably or otherwise upon household food security.

The above authors emphasized that low energy consumption is not the cause of poverty, but an indicator, as it was found to be linked, to many **elements**/facets of household poverty. Such facets include poor education, poor health care, and the hardship imposed on women and children, for example in fetching firewood and water). Although energy in itself is not a basic need, it is required in meeting any, and all of the basic needs such as food, shelter, health, education and employment. Energy, therefore, becomes an instrument for the eradication of poverty only when it is directed deliberately and specifically towards the needs of the poor. The fieldwork results presented in chapter seven also revealed the possibility of having environmental degradation beginning to take place in Nyando District in terms of soil or loss of plant species, which also could have contributed to low food crop production encouraged in the area. Different types of fuel are in use in Nyando District, as shown in Figure 8.4.

Fuelwood was the most common source of energy, which was being blamed for environmental degradation, with electricity being the energy that was least used in the area. Low use of electricity could be attributed to problems of inaccessibility to electnc grids and inability to afford, in areas where the grid transected. Some of the fuelwood used was purchased from markets (25.7 percent), obtained from the immediate neighbourhood (41.0 percent) and fetched from own farm (33.2 percent). These analyses, apart from indicating energy as a compedtive enterprise in respect of household food production, in terms of time taken to acquire it, they also indicated that energy demanded a good percentage of household capital. This meant that so long as there were many poor

Figure 8.4:

Different Types of Fuel used in Nyando District

- Fuelwood (97.5 percent)
- Gas (1.1 percent)
- Electricity (0.4 percent)
- Charcoal (1.1 percent)

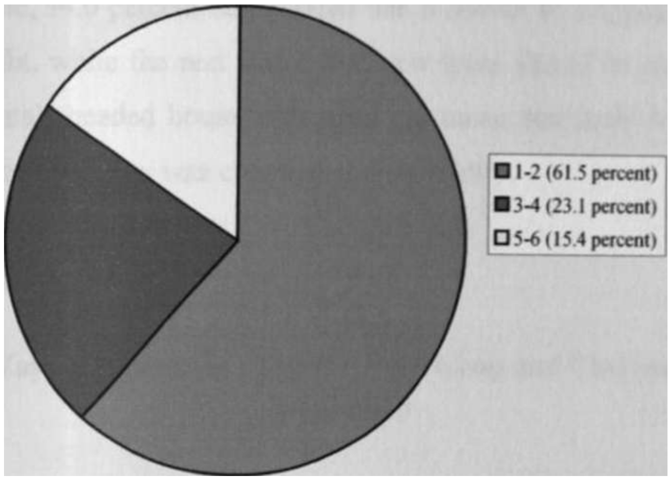
households, environmental degradation would continue to rise due to heavy dependence on fuelwood as the main source of energy, accompanied with lower household food production. Poor households, therefore, need affordable energy sources, in order to attain household food security, meet their basic needs, and fight against household poverty.

Spatially, fuelwood was found to be in use in all the divisions, with the use of gas mentioned by respondents in Upper Nyakach, Lower Nyakach and Muhoroni divisions. Electricity and charcoal was used in Miwani, with households in Muhoroni division mainly depending on charcoal. An explanation could be the presence of urban centres in these areas where charcoal use is considered more convenient than fuelwood. The researcher would like to state that weighing the size of fuelwood used per household, was not part of the objectives of this research. Mbuthi (2002) recommended incorporation of **agro-**forestry in the farming activities so that wood fuel is available to various households.

As far as charcoal use is concerned, about 43 percent of the households made their own charcoal and the number of 90Kg-bags of charcoal made in a fortnight were as shown in Figure 8.5.

Figure 8.5:

Number of 90-KR hags of Charcoal Fortnight



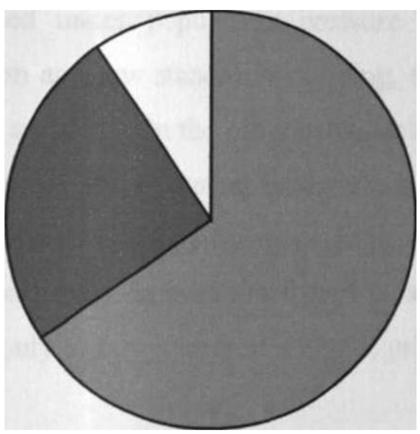
About 936 bags of charcoal were made annually in 39 households, which responded to the question. This represents a remarkable loss of forests and woodlands and added to the number of trees felled for fiielwood. The data analyses revealed that about 84,240Kg or 84.24 tonnes of the forest could be lost annually in the area to charcoal makers. Among those interviewed, only 1.1 percent used charcoal as a source of energy within the household, this meant that the charcoal made was being transported to other areas, probably, urban areas.

Among the households which bought charcoal, over 70 percent stated that one-90Kg bag of charcoal lasted less than 14 days, with 27.3 percent and 1.8 percent stating that it lasted between 14 to 60 days and 60 to 90 days, respectively. The cost of one bag of charcoal ranged from Ksh. 100 to Ksh. 400, and although many households made charcoal, they were aware of the dangers associated with charcoal burning. Additional results revealed that there could be a connection between household food production and type of fuel used and number of bags made in a fortnight, though such investigations were beyond the scope of this research. Various households balanced time between food production and charcoal burning as shown in Figure 8.6.

Other sources of energy used were solar energy (photo voltaic, and others) (1.3 percent), paraffin (22.0 percent) and others (diesel and dungX2.9 percent). Regarding actions to be taken to curb charcoal burning, various households gave different answers, for example, 94.0 percent emphasized that it should be stopped as it causes deforestation and drought, while the rest stated that new trees should be planted to replace the used ones. Female-headed households used gas more than male headed households, whose main source of energy was charcoal and electricity.

Figure 8.6:

Ways of balancing Time for Food Crop and Charcoal Production



- Attending to charcoal after farm operations (65.5 percent)
- Using child labour (25.0 percent)
- Other means (9.4 percent)

Lack of accessible commercial energy sources could be responsible for heavy dependence on small-scale informal industries (referred to as Jua-Kali), such as Basketry (58.2 percent), tailoring (14.5 percent), Carpentry (10.9 percent), fishing, and plumbing 3.6 percent and 1.8 percent, respectively. Welding and battery charging, which demand the use of electricity constituted 11.0 percent only. Lower Nyakach had the highest concentration of industries in the area followed by Muhoroni, Miwani, Upper Nyakach and Nyando divisions. Battery charging, welding, plumbing, carpentry, basketry and fishing were more concentrated in Upper Nyakach.

8.4 DETERMINANTS OF INTER-HOUSEHOLD POVERTY

This study has established that households used their resources of land, labour and capital to generate income from both farming and non-farming activities. Off-farm opportunities (work) detracts labour from the available household agricultural labour, responsible for farm activities, but may increase the resources for family cash incomes and / or investments, and their sources of information. According to Tiffen, ***et al,*** (1994), various households react to the consequences of population growth (both within the household itself and in its environment), changes in the markets for its labour and products dealt with, and the weather conditions, in which it operates.

According to Rodgers (1989), the process under which land is subdivided and fragmented under population pressure is not sufficient to lead to low food crop production and low standards of living, so long as there is equity and concentration of holdings avoided. On the other hand, lack of storage facilities like granaries, which were conspicuously absent during fieldwork could create a poverty cycle. Rodgers referred to such a cycle as arising from poor grain storage, and need for cash. In such a situation, many small-scale farmers are forced to sell their crop at a low price immediately after harvest, only to buy it later at a higher price in order to feed their families until the next harvest.

8.4.1 Socio-economic factors

The results obtained from the fieldwork analysis isolated farm size, land cultivated and household labour, together with distance to the nearest market (land, labour, and capital), as the most important factors determining household food production, and accounting for 49 percent of the variation (refer to Table 6.19). This meant that poverty arising from lack of food security could be reduced by at least 49 percent if efforts were made to improve these variables, among households to enhance household food security. Accessibility and experience of the household head accounted for 16 percent.

In terms of wealth, radio was the most commonly owned asset by households, followed by bicycles. Households having incomes from off-farm employment within the range of Ksh. 1,000 to Ksh. 2,999 and from less than Ksh. 1,000 to Ksh. 3,000 were 74.6 percent and 63.1 percent respectively.

According to the government of Kenya records, the main poverty line is a minimum of Ksh. 927, which is required per month to provide recommended daily energy allowance of 2250 calories per adult (Ministry of Finance and Planning (2003c)). This meant that a minimum of Ksh. 11,124 is required annually per adult to meet the recommended energy allowance, and according to this index by the Kenya Government, almost all households in Nyando were food poor. It is however important to note that using cash could be misleading as it does not cost the value of household food crop production adequately.

8.4.2 Demographic Factors

According to Ministry of Finance and Planning (2000b) the size of the reproductive female population (age 15 to 49) determines the crude birth rate, the rate of population growth and the demand for health services. In addition, having such a growing population implies that:

- The country has a very large proportion of school age going children and greater proportions of the national income that must be spent on educational facilities and teaching personnel,
- A large proportion of young people in a population implies that the labour force (age 15 to 64) is small, which constraints production growth and also reduces the rate of growth of per capita income, due to high dependency,
- Large population size has negative effects on savings, which may lead to low investment and high interest rates within the country,
- There is also a possibility of having shortage of skilled man power which can constrain/reduce production from the household level to the national level.

Kenyans population is characterized by a high growing rate of natural increase, resulting from an increasing crude birth rate and decreasing crude death rate, which lead to a relatively young population (Bonte, 1974). The simplest measure of fertility obtainable from the census data is the fertility or child-woman ratio (for example, the ratio of children aged 0-5 years to women aged 16 to 45 years) (Hirst, 1972). In this study, fertility variables were not included as emphasis was laid upon age of household heads, the ones who make decision on the use of agricultural land, and number of persons living within that particular household (be they his/her children or extended family members). This is partly because, the relationship between fertility and development together with sectoral advantages of fertility on class in terms of growth, still remain poorly understood due to lack of accurate and reliable data that correspond with development changes in time and space (Ayiemba, 2003). Such data would explain ways in which,

- Large households, among poor households can increase their savings, and;
- Non-poor households can invest in industry (secondary or tertiary activities), which have higher returns to sustain large household sizes instead of primary activities, and leave land for those who will use it productively,

Chaudhury (1989) and Seddon (1989) recorded that population pressure and its effects on land and access to land are aggravated by the pre-existing patterns of inequality and exploitation. Chaudhury added that while small farms are more productive, they are less able to make the large investments and innovations required for a rapid growth in productivity.

Rodgers (1989) also stated that at household level, strategies for labour supply, migration, childbearing and other aspects of demographic behaviour respond to and seek to avoid poverty. In addition, the impacts of income, education and access to job opportunities vary in space and their impact among the poor may often differ from the broader impact across the population. Further, according to Chaudhury (1989), population pressure operates through social relationships to cause poverty, particularly, when it leads to land fragmentation, or landlessness, and landless households with minimal sizes of land become vulnerable to indebtedness or calamity.

This section attempts to make comparisons from experiences in India, and Bangladesh (where household sizes were able to contribute to strategies for escaping poverty), and Kenya and the study area, to show the link between demographic factors and household food security. The current study, however, did not investigate the number of children per woman, but instead used the number of people living in a house as is common in the study area.

The fieldwork analyses revealed that there is a direct relationship between household food production and household labour, which could explain up to 10 percent of the variation in household food crop production. Having no family members in farm work impacted negatively on household food production and the intensity varied with household size. Large household sizes, which did not participate in household food crop production, could suffer from hunger. Further, so long as there were at least two full-time family members in farm work, it was possible to attain 600Kg of household food production. Five (5) to ten (10) household members were also required with at least two (2) full-time household members in farm work, in order to attain a production of between lOOKg and 400Kg of cereals, as was shown in chapter six (refer to Figure 7.9, 7.10 and 7.11). Among the households studied in this research, 73.0 percent, 67.0 percent and 82.8 percent were able to eat breakfast, lunch and supper respectively.

The results above were not in accordance with those from the Ministry of Finance and Planning, which related high poverty levels to large households. The study used income levels but did not consider household food crop production, as is common among rural households with cash limitations. The issue of age (in terms of dependency ratios) was also not considered as a major factor in household food crop production. This is because almost everyone in the rural areas engaged in agricultural activities, including those above 64 years of age, who may even perform better due to availability of capital from previous employment earnings.

Another factor of demography is migration. Whole household out-migration was observed in Nepal when a new settlement area was opened (Seddon, 1989) due to the need to search for new land, indebtedness and or loss/ or loss of agricultural land. Within the larger households, Irfan (1989) observed that individuals migrate rather than whole households, particularly, those with resources to cover migration costs. Such a strategy had been exploited before by larger households to fight poverty, through internal division of labour (Irfan, 1989; and Rodgers, 1989). In these cases, poverty is seen as a major cause of migration particularly, in the rural areas, though in extremely poor households, resources for out-migration may be limited. Seddon (1989), Rodgers (1989) and Irfan (1989), however, concur, that out-migration, as a strategy has been useful in reducing poverty.

Commenting on migration, Engmann (1972) observed that migration patterns could affect the distribution and structure of income and consumption, particularly, when it brings additional labour where it is needed for regional development and to some extent reduce unemployment and underemployment in the region of origin. Since migration deprives the regions of origin of their younger and more active workers, a geographically balanced distribution of income and development would slow down migration, which in turn may influence levels of poverty in an area.

The fieldwork results revealed that 84.7 percent of the sampled households would like to continue with food crop production, while only 15.3 percent preferred abandoning the farm work. In addition, when the sampled households were asked whether they would like to move to town for off-farm employment, 93.2 percent and 6.8 percent stated that they would like to continue with food production and move to town, respectively. This meant that there were other reasons needing investigation, which prompted households to abandon household food production other than off-farm employment.

8.4.3 Health Issues

Poverty together with physical handicap and low performance of the worker, lack of initiative and drive, susceptibility to endemic and infectious diseases are responsible for widespread malnutrition in Africa (Engmann, 1972), as diets in Africa are frequently insufficient in quality and lacking in variety and protective values. Since there is hardly any country that has completely satisfied its requirements for manpower of the correct quantity, quality, and balance, Engmann, refutes the assumption that with a reduced or slowly growing population, government revenues would remain the same or even improve. This is because a rise in agricultural productivity would also enable the farmer to demand and use more of those services, which hitherto he could not afford. Engmann, therefore, proposes that population should be viewed as both a resource, and a consumer of resources in an economy, as such large number of children should be seen as a stimulant for more imaginative and efficient use of resources.

Ominde (1971) emphasized that geographic distribution of morbidity and mortality data, on the other hand, are vital in establishing health conditions and the planning of needs and priorities for health programmes and as indices for monitoring the progress and effectiveness of health development plans. Other studies have shown that increased food crop production may not necessarily lead to poverty eradication amidst poor health, coupled with safe water and good sanitation for making adequate nutrition (Sanchez, ***et al,*** 2005 and G8, 2005). This is because infectious diseases and parasites, if not eradicated, prevent people from absorbing and utilizing food properly, leading to malnutrition. Malnutrition then weakens the immune system, and weakens those affected by HIV/AIDS, making them succumb more quickly to such diseases.

Generally, a larger family/ household size (both through more children or joint/ extended family structures) was associated with less poverty. In addition, child dependency did not appear to adversely affect food consumption, while high levels of mortality may well aggravate poverty, apart from direct consequences of mortality itself, by creating, for example, more vulnerable female-headed households (Chaudhury (1989), Krishnaji (1989), Rodgers et al (1989) and Irfan (1989). The researcher, therefore, believes that more research is required on various sectors of development, particularly, the relationship between food crop production and recommended household size, and; population be viewed more as a resource rather than a 'burden' as seen in Kenya. Such a strategy would enable Kenya to borrow from countries like India in terms of development in order to eliminate poverty.

The availability and utilization of imported medical technology (use of anti-biotic to treat infectious and respiratory diseases, immunization against tuberculosis and smallpox and anti-malarial campaigns), have contributed to the declines in mortality. Natural factors (droughts and floods), inadequate health facilities, and presence of infectious diseases, have also been held responsible for regional mortality differentials (Muganzi, 2000). Although mortality decline increases the labour force, higher life expectancy may increase expenditures for retirement facilities and other related social benefits (Engmann, 1972).

The fieldwork results revealed a direct relationship between morbidity (number of persons ill in a particular household) and household food crop production. Secondly, among the sampled households, morbidity worked in combination with mortality to impact upon household food crop production, whereby increases in morbidity and mortality resulted into low food crop production. Health issues must, therefore, be considered in order to increase household food crop production and reduce/ eliminate poverty. Since health care has been listed as one of the basic needs by several authors (Batiwalla, 1994; Sanchez, ***et al,*** 2005 and G8, 2005), with food security being a priority in any fight against poverty, health issues must, therefore, be prioritized.

8.5 DETERMINANTS OF INTRA-HOUSEHOLD POVERTY

This section deals with intra-household problems of gender, education, energy and environmental degradation as issues that are determined by the status of individual household itself, and which are related to the level of poverty within that particular household. The aim is to evaluate the impact of these considerations on household levels of poverty and ultimately on food security.

8.5.1 Gender

Although women's role in food security has remained practically invisible in many policy-makers' pronouncements, there are many facets of food security, which are all critical to women. These include (a) population growth, control, and mobility (b) resource distribution, consumption patterns and agricultural production, (c) climate issues, and environmental degradation, (d) socio-economic status, development, trade relations, land ownership rights, access to micro-finance and access to health care services (Google, 2005a). Adequate nutrition begins at the household level, where gender discrimination, traditional practices and inadequate nutrition awareness can limit the food intake of women and children (Sanchez, ***et al*** (2005)). According to Cole, ***et al,*** (1958), attention should be focussed not on growth ***per se*** but rather on declines in fertility, which immediately lower the number of persons below working age without a concomitant decline in the size of labour force. The main reason is to increase female labour force participation. As far as the author is concerned, in Africa, women in the rural areas may start farm work, one to three months after delivery, and therefore, high birth rates do not interfere much with agricultural production.

The Ministry of Finance and Planning (2000a) in their study on household poverty and gender established that 75 percent of the households in rural areas were **male**-headed and 35 percent fell below the absolute poverty line. Female-headed households constituted 25 percent of rural households but poverty levels were 54 percent. The study defined a household member as a person who resided in that house during the last 3 months before the survey. ***De facto*** female-headed households referred to females who were heading households because they were not living with their husbands, while actual female-headed households referred to females who were heading households because they were not married. This meant that there was inadequate information concerning the household members who participate in off-farm employment but returned home at least 50 percent of the time together with those in instruction centres. This is the reason why the current study used household members present at least 50 percent of the time (as household size), in order to obtain the average food requirements, in terms of quantity and quality per household. This meant that food available per household was **expected** to be greater than 50 percent in every household. The current study did not distinguish also the ***de facto*** and actual female headed households, as women within the study area, based on the existing traditional practices, would only be declared household heads when their spouses die, otherwise, young women rarely build their own houses next to their parents.

Similarly, in Africa, there are differences in decision-making between genders and among different cultural and ethnic groups within the same country. The decision-making rests with the male household head when present, while women's decision-making power tends to increase when the husband is not present. In farm related activities, the women decision-making was evidenced in planting, ploughing, weeding and harvesting among others (Google, 2005c). Given equal access to opportunities and resources, women like men have proven to be efficient, dynamic and indispensable partners in development, as they constitute a formidable partnership to achieve food security in the twenty first century (Google, 2005b). The processes of decision-making in farm activities (with respect to the roles of male and female genders), were assumed to have resulted into the stated food crop production and cash incomes, within the sampled households, irrespective of the gender of household head. In this study, there were 52.4 percent male-headed households and 47.6 female-headed households. The fieldwork results revealed that there were not major differences in the food crop production and cash incomes within the male- and female- headed households. This meant that both genders participated in food crop production almost equally, and therefore, both genders are important in the planning of food security and poverty reduction strategies.

As far as climate and food security was concerned, climatic issues do not discriminate along gender lines but affect both male and female headed households equally from droughts and floods in Nyando District. All the figures given in this section (Table 8.2, and 8.3) are in absolute numbers and not percentages.

The issues regarding land (farm size in acres/hectares, years of farm operation and whether there is a title deed), household income and education, are also provided in table 8.2. The data shows that women's income from off-farm employment was below Ksh.6000 while that for men exceeded Ksh. 10,000 a month. This could be due to high salaries obtained in industry where women, among the sampled households did not participate in. Table 8.2 indicates that compensation was better within the male headed households either as food or cash with labour (man-hours) per day taking longer in these male-headed households compared to female-headed ones. Female-headed households performed similar duties, as those within the male-headed households, except slashing where the women headed households did not participate. It was possible that they used hired labour in such jobs.

Table 8.2 also shows that male headed households cared for their health better than females headed households, though the difference was minimal. This could be due to availability of excess cash from off-farm employment, which is necessary for proper treatment. Within the two groups of households, chemists played a more important role in improving health than hospitals, a condition, which could be explained by the inaccessibility of hospital facilities, inefficiencies, or lack of medicines in hospitals. Only female headed households ignored their health when sick.

Within the female-headed household heads, when the household head was unwell, her friends tended to assist with farm work more than was happening within the male-headed households, where additional use of hired labour was preferred. Women also assisted their husbands more whenever their spouses were unwell compared to men, and female household heads were only declared after the death of their spouses. More land resources remain unattended within the female headed households when the household head was unwell, and this could be responsible for the presence of idle land found in Nyando District, particularly, Nyando Division, which had more widows compared to other areas. See Table 8.3 with additional variables concerning these gender issues.

Table **8.2** **Variables relating to Household land, Income** and **Education within the Male- and Female- headed households**

Item	**Male-headed household/HHd**	**Female-headed household/HHd**
Has title deed	Yes - 76; No - 55	Yes - 76; No - 44
Farm size hectares	0.4-0.9 1.7-2.6 3.0-3.9 4.3 & > 66 36 16 31	0.4-0.9 1.7-2.6 3.0-3.9 4.3 &> 85 15 9 23
Years of farm operation	Below 19 20-29 30-39 >40 69 19 25 23	Below 19 20-29 30-39 >40 65 22 17 16
Sell some of the crops	Yes - 40; No-55	Yes - 25; No - 56
Income from off-farm employment (in Ksh. 000s)	1-3 4-6 7-10 >10 20 1	1-3 4-6 7-10 >10 21 0 0
Occupation apart from fanning	Agriculture-24; Forestry-45; Fishery-9; H/craft-3; Industry-5; Transport-1 and self-employed-2	Agriculture-11; Forestry-49; Fishing-13; H/craft-1; Industry-0; Transport-1 and self-employed-2
Source-of finance	Employment-12; cooperative society-10; Remittances from relatives-7; **Offers**/donations-1	Employment-10; Cooperative society-7; Remittances from relatives-5 and **Offers**/donations-1
Education	Primary-58; Secondary-49; A-level-15; College-5 and University-1	Primary-59; Secondary-28; A-level-5; College-1 and University-1
Crops grown	Cash-18; Food-16; Food/Cash-**20**	Cash-17; Food-16; Food/cash-11
Use hired labour	Yes-70; No - 57	Yes - 54; No - 63
Compensation	Food-26; Money-8	Food-8; Money-1
Labour/day	1 -2 3 - 4	1-2 3-4

(man-hours)	13 9	8 1
Activity performed	Slashing-1; Digging-2; Planting-3; Weeding-47; and Milking-1	Slashing-0; Digging-2; Planting-3; Weeding-35; Milking-1
Number of ill family members	1-2 3-4 5-7 90 9 0	1-2 1 4 5£7 81 9 1
What happens when household head is sick	Go to hospital-12; buy medicine-59; just ignore-2	Go to hospital-7; buy medicine-58; just ignore-0
Ways of coping when sick	Get help from friends-7; children assist-54; use hired labour-29; spouse-8; family members-1; nobody/goes bushy-1	Get help from friends-12; children assist-54; use hired labour-21; spouse-2; family members-1; nobody/goes bushy-3
Try hybrid seed	Yes-106; No-27	Yes-80; No-36
Irrigates farm	Yes-19; No-18	Yes-16; No-14
Participates in development groups	Yes-81; No-47	Yes-76; No-47

Source: Fieldwork data (H/craft refers to hand craft).

Table 8.3 Sex of household head, production, consumption, household size, technology and wealth index.

Item	Description of Variable/HHd
Sex of household head - Male (M) Female (F)	Upper Nvakach Lower Nyakach Nvando Miwani Muhoroni 32 19 18 41 37 27 31 23 31
Age of household head M F	11-15 16-20 21-60 60 and above 1 7 121 16 2 6 107 18
Family members present- M F	1 -3 4-7 8 and above 88 40 4 70 34 4
Household labour M F	1-1 4-5 6-10 11-12 >12 48 42 37 4 13 49 36 37 1 6
Sex of household head/production (P)/consumption (C)/surplus (S) (bags)- Male - P C S Female - P C S	4-6 7-9 10 and above All 53 17 0 4 21 5 0 0 53 12 2 0 1 0 54 16 0 2 15 8 0 0 56 1 2 1 0 0
Sex/Type of seed M	Pioneer 513 511 512 Maseno cobber 614 Senando 54 15 30 2 4 2 1

F	36	18	20	1	1	0	1
Sex/Farm tools used	Hoe	Slasher	Panga	Tractor			
M	141	0	2	1			
F	121	3	1	1			
Sex/mode of transport to market	Walk	Bicycle	Vehicle	Handcart	Tractor	sell at home	
M	14	9	8	3	0	4	
F	19	3	3	5	3	0	
Sex/ wealth index-	Ox-plough	Tractor	Radio	Bicycle	P/house	T/house	S.P/house
M	47	1	42	12	11	9	2
F	35	5	35	4	8	24	0
CBO participated in / Benefits (B)-	Agro-forestrv	School/church c.	Farmers' Ass.	Food security	other		
M	22	2	40	1	7		
B-	Cash/remittances-36; Education-27; Spiritual guidance-14; other-3						
F	15	2	28	0	16		
B-	Cash/remittances-43; Education-18; Spiritual guidance-10; other-1						
Sex/Energy used-	Fuelwood	Gas	Electricity	Charcoal			
M	141	1	1	2			
F	130	4	0	1			

Source: Fieldwork data (P/house, S.P/house, T/house refer to permanent house, semi-permanent house and temporary house).

Table 8.3 indicates that the male-headed and female-headed households constituted 51.3 percent and 48.7 percent of the total sampled household population, and 58.2 percent and 41.8 percent of labour, respectively. About 91 percent and 83.7 percent of the household members present provided family farm labour, showing that more labour input was obtained where the household head was male. More research is, needed to establish the impact of the presence of a male household head over the female household head in terms of the level of household food production. Further, 67.1 percent and 70.9 percent of the **male**-headed and **female**-headed households, respectively, consumed all the food produced. This meant that it was these households that had food deficits (or were food insecure). The responses regarding whether individual households ate breakfast and supper showed that, 75.7 percent and 84.3 percent male-headed and female-headed households ate breakfast, respectively, while 80.4 and 87 percent of the male- headed and female-headed households ate supper, respectively.

About 81.3 percent and 83.6 percent of the male-headed households and female headed households, respectively, experienced food shortages in the last three years, which was well above the stated food deficit by the government in the District. The results also revealed that the male-headed households used hybrid seeds, pesticides, and irrigated their farm more than female-headed households, with pioneer composites numbers, 513, 511 being the most popular seeds in the area. The hoe and slashers were the most common farm tools used within the two groups of households, with female headed households walking or using hand-cart as their mode of transport. The male headed households also walked or used bicycle or vehicle for transport. The wealth index **revealed** that female-headed households were leading in terms of ownership of tractors and semi-permanent houses. The male-headed households were leading on wealth index for ox-plough, radio, bicycle, permanent house and temporary house. It is possible that in such female-headed households, the spouses were working in well paying jobs in urban areas or they inherited the property from their dead husbands.

Writing about similar issues for most of Tropical Africa, Google (2005a) noted that throughout Africa, while women were present in greater degrees in agricultural organizations, they tended to compromise being allowed in proportion of membership and are often not represented in the higher levels of leadership. The major constraints mentioned were socio-cultural factors, women's limited time and energy, limited formal and land ownership and rights to land resources, and the commercial bias of many of the organizations and subsequent neglect of many of those issues of concern to women farmers. The study mentioned countries like Mauritania, Morocco, Namibia and Zimbabwe as some of the countries where women groups and Community Based Organizations (CBOs) have been seeking to have women's needs addressed. The fieldwork results revealed that more male-headed households participated in development groups more than the **female**-headed households, with male- headed households dominating Agro-forestry and Farmers' Associations, while female-headed households participated in Agro-forestry, Farmers' Associations and others (the small female owned groups in the village). Both groups benefited more in terms of cash/remittances and education compared to other benefits like spiritual guidance. An independent survey on real problems of women from various different categories of women revealed several interesting issues: First, among the married women, the most important need was to make them self-reliant and beyond this, there were no serious problems. Secondly, women were the custodians of most cultural norms as they were more concerned about the welfare of their children, either academically, traditionally, spiritually or in terms of societal values. Thirdly, there were communication barriers among women themselves between Female-headed heads and those within the male-headed households.

The above results have shown that gender studies alone cannot be used to address food security problems in an area. Secondly, irrespective of the nature of household head, the resulting decisions made were the ones, responsible for the existing household food crop production levels and, hence, food security. Thirdly, without putting emphasis on the household head, maximization of household food crop production to eliminate hunger, which is a manifestation of poverty, must be prioritized.

8.5.2 Education

EL-Zanaty, ***et al,*** (2001) recorded that the level of education of household members is among the most important characteristics of the household because it is associated with many phenomena including reproductive behaviour, use of contraceptives and the health of children, which are all important to household food crop production. Further, Ayiemba (2000) found out that there was an inverse relationship between age at first marriage and fertility, and this is a factor which should be used to control population sizes to reduce total dependence on contraceptives. Ayiemba also suggested that age at first marriage should be raised to about 21 years, higher education availed for girls, and a health care policy and equitable development be encouraged. This means that many resources spent on family planning methods could be used particularly for compulsory education of girls in favourable institutions. Muganzi (2000) also attributed reduced mortality to increasing levels of education.

The fieldwork data revealed that most women attain up to secondary level of education with very few enrolling in A-level and beyond. Only one (1) female household head had attained college and university education compared to 5 and 1 men, respectively. Education enabled the various households to earn extra income, which they used to buy extra food to fill the production-consumption deficits. However, in terms of household food crop production, the households where household head attained only primary school education performed better as such household heads dedicate all their time and energy to the farm due to lack of alternative off-farm employment.

The researcher would like to emphasize that gender campaigns should concentrate on women education and food crop production and security and avoid activities that destroy households and interfere with household food production. In addition, farm work is tedious and purely manual, professional women should aim at investing their cash in more lucrative opportunities like service industries (off-farm activities). This will leave the manual labour demanding farm work to their colleagues who were not fortunate to acquire the right education at the right time. Further, gender activists should focus on households and household heads and encourage them to provide equal education to the girls before they decide to marry, as education appears to be the key to the rights of women, and a road that most of their male counterparts used towards their success. Such actions could free the women from conditions attached to inherited property or properties acquired through court injunctions in which, payments may be in kind, but extremely dear. The results have, therefore, revealed that education must work with other factors, if household security was to be improved and household poverty eradicated.

8.6 RESULTS FROM PRINCIPAL COMPONENT ANALYSIS (PCA); CLUSTER ANALYSIS AND FACTOR ANALYSIS

The analyses were carried out in order to assist in arriving at general conclusions and recommendations for this study. The variables used in the analysis were already outlined in chapter four. PCA was used to isolate the Principal variables, which operate to explain food security and poverty issues in Nyando District, and was strengthened by Cluster Analysis as well as, Factor Analysis.

8.6.1 Results from Principal Component Analysis

The variance in food crop production was explained by five (5) variables: Years of farm operation, age of household head, distance to the nearest health facility, duration of drought, and number of household members present (household size). The five components explained 59.41 percent of the variance in household food crop production, with the first, second, third, fourth, and fifth explaining 54.94 percent, 24.93 percent, 13.01 percent, 3.23 percent and 1.58 percent, respectively. It should be remembered that demographic and health factors are part of socio-economic factors (labour) and explain only how quality and quantity of labour affect household food crop production. Additional factors included in the analyses, were: size of farm, distance to the nearest market centre, distance to the nearest primary school, household morbidity and mortality, land cultivated the previous year and household labour) added to those given in Figure 2.1. These components explained only 40.59 percent of the variance in household food production.

The first five components explaining the 59.41 percent of the variations in household food crop production revealed the importance of other socio-economic factors (years of farm operation/experience), demographic factors (age of household head and household size), health issues (distance to the nearest health facility) and weather fluctuations (duration of droughts). Among the five components, age of household head and household size loaded highest on household food crop production with 0.55 and 0.53, respectively. Size of farm loaded very high on production but explained only 0.84, percent of the variation in household food production. Component loading for duration of floods, years of farm operation and distance to the nearest health facility on household food production were 0.12, 0.21 and 0.44, respectively. Distance to the nearest market centre, distance to the nearest primary school and number of deceased persons in household, which explained 1.25 percent of total household food crop production, impacted negatively on household food crop production. These results are provided in Table 8.4. The table shows that the factors dealt with in the research were important as a basis for policy frameworks in order to improve household food production and reduce / eradicate poverty.

Table 8.4 also confirms the reliability of the data used in this research, as the variations between results of Multiple Regression Analysis and Principal Component Analysis were minimal. The reader should remember that, the 40.59 percent, which account for factors not considered in the study, using Principal Component Analysis, also included floods. The impact of floods was, however, considered in Multiple Regression

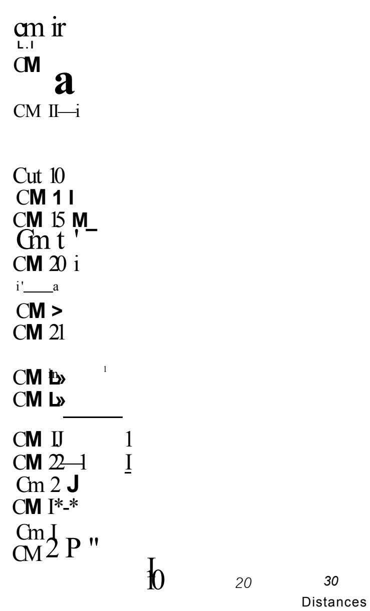
Analysis. The results also provide the contribution of individual factors, which could not be obtained using Multiple Regression alone.

8.6.2 Results from Cluster Analysis

The cluster analysis revealed that many households did not know the exact names of their villages, sub-locations and locations, leading to confusing data on their spatial characteristics. The households used in the analysis came from Upper Nyakach which vary from medium to high potential agro-ecological zones (UM3 and LM3), yet they were clustered into three (3) clusters with varying distances. These are provided in Figure 8.7.

Figure 8.7 Clustered Households

Cluster



All the three clusters consisted of households found in different villages of Sigoti and W. Nyakach Locations. Explanations could be:

- That the households in these two locations were able to answer the questions better than the others,
- The area was more accessible,

- The households took farming more seriously.

As the Agro-ecological zones could not be used to explain the cluster of the households, it was concluded that there are other factors, which vary spatially and, which influence individual household food production. These could be explained by the individual problems, which were stated by households during data collection (and as stated in the section dealing with regional determinants of poverty) together with other factors, which constituted 40.49 percent of the variables not included in the analysis. When examining the relationships between variables, it was realized that all variables could fall in two (2) groups with varying distances, with group one consisting of age of household head and years of farm operation.

Table 8.4 Results from Principal Component Analysis compared with Multiple Regression Analysis

Environmental Issue	Description	% variance explained	Total % of variance explained	Results of Multiple Regression Analysis (%)
Climate	Drought Flood	3.23	3.23	7.8 5.0
Socio-economic	Farm size- Years of farm operation- Distance to the nearest market- Household labour-	0.84 54.94 0.28 0.40	56.18	Socio- Economic- 55
Demographic and health factors	Age of household head- Household size- Distance to the nearest health facility-	24.93 1.58 13.01	39.52	Demographic- 55 10.2 Health- 20 30.2
Total (%) measured variables		59.41	59.41	67.8
Other Internal and external household issues not measured	For example seed type, timing of agronomic practices, soil quality, education/religion, government policy, energy demand and use, research and marketing, gender.			

	nutrition and malnutrition, food imports and food aid.	40.59	40.59	32.2

Source: Principal Component analysis and Multiple Regression Analysis

The second group comprised of climate (drought), household size, household labour, farm size, distance to the nearest market centre and nearest primary school, deceased and ill persons, land cultivated the previous year and distance to the nearest health centre, which appeared to be furthest from all the rest. The results could also mean that the four factors (age of household head, years of farm operation, duration of droughts and distance to the nearest health centre could assist in explaining most of the variations in household food crop production. See figure 8.8.

The results were in accordance with the findings of Principal Component Analysis carried out and isolated the five variables (the above four arrived at during cluster analysis and household labour), which emerged as the most important components, and explaining over 59 percent of the variation in household food crop production. The results mean that the condition of the household head (age, experience in farm-work and health) explains most of the variations in household food crop production (79.87 percent), while the household size which is responsible for providing labour and duration of drought explained 1.98 percent of the total variation. These results emphasized the role played by household head (in terms of quality of education and experience) in food security. Further, according to these results, in order to increase household food crop production and reduce and /or eliminate poverty, the government must stop land sub-division, which bring in inexperienced farmers into the system, and also provide relevant and affordable health care to smallholder households.

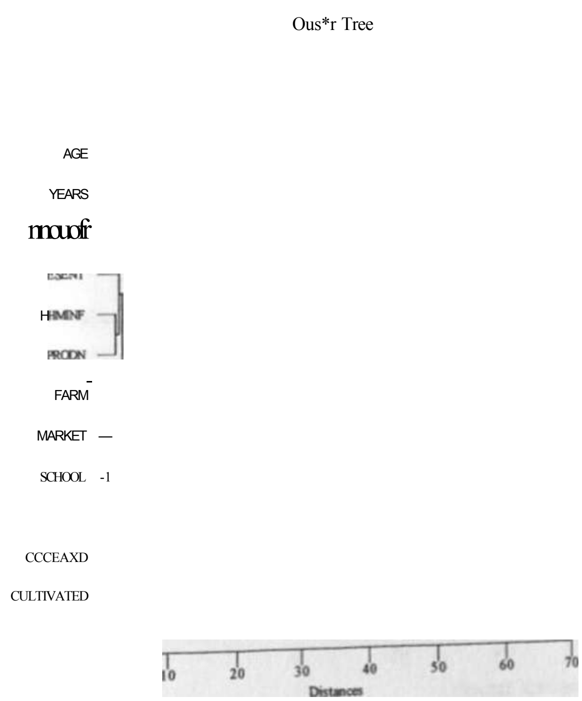
8.6.3 Results from Factor Analysis

Factor Analysis was useful when trying to target a given production level and the factors that influence that production. Due to lack of sufficient data, 700Kg, which tallied with 75th percentile and represented upto 75 percent food security within the region, as was initially intended, could not be used. The first lOOKg and 300Kg were therefore used to examine which factors would yield the results.

In order to get lOOKg of cereals in each household, the following variables ranked as follows: 1-distance to the nearest market centre, 2-household size, 3-size of farm, 4-distance to the nearest primary school, and 5-household labour. Others were: 6-land cultivated the previous year, 7-Years of farm operation, 8-duration of droughts, 9-number of deceased persons, 10-distance to the nearest health centre, 11-number of ill persons, and 12-Age of household head. These variables explained the percent variation as shown in Figure 8.9.

The results obtained during Principal Component Analysis and Cluster Analysis gave different factors that influenced household food crop production in Nyando District without any target, but in this case the target was lOOKg. The first five factors in this case- distance to the nearest market centre, household size, farm size, distance to the

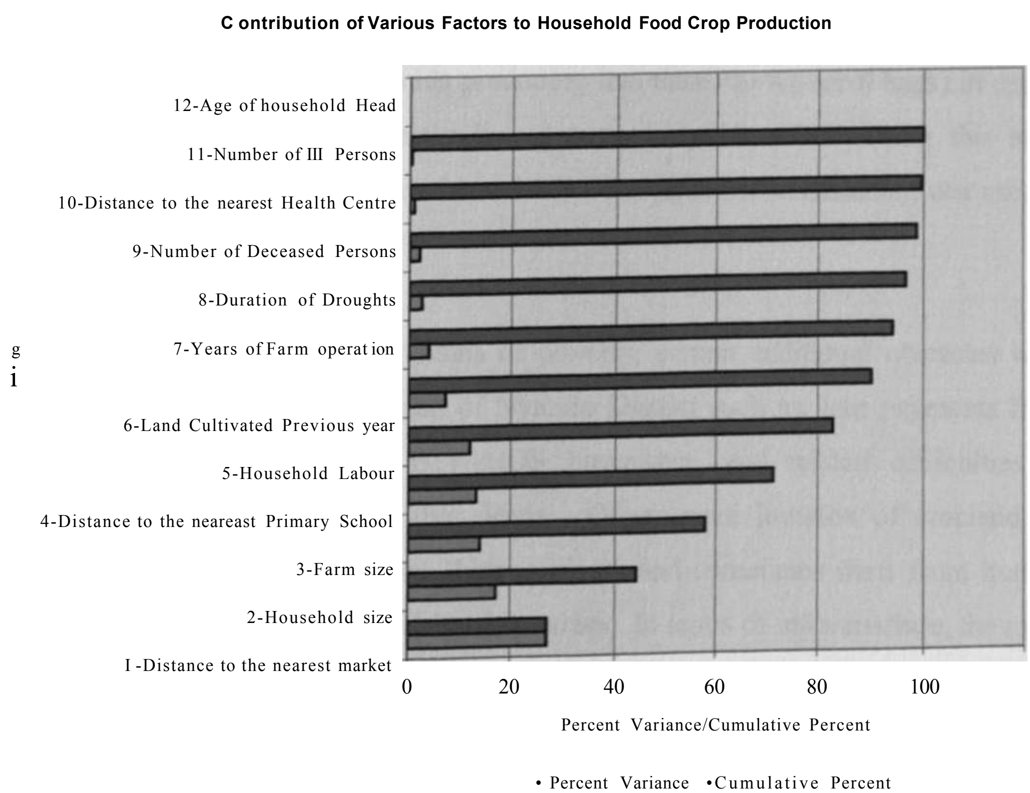
Figure 8.8 Cluster of the variables used in the Analysis



Source: Fieldwork results

nearest primary school and household labour explained up to 82.93 percent of the variation in attaining 100kg of production per household. In the case of 300Kg (equivalent to 32nd Percentile and which suited the available data), isolated age, farm size, and years of farm operation as major factors contributing to the production of at least 300Kg of household food crop production. In order to achieve at least 700 Kg of production per household, the researcher believes that the three factors would still hold, as there was consistency with the results of Principal Component Analysis (PCA) and Cluster Analysis. The farm size, however, emerged third, when initially it was emerging sixth in PCA. These results reveal that for targeted increases in household food crop production, apart from the health of the farmer, farm size must also be considered as an important aspect.

Figure 8.9:



Therefore, in order to eliminate poverty, through household food security, there is need for a proper health care delivery system and control in the minimum farm size that can be used to produce at least 7Q0Kg per household per year. The earlier results showed that a minimum size of 3 hectares would be required immediately within the unimodal rainfall dominated areas, where cultivation is carried out once every year. Whereas in areas experiencing bimodal rainfall patterns, a minimum size of 1.5 hectares would be needed to attain annual household production of at least 700Kg, assuming that the climatic conditions are favourable. As the figure corresponds to 75^{th} percentile, when all the recommendations are considered, the District would automatically achieve at least 75 percent food security, and added to suitable inputs and appropriate technology, the results could be amazing.

8.7 SUMMARY

The chapter was built upon the previous findings of causes of poverty such as lack of food, cash and other basic needs like clothing, shelter, health care and other livelihoods. The chapter laid emphasis on food poor and non-food poor households, regional poverty and those households producing less than 700 Kg (or 8 bags) of cereals annually. The three factors directly linked to poverty identified during this study (regional determinants, inter-household and intra-household determinants), are used in the discussions.

Among the regional determinants of poverty, certain additional obstacles were observed in almost in all the division of Nyando District such as, late payments from sugarcane delivered to factories, HIV/AIDS prevalence, and related difficulties of widows and orphans, and lack of title deeds. Others were invasion of cropland by wildlife - such as monkeys, baboons, hippos, dogs, and sometimes theft from human beings, added to problems of diminishing farm sizes. In terms of infrastructure, the most relevant services to agricultural production such as market, banking and industrial centres were the furthest from various households compared to primary schools, sources of water, and places for fetching of firewood, which were relatively close. Energy demand and use, on the other hand, competed with household food production in terms of time taken to acquire the preferred energy type.

Some of the inter-household issues discussed and related to demographic factors revealed that although economic models have not adequately related household size to levels of poverty, large household sizes assisted the poor households to escape poverty. Further, increases in household morbidity and mortality impacted negatively on household food crop production, with only a few household heads willing to abandon farm activities for off-farm employment in urban areas. The male-headed households had bigger sizes of household labour compared to female-headed households when dealing with intra-household determinants of poverty. Similarly, household heads with better education benefited from off-farm employment, though their household food crop production was lower.

The results of Principal Component Analysis revealed that, years of farm operation, age of household head, distance to the nearest health facility, duration of droughts and size of household, respectively, among the sampled households need to be prioritized, when dealing with household food security. The Cluster analysis results showed age of household head as belonging to its own cluster with all the other variables used in the analysis belonging to the other clusters. According to the findings, the age of household head, experience, and health, could contribute upto 79.87 percent of the variations in household food crop production. Finally, in order to raise production within Nyando to at least 700Kg or cereals annually per households, Factor Analysis revealed that age of household head, farm size and years of farm operation were the most important factors to be considered.

CHAPTER 9:

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

9.1 INTRODUCTION

The findings, conclusions and recommendations listed in this section are those obtained from the various analyses carried out in the respective chapters and sections of this study. Every attempt has been made to relate findings to the objectives stated in chapter four. The Multiple Correlation and Regression Analyses and stepwise Multiple Regression Analyses were used to determine the relationship between household food crop production (largely cereals), and climatic factors, socio-economic, and demographic factors, as well as health issues. The two-tailed test was in each case set at 95 percent confidence interval to decide on the significance of the relationships, with household food crop production being the dependent variable in all the analyses. The household food crop production was in each case taken as the dependent variable for purposes of all the analyses. The results from Principal Component analysis (PCA), Cluster Analysis (CA) and Factor Analysis (FA) were then used to summarize all the findings and conclusions made. Lastly, on the basis of the research findings, the researcher summarized the emerging conclusions concerning poverty, which although it did not form part of this study, could be used by future scholars interested in modeling poverty in space and time. Having followed the various steps as outlined above, it was not difficult to arrive at clear conclusions from the research effort, and these are now summarized below:

9.2 MAJOR FINDINGS AND CONCLUSIONS

Chapter five of the study set out to deal with the first objective meant to examine the influence of drought and floods on household food security in the study area. The null hypothesis formulated negated the existence of any relationship between household food crop production and droughts and floods. The variables used in the analysis (as already stated in chapter four and five), included duration of droughts/floods, months dependent on household food crop production and purchased food as independent variables. The null hypothesis tested aimed at examining the existence of a significant relationship between household food crop production and drought on the one hand and or floods occurrence on the other, months dependent on food production and food purchases and duration of drought/floods on the other. In terms of drought occurrence, the independent variables were found to explain upto 5 percent of the variation in household food crop production, while in the case of floods occurrence, the same variables accounted for 7.8 percent of the variation. In both cases, the null hypotheses could not be rejected to avoid type I and type II errors. The following were some of the research findings regarding drought and flood occurrence in the study area:

- In the absence of drought (during a good harvest), households depended more on household food crop production with minimal purchases.

- Drought in the area did not lead to total crop failures as up to 8 months of drought still resulted in about 200Kg of cereal production per household. On the other hand, if the droughts were serious, then, there were some households with farms located elsewhere, which were in the particular circumstance, used for food crop production, and which were not affected by crop failures within the lower zones. In other words, some households (though not all) had an escape route in cases of bad drought occurrence. This can be regarded as a standard coping mechanism to deal with drought in a country where there is still idle land in the neighbourhood.

- During floods, most of the affected households were dependent on food purchases and the level of suffering in each case was determined by the success of the previous harvest.

- Absence of floods led to less food purchases, while more floods escalated the demand for foodstuff in the area, due to crop failures or minimal cereal production.

- While six months of floods could lead to total crop failure, some farms could also be lying fallow/idle in the area, due to permanent floods, and which could partly be explained by the unavoidable degradation of agricultural lands.

On the basis of these analyses, it was concluded that drought ***per se*** was not in this case as serious a problem as usually assumed, and its effects, could be minimized by using drought resistant crops, as well as other escaping actions by farmers. All the same, adverse climatic patterns should always be incorporated into all food security plans, and flood occurrence accorded the greater attention, which it deserves.

The second objective of the study was to examine the effects of socio-economic factors on household food security in the study area. The independent factors entered into the analysis included farm size, land cultivated the previous year, household labour, hired labour and distance to the nearest market centre, as major socio-economic factors. Additional factors included years of farm operation, distance to the nearest banking centre, primary school, source of water and firewood place. According to the null hypothesis formulated, there was no relationship between these **socio**-economic factors and household food crop production. After the analyses, a negative relationship was revealed between household food crop production and farm size, hired labour and distances to the nearest market centre, primary school, clean source of water and place of obtaining firewood. Additional findings showed that household labour was more important in terms of household food security, with all the **socio**-economic factors accounting for 55 percent of the variation in household food crop production. These findings are shown below:

- Household cereal production was found to be related to all the variables used in the analysis (farm size, land cultivated the previous year, household labour, hired labour, distance to the nearest market centre, years of farm operation, distance to the nearest banking centre, clean source of water and firewood place).

- The distance to the market centre could be both an internal problem (due to the size of the farm), or external, due to remoteness of an area, while the hired labour was not productive enough to pay for all the costs incurred.

- The Stepwise Multiple Regression Analysis removed hired labour from the prediction equation, and left farm size, land cultivated the previous year, household labour, and distance to market, as the most important factors contributing together, nearly 50 percent of the variation. Small farm sizes emerged as uneconomical.

Having rejected the null hypotheses, it was concluded that these socio-economic factors are very important in household food crop production, and must be considered if household food security is to be achieved. Such considerations have been stated in the sections dealing with research recommendations.

The analysis concerning the demographic and health factors were based on the objective intended to investigate how household population and health influenced household food security. The null hypothesis formulated stated that no relationship existed between household food crop production and age of household head, household labour, household size, household morbidity and mortality. These analyses revealed that, household size was one of the most important factors influencing household food security, and both morbidity and mortality, were positively correlated with the level of household food production. The null hypotheses were aimed at finding out the existence, and the strength of relationship between household food crop production and the demographic and health factors. The two null hypotheses formulated were rejected, and the results showed that demographic factors accounted for 10.5 of the variation in household food crop production, while health issues were responsible for 20 percent. Additional findings were as stated below:

- Greatest variability existed in the age of household head, which was also not related directly to household food crop production.

- Availability of household labour was directly related to household food crop production, while having no household members impacted negatively on household food crop production.

- At least two full-time household members in farm work were needed to produce upto 600Kg of cereals annually, with household size of between 5 and less than 10 persons being the most productive, particularly, when at least 2 persons were engaged in full-time farm work.

- Morbidity and mortality were inter-dependent and affected household food crop production jointly, with household size, and family health, accounting for nearly 50 percent of the variation in household food crop production. The effects of illness were more severe for a target of 200Kg of cereal or more for each sampled household.

It was then concluded that although these factors form part of the socio-economic factors (labour quantity and quality), they constitute a large percentage of the socio-economic factors, and must be taken seriously when planning for household food security.

The fourth and the last objective of the theses was meant to investigate the significance of household poverty as an important aspect of food security among small-scale farmers. No null hypothesis was formulated for this particular objective as the analytical techniques used in the chapter (Principal Component Analysis, Cluster Analysis and Factor Anaqlysis) were merely designed to verify the results already stated in the previous analyses. The verification was necessary in establishing the importance of each variable in maintaining household food security and poverty.

The results obtained from Principal Component Analysis together with those from Cluster Analysis revealed that the status of household head (Age, experience in farm work and health) explained over 90 percent of the variation in household food crop production so long as no fixed production target was set. On the other hand, Factor Analysis, revealed that, in order to obtain at least 300Kg of household cereal production annually (corresponding to 32^{nd} percentile), age of household head, years of farm operation, and farm size were the major factors to be considered. These factors accounted for nearly 81 percent of the variation in household cereal production.

On the basis of Principal Component Analysis, Cluster Analysis and Factor Analysis, several conclusions were made such as:

- For targeted results in household food crop production (cereals), farm size and health of the farmer/household head must be prioritized.

- In order to reduce/ eliminate poverty (achieve a target of at least 700Kg of household food crop production), a minimum farm size of 3 Hectares on household food production must be set for areas receiving unimodal patterns of rainfall, where cultivation is done once a year. Areas receiving bimodal patterns of rainfall should have at least a minimum farm size of 1.5 Hectares under production.

- After controlling farm sizes, additional benefits obtained from the use of suitable inputs and appropriate technology could assist in eliminating poverty in the area of study. Household size should then be seen as a resource and not a problem.

- Further, the discussions and analyses of all the factors included in the analysis lead to a new definition of poverty, which is more inclusive as:

"Lack of or inadequate food (in terms of quality and quantity) or its cash equivalent within a particular household, and aggravated by minimal or lack of other basic needs". The basic needs referred to included clothing, shelter, health care, education and other livelihoods. Similar households were also the vulnerable households to food insecurity problems and are in need of assistance.

- The results also led to the grouping of poverty indicators/ indices as determinants and which were discussed in three different categories: The regional determinants (climate and other situational issues, infrastructure and energy availability), Inter-household determinants (socio-economic factors, and demographic and health issues), and Intra-household determinants (gender and education).

The most vulnerable groups according to the research findings included those households with less than 2.15 hectares of land in areas receiving unimodal patterns of rainfall and 1.1 hectares in areas with bimodal patterns of rainfall, and without other sources of income. Priority should be given to female-headed households, because in this case, they are mostly widowed, as women are not allowed to build homes next to their parents in the study area. As far as gender was concerned, irrespective of the nature of household head, household food crop production should be prioritized.

In conclusion, the Researcher's view on poverty states that:
"At one point in space and time, everyone is non-poor and the intra-household, inter-household and regional determinants of poverty constantly impact upon the time and space to dictate the size of actual physical wealth owned by an individual".

9.3 NEW FINDINGS AND CONTRIBUTIONS TO KNOWLEDGE IN THE THESIS

There are three different categories of findings and contributions to knowledge in this thesis (those relating to general food security and poverty, the role of and the decisions made by the government and the status of a particular household). Those relating to the general food security and poverty include the following:

- Initially, climate (drought and floods) were expected to dominate the food security problem, but the analysis revealed that socio-economic factors were the main decisive factors, though climate complicated the issue.
- Poverty is the main contributor to food insecurity in the area as the majority of the households (over 60 percent) are poor and cannot even afford food for their families,
- A new definition of poverty was derived as "lack of or inadequate food (in terms of quality and quantity) or its cash equivalent within a particular household, and aggravated by minimal or lack of other basic needs, and;

- It is pointless to talk about food security without poverty eradication as poverty is more problematic than food security.

The findings relating to the role of and decisions made by the government were as follows:

- The government has not put in place incentives to encourage farmers to produce food security/famine crops, and;
- Contrary to the government decision to spend much more money on education than agriculture, in the current status it seems to exercabate vulnerability to food insecurity at the household level, as much of the population move to urban areas and abandon agriculture.

At the household/farm level, the analyses revealed that:

- Apart from the new definition to food security on the basis of poverty provided in this thesis, the research has shown that the issues of basic needs (clothing, shelter, health care education and other livelihoods) cannot be ignored if food securty is to be achieved,
- The effects of disease and lack of coping mechanisms is likely to negate the positive achievements on food security,
- Further, the impact of absenteeism and inadequate labour within households could also complicate food security issues, and;
- Vulnerability and adaptation assessment to emphasize household level /family level rather than region as coping strategies vary from household to household.

9.4 RECOMMENDATIONS

Recommendations have been made to both policy makers and for further study as shown in the subsequent paragraphs. The recommendations are aimed at achieving certain goals as is explained by the two sections dealing with policy makers and further research.

9.4.1 Recommendations to Policy makers

On the basis of research results, the following policy issues were highlighted.

First, policies that raise household food production to about 700Kg annually are required to make Nyando District at least 75 percent food secure, by providing timely climatic data to farmers as these form the basis of planning for any achievement on household food security.

Secondly, issues relating to age of household head, years of farm operation, health care, weather fluctuations and household size should be incorporated into such food security policies, as this research has revealed their importance in household food security.

Thirdly, government policies should insist on and encourage all dual-purpose crops as staple food crops (maize, beans, rice and groundnuts, which served well as food and cash crops), among sampled households. Such crops are consumed locally, and are less affected by problems of international markets like most cash crops. In addition, different food types should be introduced in learning institutions to influence tastes and preferences for maize and rice only, as is common among youth and children, to other more nutritious and drought tolerant crops like millet and sorghum, which are usually cheaper and readily available. These will encourage households to use more nutritious and drought tolerant crops like millet and sorghum.

Fourthly, the construction of more banking centres or agricultural financial facilities should be encouraged in the area, while also providing low interest rates to small-scale farmers to enable them buy farm inputs. This will reduce the effects of regional determinants of poverty among households.

Fifthly, price controls should be re-introduced with practical government subsidized staple food crops to enable various households afford food. Additional methods of controlling prices could include targeted government purchases and storage and supporting households which have land but lack capital to develop them, in order to reduce the number of absentee land lords and enhance equitable regional food production.

Sixthly, policies should also aim to make costs of farm inputs affordable and support zero grazing by giving farmers grants so that they can use manure and income to subsidize farming operations. Additional areas of policy interventions include resettling households with uneconomical pieces of land and maintaining a minimum and profitable farm size of 3 hectares. Uneconomical/land sub-division could be discouraged through creation of centres with several openings for off-farm employment opportunities calculated to absorb some of the households with less than three hectares of land. The small pieces could be joined, where practical, together and sold to neighbouring households to improve their farm sizes. In addition, households in the area with large hectarages of medium to high potential land should be encouraged to sub-divide them into smaller (3 Hectare) plots and allow others (particularly landless household through government assistance) to buy and gradually eliminate poverty in space and time.

Seventhly, policies which encourage the development of rural access roads within the area should be encouraged with the aim of opening up new market centres, while also making it a requirement, where possible, that the Community Based Organizations to include food security related programmes in their agenda at the grass-root level. Ways of monitoring such endeavours should also be put in place alongside the agricultural and food policies to ascertain that the policies and laws are strictly followed from grass-root to national levels.

Eighthly, there should be policies to regularize the costs of labour to facilitate agricultural production. It is also necessary to prepare data on income groups and assets of various households in order to determine household sizes relevant to reduction of poverty and drudgery, while encouraging agriculturally productive pursuits. In addition, farmers should be educated to keep records on household farm inputs, production, consumption and yield.

Ninthly, government policies should encourage research on food crops through Research Institutions like the Tea and Coffee Research Foundations. The vulnerable groups/households should be assisted with education for their children in addition to the provision of free health care, where possible, while encouraging the economically able to invest their resources in secondary and tertiary activities to create more employment opportunities.

The farmers who were interviewed also recommended that the government should carry out the following as a way of assisting them:

(a) provide loans (80.5 percent),

(b) provide relief food (13.0 percent),

(c) carry out research at certain intervals to find out the farmers' needs (0.8 percent),

(d) provide farm inputs - equipment, seeds and fertilizers (5.7 percent), and;

Lastly, policies should be put in place to increase the use of other types of energy besides fuelwood and charcoal, in order to preserve the environment, provide affordable and efficient energy to the poor (to reduce the work-load of women and girls), and enhance the provision of other basic needs. Stalled projects in the area should be completed, for example, efforts on floods in Lower Nyakach, Upper Nyakach and Miwani divisions should be properly managed and enough teachers supplied to Lower Nyakach and Nyando divisions. Geographical studies should be core at both secondary and tertiary levels of education to ensure success in the above recommendations.

9.4.2 Recommendations for Further Research

Studies should be aimed at investigating:

Various crop types, combinations, and respective farm sizes together with annual household production and yield, consumption, sales, storage and the reasons for sale (whether for food or for cash). Additional related issues include effectiveness of extension services and methods of land preparation, and the relationship between farm size and costs of farm implements and storage facilities.

Secondly, the impact of environmental degradation indicators, particularly the emerging new weeds on household food security in the area should be quantified. Other related areas include economics of group labour, and the inter- and intra- household energy type, use, time taken to acquire it and their impacts on household food security.

Individual Community Based Organizations (CBOs) (whether government oriented, Non-governmental organization or Self-help groups in nature) require investigation to find out the type of food security related services they render to the community. Additional interesting variables should include relationships between household food production and the time spent on CBOs, approximate costs per year, and the benefits obtained.

Further regional variables that did not form part hypothesis testing in this study like the role of government and religion, wildlife, and decision-making processes should be examined, and the purpose of loans as demanded by households.

Therefore, the study has brought a new dimension in the study of food security challenges together with vulnerability and adaptation strategies to food insecurity, which can be used at household, regional and international levels.

REFERENCES

Acland, J.D. (1971): East African Crops. London, Longman Group Ltd.

Allee, W.C. and Schmidt, W.C. (1951): Ecological Animal Geography. U.S.A., John Wiley and sons Ltd.

Akech, S.O. (1990): Smallholder Food Production: A Geographical analysis of Maize Production in Rongo Division, South Nyanza, District, M.A. Thesis in Agricultural Geography, University of Nairobi.

Anderberg, M. R. (1973): Cluster Analysis for Applications, New York, Academic Press Inc.

Atieno, R. (1988): Incentives for Increasing the Production of Food Crops among Small-scale farmers: A Case of Siaya District, M.A. Thesis in Economics, University of Nairobi.

Ayiemba, E.H.O (2003): "Fertility and Development Issues in Africa: A Critical Review" Journal of Humanities and Social Sciences II (1), 1-13.

Baldwin, K.P. S. (1975): Demography for Agricultural Planners, Development Research and Training Service. Policy Analysis Division. Rome, FAO of the United Nations.

Barry, R.G. and Chorley, R.J. (1982): Atmosphere, Weather and Climate, Methuen and Co. Ltd

Batiwalla, S. (1995) "Energy as an obstacle to improved living standards" In Energy as an Instrument for Socio-economic Development [Goldenberg, J. and Johansson, T.B. (ed)], New York, UNDP.

Beanjeu-Garnier (1978): Geography of Population. London, Longman.

Bernhardsen, T. (1992): Geographic Information Systems. Norway, Viak IT.

Billings, W.D. (1970): Plants. Man and the Ecosystem. Great Britain, Wadsworth Publishing Company.

Birch, T.W. (1959): Topographical and Statistical. Oxford, Claredon Press.

Birundu, S. (2005) Interactive - The Standard, Monday, March 21. Pg I.

Blalock, H.M. (1979): Social Statistics, New York, University of Washington (McGraw-Hill Series).

Blankhart, D.M. (1974): "Human Nutrition" In Health and Disease in Kenya [Vogel, L.C.; Muller, A.S.; Odingo, R.S.; Onyango, Z. and De Geus, A.K. (ed)], Nairobi, East African Literature Bureau.

Bohle, H. and Kriiger, F. (1993): "Perspectives of Geographical Food Crisis Research" In Applied Geography and Development: A Biannual Collection of Recent German contributions [Institute for Scientific Co operation (ed)], Tubigen. 42(98).

Bonte, J. (1974):"Pattems of Mortality and Morbidity" In Health and Disease in Kenya (Vogel, C.G.; Muller, A.S.; Odingo, R.S.; Onyango, Z. and De Geus, A. (ed)), Nairobi, East African Literature Bureau.

Brandt, H.(1985): "Programmes to Secure Food Supplies in the Sudan-Sahel Region: Experience, Question, and Suppositions" In A~~pplied Geography~~ anH TWInpment: A Bia~~nnual Collection of Recent German Contributions~~ [Institute for Scientific Cooperation (ed)], Tubingen, **25** (25).

Buliro, J.D. (1974): Maximization of Food Production in the National Economy, Paper Presented to the Symposium on October 24-31-1974, Nairobi, Kenya.

Burton, G.J.C. (1932): Further Studies on Improvement on Maize yields in Kenyan Colony and Protectorate, Bulletin, No. 4 of 1932, Government Printer.

Caldwin, J.C.; Reddy, P.H. and Caldwell, P. (1984): Causes of Fertility decline in south India, The Population Council Development, 1984, No. 3.

Camberlin, P. and Okoola, R.E. (2003): "The onset and cessation of the "long rains" in Eastern Africa and their inter-annual variability" Theoretical and Applied Climatology, 75,43-54, (2003), Springer.

Central Bureau of Statistics (CBS) (2005): Economic Survey - 2005, Nairobi, Government Printer.

Central Bureau of Statistics (2004): Statistical Abstract, Nairobi, Government Printer.

Central Bureau of Statistics (2003a): Geographic Dimension of Well-being in Kenva: Where are the poor? From Districts to locations. Vol. 1, Nairobi, Ministry of Planning and National Development,.

_(2003b): Statistical Abstract, Nairobi, Government Printer.

(2001a): Second Report on Poverty in Kenva. Vol. I: Incidence and Depth of Poverty, Nairobi, Ministry of Finance and Planning.

(2001b): Second Report on Poverty in Kenya. Vol. II: Poverty and Social Indicators. Nairobi, Ministry of Finance and Planning.

(2001c): Poverty in Kenya. Vol. Ill: Welfare Indicators Atlas: A report prepared by the Central Bureau of Statistics and Human Resources and Social services Department Nairobi, Ministry of Finance and Planning.

(200Id): Statistical Abstract. Nairobi, Ministry of Finance and Planning.

(2001e): 1999 Population and Housing Census: Counting our people for development. Vol. I, Nairobi, Ministry of Finance and Planning.

(1996a): Economic Survey, Nairobi, Government Printer.

(1996b): Kenya Population Census 1989 - Analytical Report Vol. VII: Population Projections, Nairobi, Ministry of Planning and National Development.

(1994): Kenya Population Census 1989, Nairobi, Government Printer.

(1989): Kenva Population Census 1989, Vol. II, Nairobi, Government Printer.

(1981): Kenva Population Census 1979. Vol. I, Nairobi, Ministry of Economic Planning and Development.

(1970): Kenva Population Census 1969, Nairobi, Ministry of Finance and Economic Planning.

Central Bureau Statistics, Ministry of Health (MOH) and ORC Macro (2004): Kenva Demographic and Health Survey 2003, Maryland, Calverton.

Chang' Jen-Hu (1966): Climate and Agriculture: An Ecological Survey. Chicago, Aldine Publishing Company.

Chaudhury, R.H.(1989): "Population Pressure and its effects on Changes in Agrarian structure and productivity in Rural Bangladesh" In Population Growth and Poverty in Rural South Asia (Rodgers, G. (ed)), London, Sage Publications.

Cherongony, M.J. (1995): The implications of Grain Market Liberalization on farm maize storage in Kenya, MSc Thesis in Agricultural Economics and Farm Management, University of Manitoba, Winnipeg.

Chipeta, W. (1972): "A Model of Production and Distribution for Chiwira" In East African Journal of rural Development [Amann, V.F. (ed)], The EAAE and Makerere University, Kampala.

Chisholm, M. and Rodgers, B. (1972): (ed) Studies in Human Geography, London, Heinemann Educational Books.

Congalton (1991): "A Review of Assessing the Accuracy of Classifications of Remotely Sensed Data", Remote Sensing of Environment, Vol. **37:35-46.**

Consultative Group on International Agricultural Research (CGIAR) and Inter-centre working Group on Climate Change (ICWG-CC) (2002): The **Challenges** of Climate Change Research to overcome **its** impact on Food **Security.** Poverty and Natural resources Depredation in Developing World, Challenge Programme Pre-Proposal, August 2002.

Clark, W.A.V. and Hosking, P.K. (1986): Statistical Methods for Geographers U.S.A, John Wiley and Sons.

Climate Change Secretariat (1999a): United Nations Framework Convention on Climate Change-Convention on Climate Change. Geneva, UNEP (IUC).

Cole, R. and Stern, R.D. (1982): "Rating Models to Daily rainfall Data", Journal of Applied Meteorology, **21,** July, 1982.

Cole, A.J. and Hoover, E.M. (1958): Population Growth and Economic Development in low-income countries. New Jersey, Princeton.

Cruickshank, J. and Amstrong, W.J. (1970): Soil and Agricultural Land Classification in County Londondery, University of Exeter and Queens University, Belfast-Incomplete Citation.

Dache, O.S.A. (1989): Population-Food Inter-relationships in Kenya: District Level Analysis 1980 to 2000-A Case study of maize and beans, MSc. Thesis in Population Studies, University of Nairobi.

Davis, J. (1986): Statistics and Data Analysis in Geology. Toronto, John Wiley and Sons, Toronto.

IGAD-DMCN (2002): Factoring of Weather and Climate Information and Products into **Disaster** Management Policy: A contribution to Strategies for Disaster Reduction in Kenya, Nairobi. DMCN.

DMCN - UNEP (2004): Conine with floods in Kenya: Vulnerabi~~lity, Impacts and~~ Adantation Options for the Flood **prone** Areas of Western Kenya. Nairobi, UNEP.

East Africa Standard (2002): Kenya's Agricultural and Livestock Sector, Wednesday, February 6,2002.

Egal, A.M. (1999): Effect of Clump Planting of Maize and time of Planting of Beans on Growth and Yield of Inter-cropped Maize and Beans, MSc. Thesis in Agriculture, University of Nairobi.

Eicher, C.L.(1986): Transforming African Agriculture

(1984): "Africa's Food Battles" In Agricultural Development in the Third World [Eicher, c. and Staatz, J.M. (eds)], 2Nt) Edition, London, John Hopkin's University Press.

Elamass, I.A. (1997): The Prevalence of Malnutrition and Some Associated Factors among Pre-School Children in an Urban Slum, Kibera, Nairobi-Kenya, MSc. Thesis in Applied Human Nutrition, University of Nairobi.

El-Zanaty, F. and Way, A.A. (2001): Egypt Demographic and Health Survey 2000, Ministry of Health and Population National Council and PRS, Maner.

Engmann, E.V.T. (1972): "Food Production and Population Growth" In Population Growth and Economic Development in Africa (Ominde, S.H. and Ejiogu, C. N. (ed)), London, Heinemann.

Etherington, D.M. (1970): Hypothesis Formulation and the Analysis of Farm Survey data: A Case Study. EAAS Conference, Dar es Salaam, 31st March, 1970.

Etherington, D.M. (1966): The Calculation of Smallholder Tea Yields in Kenya by Multiple Regression Analysis, Discussion Paper No. 40, Institute for Diplomacy Studies, UoN.

EU and UNDP (1999): Energy as a tool for Sustainable Development: for African. Carribbean and Pacific Countries, New York, UNDP.

FAO (2001a): Food Outlook: Global Information and Early Warning Systems on Food and Agriculture. No.l, Rome, FAO.

(2001 b): Food Crops and Shortages: Global Information on Early Warning Systems on Food and Agriculture, Rome, FAO.

(1996): Food Security and Nutrition: World Food Summit. Rome, FAO.

(1987): The Fifth World Food Survey. Rome, FAO.

(1986): African Agriculture: The next 25 years. Vol. 5, Rome, FAO.

(1982a): The state of Food and Agriculture 1982. Rome, United Nations Publication.

(1982b): Famine in Africa: Situation. Cause. Prevention and Control, Rome, FAO.

(1981): Agriculture: Towards 2000, Rome, FAO.

(1970a): Provisional Indicative World Plan for Agricultural Development: A Synthesis and Analysis of Factors relevant to World. Regional and National Agricultural Development. Rome, FAO.

(1970b): Provisional Indicative World Plan for Agricultural Development: A Synthesis of Factors Relevant to World. Regional and National Agricultural Development, Rome, FAO, Vol.2

Fischer, G.; Frohberg, K.; Pary, M. and Rosenzweig, C. (1996): "The Potential Effects of Climate Change on World Food Production and security" In Global Climate Change and Agricultural Production [Bazzaz, F and Sombroek, W. (ed)], Chichester, John Wiley and Sons Ltd,.

Frankfort-Nachmias, C. and Nachmias, D. (1996): Research methods in the Social Sciences. 5th Ed, St. Martin's Press, Inc., Bristol, J.W. Arrowsmith Ltd,.

Frohberg, H, and Shah, M.M.(1980): Nutrition Status-Rural and Urban Kenya, A Working Paper Prepared for the International 1 Institute for Applied Systems Analysis.

G8 (2005): The Gleneagles Communique, United Kingdom.

Gerhart, J.D. (1974): The Diffusion of Hybrid Maize in Western Kenya, PhD Thesis, Princeton University.

Ghansan, D.K. (1972): "Family Planning and Economic Development in Africa" In Population Growth and Economic Development in Africa (Ominde, S.H. and Ejiogu, C.N. (ed)), London, Heinemann,.

Goldemberg, J. and Johansson, T.B. (ed) (1995): Energy as an Instrument for Socio-economic Development, New York, UNDP.

Google (2006): http://www.genomics.edu/gmo/SubSah-issues.htm.

Google (2005a): http//www.paho.org/English/DPM/GPP/GH/food security.PDF.

(2005b): http//www.fao.org/Gender/gender.htm.

(2005c): http//www.fao.org//docrep/x0250e/x0250e 04.htm.

Google (2004): http:/news.bbc.co.uk/2/hi/Africa/39107.stm.

Gregory, S. (1970): Statistical Methods and the Geographer, London.

Griffiths, J.R. (1966): Applied Climatology: An introduction, London, Oxford University Press

Guerry, du, J. (1978): Migration and Rural development selected topics for teaching and research. Rome, Food and Agricultural Organization of the United Nations.

Gupta, B. and Gupta, V. (1998): An Introduction to Statistical Methods. New Delhi, Vikas Publishing House Put Ltd..

Hammond, R. and McCullagh, P. (1978): Quantitative Techniques in Geography: An Introduction, Oxford, Claredon Press.

Hancock, G. (1989): Lords of Poverty, London, A Mandarin Paperback.

Harris, R.J. (1975): A Primer of Multivariate Statistics. New York, Academic Press.

Hartigan, J.A. (1977): "Distribution Problems in Clustering" In Classification and Clustering (Ryzin, V. (ed)), New York, Academic Press, Inc, Pg 45-72.

Hartigan, J.A. (1975VClustering Algorithms, New York, John Wiley and Sons Inc.

Henshall, J.D. (1966a): "Some structural Characteristics of Peasant Agriculture in Barbados" Economic Geography, 42(1), 74-84.

Henshall, J.D. (1966b): "Models of Agricultural Activity" In ~~Models in~~ Geography, (Hagget P. and Chorley, R.J. (ed), Methuen.

Hertsgaard, M. (2004): "Climate, the Absent Issue" Nation, January, 11, 2004, Vol. 279, Issue 14 page 2.

Hirst, M.A. (1972): "Population Growth in Mainland Tanzania" In Population Growth and Economic Development in Africa (Ominde, S.H. and Ejiogu, C.N. (ed)), London, Heinemann.

Hyde, R.J. and Langlands, B.W. (1974): Patterns of Food Crop Production and Nutrition in Uganda, Occassional Paper No. 58, Department of Geography, Makerere University, Kampala-Uganda.

IGAD (2005): Report of the 16th Climate Outlook Forum for the Greater Horn of Africa (COF 16), held on 31st August to 2nd September, 2005, Nairobi, Kenya.

IGAD Climate Prediction and Application Centre (ICPAC) (2006): The Seventh Climate Outlook Forum for the Greater Horn of Africa (GHA): 1-3, March, Nairobi, Kenya.

International Labour Organization (ILO)(1972): Employment, Incomes and Equality: A strategy for increasiing Production Employment in Kenya, Geneva

IPCC (2001): Climate Change 2001: Impacts. Adaptations and Vulnerability - A Contribution of Working Group II to the Third Assessment Report of the IPCC, Cambridge, Cambridge University Press.

Irfan, M. (1989): "Poverty, Class structure and Household Demographic Behaviour in Rural Pakistan" In Population Growth and Poverty in Rural South Asia (Rodgers, G. (ed)), London, Sage Publications.

Jaetzold, R. and Schmidt, H. (1982): ~~Farm Management Handbook of Kenya~~ Natural conditions and Farm **management** Information, Vol. II/A. Nairobi, Ministry of Agriculture, Kenya, in cooperation with the German Agricultural Team (GAT) of the German Agency for Technical Cooperation (GTZ).

James, D.K. (1982): The New Open Bible study Edition-Faith Partners. Coral Ridge Ministries, U.S.A, Thomas Nelson, Inc.

Jeffers, J.R. (1978): Critique of the Kenya Health Sector Plan, Unpublished.

Johnston, R.J. (1978): Multivariate Statistical Analysis in Geography: A Primer on the General model, London, Longman.

Juma, A. (1985): The Impact of Present Population Growth Rates on Health Expenditures in Kenya, Msc. Thesis, Population Studies, University of Nairobi.

Kariungi, F.T. (1976): Structure, Conduct and Performance of Kitui Local Maize Markets, MSc. Thesis in Agriculture, University of Nairobi.

Kathuri, B. (2005): The standard-Africa's food insecurity set to persist-Tuesday, January, 25 Page 9

Kennedy, E. (1989): The Effects of Sugarcane Production on Food Security, Health, and Nutrition in Kenya: A Longitudinal Analysis - Research Report, International Food Policy Research Institute.

Khaemba, E. (1992): Combining Ability for Yield Components of Early Maturity Prolific Maize (7.ea mavs L.). MSc. Thesis in Crop Science, University of Nairobi.

Klastorin, J.D. (1983): "Assessing Cluster analysis Results" ~~Journal of Marketing~~ Research, **20,** 92-98.

Kohlhepp, G. (1986): " Problems of Agriculture in Latin America: Production of Food Crops versus Production of energy Plants and Export" In ~~Applied~~

Geography and Development: A biannual Collection of Recent German Contributions [Institute for Scientific Cooperation (ed)], 27(60).

Koske, J.K. (1988): Balance Between Cash Crop and Food Crop Production in Kenya: A Case study of Smallholder farms in Kericho District, M.A. thesis in Economics, University of Nairobi.

Kokwaro, J.O. (1972): Luo-English Botanical Dictioinary of Plant names and uses, Nairobi, E.A. Publishing House.

Kokwaro, J.O. and Johns, T. (1998): Luo Biological Dictionary, Nairobi, East African Educational Publishers.

Krishnaji, N. (1989): "The size and structure of agricultural Labour households in India" In Population Growth and Poverty in Rural South Asia (Rodgers, G. (ed)), London, Sage Publications.

Laut, P. (1968): Agricultural Geography: Vol 1 Systems, Sub-systems and Plantation Agriculture, Australia, Thomas Nelson.

Maclain, J.O. and Rao, V.R. (1975): "Clustiz: A program to test for the quality of clustering of a set of observations", Journal of Marketing Research, **20.** 92-98.

Magare, B. (2005): The Standard- 18 Schools closed as floods losses Mount - Thursday, March 24. Pg. 6.

Magare, B. and Ojwang, A. (2005): "Work and Eat: It is the life in Nyando" U, Monday February 7.

Magare, B. (2004): "State Acts to curb flooding in Nyando" The Standard, Monday, November 29,2004, page 7.

Malthus, T.R. (1798): An Essay on the Principle of Population as it affects the Future Improvement of Society, with the Remark and Speculation of Mr. Godwin, M. Condorcet and other Writers-London, (dt Ubers von C.M. Barth, Munchen, 1977).

Maher, R.V.; Boyd, M. and Langford, G. (1980): " Integration of Geographic Information and Landsat Imagery: A Case Study of Vegetation Mapping in the White Goat Wilderness Area, Alberta" Canadian Journal of Remote sensing, 6 (2), December, 1980.

Mahmud, S. and Mcintosh, J.P. (1980): "Returns to Scale to Family size-Who gains from high fertility?" Population Studies, Vol. 34, No. 3 November.

Mbithi, J. (1991): "The Challenges of Economic Development in Kenya" In Population and Human Resources Development Planning in Kenya, Ministry of Manpower Development and Employment, Nairobi.

Malthus, T.R. (1798): An Essay on the Principle of Population as it affects the Future Improvement of Society, with the Remark and Speculation of Mr. Godwin, M. Condorcet and other Writers-London, (dt Ubers von C.M. Barth, Munchen, 1977).

Mbuthi, P. (2002): "Agro-forestry and Sustainable energy development in Africa" Imnact- Special edition - Energy. Environment and Sustainable Development, Nairobi, Climate Network Africa (CNA).

McCarthy, J.J.; Canzani, O.F.; Leary, N.A.; Dokken, D.J. and White (ed) (2001): Climate Chanpe 2001: Impacts. Adaptation, and Vulnerability-Contribution of Working Groi.p II to the Third Assessment Report of the IPCC, UK, Cambridge University Press.

McMaster, D.N. and Wegulo (1989): Using Maps and Photographs: A senior Secondary School Course. U.K, Longman Group Ltd.

McNeil, K. A.; Kelly, F.J. and McNeil, J.T. (1975): Testing Research Hypothesis using Multiple Linear Regression, Southern Illinois. London, University Press.

Mecklein, W. (1986): "Geography-Planning for the Future" In Applied Geography and Development: A Biannual Collection of Recent German Contributionsflnstitute for Scientific Research (ed)], Tubingen, 28(7).

Mellor, J.N.; Delgado, C.L. and Blackie, M.J. (edX1987): Accelerating Food Production in Sub-Saharan Africa. International Food Policy Research Institute, London, The John Hopkins university Press.

Metzner, J. (1981): "Innovations in Agriculture-Incorporating Traditional Production Methods: The Case of Amarasi (Timor)" In Applied Geography and Development: A Biannual Collection of Recent German Contributions, Tubingen. 17(91).

Miller, N.N. (1974): "Journey in a Forgotten Land Part 1: Food and Drought in the Ethiopian -Kenya Boarder Lands" Northeast African Series XIX:4

Ministry of Agriculture (2004): Monthly Food crop situation Report for January-July 2004, District Agricultural Office, Nyando.

(1969): Storage and Handling of Wheat and Maize in Kenya, Unpublished.

Ministry of Finance and Planning (2000a): Second Report on Poverty in Kenya, Vol. I. Incidence and Depth of Poverty, Nairobi, Government Printer.

Ministry of Finance and Planning (2000b): Second Report on Poverty in Kenya. Vol. II.. Poverty and Social Indicators. Nairobi, Government Printer.

Monke, E.A. and Pearson, S.R. (1989): The Policy Analysis Matrix for Agricultural Development, New York, Cornell University Press.

Monkhouse, F.J. and Wilkinson, H.R. (1963): Maps and Diagrams, London, University Paperbacks.

Moore, D. and McCabe, G. (1993): Introduction to the Practice of Statistics. New York, W.H. Freeman and Company.

Miring'uh, E. (2005): Agriculture: Government moves to revive agriculture, The Standard, Tuesday, March 15, 2005. FS.II.

Munganzi, Z. (2000): "Mortality Differentials and their Implications for socio-economic Planning in Kenya" In Issues in Resource Management and Development in Kenya (Obudho, R.A. and Ojwang', J.B. (ed)), Nairobi, East African Educational Publishers Ltd.

Nana-Sinkam, S.C. (1995): Land and Environmental Degradation and Desertification in Africa, Joint UNECA/FAO Publication, Addis Ababa. Ethiopia, February, 1995.

Natarajan, C.P.; Majumba, S.K. and Shankar, J.V. (1984): Interactions in Food Technology. Agriculture and Nutrition [Achaya, K.T. (ed)], Tokyo-Japan, United Nations University (UNU).

National Academy of Sciences (1971): Rapid Population Growth - Consequences and policy Implications - Vol- 1- Summary and Recommendations. London, The John Hopkins Press Ltd.

Ndey-Isatou Njue (1995): "Energy's role in Deforestation and Land Degradation" In Energy as an Instrument for Socio-economic development (Goldemberg, J. and Johansson, T.B. (ed)), New York, UNDP.

Ngugi, M.N. (1987): The Effect of Tillage Methods and Subsequent Weed control on Maize (Zea mays L.), MSc. Thesis in Agronomy, University of Nairobi.

Njagi, K. and Were, E. (2004): "Malaria" In CBS. MOH. and ORG Macro (2004)- Kenva Demographic and Health Survey 2003, Maryland, Calverton.

Nyaranga, N. (2002): East African Standard Article, Monday, February 11,2002.

Nyenzi, B.S. (1990): "A Review of Climate Change in Africa" In Observed Climate Variations and Change: Contributions in support of Section of the 1990 IPCC Scientific Assessment (Parker D.E (ed)), IPCC.

Nyong'o, E. (1991): " The Challenges of Social Development in Kenya" In Population and Human Resource Development Planning in Kenya: Proceedings of a National workshop on Population and Human Resources Development Planning in Kenya. Nairobi, Ministry of Man-Power.

Obara, D.A. (1983): Environmental and Agronomic Factors Influencing Variation in Smallholder Cotton Yields in the Kano Plain; Kisumu District, Western Kenya, PhD Thesis in Agricultural Geography, University of Nairobi, Department of Geography.

Okoth, D. (2005): The Big Issue- How Long will it take to end flood devastation - The Standard, Monday, March, 28,2005, Pg,7.

Olusanya, P. O. (1985): The Demographic, Health, Economic and Social Impact of Family Planning in selected African Countries, Economic Commission for Africa.

Ominde, S.H. (1971): The Contribution of Population Geography to Development Planning especially in Africa (Clarke, J.I. (ed)), Oxford, Pergamon Press.

Onchere, M.A. (1999): Policy incentives and Competitiveness of Maize Production in Trans-Nzoia Disrict, Kenya, MSc. Thesis in Agricultural Economics, University of Nairobi.

Odingo, R.S. (1987): "State -of -the -Art Review of Social Science Research on Eastern Africa" In Drought in Africa: Proceedings of a Workshop Held in Timbuktu. Mali 24-28. November, 1986, Canada, IDRC.

Odingo, R.S. (1979): "Landuse and Agricultural Settlement in the Kamburu-Gtaru Dams Area" In An African Dam[Odingo, R.S. (ed)], Ecological Bulletins, Stockholm, 29(85-104).

Oduor-Otieno, B.E. (1991): "Labour Supply and Demand and the Employment Problem in Kenya" In Population and Human Resources Development Planning in Kenya, Nairobi, Ministry of Manpower Development and Employment.

Ofosu, Y. (1991): "Population Factors in Development Planning" In Population and Human Resources Development Planning in Kenya. Nairobi, Ministry of Manpower Development and Employment.

Ogallo, L.J. (1989): "The spatial and temporal patterns of the East African seasonal rainfall derived from Principal Component Analysis", International Journal of Climatology, 9. 145-167.

Ogallo, L.G. and Bazira, E. (2003) Daily rainfall characteristics over Uganda, Unpublished.

Ogallo, L.G.; Okoola, R.E. and Wanjohi, D.N. (1993): "Characteristics of quasi-biennial oscillation over Kenya and their predictability potential for the seasonal rainfall" Mausam, **45,** 57-62.

Ogora, K. (2004): "Child Labour in Nyando District now alarming" The Standard, Monday, November 29, 2004, Page 7.

Okai M. (1972): "Some Aspects of Agricultural Labour Use in the Main Short Grass Zone of Uganda" In East African Journal of Rural DevelopmentfAmann, V.F. (ed)1. East African Agricultural Economics Society and Makerere University, Kampala.

Okumu, D.A. (1991): "Fertility and Family Health in Kenya: Implications fro Social Economic Development", In Population and Human Resources Development Planning in Kenya, Nairobi, Ministry of Manpower Development and Employment.

Oluoko, A.A. (1999): Some Aspects of Smallholder Tea Production in Belgut Division of Kericho District, Kenya, M.A. Thesis in Agricultural Geography, University of Nairobi, Department of Geography.

(1995): Environmental Epidemiology of Siaya District: Geographical Investigation of Disease Patterns, B.A. Dissertation, University of Nairobi.

Olusanya, P.O. (1985): The Demographic Health, Economic and Social Impact of Family Planning in selected African countries, Economic Commission for Africa.

Oomen, J.M.V.; Kinoti, G.K.; Siongok, A.T.K. and Mutinga, M.J. (1979): "Health and Disease in the Kamburu-Gtaru Dam Area" In An African Dam [Odingo, R.S. (ed)] Ecological Bulletins, Stockholm **29** (105-150).

Otieno, S. (2006): "WFP needs Ksh. 13 billion to buy food" The Standard. Monday, March 6,2006, p. 28.

Ottichilo, W. K. and Sirange, R.K. (1990): Long rains Maize and Wheat Production. Trends in Kenya for 1985-1989, Department for Resource Survey and Remote Sensing, Ministry of Planing and National Development.

Owuor, J. and Mburu, J.K. (2004): "Nutritional status of children under five" In CBS. MOH. and ORG Macro (2004)- Kenva Demographic and Health Survey 2003, Maryland, Calverton.

Palmer-Jones, R.W. (1974): The Economics of Tea Production and Marketing in Malawi, University of Reading, Department of Agricultural Economics and Management, Development Study, No. 15.

Papia, H. A. B. (1984): Generating Multidisciplinarv Action: The Importance of Interface activity between Agriculture. Food Science and Nutrition. [Achaya, K.T. (ed)], Tokyo, UNU.

Parikh, K. and Rabar, F. (eds) (1981): Food for All in a Sustainable World: The NASA Food and Agriculture Program. International Institute for Applied Systems Analysis.

Parry, M. (1990): Climate **Chanpe** and World Agriculture, London, Earthscan Publications Ltd.

Paul, M. (2004): "FAO studies the impact of AIDS on Malnutrition in Africa" Medias, April, 2004, No. 14, Page 41, Eumetsat.

Pearson, P.B. and Greenwell, R. (ed) (1980): Nutrition. Food and Man: An Interdisciplinary Perspective. Tucson, Arizona. The University of Arizona Press.

Piwoz, E.J. and Viteri, F.E. (1985): "Studying Health and Nutrition Behaviour by Examining Household Decision-Making, Intra-Household Resource Distribution, and the role of Women in these Processes" Food and Nutrition Bulletin, 7(4), December, 1985.

Pohl, P. (2002): International Herald Tribune: Health Science, Thursday, March, 2002, Page 7.

Population Studies and Research Institute (PSRI) (1990): Population Development and Economic Planning-for Provincial Planners Seminars. Nairobi, University of Nairobi.

Pritchard, J.M. (1984): Practical Geography for Africa, United Kingdom, Longman Group Ltd.

Rampel, H. (1985): The Food Situation in the Horn of African, Working Paper No. 420, Institute of Development studies (IDS), University of Nairobi (UoN).

Rask, N. and Rask, K. (2005) Economic Development and Food Demand Changes: Production and Management Implcations, College of the Holy Cross, Department of Economics, Faculty Research Series, Paper No. 05-14 - http://www.holycross.edu/department/economics/website.

Republic of Kenya (2006): "The Rainfall Outlook for March-April-May (MAM) 2006 'Long Rains'" The Standard, Wdnesday. March 15, 2006, p.21

Republic of Kenya (2005): The Proposed New Constitution of Kenva. Nairobi, Government Printer.

Republic of Kenya (2004): The Bomas Draft. Nairobi, Government Printer.

Republic of Kenya (2002a): Kenva 1999 Population and Housing Census: Analytical Report on Fertility and Nuptialitv, Vol IV. Nairobi, Central Bureau of Statistics.

(2002b): Kenva 1999 Population and Housing Census: Analytical Report on Housing Conditions and Housing Amenities, Vol. X. Nairobi, Central Bureau of Statistics.

(2001a): National Development Plan 2002 - 2008. Effective Management for Sustainable Economic Growth and Poverty Reduction, Nairobi, Government Printer.

(2001b): Nyando District Development Plan 2002 - 2008:Efiective Management for Sustainable Economic Growth and Poverty Reduction. Nairobi, Government Printer.

(2001c): Central Bureau of Statistics - 1999 Population and Housing Census: Vol. 1 - Population distribution by administrative areas and urban centres, Nairobi, Government Printer.

(1996a): National Development Plan, Nairobi, Government Printer.

(1996b): Kisumu Development Plan, Nairobi, Government Printer.

(1986): Economic Management for Renewed growth-Sessional Paper No. 1 or 1986. Nairobi, Government Printer.

(1981): National Food Policy-Sessional Paper No. 4 of 1981. Nairobi, Government Printer.

Riungu, G.M. (1982): Marketing and Pricing Policies: Implications for Food Policy Research, A Paper Prepared for the National Council of Science and Technology for the Workshop on Food Policy Research.

Roberts, J.M.D. (1974): "Malaria" In Health and Disease in Kenya (Vogel, C.G.; Muller, A.S.; Odingo, R.S.; Onyango, Z. and De Geus, A. (ed)), Nairobi, East African Literature Bureau.

Rodgers, G. (1989): "An Overview" In Population Growth and Poverty in Rural South Asia (Rodgers, G. (ed)), London, Sage Publications.

Rodgers, G; Gupta, S.; Sharma, A.N. and Sharma, B. (1989): "Demographic Patterns and Poverty among households in Rural Bihar" In Population Growth and Poverty in Rural South Asia (Rodgers, G. (ed)), London, Sage Publications.

Ruthenberg, H. (1980): Farming Systems in the Tropics-3rd ed, Oxford. Claredon Press.

Rwigema, F. (1990): Maize Marketing in Uganda, MSc. Thesis in Agricultural Economics, UoN.

Ryerson, R.A.; Mosner, P.; Waker, V.R.and Stewart, N.E. (1979): "Three Tests of Agricultural Remote Sensing for Crop Inventory in Eastern Canada: Results, Problems, and Prospects" Canadian Journal of Remote Sensing, 15:1, May 1979.

Saggerson, E.P. (1952): Mines and Geological Survey. Nairobi, Government Printer.

Sai, T. (1977): Defining Family Health Needs, Standards of Care and Priorities - with Particular Reference to Family Planning, International Planned Parenthood Federation.

Sanchez, P., Swaminathan, S.M., Dobie, P. and Yukshel, N. (2005): Halving Hunger: It can be Done. New York, United Nations Millennium Project.

Sandbrook, R.C. (1982): The Politics of Basic Needs: Urban Aspects of Assaulting Poverty in Africa. Heinamann.

Schliephake, K. (1987): "Irrigation and Food Production: Experiences from North Africa and Application to East Africa" In Applied Geography and Development: A Biannual Recent German Contributions [Institute for Scientific Cooperation(ed)], **35**(30).

Schultz, L. (1968): Transforming Traditional Agriculture, U.S.A, The Carl Purington Rollings Printing office.

Scott, W. and Mathew, N.T. (1983): Levels of Living and Poverty in Kerala. Geneva, United Nations Research Institute for Social Development.

Seckler, D. (1984): "Malnutrition: An Intellectual Odysey" In Interfaces Between Agriculture. Nutrition, and Food Science [Acharya, K.T.(ed)], Tokyo-Japan, UNU.

Seddon, D. (1989): "Population and Poverty in Nepal" In Population growth and Poverty in Rural south Asia (Rodgers, G. (ed)), London, Sage publications.

Sehmi, J.K. (1993): National Food Composition Tables and the Planning of Satisfactory diets in Kenya. Nairobi, Government Printer.

Sekaran, U. (1984): Research Methods for Business: A skill-building Approach. New York, John Wiley and Sons.

Shah, M.M. (1980): Food Consumption Patterns-Rural and Urban Kenya. Paper of the International Institute for Applied Systems Analysis.

Shan and Wheeler (1985): Statistical techniques in geographical Analysis, incomplete citation.

Simango, V.A. (1976): Maize Yield in Relation to Rainfall and Solar Energy in Kenya, MSc. Thesis in Meteorology, UoN.

Silitshena, R.M.K. (1987): "Social Science Research in Drought in Botswana, Lesotho and Swaziland" In Drought in Africa - Proceedings of a workshop Held in Timbuktu. Mali, 24-28. November, 1986, Canada, IDRC.

Sinha, S.K. Rao, N.H. and Swaminathan, M.S. (1988): "Food Security in the Changing Global Climate" Paper Presented at the World Conference on the Changing Atmospheres-Implications for Global Security, Toronto, Canada.

Spiegel, M.R. (1961): Schaums Outline: Theory and Problems of Statistics, New York, McGraw Hill Book Company.

Suda, C. (1991): "Social, Cultural Demographic Factors in Female Labour Force Participation in Kenya", In Population and Human Resources Development Planning in Kenya, Nairobi, Ministry of Manpower Development and Employment.

Survey of Kenya (1991): National Atlas of Kenya (Ed 4), Nairobi, Survey of Kenya.

Swynnerton, R.J.M. (1955): A Plan to Intensify African Agriculture. Nairobi, Government Printer.

Symons, L. (1968): Agricultural Geography, London, G. Bell and Sons Ltd.

Tabachnick, B. and Fidell, L. (1989): Using Multivariate Statistics. New York, Harper and Row Publishers.

Tang, A. M. and Stone, B. (1980): Food Production in the Peoples Republic of China, International Food Policy Research Institute, Research Report, No. 15.

Terramura, A.H. (1986): "Potential Consequences of Ozone Depletion upon Global Agriculture" In Effects of Changes in Stratospheric Ozone, Proceedings of the Conference Convened by UNEP and the United States Environment Protection Agency (U.S. EPA).

The Editors of Life and Rand McNally (1961): Life Pictoral Atlas of the World, New York, Time incorporated.

Thomas, I. (1980): Population Growth: Aspects of Geography. University of East Anglia, School of Development studies.

Tiffen, M. and Gichuki, F. (1994): More People less Erosion: Environmental Recovery in Kenya London, Acts Press and Overseas Development Institute.

Titus, J.G. and Soidel. R.S. (ed)(1986): Effects of Changes in Stratospheric ozone and Global Climate Vol. 2, Stratospheric Ozone, Proceedings of the Conference convened by UNEP and U.S. EPA.

Traub, P. (1987): "Regional Differences in Cane Sugar Production in Thailand-A Geographical Contribution" In Applied Geography and Development: A

Biannual Recent German Contributions [Institute for Scientific Cooperation (ed)], 35(95).

UNCTAD (1996): Annual Report, Geneva, Switzerland, UNCTAD.

United Nation Convention on Biological Diversity (CCD) (1999b): SBSTT. Montreal, Canada.

United Nations Convention to Combat Desertification (CCD) (1999): United Nations Convention to Combat Desertification in Countries Experiencing Drought and/or Desertification. Particularly in Africa, CCD.

UNDP/BCPR & UN/ISDR Africa (2004): Disaster Risk Reduction, Governance and Development, UN/ISDR Africa Educational Series, Volume 2, Issue 4, December 2004.

UNEP (2001): Vulnerability Indices: Climate Change Impacts and Adaptation, UNEP.

(1999a): Convention on Biological Diversity, Subsidiary Body on Science, Technology and Technological Advice (SBSTTA), Montreal-Canada.

(1999b): Global Environment Outlook 2000, Earthscan Publications Ltd. London.

(1995): Poverty and the Environment: Reconstructing Short-term needs with Long-term Sustainabilitv goals, Nairobi-Kenya, UNEP.

(1987): Montreal Protocol on Substances that deplete the ozone Layer, Final Act, UNEP.

UNDP (2000a): Overcoming Human Poverty: Poverty Report 2000. New York, UNDP.

(2000b): Energy Assessment New York, UNDP.

(1997): Energy After Rio: Prospects and Challenges. New York, UNDP.

Werner, R. and Assfalg, W. (1993): "The Optimal Use of Agricultural Landscapes" In Applied Geography and Development: A Biannual Recent German Contributions [Institute for Scientific Cooperation (ed)]. **42**(60).

Weslowsky, G. (1976): Multiple Regression and Analysis of Variance. Toronto, John Wiley and Sons.

Whittlesey, D. (1954): "The Regional Concept and the Regional Method" In American Geography. Inventory and Prospect (James, P.E.; Jones, C.F. and Wright, J.K. (ed)), Syracuse.

Whittlesey, D. (1936): "Major Agricultural Regions of the Earth" Annals of the Association of American Geographers, **26:** 199-240.

Wilson, R.J.A. (1972): "Land Control in Kenya's Smallholder Farming areas" In Hast African Journal of Rural Development [Amann, V.F.(ed)], Kampala, The East Africa Agricultural Economics Society (EAAS) and Makerere University.

World Bank (1990): Agricultural Growth Prospects and Strategy Options, Vol. 2: Annexes, PP 52.

World Bank (1989): "Kenya Country Economic Memorandum", Annex 1: Agricultural Issue, pp25-28.

(1988): The Challenges of Hunger in Africa: A Call to Action. Washington, The World Bank.

World Commission on Environment and Development (WCED) (1987): Our Common Future, Oxford, Oxford University Press.

WRI, UNEP, UNDP and World Bank (1996): World Resources: A Guide to the Global Environment - The urban Environment, New York, Oxford, Oxford University Press.

(1990): World Resources 1990-91, Oxford, Oxford University Press.

Yotopoulos, P.A. (1967): Allocative Efficiency in Economic Development: A Cross-section analysis of Epirus farming. Research Monograph Series-Athens, Greece, Centre of Planning and Economic Research.

APPENDIX 1:

CONFIDENTIAL

Sample No. . . . . .Name of Interv iewer

QUESTIONNAIRE FOR INTERVIEW OF FARMERS ON FOOD SECURITY IN NYANDO DISTRICT, NYANZA PROVINCE

000: GENERAL INFORMATION

001 Date of Interview. . . . . .002 Survey Area (village)

003 Sub-location. . . . . .004 Location

005 Division. . . . . .006 Farm No

100: PERSONAL DATA

101 Name Household head. . . . . .102 Respondent. . . . . .103 Sex

104 Age. . . . . .105 Relationship to household head. . . . . .106 Occupation apart from farming. .107 Education. . . . . .108 Type of employment

109 Income from off-farm employment

109: Household population present most time of the year (50%)

Name	Sex	Age	Education	Rel. with the Farm owner	Contr. to F. Labour	Occupation

110: Household population absent most of the season/year (50%)

Name	Sex	Age	Residence	Freq. of visit	Reason for absence

Code: **103- 01 Male 02 Female**

104- 01=1-10 02=11-15 03=16-20 04=21-60 05=0ver 60

105- 01 Farmer 02 Wife 03 Daughter 04 Son 05 Employee 06 Other (sp)

106- 01 Employee 02 Self-employed 03 Economically unproductive 04 Schooling 05 Other (sp)

11 Agriculture 12 Forestry 13 Fishery 14 Handicraft 15 Industry 16 Commerce 17 Transport 18 Public Service 19 Builder 20 NGO (sp.)......21 Other (sp)

107- 01 Primary 02 Secondary' 03 Higher education 04 University

108- 01 Permanent 02 Temporary 03 Seasonal from...........to

109/110 01=1-10 02=11-15 03=16-20 04=21-60 05=over 60

200: LAND OWNERSHIP AND HISTORY OF FARMING SYSTEMS

201: How did you acquire the farm?

a) Inherited from father b) Bought c) Rented

d) Given by a relative -1: Temporary 2: Permanent

202: How many Acres/Ha of land do you have?

203: How long have you been operating this farm?

204: Do you have title deed for it?

205: If yes, have you ever used the title deed to acquire loan?

206: If yes, please specify

207: Do you have any other piece of land anywhere else?

208: If yes, please specify

209: Have you subdivided the farm?

210: If yes, please specify

211: How much land did you cultivate the previous year? (/AcresHa)

Crop(s)

209: How much have you cultivated this year? (Acres/Ha)

Crop(s)

210: What are the reasons for the differences? (a) Lack of cash (b) Insufficient labour (c) Leased out some land (d) Sold some land (e) Subdivided among sons (f) Others, please specify

Code: 01=Yes 02=No (Throughout the questionnaire)

201: 01 Inherited 02 bought 03 Rented 04 Given by a relative

Crops: 01 Maize 02 Sorghum 03 Millet 04 Rice 05 Sweet potatoes 06 Cassava 07 Sugarcane 08 Coffee 09 other, please specify

300: LAND USE AMONG FARMERS

301: Which crops have you been growing from the year of acquisition to date?

Year	Crop	Ha.	Yield-Good/Medium/Poor

302: Which crops do you grow for food?

Please assist us to fill in the table below concerning performance of crop, cost of inputs used, production from previous year, amount consumed within the family and the surplus.:

Crop	Ha	Performance	Cost of I/P	Prod.	Consump.	Surplus	C. of farm p.& Storage fac	

Code: 302 (c) 01 Good 02 Not so good 03 Poor

303: Which ones for cash?

Please assist us to fill in the table below (refer to 302):

-Crop—	rHa—	Performance	lost of I/P	Prod.	Consump	Surplus	c »f rami imp a wiuiif facility

304: Did you buy any cereals last year?

305: If yes, where did you buy it?

Code: 01) market 02) Neighbour 03) Other, specify

306: How many bags did you buy?

307: At how much per bag? (note size of bag)

308: Which are the months when you constantly buy food?

309: Do you get any assistance from the government as food relief?

310: If yes, please specify

311: How many months of the year do you depend on crop production?

312: How many months do you depend on purchased food stuff?

313: Where do you get the money from?

314: What are the famine crops?

315: During floods, how do you cope?

Code: 01) off-farm employment 02)rely on government, 03)use remittances from relatives 04)go somewhere else 05) other, specify

316: How well is this land suitable to agricultural usage?

Code: 01) well suited, 02) medium suited, 03) marginal.

317: How much does it cause you to rent land in this place?

318: What yield do you expect from rented land?

Code: 01) Good 02) Medium 03) Poor

319: Is land always available for renting?

320: If yes, or If seasonal, answer 323

321: What is the rent period?

322: What is the lease period?

323: If seasonal, from.........................to

324: What is the cost per hectare

325: Do you grow the same crop on the same piece of land?

326: If no, why have you been changing crops?

Code: 01) Reduced yield 02) Expensive inputs 03) Vulnerability to pests/disease 04) To increase income 05) Better nutrition 06) Other (specify)

327: When is the long rains season? From. . . . . .to

328: When is the short rains season? From. . . . . .to

329: Which crops do you grow during the Long rains period. . . . . .Acres/Ha and total yield

330: Did you consume it all or sold some of it,

331: If yes, How many sacks did you consume

332: And how much did you sell?

Crop plantec	Hectarage	Product.	Consumpt.	Sales	Storage

333: Which ones do you grow during the Short rains period?

334: Did you consume it all or sold some of it,

335: If yes, How many sacks did you consume

336: And how much did you sell?

Crop planted	Hectarage	Product.	Consumpt.	Sales	Storage

337: What are the reasons for inter-cropping or single strand?

Code: 01) increase yield 02) better nutrition 03) ensure against bad weather 04) insure against hunger 05) increase income 06) Other (specify)

338: What are the reasons for growing the crops mentioned?

Code 01) less **vulnerability to pests/disease 02) better performance in this area 03) recommended by government 04) recommended by neighbour/friend 05) Other(specify)**

339: What makes you choose a location for a particular crop?,

Code: 01) suitable environmental condition 02) size of land available 03) its grown by people in the area 04) other(specify)

340: What problems do you experience in crop farming?

Code 01) weather fluctuations 02) high costs of inputs 03) inadequate labour 04) lack of market/poor prices 05) other (specify)

400: OWNERSHIP OF LIVESTOCK ON THE FARM

401: Do you have any livestock or poultry in the farm?, If yes, please specify.

402: If so, how many? **01) cattle 02) sheep 03)goats 04) pigs 05) Poultry 07) Donkeys 08)0thers (specify)**

403: What type of livestock do you keep?..Code:

01) local breeds 02) hybrids

404: If hybrid, which ones (specify)

405: How many hectares of land do you use for pasture?

406: Who attends to your livestock?

Code: 01) Self 02) children 03) hired labour 04) other (spccify)

407: How far do you walk to graze them?

408: Do you have any access to communal land for grazing?

409: If **yes,** please specify approximate distance from home in Km

410: How do the animals or poultry contribute to your family food requirements?

Code: 01) meat 02) milk 03) income 04) other (specify)

411: Do you use veterinary services in your farm?,

412: If **yes,** at what cost?

413: What is the source of labour for:

Code: 01) watering 02) Feeding/grazing 03) milking 04) others (specify)

414: Do you produce any manure in your farm?, If yes, what do you use it for?

Code: 01) Use it on the farm 02) Sell to other people 03) Other (specify)

415: If sold, then for how much?

416: What type of poultry do you keep?

Code: 01) local breeds 02) Hybrids

417: If hybrid, which ones?

Code: 01) layers 02) Broilers 03) Others (sp)

500: ENVIRONMENTAL DEGRADATION ASSESSMENT

501: Are you aware of any environmental conservation method?..

502: If yes, which one(s)?

503: What do you do to preserve your soil?...Code

01) add manure 02) build gabions 03) terracing 04) plant recommended trees 05) other (specify)

504: wetland?

505: Forest?

506: Marginal land?

507: Other?

508: What is the source of information concerning the method which you are using?

Code: 01) Self 02) NGO 03)Community Development Group 04)Government 05) Other (specify)

509: Are you aware of any existing environmental law that prohibits deforestation ?

Have you experienced any problems below in your farm:

510: Reduction in yield over the years irrespective of the sufficient amount of rainfall received

511: Reduction of the number of trees within the village

512: Long periods of inadequate rain leading to low yields,

513: Floods,

514: If yes (floods), for how long...................... and how frequent

515: Droughts

516: If yes (droughts), for how long..................... and how frequent

517: Increase in bare land surfaces

518: Emergence of new plants (weeds) which are difficult to control?

519: Please name them

520: Loss of some plant species which were hitherto available in plenty

600: TECHNOLOGY AND WEALTH INDEX

600: Have you tried any exotic seeds in your farm?,

601: If yes, please specify

602: Which farm tools do you use?

603: Do you own

Code: 01)x-plough 02)tractor 03) radio 04)bicycle 05)permancnt house 06) Temporary house 07) Semi-permanent house

604: How do you till the land

Code: 01) use family hand labour 02) ox-plough 04) tractor 05) other (specify)

605: How do you harvest your crops?

Code: 01) using machinery 02) by hand 03) use group labour 04) other (specify)

606: Do you irrigate any piece of your land?

607: If yes, What type of irrigation equipment **do you** Uv

608: If you use an equipment, who owns the equipment?

609: When was it bought ?

610: What is the lifespan of the **equipment?...**

611: What is the estimated annual **maintenance costs"**

612: How much fuel do you use per day?

613: Other costs incurred (please specify)

614: How do you irrigate your land?

Code: 01) Diversion with field storage 02) Diversion. without field storage 03) Pumped, well with field storage 04) Pum|»«.l, wrll without field storage 05) pumped, surface flow

615: What is the Method of **irrigation and regulating of water** supply

Code: 01) sprinkler, 02) surface, flow, 03) surfacc, basin 04)»urfm« border, 11 constant supply 12 intermittent supph

616: Do you use any pesticides?

617: If yes, please specify

618: Specify also mode of processing of crops if done on farm

619: Where do you sell your crops?

Code: **01) in the village 02) at the market O co-opcra»,I other (specify)**

620: What mode of transport do you use to the placc ol sale?

Code: 01) walk 02) Bicycle 03)Vehiclc 04,H.ndc.ri

Other (specify)

700: LABOUR *(man-hours/day)*

701: How many family members help full time' **• with farm work? (spccify No of** persons,............type of activity,........^ **r tvt>e** of **compensation.** ^

702: Do you use any hired labour?

703: Please state status and age

Permanent labour

(a) Males Age

(b) Females Age

Temporary labour

(a) Males Age ..

(b) Females • Age

704: Please assist us with the following information concerning hired labour:

Crop	Labour/day	Wage/day	Sex (M/F)	Activity	Season

705: Do you sell any of the crops?

706: If yes, please assist us with the following information:

3rop	Total Prod.	Cost of Labom	Sale for Food	Sale for Cash	Other uses

707: Would you continue with food production or would like to move to town for off-farm employment?

Code: 01) Continue 02) move to town

708: What does agriculture do to improve the development of -

(i) your family

(ii) Your community

(iii) Your country

Code: **01) food** **02) clothing** **03) shelter** **04) other (specify)**

709: How do you prepare land during the-

i) short rains ?

710: ii) long rains

711: Has any member of your family contributed to family labour this year?

712: If so, state the number of days

713: How does communal work assist you?

800: HOSEHOLD FOOD CONSUMPTION

801: Do you regularly eat breakfast. Lunch and Supper?

802: Do you have adequate food for each member of the family?

803: If not, please specify

804: What do you feed on during the dry season?

805: Which ones during the wet season? **Code:**

01) maize 02) sorghum 03) millet 04) Ricc 05) Sweet potatoes 07) Cassava 08) Beans 09) green grams 10) **other (specify)**

900: HOUSEHOLD SERVICE ACCESSIBILITY TO MARKET/URBAN FACILITIES

901: Do you have any credit facilities?_

902: If Yes, why do you take them? **01) to buy farm inputs 02) to cultivate 03)** buy **extra food 04) Fees 05) hospital bills 06) other (specify)**

How do you transport your crops /cost of transport

903: From farm to the house?

904: From House to market?

905: Any other destination? 01) on my head 02) wheelbarrow 03) Vehicle 04) Bicycle 05) Other 11 cost

What is the distance to the nearest

906: market centre?

907: banking centre?

908: primary school?

909: clean source of water?

910: town?

911: place of intertainment?

912: industry?

913: health facility?

914: firewood place?

1000: THE IMPACT OF MALARIA AND HIV/AIDS ON HOUSEHOLD FOOD SECURITY

1001: Do you have any relatives who have passed away in the last one year ?

1002: If yes, what is the relationship with you and how many are they ?

Deceased	Age	Relationship	Symptoms Of the disease	Children Left and age	Responsib-ility

1003: What do you think caused the death? 01) malaria 02) HIV/AIDs related 03) Tb 04) Chira 05) other (specify)

1004: Did you have any relative who was sick in the past 1 year and recovered?

Person ill	Cost of treatment	Source of finance	Symptoms	Recommendation to Government

1005: Explain how sickness affects farm operations

1006: Has the family experienced food shortages in the last three years?

1007: If Yes, how do you solve such problems?

Code: 01) buy food with income from off-farm employment 02) Buy food with remittances from relatives 04) borrow food/cash from neighbour or friend 05) Other (specify)

1008: How long does stored grain from the previous harvest last?

1100: THE IMPACT OF FARMER'S HEALTH ON FOOD SECURITY

1101: What do you do when you are sick?

Code: 01) go to hospital 02) buy medicines from chemist 03) just ignore it 04) other (specify)

1102: Have you been admitted in hospital recently (in the last one year)?

1103: If yes, when?

1104: How long?

01) less than 1 week 02) 1 week 03) 7-10 days 04) other (specify)..

1105: How do you cope with your farm activities during such illnesses?

01) get help from friends/group 02) children assist 03) hired labour 04) other (specify)

1106: What can you recommend to the government on this matter?

1200: HOUSEHOLD ENERGY USE AND TYPE

1201: What type of fuel do you use? **01) fuehvood 02) gas 03) electricity 04) solar energy 05) charcoal 06) other (specify)**

1202: If fuel wood, where do you collect it ? **01) neighbour 02) market 03) other (specify)**

1203: How do you process your crops before storing them?

1204: How many jua kali industries do you have in this village?

1205: Please name them

1206: Is charcoal making common in this place?

1207: If you make, how many sacks do you make in a fortnight?

1208: If you buy, how long does one sack of charcoal last you ?

1209: What is the cost of one sack?

1210: Are you aware of any dangers associated with charcoal burning?

1211: How do you balance the time of charcoal burning and food production? **01) go** after **farm 02) use children's labour 03) other (specify)...**

1212: Which other fuels do you use apart from charcoal? (refer to 1201)

1213: What can you tell other people about charcoal burning?

1300: COMMUNITY DEVELOPMENT PARTICIPATION

1301: Do you participate in any development group?

1302: If yes, which one(s) **01) agroforestry 02) road maintenance 04) school/church construction 04) other (specify)**

1303 What is the approximate cost per year?

1304: How have you benefited from them? **01) cash/remittances 02) education 03) other (specify)**

1305: What things have they done below your expectation?

1306: What recommendations can you make to them?

1307: recommendations to the government on this issue?

1308: How much time do you spend on it a month?

1400: VULNERABILITY

1401: According to you, who should be termed poor and in need of the government support?

1402: What are their characteristics?

1403: What should the government do to help them improve their food security?

1404: Do you consider yourself to be...............**01) Poor 02)Average 03**
Rich

1405: According to you, how small should the smallest farm be?

1406: what should be done to ascertain this by the government?

1407 Based on your experience, which crop (s) does/do better in this area? …
1408

why?

1409: When is hunger a problem?

1410: When is one malnourished/undernourished?

APPENDIX 2: t-Ratios

Drought and Food Security

Model	Standardard Coefficient	t	Significance
Constant	4.371	4.334	0.000
Months Dependent on Crop production	0.058	0.532	0.596
Months dependent on purchased food	-0.167	-1.537	0.128
Duration of Droughts	-0.122	-1.131	0.261

Floods and Food Security

Model	Standardized Coefficients	t	Significance
Constant	4.072	6.931	0.000
Months Depended on Crop Production	-0.163	-1.763	0.081
Months Depended on purchased food	-0.203	-2.238	0.027
Duration of Floods	0.058	0.637	0.526

Socio-economic factors and food security

Model	Standardized Coefficients	t	Significance
Constant	4.072	6.931	0.000
Distance to the nearest primary school	-0.163	-1.763	0.081
Distance to the nearest source of clean water	0.203	-2.238	0.027
Distance to the nearest firewood place	0.058	0.637	0.526

Demographic Factors and Food Security

Model	Standardized Coefficients	t	Significance
Constant	1.851	3.707	0.000
Age of Household Head	0.270	3.096	0.002
Household Labour	0.007	0.077	0.939
Household Size	0.188	2.103	0.038

Health Issues and Food Security

Model	Standardized cofficients	t	Significance
Constant	-0.228	-0.192	0.849
Number of deceased persons	0.440	2.827	0.008
Number of ill persons	0.044	0.285	0.777