

**HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF
VULNERABLE GROUPS IN KENYA:**

A seasonal study among low income smallholder rural households.

Hilda N. Kigutha

CENTRALE LANDBOUWCATALOGUS



0000 0572 2638

Promotoren:

Dr.J.G.A.J. Hautvast

Hoogleraar in de leer van de voeding en de voedselbereiding

Dr. W.A. van Staveren

Bijzonder hoogleraar in de voeding van de oudere mens

NNO 8201, 1829.

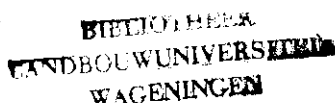
**HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF
VULNERABLE GROUPS IN KENYA:
A seasonal study among low income smallholder rural households.**

Hilda N. Kigutha

Proefschrift
ter verkrijging van de graad van doctor
in de landbouw- en milieuwetenschappen,
op gezag van de rector magnificus,
dr. C.M. Karssen,
in het openbaar te verdedigen
op dinsdag 27 september 1994
des namiddags om 13.30 uur in de Aula
van de Landbouwniversiteit te Wageningen

15n365g82.

This study was supported by a grant from the International Development Research Centre (IDRC) Canada, through grant number 3-P-89-0241; and by the Food and Nutrition Studies Programme (FNSP), a research project funded by the Netherlands government through the African Studies Centre (ASC), Leiden, The Netherlands



CIP-DATA KONINKLIJKE BIBLIOTHEEK, DEN HAAG

Kigutha, Hilda N.

Household food security and nutritional status of
vulnerable groups in Kenya : a seasonal study among low
income smallholder rural households / Hilda N. Kigutha. -
[S.l.: s.n.]. - III
Thesis Wageningen. - With ref.- With summary in Dutch.
ISBN 90-5485-294-1
Subject headings: nutritional status; vulnerable groups;
Kenya.

Cover design: Hilda N. Kigutha

Printing: Grafisch Bedrijf Ponsen & Looijen BV Wageningen

© 1994 Kigutha. No part of this publication may be reproduced, stored in any retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying, recording, or otherwise, without the permission of the author, or, when appropriate, of the publishers.

Propositions

1. When the diet of a community is simple and monotonous, it can lead to lower energy intakes and may carry the risk of nutrient inadequacies especially for young children.

This thesis

2. Household food security per se does not guarantee adequacy in children's nutrient intake

This thesis

3. In addition to increased workload, body weight loss of lactating women may be greatly enhanced by fluctuating levels of household food availability.

This thesis

4. The nutritional status of physically active elderly subjects may be at greater risk from seasonal fluctuations in household food availability than that of younger and less active adults

This thesis

5. When rural women's work is too heavy, it becomes a constraint to higher production of food, to adequate child care and a health risk to women themselves.

6. Poverty should not be seen as an evil, but as a basic injustice to be corrected. Nutrition deficits therefore should be expressed in the units of their primary determinants- units of money- if one desires to genuinely improve nutrition and reduce poverty.

C. Schuftan Ecology of Food and Nutrition 1979 (8): 29-35

7. The current practice of the developed world to respond to crisis of famine does little to prevent the next one. International assistance cannot eliminate hunger of this kind without changes in national government policy.

N.S. Scrimshaw Food and Nutrition Bulletin.15 (1):1994

8. Undernutrition is more than a simple problem of food supply. The poor are not always undernourished, but the undernourished are almost always poor

FAO, 1985.

9. The current economic programmes being implemented in many African countries have no element of "adjustment with a human face".

10. The world has enough for everybody's need, but not for everybody's greed
11. Development programmes which concentrate their action on child welfare out of context of the family may be treating symptoms rather than the causes.
12. From what we get, we can make a living, from what we give, however, may save a life.
13. Age does not protect you from love, but love, to some extent protects you from age.
14. We ought to think that we are one of the leaves of a tree, and the tree is all humanity. We cannot live without the others, or without the tree.
15. True heroism is remarkably sober and very undramatic. It is not the urge to surpass all others at whatever cost, but the urge to serve others, at whatever cost.

Propositions from the thesis entitled

*"Household food security and nutritional status of vulnerable groups in Kenya :
a seasonal study among low income smallholder rural households"*

By Hilda N Kigutha

Wageningen, September 27, 1994.

*To my husband Peter Karongo
and children
Josephine Njoki, Anne Mumbi, and Henry Kigutha Jr.*

ABSTRACT

Household food security and the nutritional status of vulnerable groups in Kenya: A seasonal study among low income smallholder rural households

PhD Thesis by Hilda N. Kigutha, Department of Human Nutrition,
Wageningen Agricultural University, The Netherlands.

Climatic seasonality is now recognized as being a constraint to agricultural production and to household food security in many countries within the tropical regions of the world. This study investigated the extent to which a unimodal climatic pattern affects food production and food availability of smallholder rural households, with special emphasis on households with limited landholdings and low cash incomes. Further investigations involved looking at the effect of fluctuating levels of food availability on dietary intakes and the nutritional status of three vulnerable groups namely: preschool children, lactating women and the elderly. The study was carried out in Nakuru district within the Rift Valley province in Kenya between April 1992 and June 1993. Foods coming into the household from own production, purchases, and gifts were recorded on monthly basis from recalls. Body weight of all the subjects was measured once every month. Height was measured once at baseline for the adults, while length for preschool children was measured three times. Food consumption was determined by 24-hour recall method on monthly basis, and by 3-day weighed records at three points during the lean and the harvest seasons. A unimodal climatic pattern was found to influence food production and hence household food availability during most months within the production cycle. This subsequently influenced food consumption and the nutritional status of the vulnerable groups in the study. Lactating women lost up to 9 percent, elderly men 7 percent, and elderly women 3 percent of their body weight. While no weight losses were observed in the children, weight gains were minimal during the lean season but improved slightly during the postharvest period. It was observed that the energy and nutrient intakes of the children depended more on diet quality rather than on household food availability per se.

CONTENTS

Chapter 1	Household food security and nutritional status of vulnerable groups	1
	in Kenya: A seasonal study among low income smallholder rural households	
	General Introduction	
Chapter 2	Effects of seasonality on household food security among smallholders:	21
	Impact of land size, household size and composition	
	<i>(submitted for publication)</i>	
Chapter 3	Child malnutrition in poor smallholder households in rural Kenya :	47
	An indepth situation analysis	
	<i>(submitted for publication)</i>	
Chapter 4	Maternal nutritional status may be stressed by seasonal fluctuations in	73
	food availability : Evidence from rural women in Kenya	
	<i>(Submitted for publication)</i>	
Chapter 5	Elderly under nutritional stress: A seasonal study on food consumption	93
	and nutritional status in Kenya	
	<i>(Submitted for publication)</i>	
Chapter 6	Household food security and nutritional status of vulnerable groups	115
	in Kenya: A seasonal study among low income smallholder rural households	
	General discussion	
Appendix 1		133
Summary		149
Samenvatting		153
Acknowledgements		157
Curriculum vitae		161

CHAPTER 1

HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF VULNERABLE GROUPS IN KENYA :

A seasonal study among low income smallholder rural households.

GENERAL INTRODUCTION

Agricultural production in many of the tropical countries depends on rainfall which is usually seasonal in nature and often unreliable in timing and in the amount of precipitation. Climatic seasonality is now recognized as being a constraint to agricultural production in these countries (Annegers, 1973; Chambers et al., 1981; Teokul et al. 1986; Sahn 1989; Ferro-Luzzi et al., 1990; Pastore et al., 1993). In particular unimodal rainfall patterns which have one short rain season reduce the optimal period for plant growth and thereby oblige the farmers to engage in short intensive bouts of agricultural labour. This tends to occur at times of the year when the household's food stores are at their lowest levels. The coincidence of food shortage and heavy workloads creates competing demands on the allocation of scarce energy resources and is likely to have an impact on the energy turnover of rural households. The duration and severity of food shortages are mainly related to the rainfall pattern, whether unimodal or bimodal (Chambers et al., 1981; Teokul et al., 1986; Foeken and den Hartog, 1990). However, irrespective of the climatic pattern, food shortages especially for the agriculturally dependent households usually occur during the wet season, when food stocks from the previous harvest are almost depleted (Annegers 1973; Schofield 1974; Chambers et al, 1981; Teokul et al., 1986; Ferro-Luzzi et al., 1990; Foeken and den Hartog, 1990).

The influence of seasonal fluctuations in food availability on the energy and nutrient intake, as well as the body weight of adults and growth of children, are documented in many studies

(Rowland et al., 1977; Paul et al., 1979; Pagezy 1984; Abdullah and Wheeler 1985; Rosetta 1986; McNeill et al., 1988; Durnin et al., 1990; Ferro-Luzzi et al., 1990; Schultink et al., 1990; Minghelli et al., 1991; Ategbo 1993; Branca et al., 1993; Pastore et.al., 1993). During these periods, adults are reported to lose between 2 to 10 percent of their body weights. At the same time child mortality rates are reported to be higher than during the dry season, and sickness is more prevalent (Onchere and Slooff, 1981; FAO, 1986; Neimeijer and Klaver, 1990).

Seasonality affects the nutritional status of household members through a number of intervening variables. The most important of these are changes in activity patterns, food supply, and health status. In most agricultural communities, body weight is maximal shortly after the harvest period, while the minimum is achieved during the preharvest cultivation, usually in the wet season. The time when food availability is lowest coincides with the period when agricultural work is at its peak during the wet season, when the farms have to be prepared, planted, and the crops weeded. As such, the energy demand is greatest during this period, but the food supplies are low. When periods of food shortages coincide with periods of heavy physical work, people experience negative energy balance and lose weight as demonstrated in the studies cited above. Recent studies on seasonal fluctuations in activity patterns of rural communities confirm that energy expenditure during the rainy season is higher than during the slack postharvest period (Bleiberg et al., 1980; Brun et al., 1981; Schultink et al., 1990).

A distinction has been reported to exist between bimodal and unimodal climatic conditions in relation to seasonality in food availability. In general, people living in regions with bimodal climatic patterns are reported to experience less seasonal food stress than those living in unimodal climates. In the former case, two annual harvest are often possible, and thus reduce the time gap between harvests as well as the storage problems often experienced by small farmers. This situation was first observed by Schofield (1974), when using survey material from 25 African villages. She observed that in the 15 villages with a unimodal climate, energy requirements were met at 100 percent during the dry season, but only at 88 percent in the wet season. In the ten villages with a bimodal climate, no such seasonal differences were observed.

Other investigators have however observed that even in bimodal climates, seasonal food shortages do occur. Studies from the smallholder areas in Central, Eastern, and Coast provinces

of Kenya, found that even in bimodal climatic conditions, food stocks from the long rain harvest were at a minimum level or totally depleted by the end of the rainy season (Onchere, 1987; Foeken and den Hartog, 1990). In the smallholder areas of Central province of Kenya, for example, less than one-sixth of the households had any food items left in store by the end of the short rains, while in Eastern province, the food stocks from the long rain harvest did not last until the harvest from the short rain crop was ready (Onchere, 1987). It appears then, that whatever the type of climate, be it unimodal or bimodal, there are other factors which determine the degree to which households are exposed to seasonal fluctuations in food availability. Some of these factors especially for the smallholder farming communities may include the size and the nature of the land available for food crop cultivation, the size of the household, and the availability of other resources such as income from employment outside the farm.

Land tenure and household food availability

In many developing countries, the rural sector accounts for the majority of the population and an even greater proportion of those falling below the poverty line and having grossly inadequate access to basic services, such as water and sanitation, health, and education (Fleuret and Fleuret, 1980; Longhurst, 1987). Small-scale farmers (smallholders) are typically the majority of the working population within the rural sector in these countries (FAO, 1986). Land is the basis for the production of food and raw materials. It is also the source of income, employment and economic security of most rural people. Since land is the productive asset which mainly determines income distribution and thus access to food in the rural areas, it should follow that nutrition among rural people is closely related to land tenure status and to the size of the land holdings. For this reason, the distribution of rural wealth and the incidence of poverty are intrinsically connected to the socio-economic order which determines the type of access to land and its use in society (Valverde et al., 1977; FAO, 1986). A review of literature by Melville (1988), indicated that there is not sufficient evidence to show a clear-cut relationship between the amount of land owned and nutritional status. He concluded that this may be a failure by

researchers to control for confounding factors such as quality of the soil, the amount of incomes spent on food, and other factors which could have biased the results.

The minimum landholding necessary for subsistence varies from country to country and is determined according to three criteria; the minimum area needed to employ a family, to satisfy its nutritional requirements, and to produce a basic income. The same piece of land can produce varying income depending on the cropping pattern, intensity of land use, rainfall pattern and the technology employed. For example, the subsistence farmholding in Bangladesh is 2 acres, while in Egypt it is 3 acres, and in Kenya it is about 12 acres (or 5 hectares) (World Bank, 1973; FAO, 1986). However, due to increasing scarcity of arable land combined with rapid population growth and strong land inheritance traditions, fragmentation of land has reduced the size of landholdings to uneconomic sizes in Kenya and many other countries. In 1975, it was estimated that the number of rural households in Kenya holding less than one hectare of land (2.5 acres) was 31.8 percent of the total rural population (FAO, 1986). It is likely that this number may have increased in recent years as a result of the rising population coupled with continued fragmentation of the land.

Household food security in smallholder households

Food security has been defined in its most basic form, as access by all people at all times to food needed for a healthy life. At the household level, food security has been defined as a state in which households have continuous access to food supplies which can fully satisfy the nutritional and dietary needs of all its members at all times (FAO/WHO, 1992; Maxwell and Frankenberger, 1992; Frankenberger et al., 1993). Such a situation implies that a household has the capacity to procure adequate food supplies on a stable basis and in a sustainable manner. Thus, a state of household food security satisfies three essential conditions; a capacity to procure adequate food supplies, the stability, and the sustainability of these supplies (Frankenberger et al., 1993; WHO, 1993).

The stability of household supplies refers to the ability of a household to procure food supplies on a continuing basis including when faced with stress or shocks brought about by

crop failures, market price fluctuations, or loss of employment. Sustainability implies that a household is able to minimize the extent and duration of food deficits and be able to bounce back and quickly regain an adequate supply in case of a shortfall. Such resilience is possible only where a household has buffer mechanisms to absorb the effects of short term production or income deficits (Frankenberger et al., 1993). As such households lacking access to buffer mechanisms of some kind tend to be fragile and highly vulnerable to food supply deficits (Maxwell and Frankenberger, 1992). For smallholder rural households, the capacity to procure adequate food supplies, implies the ability of such households to obtain through own production, income and/or transfers, an assortment of foods which is adequate in quantity and quality for composing diets that meet the nutritional needs of all their members on a continuing basis.

Most of the food insecure socio-economic groups include low income small farmers many of whom have limited access to financial resources and farm inputs. The food insecurity problem among smallholders is worsened by climatic conditions which limit what foods, how much, and how frequently they can be grown. In such conditions, a change in the rainfall pattern may bring about total or partial crop failure, followed by localized or country-wide food shortages as witnessed in several African countries in recent years. In communities marked by landholding and income inequalities, household responses to food shortages occur differently along the lines of wealth and access to resources (Longhurst, 1987). Identical climatic conditions can affect households of varied economic levels to different degrees. For example, seasonal shortages for some families may produce famine conditions for others. Poorer households having smaller land holdings, and a weaker resource base are more vulnerable to food stress than wealthier households, and begin to suffer earlier than the rest when food shortages occur (FAO, 1986; Frankenberger and Goldstein, 1991; Maxwell and Frankenberger, 1992).

It has already been reported that the immediate causes of households inability to acquire sufficient quantities of food during certain periods of the year revolve around a decline in their income (either in cash or in kind), and an increase in market prices (Sahn, 1989). The fluctuations in income and prices are largely a reflection of the cyclic nature of agricultural production. Variations in income and prices represent a threat to food security when a

household is not able to save either in the form of food stocks or cash, and when the patterns of the seasonal changes is not predictable, thus introducing an element of risk into household savings and consumption behaviour (Sahn, 1989). The rural poor have traditionally relied upon agricultural based savings in terms of food stocks. When these households deplete their stocks long before the next harvest, the availability of wage labour becomes vital for their survival. Wage labour, especially in the rural areas is usually scarce and seasonally influenced. In areas with unimodal climatic pattern, on-farm wage labour may be available for very brief periods within the annual crop production cycle, especially during the wet season (Foeken et al., 1989).

Two types of household food insecurity have been identified: chronic and transitory. Chronic food insecurity is persistently due to inadequate diet arising from the continual inability of households to acquire needed food either through production or through market purchases. Transitory food insecurity, on the other hand, is a temporary decline in household's access to needed food, due to instability in production, food prices or incomes. It is typically the chronically food insecure or the poor households who are hit hardest by transitory food insecurity (FAO/WHO, 1992). Seasonal variations in production and fluctuations in prices of foods are important factors contributing to transitory food insecurity of poor households, which over time can escalate into chronic food insecurity and nutritional deterioration (Sahn, 1989). Sudden changes in incomes and prices affect the ability of households to obtain food that is available in the markets. Consequently, low household incomes are a major cause of household food insecurity among the poor rural communities and households, as they make it impossible for them to meet their minimum food needs. While this is a chronic problem of poor people in poor societies, it is often accentuated following food shortages arising from seasonal food deficits, recession, and adjustments policies which cause employment and wages to fall and food prices to rise (Longhurst, 1987).

Seasonality and the nutritional status of vulnerable groups

The effects of seasonal fluctuations in dietary intake and the nutritional status of household members have been demonstrated in many studies indicated above. Most of the studies focussed

their investigations on changes in food intakes and body weights of the economically active adult men and women. Very few studies have given attention to the effects of seasonality on the nutritional status of specific nutritionally vulnerable groups within households. The nutritionally vulnerable may be at greater nutritional risk during periods of food scarcity than the rest of the household members. While some of the studies have included women of reproductive age in their investigations, few studies have investigated the effects of seasonality on children and hardly any studies have been conducted among the elderly population groups in relation to seasonal factors.

The few studies available on the nutritional status of the preschool children show that this group is likely to experience greater nutritional risk during times of food scarcity than the older school-age children. In Bangladesh, Abdullah et al. (1985), found that the energy and protein intake of preschoolers had significant seasonal differences. In analysing data from ten African countries, Schofield (1974) found that preschool children fulfilled their energy requirements at a much lower level of 80 percent. In the coast province of Kenya, Niemeijer et al. (1990), found that children showed a different seasonality pattern than that of adults. Children had a growth spurt in height during the dry season coupled by lesser weight growth resulting from low food supplies. However, weight growth improved when household food supplies increased. Similar findings were reported from Benin (Ategbo, 1993). On the other hand, a recent study in Ethiopia (Branca et al., 1993) observed that seasonal changes in household food availability did not significantly affect the weight-for-height Z scores. However, the height growth velocity had marked seasonal pattern with values close to normal during the periods when food availability was better between July and December, and lower values during the wet season between January and June.

The effect of seasonality on the nutritional status of young children is further complicated by the prevalence of diseases, some of which are seasonally influenced. In general, the wet season is the worst period as far as the health situation of young children is concerned. This is because some childhood diseases occur more often then, than during the dry season (Schofield, 1974; Onchere and Slooff, 1981; Tomkins, 1981; Neimeijer and Klaver, 1990). It is also the period of

intensive labour input by the mothers, which means that the amount of care given to the children is much less in the wet season, than during the dry season.

No information concerning exists the nutritional condition of the elderly in the seasonal cycle of household food fluctuations. The elderly are rapidly becoming a substantial proportion of the population in both the developed and the developing countries. Today, more than half of the world's elderly persons live in the developing countries, and it is estimated that by the year 2000, roughly two out of every three of the world's elderly people will be living in the developing countries (WHO, 1983; Macfaden, 1988; FAO/WHO, 1992). In the tropical countries of Africa, most of the elderly are living in the rural areas as smallholders themselves, or as members of the extended families. As a nutritionally vulnerable group, they are also likely to be exposed to the seasonal cycle of food shortages and nutritional insecurity especially if they come from economically deprived households. As very little is known about the effects of seasonality on specific vulnerable groups, there seems to be a need for this kind of data to be made available in order to assist development planners and project managers to target the right groups during periods of food crises.

Kenya's food production potential

Despite significant industrialization, Kenya is basically an agricultural nation with the majority of its people (about 90 percent) living in the rural areas and depending on agriculture, either directly or indirectly, for their incomes (Greer and Thorbecke, 1986). In the first decade of independence in the early 70s, Kenyan agriculture particularly in the smallholder sector, played a key role through increased production and exports in raising rural incomes and fueling the growth of the urban manufacturing sector. In recent years however, agricultural production has not kept pace with population growth rate and the country has become a net importer of its two major staple foods, maize and wheat (Greer and Thorbecke, 1986; Heyer, 1990).

Kenya is a country with a varied ecological environment which is characterized by differences in agricultural potential and in patterns of food production. Its agricultural potential is quite low. Only about 13 percent of the total land area can be classified as high potential agricultural land

which receives more than 1400 mm of rainfall per year. Another 6 percent is termed medium potential and receives between 800 and 1400 mm of rainfall annually. The remaining 81 percent receives less than 800 mm and consists of semi-arid and arid wastelands with very low potential for agricultural production (Kliest, 1985). The various types of agricultural land are not evenly distributed over the country and the majority of the population is concentrated in the parts of the country with good agricultural land, while the remaining low potential land is occupied by nomadic pastoralists and wild life reserves. Figure 1 presents an overview of Kenya's land area showing the availability of high potential agricultural land per capita by district.

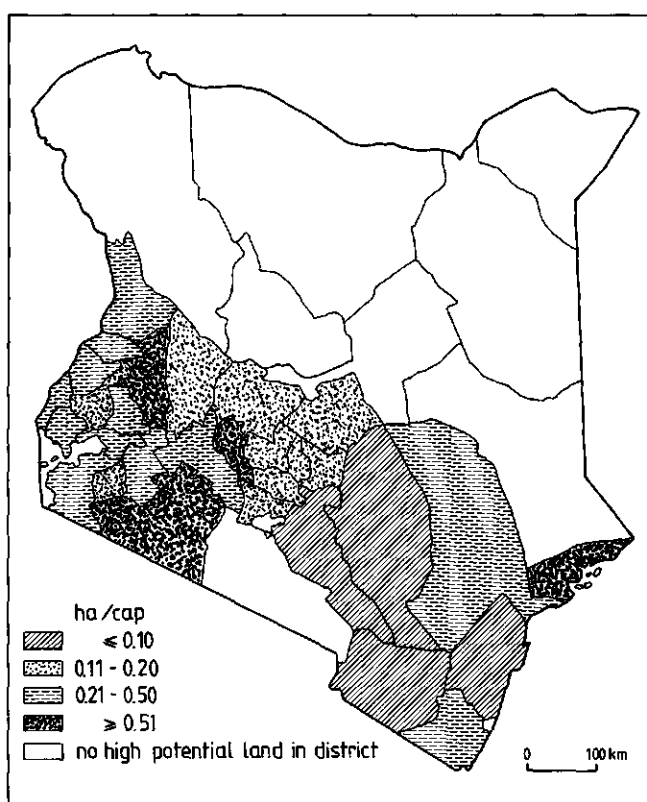


Figure 1 Map of Kenya showing availability of good agricultural land per capita by district

The majority of Kenya's population is concentrated in the 20 percent of the country where the environmental factors do not limit agricultural activities. However, under the influence of the steadily increasing pressure on land, there has been a shift from large-scale farming to smallholder farming. This process of converting large farms into smallholder farms has resulted in a movement of the population from areas which are already experiencing population pressure into areas formerly occupied by large settler farms.

In the post independence period from 1963, the population movement has been directed mainly to the districts of the Rift Valley province such as Nakuru, Trans Nzoia, Uasin Gishu, and Laikipia, all of which had good arable land. Furthermore the population pressure has continued to create a growing demand and increasing competition for arable land and this has brought about considerable land fragmentation in the high and medium potential areas, resulting in a decline in farm sizes as well as in per capita production levels of food crops. It has also helped create an increasing group of rural landless households (Kliest, 1985). In the past few years the country has witnessed an increasing level of rural-to-rural migration directed towards areas with only marginal agricultural potential. The expansion of cropping activities into such areas, and the settlement of families in areas with unreliable rainfall and low crop production is likely to expose these families to risks of regular food shortages and may lead to environmental degradation.

Regional and seasonal food problems in Kenya

Roughly 90 percent of all Kenyans live in the rural areas and most of them, or about 80 percent of the country's population belong to smallholder households (Greer and Thorbecke, 1986). Throughout Kenya, altitude is a major determinant of rainfall, temperature and soil fertility. Cropping patterns, population density, employment opportunities, and relative food prices are heavily influenced by the agricultural potential of the land (Kliest, 1985).

Food production patterns in Kenya are characterized by considerable seasonal fluctuations which are closely related to environmental factors (Kliest, 1985). Such fluctuations in output contribute to unstable levels of food availability, especially in those parts of the country where farmers are confronted with relatively short and unstable cropping seasons. This instability in

food production and food availability frequently results in localized and sometimes more widespread food shortages (Kliest, 1985). As such, Kenya's short and long term food problems are closely related to specific ecological conditions prevailing in a large part of the country, as well as the country's relative lack of land resources, as shown in Figure 1. Such problems are likely to worsen as a result of the impact of the present population movements into ecological areas which are basically unsuitable for crop production under rainfed conditions (Kliest, 1985; Greer and Thorbecke, 1986; Heyer, 1990).

Nearly all parts of Kenya where arable agriculture under rainfed conditions is possible have bimodal climates except the thirteen districts within the Rift Valley province, and parts of the Coast province which have a unimodal climate, allowing only one planting and one harvesting season per year. They represent the high potential agricultural areas where the country's staple foods, maize and wheat, are produced on large farms for commercial purposes, but also on smallholder subsistence farm holdings.

Food consumption patterns in Kenya

Maize is the staple food for the majority of Kenyans, and thus the chief source of energy and protein for both the rural and the urban populations. It is reported that the average smallholder in the rural areas of Kenya obtains a large share of daily energy intake from a limited range of foods. This is made up of about 61 percent from cereals, 12 percent from roots crops, 5 percent from beans, 5 percent from sugar, and 4 percent from milk (Shah and Frohberg, 1980). These foods represented 87 percent of the total energy intake for the rural farming community. The limitations in the variety of crops grown in most rural areas are likely to reflect a monotony in the diets which may also be limited in quality.

It is reported that poor households in Kenya's smallholder areas suffer from intermittent food shortages some of which can be acute, but that the grossly inadequate intake of food that is prolonged enough to show up in high incidence of severe malnutrition is rare (Heyer, 1990). Different estimates of poverty in smallholder agricultural areas suggest that more than 25 percent of the rural agricultural households are poor enough not to be able to afford what are regarded as

minimum food requirements (FAO, 1986; Greer and Thorbecke, 1986 ; Heyer, 1990). Some studies have noted a declining trend in overall nutritional levels in Kenya. At the national level, a reduction in the nutritional status between a survey conducted in 1977 and later surveys in 1979 and 1982 was reported (Central Bureau of Statistics, 1982). The average daily food availability which amounted to 2412 and 2453 kcals per capita in the periods 1965-1970 and 1971 and 1975 respectively decreased to 2385 kcals between 1976 and 1980 (Republic of Kenya, 1982). Although the latter figures are higher than the FAO/WHO recommended average of 2362 kcals for Kenya, it should be noted that satisfactory per capita intake does not reflect the situation at the household level. The most recent data from the fourth rural child survey carried out in 1987 (Central Bureau of Statistics, 1991) showed that child nutritional status was poor, and continued to worsen in most districts compared to earlier surveys. However, the question of seasonality was not addressed.

The studies described in the different chapters of this thesis were aimed at identifying the extent to which climatic seasonality affects food production and household food availability of low income smallholder rural households, and how this in turn affects the food consumption and nutritional status of three nutritionally vulnerable groups namely; preschool children, lactating women and the elderly subjects from these households.

Description of the study area

The study was carried out in Njoro division within Nakuru district in Kenya. Nakuru district with an area of 72000 sq km is located between 35 degrees 28' and 36 degrees 35' East and 0 degrees 13' North and 1 degree 10' South. The district is one of the 13 districts in the Rift Valley province and lies within the Great Rift Valley. It has a unimodal climatic pattern. The climatic conditions are strongly influenced by altitude which range from 1520-2740 metres above sea level, and the physical features of escarpments, lakes and volcanic peaks found within the district.

The long rains fall between March and June with peak periods in April and May, and the short rains fall between October and December. The amount and timing of the rains however, differ

from year to year, and this greatly affects crop yields and pastures, especially in the lower and more marginal areas within the Rift Valley floor. Maize is the main staple food. It is planted during the long rains in March or April and takes between 8 and 9 months from planting to harvest. As such only one crop can be planted in one year. In the smallholder farms, maize is interplanted with other food crops such as beans, peas, potatoes and a variety of vegetables. The lean season normally starts from May to October, with June and July being the leanest months in terms of food availability. The maize harvest season starts from November to January, while small harvests of the early maturing crops such as beans, potatoes, and vegetables take place in late July and early August.

Nakuru district suffers from a shortage of surface water for domestic use, and more reliance has been put on ground water sources. At the same time the lack of aquifers and the presence of porous volcanic rocks limit the availability of ground water. These constraints together with a large influx of people into the settlement areas in the district has seriously strained both surface and ground water supplies (Republic of Kenya, 1986). The location of Nakuru district within Kenya as well as the study sites are shown in Figure 2.

The majority of the population in Nakuru district are recent immigrants from other districts due to the conditions of land ownership existing during the colonial era. Before Kenya obtained independence from Britain in 1963, most of the land in the district was owned and farmed by a few large-scale white settlers. The local people were not allowed to own land but were hired to assist in farm work and lived in villages situated on the large farms as squatters. After independence in the early 1970s, many families, either from the squatter communities or from outside the district formed land-buying cooperative societies and bought these farms collectively and then subdivided them among themselves, each family getting a portion of land worth the money contributed. As the majority of cooperative members were of low income, they could raise just enough money for one share at the time of purchase. At the time of this research the majority of the smallholders in this area owned an average of two and a half acres of land (about 1 hectare).

The study was carried out in Njoro division, which is one of the four administrative divisions in Nakuru district. It is located in the western part of the district along the Mau escarpment with

an average altitude of 2500 metres above sea level. The division is within the medium climatic zone with dry subhumid equatorial climate, with annual rainfall between 760 mm and 1015 mm, and a moisture index of between 10 and 30. Njoro town is situated in the mid western part of Kenya, about 200 kilometres from Nairobi, the nation's capital city.

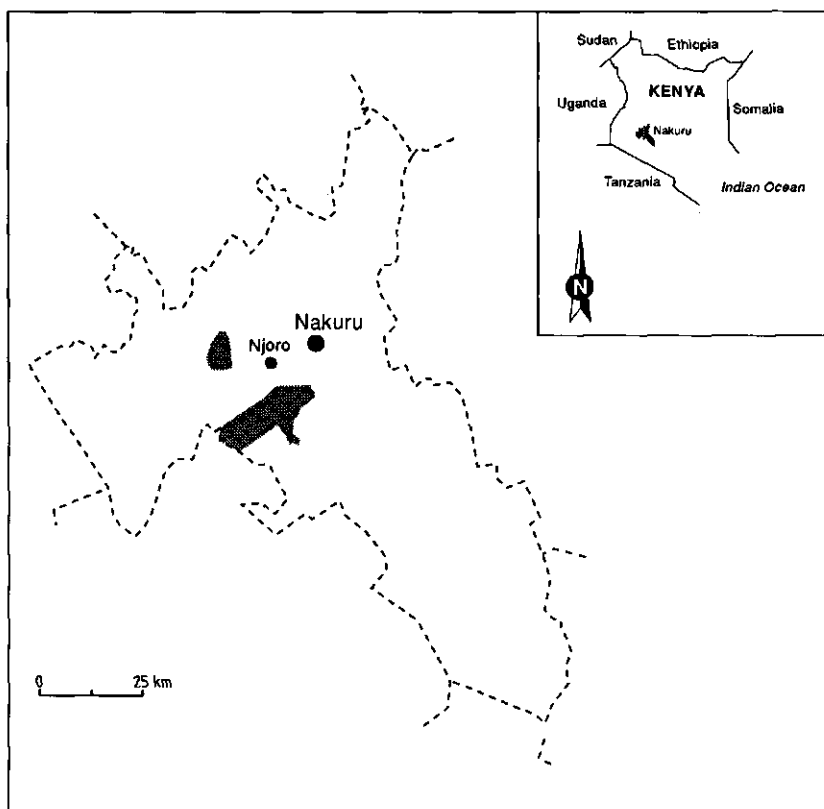


Figure 2 Map of Nakuru district showing the research sites : inset, Kenya

The study objectives

The effects of seasonal fluctuations in food availability and the nutritional status of people living in unimodal climatic conditions is not well known. Secondly, when describing seasonal body weight changes or seasonal fluctuations in energy and nutrient intakes, the question as to which vulnerable group within the family suffers most from seasonal food stress has received little attention. The present study was designed to investigate the extent to which seasonal food shortages in a unimodal climatic pattern affects energy and nutrient intake, as well as the nutritional status of three vulnerable groups namely; preschool children, lactating women and the elderly. The subjects were from ninety-four smallholder rural households with landholding sizes of between 1-3 acres, with mean monthly incomes of not more than 500 Kenya Shillings. The study was carried out in Nakuru district, within the Rift Valley province in Kenya between April 1992 and June 1993.

Research questions

The study was expected to provide answers to the following research questions:

1. What is the effect of a unimodal climatic pattern on the annual food production and food availability of such a group of households?
2. Are land size and family size important factors in determining household food availability of such a group ?
3. Are there important seasonal differences in energy and nutrients intakes of preschool children, lactating women, and the elderly in these households?
4. Do the seasonal differences in energy and nutrient intakes affect the nutritional status of each of these vulnerable groups ?
5. Do any of these vulnerable groups provide an early warning sign of energy stress during times of transitory food insecurity ?

Outline of the thesis

This thesis presents the results of the studies on the effect of climatic seasonality on the food and nutritional situation in smallholder rural households. The chapters are written as articles to be published in relevant international journals. **Chapter 2** describes how household food security of the rural smallholder households during different months of the agricultural cycle is influenced by a unimodal climatic pattern. It also describes other factors such as land size, family size, and income, which affect the household's ability to achieve a state of household food security. In **chapters 3**, the influence of seasonal fluctuations in energy and nutrient intake on the nutritional status of preschool children is explained. Similar influences on the dietary intake and the nutritional status of lactating women and the elderly are described in **chapter 4** and **chapter 5** respectively. The relationship between seasonality, household food availability and the nutritional status of the different vulnerable groups are discussed in **chapter 6**. In this chapter, an attempt is also made to identify which one of the three groups studied, i.e., children, lactating women or the elderly, can provide a more timely index of identifying communities or population groups at risk of transitory food crisis.

REFERENCES

- Abdullah, M. and E. F. Wheeler (1985). Seasonal variations in the intra-household distribution of food in a Bangladesh village. *American Journal of Clinical Nutrition* 41: 1305-1313.
- Annegers, J. F. (1973). Seasonal food shortages in West Africa. *Ecology of Food and Nutrition* 2: 251-257.
- Ategbo, E. D. (1993). Food and nutrition insecurity in northern Benin: Impact on growth performance of children and on year to year nutritional status of adults. *PhD thesis*. Wageningen Agricultural University.

Bleiberg, F. M., T.A. Brun, S. Goihman (1980). Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper Volta. *British Journal of Nutrition* 43: 71-82.

Branca, F., G. Pastore, T. Demissie, A. Ferro-Luzzi (1993). The nutritional impact of seasonality in children and adults of rural Ethiopia. *European Journal of Clinical Nutrition* 47: 840-850.

Brun, T. A., F.M. Bleiberg, S. Goihman (1981). Energy expenditure of male farmers in dry and rainy seasons in Upper-Volta. *British Journal of Nutrition* 45: 67-75.

Central Bureau of Statistics (1982). Third Rural Child Nutrition Survey. Ministry of Finance and Planning, Nairobi, Kenya.

Central Bureau of Statistics (1991). Fourth Child Nutrition Survey. Ministry of Finance and Planning, Nairobi, Kenya.

Chambers, R., R. Longhurst, A. Pacey, Eds. (1981). Seasonal dimensions to rural poverty. , Frances Pinter. London.

Durnin, J. V. G. A., S. Drummond, K. Satyanarayan (1990). A collaborative EEC study on seasonality and marginal nutrition: the Glasgow Hyderabad (S.India) study. *European Journal of clinical Nutrition* 44(suppl.1): 19-29.

FAO (1986). The Dynamics of Rural Poverty. FAO.Rome.

FAO/WHO (1992). International Conference on Nutrition : Major issues for nutrition strategies. FAO/WHO.Rome/Geneva..

Ferro-Luzzi, A., C. Scaccini, S. Taffese, B. Aberra, T. Demeke (1990). Seasonal energy deficiency in Ethiopian rural women. *European Journal of Clinical Nutrition* 44 (Suppl 1): 7-18.

Fleuret, P. and A. Fleuret (1980). Nutrition, consumption, and agricultural change. *Human Organization* 39: 250-257.

Foeken, D., P. Leegwater, R. Neimeijer, W. Veerman, J. Hoorweg (1989). Seasonality in the Coastal Lowlands of Kenya. Report No. 32. Ministry of Planning and National Development, Nairobi, Kenya; and African Studies Centre, Leiden, Netherlands.

Foeken, D. W. J. and A. P. den Hartog Eds. (1990). Seasons, food supply and nutrition in Africa. African Studies Centre, Leiden.

Frankenberger, T., A. Pena-Montenegro, S. Tilakaratna, N. Velarde, W.B. Eide (1993). Technical issues in rural Poverty alleviation; Rural poverty alleviation and nutrition: IFAD's evolving experiences. International Fund for Agricultural Development. Rome.

Frankenberger, T. R. and D. M. Goldstein Eds (1991). Linking Household Food Security with Environmental Sustainability Through an Analysis of Coping Strategies. Kumarian Press. New York.

Greer, J. and E. Thorbecke (1986). Food poverty and consumption patterns in Kenya. International Labour Organization. Geneva.

Heyer, J. (1990). Poverty and food deprivation in Kenya's smallholder agricultural areas. In J. Dreze and S. Amartya (eds.). The political economy of hunger. Clarendon Press. Oxford. 237-279.

Kliest, T. (1985). Regional and Seasonal Food Problems in Kenya. Food and Nutrition Planning Unit, Ministry of Finance and Planning, Nairobi, Kenya; and African Studies Centre, Leiden, The Netherlands.

Longhurst, R., (1987). Policy approaches towards small farmers. In: Cornia G.A., R.Jolly, F.Stewart (Eds) Adjustment with a Human Face. Clarendon Press.Oxford

Macfaden, D. M. (1988). Aging in the world: facts and figures. **National Research Council of Italy**. National Institute of Nutrition. Rome

Maxwell, S. and T. R. Frankenberger (1992). Household food security: concepts, indicators, measurements. A technical review. UNICEF/IFAD. New York / Rome, .

McNeill, G., P.R. Payne, J.P.W. Rivers, A.M.T. Enos, J.J. de Brito, D.S. Mukarji (1988). Socio-economic and seasonal patterns of adult energy nutrition in a south Indian village. *Ecology of Food and Nutrition* 22: 85-95.

Melville B.F. (1988). Are land availability and cropping pattern critical factors in determining nutritional status?. *Food and Nutrition Bulletin* 10: 44-48.

Minghelli, G., Y. Schutz, R. Whitehead, E. Jequier (1991). Seasonal changes in 24-hour and basal energy expenditure in rural Gambian men as measured in a respiratory chamber. *American Journal of Clinical Nutrition* 53: 14-20.

Neimeijer, R., W. Klaver.(1990). In: Foeken D.W.J., A. den Hertog Eds. Climatic seasonality and growth: longitudinal research in coast province, Kenya. Seasons, food supply and nutrition in Africa. Africa Studies Centre. Leiden.

Onchere, S. R., (1987). Agricultural and economic characteristics. In: van Ginneken,J.K., A.S. Muller Eds. Maternal and child health in Kenya: An epidemiological study. Croom Helm. London.

Onchere, S. R. and R. Slooff, (1981). Nutrition and disease in Machakos district, Kenya. In: Chambers R., R. Longhurst , A. Pacey, (eds). Seasonal dimensions in rural poverty. Frances Pinter. London.

Pagezy, H. (1984). Seasonal Hunger as experienced by the Oto and the Twa women of a Ntomba village in the equatorial forest (Lake Tumba Zaire). *Ecology of Food and Nutrition* 15: 13-27.

Pastore, G., F. Branca, T. Demissie, A. Fero-Luzzi (1993). Seasonal energy stress in an Ethiopian rural community: an analysis of the impact at the household level. *European Journal of Clinical Nutrition* 47: 851-862.

Paul, A. A., E.M. Mueller, R.G. Whitehead (1979). Seasonal variations in energy intake, body weight and skinfold thickness in pregnant and lactating women in rural Gambia. *Proceedings of the Nutrition Society* 38: 28A.

Republic of Kenya (1982). Development Plan 1984-1988. Ministry of Finance and Planning, Nairobi, Kenya.

Republic of Kenya (1986). Nakuru District Development Plan. Ministry of Finance and National Development. Nairobi, Kenya.

Rosetta, L. (1986). Sex differences in seasonal variations of the nutritional status of **Serere** adults in Senegal. *Ecology of Food and Nutrition* 18: 231-244.

Rowland, M. G. M., T.J. Cole, R.G. Whitehead (1977). A quantitative study into the role of infection in determining nutritional status in Gambian village children. *British Journal of Nutrition* 37: 441-450.

Sahn, D. E. (1989). Seasonal fluctuations in factor and products markets: Is there a nutritional risk? Cornell Food and Nutrition Policy Programme. Ithaca.

Schofield, S. (1974). Seasonal factors affecting nutrition in different age groups and especially preschool children. *Journal of Development Studies* 2: 22-40.

Schultink, W. J., W. Klaver, H. van Wijk, J.M.A. van Raaij, J.G.A.J. Hautvast (1990). Body weight changes and basal metabolic rates of rural Beninese women during seasons with different energy intakes. *European Journal of Clinical Nutrition* 44 (suppl 1): 31-40.

Shah, M. M. and H. Frohberg (1980). Food consumption patterns in rural and urban Kenya. International Institute for Applied Systems Analysis. Working paper No.80-13.

Teokul, W., P. Payne, A. Dugdale (1986). Seasonal variations in nutritional status in rural areas of developing countries: A review of literature. *Food and Nutrition Bulletin* 8: 7-10.

Tomkins, A., (1981). Seasonal health problems in the Zaria region. In: Chambers R., R. Longhurst, A. Pacey, eds Seasonal dimensions in rural poverty. Frances Pinter. London.

Valverde, V., R. Martorell, V. Mejia-Pivaral, H. Delgado, A. Lechtig, C. Teller, R.E. Klein (1977). Relationship between family land availability and nutritional status. *Ecology of Food and Nutrition* 6: 1-7.

WHO (1983). The uses of epidemiology in the study of the elderly. WHO. Geneva.

WHO/FAO (1993). World declaration on nutrition : plan of action. FAO/WHO. Rome

World Bank (1973). Agricultural Sector Survey - Kenya. World Bank. Washington D.C.

CHAPTER 2

EFFECTS OF SEASONALITY ON HOUSEHOLD FOOD SECURITY AMONG SMALLHOLDERS

Impact of land size, household size and composition.

Hilda N. Kigutha, Wija A. van Staveren, Willem Veerman, Joseph G.A.J. Hautvast

ABSTRACT

A comparative observational survey of climatic seasonality on household food security among smallholder rural households was carried out involving ninety-four households in a unimodal climatic area in Kenya. An inventory of all the foods entering and leaving the households was kept on monthly basis for a period of 14 months. Results showed that the households were able to meet about 88 percent of their energy requirements which came mainly from own production with purchases contributing only 12 percent. Grouping the households by household size showed that small households (< 4 persons) had more than adequate food (181%) while large households (> 7 persons) had only 68 percent of requirement. Comparing the food available to households with children with those of elderly subjects showed that child households were more energy deficient as they met only 62 percent of their energy needs compared to elderly households with 115 percent. Three acres of land was found to be insufficient to sustain the food needs of an average sized low income family. Our results suggest that there is an urgent need to address the poverty issue among smallholder households in Kenya, as they comprise the majority of the total population.

INTRODUCTION

In many African countries smallholder households depend mainly on their own production for food supply during most of the year. In areas with good climatic conditions and where rainfall is reliable, the households might not experience big fluctuations in food supply and they are generally able to meet their nutritional needs throughout the year. In unimodal climatic patterns, however, one short rainfall season determines food production for the whole year and as a consequence, food is not available in adequate amounts during some months of the year, and households often experience food shortages just before the harvest. Seasonal fluctuations in household food supply affect energy and nutrient availability and consumption by the household members and bring about losses in body weight when food supplies to the households are low (Teokul et al., 1986; Reardon et al., 1988; Wandel, 1989; Campbell, 1990; Ferro-Luzzi et al., 1990).

In countries where land is not communally owned, the size of land owned by a family or household becomes an important asset as it determines the amount of food that can be produced for that family in terms of crops or livestock at any given time. Landlessness therefore, means lack of an important production resource and a sign of poverty, especially in the rural areas. It is reported that unequal distribution of land is the most widespread cause of rural poverty in most of the developing countries (Melville, 1988) and some nutrition planners advocate for land redistribution as a means of ending malnutrition in these countries (Omawale and McLeod, 1984; Melville, 1988).

Several studies have found that malnutrition is more prevalent in children of rural landless than in landed households (Omawale and McLeod, 1984; Mason et al., 1985; Haaga et al., 1986). Some of these studies also reported a positive correlation between household land size and child nutritional status especially in relation to weight-for-age (Valverde et al., 1977; Omawale and McLeod, 1984; Haaga et al., 1986; Victora et al., 1986). From these studies, there is some evidence that a relationship exists between the amount of land owned and the nutritional status of the household members, especially of preschool age children. However, they do not answer the question as to how much land would be considered adequate in ensuring

food and nutritional security of rural households. On the other hand, it may be impossible to arrive at any appropriate figure for land sizes which would be considered adequate because of the many confounding factors which could bias the results, such as quality of the soil, rainfall patterns, as well as the occupational multiplicity of households.

Other studies have reported that many smallholder rural households rely on market sources for food when their own farm produced stocks decline (Reardon et al., 1988; Campbell, 1990; Delisle et al., 1991; Hoorweg et al., 1991; Foeken and Tellegen, 1992; Leonard et al., 1993). Some studies which were carried out in the rural areas of the coast province in Kenya found that households with regular cash incomes depended to a great extent on purchased foods when home produced supplies declined during most months in the year (Foeken et al., 1989; Hoorweg et al., 1991). While this reliance on purchased foods may be appropriate for households with reliable sources of income, households without adequate extra cash incomes will not be able to purchase enough supplementary foods when their home produced supplies run out. If this is true, then the poor households would be experiencing greater food stress than others within the same environment during most months of the year, but much more so during the lean seasons. The purpose of this study was to try and gain insight into how smallholder households with limited land and cash and living in a unimodal climatic area, are able to meet their food and energy needs throughout the year. The study tried to find answers for the following questions: 1) What is the effect of a unimodal climatic pattern on the annual food production of smallholder rural households? 2) Is land size a critical determinant of food availability in poor rural households? 3) To what extent does household size affect household food supply?

SUBJECTS AND METHODS

Background of the study area

Nakuru district with an area of 7200 sq km is located between 35 degrees 28' and 36 degrees 35' East and 0 degrees 13' North and 1 degree 10' South. The district is one of the 13 districts

of the Rift Valley province and most of it lies within the Great Rift Valley. The climatic conditions are strongly influenced by the altitude which ranges from 1520 to 2740 metres above sea level and there is considerable variation in climate throughout the district. The study was carried out in Njoro division which is situated on the western part of the district along the Mau escarpment with an average altitude of 2500 metres above sea level. Njoro division is within the medium climatic zone with dry subhumid equatorial climate with annual rainfall between 760 mm and 1015 mm, and a moisture index of between 10 and 30.

The long rains fall between March and June with peak periods between April and May, and the short rains fall between October and December. The amount and timing of the rains however, differ from year to year, and this greatly affects crop yields and pastures especially in the lower and more marginal areas within the rift valley floor. Maize is the main staple food. It is planted during the long rains in March or April and takes between 8 and 9 months from planting to harvest. As such only one crop can be planted in one year. In the smallholder farms maize is interplanted with other food crops such as beans, peas and potatoes.

The study design involved a comparative observational survey covering both the lean and the harvest season in ninety-four smallholder rural households in a Njoro division in Nakuru district, Kenya. The households were located in four cooperative farms in former settler areas of what was previously known as the 'white highlands'. Smallholders in these areas are either immigrants from other districts or are formerly squatters and labourers in the previously large farms. After independence, landless families from in and out of the district formed themselves into land buying cooperative groups and contributed money to buy former settler farms. These farms were then subdivided into plots (or shares) and each family was allocated a piece of land equivalent to the number of shares bought. Most of the shares were equivalent to between two and three acres of land, but a few others were much smaller. As the majority of cooperative members were poor, they could raise just enough money for one share at the time of purchase. At the time of the survey the majority of the small holders in this area owned about three acres of land.

Selection of study households

Smallholder households for the study were chosen from four cooperative farms Mutukanio, Kamwago, Kamwaura and Sosiot within Njoro division. To identify households to include in the study a brief census was conducted in the four farms covering all the households in them, numbering about 4000 households. This census was carried out over a two week period by a group of twenty high school leavers and university students on holiday, who had received one day training. A simple one page questionnaire was used during the census designed to identify households with the following characteristics: those owning between one and three acres of land; those without permanently employed members living at home; and those households with no regular sources of income of more than five hundred Kenya shillings per month (about US\$25 in 1992). Besides meeting the land and income criteria, households were only included if they contained one or more of the nutritionally vulnerable groups. These vulnerable groups included children between eighteen and thirty months of age; lactating women in their early stages of lactation (up to four months); and elderly men or women who were between 65 and 74 years of age, and who were "apparently healthy". Apparently healthy was defined as referring to those elderly who were not bed-ridden, not hospitalized, not suffering from life-threatening illnesses which require constant medication, and those not suffering from senile dementia. A household in this study was defined as a group of persons who shared one common pot on daily or regular basis.

All households meeting the above requirements were grouped into three sampling frames based on whether they had a child, a lactating mother or an elderly person. From each sampling frame random samples of about forty households were selected. These households were revisited by the researcher for further interviews to confirm the information given on the census form. This visit was also used to explain the purposes of the study to the household head and to obtain approval. At the end of this second visit 105 households who met our requirements agreed to participate. Only one household with a child declined to join the study on religious grounds. A few more households dropped from the study later due to change of residence or

separation from the spouse. In the end complete data sets for ninety-four households were obtained.

Study design and data collection

The study was a comparative observational design planned to cover both the lean and the harvest season, with an overlap of a few of the lean months. It was carried out over fourteen months from April 1992 to the end of May, 1993. Data collection included an estimation of the foods available to each household during the past month, either from own farm production, purchases, and for foods received as gifts from relatives or neighbours. Own farm production included any food harvested from the farm for immediate consumption by the household during different days of the month, as well as foods harvested and stored for later use. However, measurements of stocks in storage were not done due to lack of resources. All the measurements for home produced foods and gifts were obtained in household measures which were later converted into kilogrammes, while the purchases were either in grams or kilogrammes. Foods leaving the household through sales and gifts were also recorded using household measures. All the data were obtained by a detailed recall questionnaire, covering the past thirty days. The recalls were administered to the mother by trained enumerators and the information was entered into pre-coded questionnaires. The recalls were repeated every month for fourteen months covering both the lean and the harvest season.

Data treatment and analysis

To determine the total energy available to the households during the month, food harvests plus all foods coming into the households through purchases and gifts, less food leaving the households through sales and food gifts, were converted from household measures into kilogrammes and then into energy equivalents using food composition tables, mainly those developed by CTA-ECSA for use in East, Central and Southern African countries (West, et al., 1987), as well as tables developed by the Food and Agriculture Organization for use in Africa

(FAO, 1970). The total energy obtained from foods coming into the household from the farm or the market during each month was used as measure of household food availability.

In the determination of the energy needs of individuals in each household in the study, it was important to standardize household size. This was done through an approximation of the relative needs of the different household members by using consumer units. One consumer unit was equivalent to the energy needs of a reference adult male between 20-29 years of age and who was assigned a consumer unit of one with a corresponding energy requirement of 2960 kilocalories or 12.4 mega joules per day. All other individuals were expressed as a ratio of the reference adult male taking into account age, sex, body size, pregnancy, infections and the activity levels. The different conversion factors used in calculating the energy requirements of the different household members are presented in Table 1. Household's daily, monthly, and yearly energy requirements were then computed from the number of consumer units in each household. During the data analysis, households were grouped into different categories at a time, and compared. These categories were based on land size, household size, and composition (i.e households with a children, or with elderly persons), and the energy availability and requirements calculated for each category.

In order to determine the economic activities and possible sources of income of the adult members of each household, information on income earned by adults physically residing in the household during the past month was obtained by recall from each individual where possible, or from another adult. Sources of income were then classified by type (agricultural or non-agricultural), and by the amount of money earned per unit of time spent on the job.

All the data were analysed by the Systat Programme (Wilkinson, 1989), using Apple Macintosh computers. The Kruskal-Wallis one way analysis of variance test was used to compare the differences in energy availability to the three household size groups while the Wilcoxon-Mann Whitney test was used for the land size and household composition groups.

RESULTS

Table 1 presents the conversion factors (consumer units) used in calculating the energy requirements of the different household members in the study.

Table 1
Consumer units (CU) used in calculating individual and household energy needs*

age (yrs)	male cu	female cu
0	0.3	0.3
1	0.4	0.4
2-4	0.5	0.5
5-7	0.6	0.6
8-10	0.7	0.7
11-16	0.8	0.7
17-19	0.9	0.7
20-29	1.0	0.8
30-39	1.0	0.8
40-59	0.9	0.7
60 +	0.7	0.6

*Source: Focken et al. (1992)

The characteristics of the household heads are presented in Table 2. Of the ninety four household heads, seventy-seven or 82 percent were male and 18 percent were females. The majority, about 56 percent, had received primary level or adult education, 22 percent had attended high school, while 22 percent had no formal education. There were a total of 594 individuals in the households studied comprising of 273 males and 321 females. 71 percent of the households were large with more than four persons in each household while the remaining twenty nine percent had four or less persons each.

The ownership of property and livestock was very modest among all the households as reflected on Table 3. Sixty-eight percent of the households owned between two and three acres of land while the remaining 32 percent had less than two acres of land. Forty two percent of the households kept grade cows for milk production, while another twenty nine percent kept native cattle. Sheep and goats were kept by forty four percent of the households. Nearly all households kept a few chickens which were mainly for home consumption.

Table 2
Characteristic of household members

characteristics	number	percent
number of households	94	100
sex of household head		
male	77	82
female	17	18
marital status of household head		
married	77	81
single	2	2
separated	2	2
widowed	14	15
education level of household head		
high school	21	22
primary school	51	54
adult education	2	2
no education	20	22
household size by category		
1.0 - 4 persons	27	29
4.1 - 7 persons	34	36
7.1 -16 persons	33	35
total population in all households	594	
male	273	46
female	321	54

Seasonal variations in household food production

The food production pattern in the study area is clearly unimodal and seasonal in nature as presented in Figure I. The main staple food grown in the area is maize which is planted during the long rains in March or April and harvested between November and January. A few other crops are interplanted with maize. These are early maturing crops such as beans, peas, potatoes and a variety of vegetables that are harvested in smaller quantities in the months of July and August which explains the rise in the production curve in Figure 1.

Table 3

Household ownership of property and livestock

variables	numbers	percent
number of households	94	100
land owned		
1 - 1.99 acres	30	32
2 - 3 acres	64	68
livestock owned		
grade cows		
one cow	22	24
2 - 4 cows	17	19
native cows		
(1-3) cows	27	31
sheep and goats		
2 - 5 sheep/goat	30	33
6 - 14 sheep	10	11
poultry		
20 or less	62	71
21 or more	2	2

The food purchases did not seem to be affected by the seasonal fluctuations in food production and availability, as they remained low in both the lean and the harvest months. This means that the households depended more on their own production than on purchased foods.

The maize crop in the study area takes between eight and nine months to mature, from planting to the harvest. As such only one crop can be grown in one year. It requires high levels of water at different stages of growth which means that the timing and duration of the rains are crucial in determining the amount of maize harvested in any given year. In 1992, the bean crop was poor due to the lateness of the long rains, however, the maize and potato harvests though not very good were considered normal for the area. Seventy-six percent of the energy required by the households over the fourteen months of our study came from own farm production and only 12 percent was bought. However, the combined energy from own production and purchases did not meet the energy requirements of these households as they provided only about 88 percent of their total energy needs as shown on Table 4 (part a). Sales and foods given away accounted for about 9 percent of all the foods produced by the households during the study period.

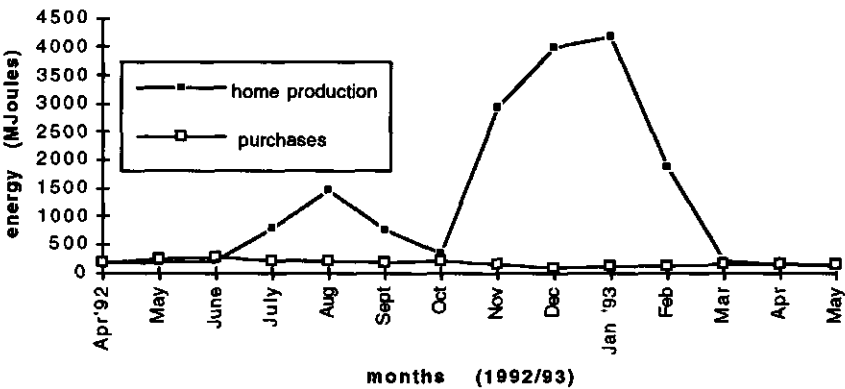


Figure 1 Household energy available from own production and purchases

The food purchases were slightly higher during the lean months of 1992 than in the harvest months, but total food purchases remained low throughout the year as presented in Figure 1. Foods purchased on regular basis included basic food items like sugar and tea leaves, cooking fat and oils. However, during the lean months some households were purchasing staple foods such as cereal grains and flours as well as potatoes and vegetables, but in smaller quantities. Wheat flour, bread and rice were purchased by only 30 percent of the households during each month. As they are expensive foods, they are considered as status foods which are not easily available to the poor households in this community. Meat was purchased irregularly by only about seven percent of the households, and the amounts purchased were low, averaging two kilograms per month.

There was a very low dependence on food gifts throughout the year, except in the month of August when six percent of the monthly energy needs came from food gifts. These gifts comprised of purchased food items such as sugar, bread, cooking fat, and other foods which were brought into the household by visiting relatives from the towns.

Food availability by household size

In order to determine the effect of household size on energy availability, households were grouped into three categories namely; those with less than four members (small), those with four to seven members (medium), and those with more than seven members (large). The three categories comprised of twenty-seven from small, thirty four from medium, and thirty-three households from large respectively. Analysis based on this categorization showed that the smaller households were better off in terms of available energy than the medium or large households. The small households were also able to meet all their energy requirements during the period of our study, and to have excess, while the medium and large households were not able to produce or purchase enough energy to meet their requirements. The medium and large size households had greater energy deficits over the study period than the smaller households, with deficits increasing with increasing household size. The latter two groups produced about 95 and 68 percent of their energy requirements respectively, while the smaller households had

more than 181 percent of their energy needs. The total amount of energy available to the different household size categories as well as the percentage of energy met from own production and purchases are presented on Table 4 (part b). The differences in available energy per consumer unit was significant ($p<0.001$) between the three household size categories during each of the study months and for the total period, with the small households having more energy per consumer unit than the other two groups. The fluctuations in energy available per consumer unit during different months of the study are shown on Figure 2.

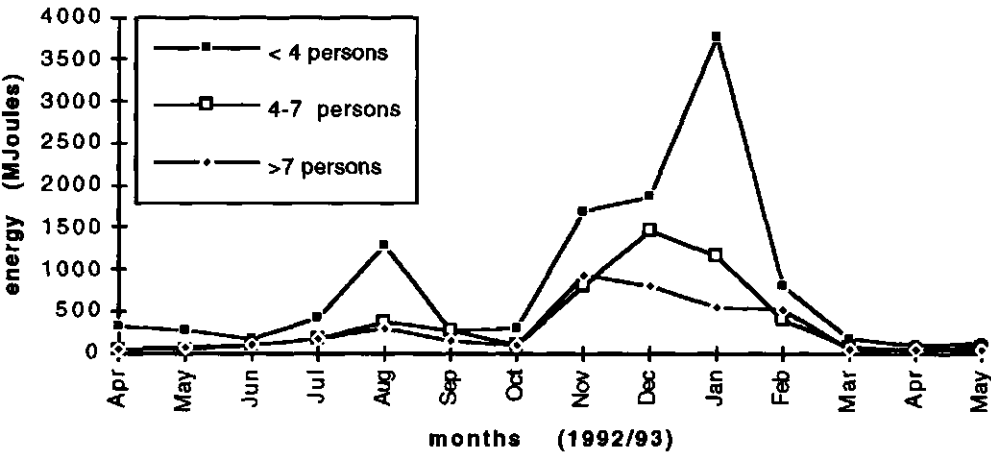


Figure 2 Household energy availability per consumer unit by household size

Food availability by land size

The relationship between the amount of land owned and food availability was examined by grouping the households into two land size categories; those with less than two acres (<0.8 ha) and those with more than two acres (>0.8 -1.21 ha). As land size was one of our selection criteria, the maximum amount of land owned by the households in this study was three acres. The data presented on Table 4 (part c) show that the households with larger farm sizes produced

more food than the smaller farm households, but none of the two groups was able to satisfy its energy needs, as both landsize groups met only about 88 percent of their energy requirements from own production and purchases, leaving a deficit of 12 percent unfulfilled. The larger farm households had significantly more total energy per consumer unit ($p < 0.002$) than the smaller farms, but monthly energy levels though different, were not significant.

Figure 3 shows the monthly fluctuations in energy available per consumer unit for the different landsize groups. As stated above, none of the landsize groups met their energy needs when the requirements for the whole period were calculated. The results seem to indicate that land size of less than or equal to three acres is not adequate to supply the energy needs of rural households, especially those living in unimodal climatic patterns where food production is restricted to one harvest season per year.

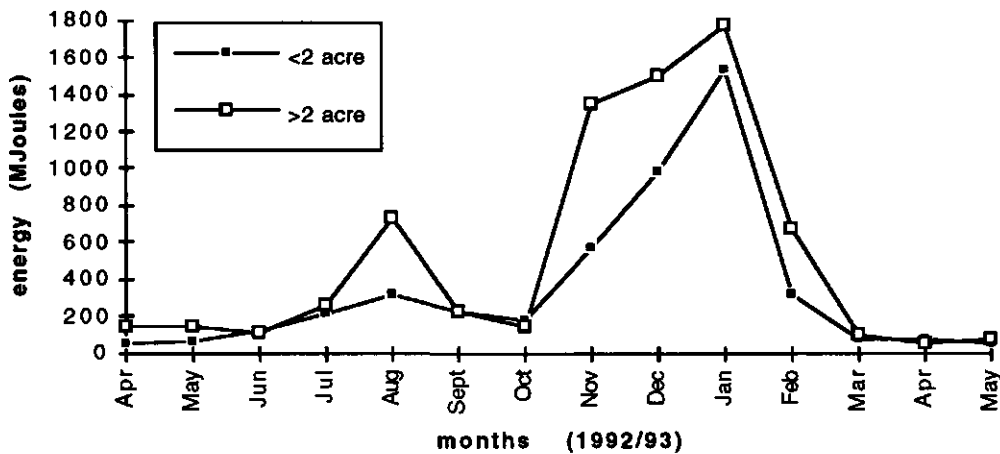


Figure 3 Household energy availability per cu by landsize

Food availability by household composition

Further household groupings were done in order to assess the food availability in households with varying member compositions. This was done by separating households with preschool children and those having elderly members and calculating their energy production and purchases during the period of the study. The households with lactating women were left out from this analysis because there was no clear-cut differences between them and the child households. Table IV (part d) presents the results obtained when the households were grouped according to household composition. These results show that households with preschool age children had much less food available for the whole study period than the elderly households. While the child households met only about 62 percent of their energy requirements from own production and purchases, the elderly households had 115 percent from the same sources. Similarly, the households with elderly persons had much more food available per consumer unit per month and in total, for the combined study months than households with children, as presented in Figure 4.

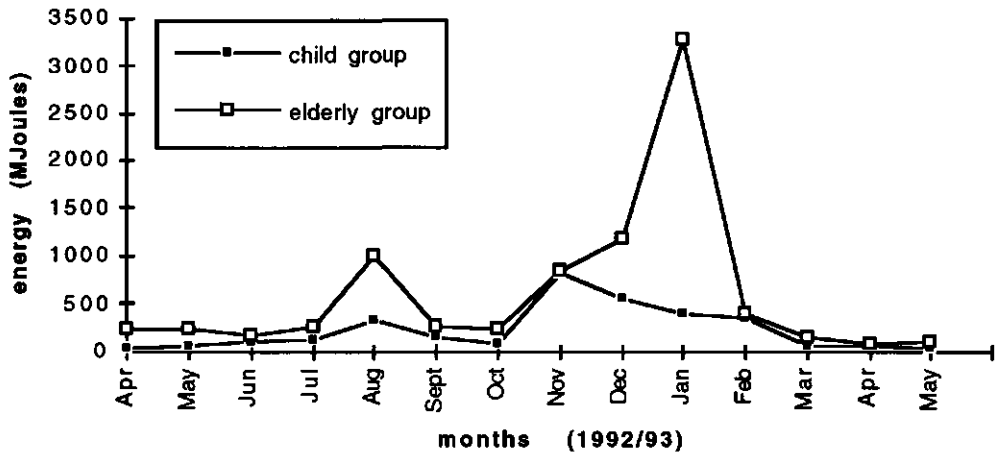


Figure 4 Household energy availability per cu by household composition

Table 4

Household energy availability in relation to requirements by different groups (MJ)*

	n	monthly requirements	14-month requirements	total energy available	percent of requirement
a) <u>all households</u>					
	94	1455 (847)	20366 (11862)	17968 (14457)	88
b) <u>by household size</u>					
< 4 persons	27	502 (229)	7031 (3211)	12731 (13535)	181
4-7 persons	34	1371 (396)	19201 (5550)	18231 (13548)	95
>7 persons	33	2320 (581)	32478 (8128)	21982 (15148)	68
c) <u>by landsize</u>					
< 2 acres	30	962 (547)	13474 (7655)	11801 (11039)	88
2-3 acres	64	1686 (868)	23597 (12146)	20859 (15028)	88
d) <u>by composition†</u>					
children	24	2060 (673)	28845 (9426)	17860 (14291)	62
elderly	36	952 (737)	13332 (10312)	15374 (13144)	115

* means (Standard Deviations)

† households with lactating women were left out of this analysis due to complications arising from the presence of preschool children in these households.

Seasonal variations in economic activities

The economic activities available to this community were limited and seasonal in occurrence. One of the reasons is that the area was located far from the large commercial farms and from large towns where casual labour would be in greater demand. During the rainy season however, casual farm work was available from the better off neighbours and many households participated. However, this was possible for only short periods of the year during land

preparation and weeding during the months of June and July. Other sources of income included off-farm casual employment and small businesses within the market centres located along the main roads. Table 5 shows the participation of the households in the economic activities in both agricultural and non-agricultural (off-farm) employment, as well as the mean monthly income realized from these activities by the participating households. As can be seen from this table only a few households participated in economic activities during each month of the study, with a maximum of 60 percent in the month of July when the agricultural activities were at their peak.

Table 5
Mean monthly income by economic activity type*

month 1992/93	agricultural		non-agricultural		households involved	
	n	amount	n	amount	total	percent
April	17	505	22	1084	39	42
May	18	233	20	1009	38	40
June	28	311	22	966	50	53
July	24	286	32	1206	56	60
August	15	404	29	1085	44	47
September	13	208	30	1210	43	46
October	11	330	33	1310	44	47
November	11	415	36	1010	47	50
December	10	361	22	822	32	34
January	8	400	22	1304	30	32
February	14	281	24	1094	38	40
March	16	442	27	1052	43	46
April	13	280	29	1063	42	45
May	11	295	18	1665	29	31

* income earned is in Kenya shillings

The income obtained from off-farm activities per month was always higher than that from agricultural activities. The main reason for this difference may be due to the fact that most off-farm employment required a skill such as carpentry, masonry or driving. Throughout the study period only seventy four percent of the households participated in some form of economic activity. The remaining twenty six percent did not participate in any economic activity, either due to age (especially for the elderly households), but mainly due to lack of employment opportunities in the area. The unimodal rainfall pattern seemed to reduce the number of months during which hired farm labour was needed, thus reducing the casual employment opportunities of the household members.

DISCUSSION

Household food security has been defined as a state in which households have continuous access to food supplies which can fully satisfy the nutritional and dietary needs of all its members (Frankenberger et al., 1993; WHO, 1993). Such a situation would imply that a household has the capacity to procure adequate food supplies on a stable basis and in a sustainable manner. In the assessment of household food security, some researchers have used the traditional definition of household food security which refers to food sufficiency in terms of energy available to a household, while others have taken a broader view which takes into account dietary adequacy with respect to other nutrients. The former method is said to be appropriate for populations suspected to suffer from chronic energy and protein deficiency (Greer and Thorbecke, 1986), and it was the one used in this study.

The data from this study indicate that seasonality is an important determinant of household food security in areas with unimodal climatic pattern because one rainfall season determines the types and amounts of foods that can be produced. As such, the timing, duration, and amount of precipitation of these rains are directly related to the amount of food which is harvested each year. Failure of the rains may mean either total or partial crop failure, thus exposing the household to food insecurity during that year and the following one. For the rural populations

living under similar circumstances like those in our study and who depend mainly on their own food production, a crop failure could mean hunger and malnutrition for all household members, but much more seriously for the vulnerable ones especially young children. The maize harvests in 1992 were considered normal for this area. However, analysis of our data show that the production did not meet the energy needs of the households in the study, even when it was combined with food purchases and gifts. It should be mentioned here that during data collection and subsequent analysis, no adjustments were made for food losses during storage or through other ways such as during processing or cooking. If this was done, the energy available to the households would be slightly less than what is presented in the tables. Due to lack of adequate resources, no attempt was made to measure foods in storage to determine when stocks from the previous harvest run out.

The food purchases were extremely low and did not seem to be influenced by seasonal fluctuations in food production from own farms. This finding is contrary to reports from other studies (Reardon et al., 1988; Neumann et al., 1989; Hoorweg et al., 1991; Foeken and Tellegen, 1992; Leonard et al., 1993), which reported increased food purchases in rural households when home produced stocks decreased. However, this observation could be attributed to the fact that our study sample belonged to the more economically deprived group of smallholder farmers in this area, as they had small land holdings and no permanent sources of income. Food prices tend to rise during the lean seasons as observed in Benin (van Liere, 1993). This would imply that when food stocks from own farm production diminished, these households did not have financial resources with which to purchase supplementary foods to fill the energy gap. As such, they were likely to be food insecure during some months of the year resulting from seasonal fluctuations in the food production cycle. In a unimodal climatic pattern such as found in the study area, the harvest months were fewer than the lean months and it is likely that one harvest may not be adequate to meet the energy needs of an average sized household.

Household size was found to be a major determinant of whether a household was food secure or insecure. Kenyan rural families are large, averaging seven members and the poorer households are larger than non-poor ones (Greer and Thorbecke, 1986). This means that while

large families have excess labour, they have lower farm operating surpluses and less land on which to grow food. As such they end up having lower total food production, as well as reduced consumption per consumer unit than smaller households. This study found that small households (those with less than four members) had significantly more total energy as well as more energy per consumer unit than the medium and large households and the deficits increased with increasing household size. This pattern of household food insecurity due to large household sizes is similar to that reported for rural households in Kenya by Greer and Thorbecke (1986), based on results from the Integrated Rural Survey I of 1974/75. This survey found that 18 percent of one member households had inadequate intakes, compared to 38 percent of households with six to seven members and 66 percent of households containing sixteen or more members.

The size of land owned by the household was found to be closely associated with total energy produced per month and per consumer unit, with the larger farm households producing more food. However, none of the two landsize groups was able to meet its energy needs, as each group produced only 88 percent of their energy needs. This observation would be interpreted to mean that three acres of land, which was the largest amount owned by the households studied, was not adequate to meet the food needs of an average household in our study and this may be true for other areas in Kenya which have similar environmental characteristics as those in our study. The World Bank (1973), estimated that an average sized household relying exclusively on own farm production in Kenya needs about 2.6 hectares (6.4 acres) of high quality land to provide adequate food and income. Our results seem to support this recommendation. However, despite this generous definition most smallholders in Kenya are truly small and they are getting smaller as land subdivision continues due to the high population pressure.

Several studies have reported an association between small landholdings and household nutritional status particularly with young children (Omawale and McLeod, 1984; Haaga et al., 1986, Valverde et al., 1977; Victora et al., 1986). Although our data does not include information on household nutritional status, our results support the fact that small land sizes were responsible for the low levels of food production as reflected in the energy deficits

observed in our study. Households which are energy deficient are also likely to have deficiencies in other nutrients.

The comparison between the energy available to households with children with those of elderly subjects showed that child households were more food insecure than elderly households. The possible explanation for this outcome is that most elderly households were likely to be small-sized, while those with children were mainly large-sized. These results are of concern because such a deficit in energy availability in the households with children will have far reaching nutritional consequences, especially if this cycle of deficiencies recurs every year with respect to energy and other nutrients. This subject needs further examination.

Purchasing food is one of the normal household responses to food shortages resulting from seasonal fluctuations or due to crop failure, as observed in several studies (Haaga et al., 1986; Reardon et al., 1988; Neumann et al., 1989; Heyer, 1990; Hoorweg et al., 1991; Foeken and Tellegen, 1992; Leonard et al., 1993). However, the level of purchases is also determined by whether there are adequate means of acquiring cash. In our study, cash acquisition was a significant problem since employment opportunities were scarce and somewhat seasonal. It has been proposed that low consumer expenditure is an indicator of poverty and therefore, an indicator of malnutrition (Schuftan, 1979). While our study did not measure expenditures on other other items besides food and only measured energy purchases, we cannot make any conclusions at this point about household expenditures. However, it can be argued that failure by the households to purchase adequate foods to supplement deficiencies from own production, as observed in this study, may be an indicator by itself of household poverty.

The present study demonstrates that the poor households in Kenya's smallholder agricultural areas suffer from intermittent food shortages, some of which may be acute. Secondly, it shows that large family sizes, small land sizes and seasonality are confounding factors to household food security. It has been estimated that the number of the poor and economically deprived households in Kenya is higher in agricultural areas than in urban or in pastoral areas (Heyer, 1990). Yet it is those in small agricultural areas that are often described as being self sufficient in food production, and are therefore likely to be neglected by government policy and development programmes. Our study shows that these households are not self sufficient in food

production and that many of them do not have the means of acquiring cash with which to purchase additional foods to supplement their production shortfalls.

The role played by the early maturing crops in ensuring food availability in a household is an important one in that they break up the long lean season. However, most of the families put most of their land under maize crop, and leave a very small portion for the short season crops. As maize crop normally takes many months to mature and has a higher chance of crop failure if the rainfall is delayed or inadequate, it appears that the smallholder families would be better off if they allocated more land to the early maturing food crops such as beans, potatoes and peas, than they are presently doing.

The results from this study lead to the conclusion that, smallholder rural families living in unimodal climatic areas in Kenya are food insecure during most months of the year, and this insecurity is probably enhanced by large household sizes, inadequate land per household, and by lack of employment opportunities within the smallerholder rural areas.

ACKNOWLEDGEMENT

We wish to thank Rudo Niemeijer for the technical assistance during the and testing of the questionnaires, to the ren enumerators who worked tirelessly throughout the study, and to all the families for their cooperation. The funds for this study came from a grant to the first author from the International Development Research Centre, Canada. Additional financial, technical and material support was provided by the Food and Nutrition Studies Programme, a project in Kenya which is supported by the Netherlands Government through the African Studies Centre, Leiden.

REFERENCES

- Campbell, D. J. (1990). Strategies of coping with severe food deficits in rural Africa: A review of literature. *Food and Foodways* 4: 143-162.
- Delisle, H., M. Alladoumgue, F. Begin, K. Nandjiger, C. Larsorsa (1991). Household food consumption and nutritional adequacy in Wadi zones of Chad, Central Africa. *Ecology of Food and Nutrition* 25: 229-248.
- FAO (1970). Food Composition Table for use in Africa. Food and Agriculture Organization, Nutrition Division, Rome.
- Ferro-Luzzi, A., C. Scaccini, S. Taffese, B. Abera, T. Demeke (1990). Seasonal energy deficiency in Ethiopian rural women. *European Journal of Clinical Nutrition* 44 (Suppl 1): 7-18.
- Foeken, D., P. Leegwater, R. Neimeijer, W. Veerman, J. Hoorweg (1989). Seasonality in the Coastal Lowlands of Kenya. Report No. 32. Ministry of Planning and National Development, Nairobi, Kenya; and African Studies centre, Leiden, Netherlands.
- Foeken, D. and N. Tellegen (1992). Household resources and nutrition of farm labourers in Trans Nzoia district, Kenya. Report no. 44. Ministry of Planning and National Development, Nairobi, Kenya, African Studies Centre, Leiden, Netherlands.
- Frankenberger, T., A. Pena-Montenegro, S. Tilakaratna, N. Velarde, W.B. Eide (1993). Technical issues in rural Poverty alleviation; Rural poverty alleviation and nutrition: IFAD's evolving experiences. International Fund for Agricultural Development. Rome.
- Greer, J. and E. Thorbecke (1986). Food poverty and consumption patterns in Kenya. International Labour Organization. Geneva.
- Haaga, J., J. Mason, F. Z. Omoro, V. Quinn, A. Rafferty, K. Test, L. Wasonga (1986). Child Malnutrition in rural Kenya: A geographical and agricultural classification. *Ecology of Food and Nutrition* 18: 297-307.
- Heyer, J. (1990). Poverty and Food deprivation in Kenya's Smallholder Agricultural Areas. In J. Dreze and S. Amartya (eds.). The political economy of hunger. Clarendon Press. Oxford.

Hoorweg, J., R. Niemeijer, D. Foeken, W. Okello, W. Veerman (1991). Economic and nutritional conditions at settlement schemes in coast province. Report No.36. Food and Nutrition Planning Unit, Ministry of Planning and National Development, Nairobi, Kenya; African Studies Centre, Leiden, Netherlands.

Leonard, W. R., K. M. Dewalt, J. E. Uqillas, B. R. Dewalt, (1993). Ecological correlates of dietary consumption and nutritional status in highland and coastal Ecuador. *Ecology of Food and Nutrition* 31: 67-85.

van Liere, M. J. (1993). Coping with household food security: a longitudinal and seasonal study among the Ottomari in North-western Benin. PhD thesis. Wageningen Agricultural University.

Mason, J. B., T. Ahlers, C. Henderson, I.J. Shorr, Tabatabai (1985). Identifying nutritional considerations in planning a rural development project in N. Haiti. *Ecology of Food and Nutrition* 18: 1-17.

Melville, B. F. (1988). Are land availability and cropping pattern critical factors in determining nutritional status?. *Food and Nutrition Bulletin* 10: 44-48.

Neumann, C., R. Trostle, M. Barksh, D. Ngare, N. Bwibo, (1989). Household response to impact of drought in Kenya. *Food and Nutrition Bulletin* 11: 21-33.

Omawale and J. C. McLeod (1984). Food consumption and poverty in rural Jamaica. *Ecology of Food and Nutrition* 14: 297-306.

Reardon, T., P. Matlon, C. Delgado (1988). Coping with household-level food insecurity in drought affected areas of Burkina Faso. *World Development* 16(9): 1065-1074.

Schuftan, C. (1979). Household purchasing power deficit; A more operational indicator of express malnutrition. *Ecology of Food and Nutrition* 8: 29-35.

Teokul, W., P. Payne, A. Dugdale (1986). Seasonal variations in nutritional status in rural areas of developing countries: A review of literature. *Food and Nutrition Bulletin* 8: 7-10.

Valverde, V., R. Martorell, V. Meija-Pivaral, H. Delgado, A. Lechtig, C. Teller, R.E. Klein (1977). Relationship between family land availability and nutritional status. *Ecology of Food and Nutrition* 6: 1-7.

Victora, C. G., J. P. Vaughan, B. Kirkwood, J. C. Martines, L. B. Barcelos (1986). Child malnutrition and land ownership in Southern Brazil. *Ecology of Food and Nutrition* **18**: 265-275.

Wandel, M. (1989). Household food consumption and seasonal variations in food availability in Sri Lanka. *Ecology of Food and Nutrition* **22**: 169-182.

West, C.E, F. Pepping, I. Scholte, W. Jansen, H. F. F. Albers (Eds.) (1987). Food composition table for foods commonly eaten in East Africa. CTA and ECSA. Wageningen.

WHO/FAO (1993). World Declaration on Nutrition : Plan of Action. WHO/FAO.Geneva/Rome

Wilkinson, L. (1989). SYSTAT: The System for Statistics. Evanston..

World Bank (1973). Agricultural Sector Survey - Kenya. Washington D.C.

CHAPTER 3

CHILD MALNUTRITION IN POOR SMALLHOLDER HOUSEHOLDS IN RURAL KENYA: An indepth situation analysis

Hilda N. Kigutha, Wija A. van Staveren, Willem Veerman, and Joseph G.A.J. Hautvast

ABSTRACT

The effects of seasonal changes in household food availability on the nutritional status of preschool children from low income smallholder rural households was investigated over a 15-month period in Nakuru district, Kenya. The study comprised of 41 children (22 girls and 19 boys) aged between 18 and 36 months at recruitment. Dietary intakes and body weights were measured on monthly basis while length was measured at baseline and at two other periods selected to represent the harvest and the lean seasons. Significant seasonal differences in intake of energy, calcium, vitamin A, thiamin, and riboflavin were observed, but not with protein, fat, iron, niacin and vitamin C. The level of energy intake was however, more dependent on the type of diet rather than on household food availability per se. There were no significant seasonal differences in mean body weight changess which increased at an average rate of 182 g/month. Mean length increased at a rate of 0.90 cm/month during the lean season and at 0.80 cm/month during the postharvest months. About 51 percent of the children were stunted during the lean season compared to 28 percent in the postharvest months, but the level of wasting was low even during the lean season. An association between household size, landsize, sex, and the nutritional status of the children was observed. The results indicate a seasonal dietary intake and nutritional problem for preschool children from low income households in Kenya.

INTRODUCTION

Child malnutrition is a widespread public health problem in the rural areas of the developing countries. Some of the factors associated with child malnutrition in these areas are landlessness, general poverty, infections and poor dietary intakes. Seasonal fluctuations in food production and household food availability are common in the tropical and subtropical regions of the world, and they are reported to complicate the malnutrition problem by causing cyclic losses and gains in body weight, and retardation in linear growth (Rowland et al., 1977; Chen et al., 1979; Brown et al., 1982 ; Hassan et al. 1985; Begin, 1988; Neumann et al., 1989; Ategbo, 1993; Branca et al.,1993; Pastore et al., 1993). The nutritional impact of seasonality ranges widely according to the severity of the environmental stress and the success of the socio-economic avoidance strategies (coping strategies) adopted by the community or household. In areas with unimodal climatic patterns, in which there is one rainfall and one harvest season per year, the period of food shortage is normally longer than in those areas with bimodal climates. As such it is likely that children and other household members from unimodal climatic areas suffer more and longer nutritional insults than their counterparts in the bimodal climatic areas.

The most common forms of malnutrition affecting children in the developing countries are wasting and retardation in linear growth or stunting (Allen, 1994; Golden, 1994; Martorell et al., 1994; Neumann and Harrison, 1994; Waterlow, 1994). The causes of growth faltering and weight loss varies from one context to another, but the majority can be explained by childhood infections, parasitism, and by diets which are inadequate in both quality and quantity (Martorell and Klein ,1980; Allen et al., 1991; Stephenson et al., 1993).

Studies from the farming communities in the rural areas of Kenya, Brazil, Jamaica, and Haiti, have reported an association between land ownership and child nutritional status (Omawale and McLeod, 1984; Mason et al., 1985; Haaga et al., 1986; Victora et al., 1986; Melville, 1988). Malnutrition was reported to be more prevalent in rural landless than in landed households. Some of the studies reported a positive correlation between land size and child nutritional status (Valverde et al., 1977; Omawale and McLeod, 1984; Haaga et al., 1986; Victora et al.,1986). These studies provide some evidence that a relationship exists between the amount of land

owned by a household and the nutritional status of household members especially that of preschool age children.

More than eighty percent of Kenya's population lives in the rural areas where the land is subdivided into family plots of a few acres each. The majority of the smallholder households own on average, about 2.5 acres of land while others have less, irrespective of household size. A national child and nutrition survey conducted in 1987 in Kenya found that most children from the smallholder rural areas of the country still suffer from various levels of malnutrition, the most common being stunting (Central Bureau of Statistics, 1991). The purpose of this study was to investigate how climatic seasonality affects the nutritional status of preschool children from low income smallholder rural households living in a unimodal climatic area in Kenya. The study aimed at providing answers to the following questions: 1) what is the effect of a unimodal climatic pattern on food consumption and the nutritional status of preschool children? 2) what is the effect of household size and land size on the nutritional status of these children?

STUDY DESIGN AND METHODS

Background of the study area

The study was carried out in Njoro division within Nakuru district in Kenya, which is one of the thirteen districts in the Rift Valley Province. Njoro is situated in the mid western part of the country about 200 kilometres from Nairobi, the capital city. Nakuru is one of the districts in Kenya with a unimodal climatic pattern. Before independence in 1963, most of the land in the district was owned and farmed by a few white settlers. The local people were hired to assist in farm work and lived in villages situated on the large farms as squatters. After independence in the early 1970s, many families either from the squatter communities or from outside the district formed land buying cooperative societies and bought these farms collectively and then subdivided them among themselves, each family getting a portion of land worth the money contributed. The average size of land per household in this area is about two and a half acres (about 1 hectare). The lean season normally starts from May to October, with June and July

being the leanest months in terms of food availability. The maize harvest season starts from November to January, while small harvests of the early maturing crops such as beans, potatoes, and a variety of vegetables take place in the months of July and August.

Subjects

The study population consisted of preschool age children between the ages of 18 and 36 months selected from low income households in four cooperative farms namely; Mutukanio, Kamwago, Sosirot, and Kamwaura. Selection was done from a sampling frame prepared after a census covering all the households in these farms and in which households with children falling within the age category stated above were listed. Besides having a child households were included in the sampling frame if they were smallholders owning between 1-3 acres of land, and the parents did not have regular monthly incomes of more than five hundred Kenya shillings (about US\$ 25). From this list a random sample of 45 households was obtained from a sampling frame of 314 eligible households. The selected households were revisited by the researcher who explained the details of the study to the parents of the children and sought approval. During this visit the parents were interviewed further about the child's age, income levels, and on land ownership. Of the selected households, one refused to participate on religious grounds, one was disqualified due to wrong age, and two families moved out of the area. At the end of the study we have complete data sets for forty-one children. A household was defined as a group of persons sharing one common pot.

Study design

The study was carried out over a period of 15 months from April 1992 to June 1993, covering both the harvest and the lean seasons. Prior to the study, a pilot study lasting for three months and covering twenty-five households was undertaken in a different farm with similar characteristics as those studied. During the pilot phase questionnaires were developed and tested, and appropriate measurement techniques were developed and practiced. The pilot phase

was also used to train the field assistants. Pre-coded questionnaires were developed which were used to record the data on food preparation, food consumption, anthropometric measurements and morbidity patterns

Anthropometric measurements

The anthropometric measurements taken included body weight and length of the children. The body weights were taken every month for 15 months by the field assistants. Weight was measured to the nearest 0.1 kg using digital display Tefal scales placed on a flat surface. The subjects wore light clothing, no shoes, and stood upright with the head in a horizontal plane. All the measurements were done in the subjects' homes, and the scales were checked before each measurement using test weights. A correction for clothing was made during data analysis on body weights by subtracting 150 grams from all the weight measurements.

The length was measured with the subject lying in a supine position on a stadiometre which had a fixed head rest and a movable foot piece and placed on a flat surface. Care was taken to maintain the subject's head in an upright position, with legs stretched to a full extent and feet at right angles with the legs. Length measurements were recorded to the nearest 0.1 cm using a non-stretchable measuring tape. The length measurements were taken three times during the 15 months of the study, with the measurement periods timed to coincide with two lean seasons in 1992/1993 cropping year and one post harvest season in early 1993.

Age was obtained directly from the mothers or from child documentations such as birth certificates, clinic cards or baptismal certificates. In absence of these, an events calendar was used. Seasonal nutritional impact was evaluated by measuring attained weight and length. Weight-for-age, weight-for-length, and length-for-age as well as their corresponding standard deviation scores (Z-scores) were calculated with reference to the National Centre for Health Statistics (NCHS) population, using the methods suggested by the World Health Organization (WHO, 1983). A ZWH score of 2 or -2 means that the child is 2 SD above or below the median weight-for-length respectively. Similarly, a ZHA refers to the Z-score for length-for-age, while ZWA refers to the Z-score for weight-for-age. Based on the Z-scores children were classified

according to suggestions by Waterlow (1973) as normal ($ZWH > -2.0$, and $ZHA > -2.0$), wasted ($ZWH < -2.0$ and $ZHA > -2.0$), stunted ($ZWH > -2.0$ and $ZHA < -2.0$), or wasted and stunted ($ZWH < -2.0$ and $ZHA < -2.0$). Monthly weight-for-age Z-scores were computed for all children who had been measured, and the means were used as indicators of the changes in the nutritional status of these children during different months of the study.

Morbidity patterns

The morbidity pattern for each child was assessed once each month from recalls administered to the mother and covering illnesses affecting the child during the past seven days. The diseases that the mother was questioned about included colds, fever, diarrhoea, vomiting and any other disease symptoms which could have affected the child's appetite and food intake.

Dietary intake

Energy and nutrient intake was determined on monthly basis by the 24-hour recall method. At three periods selected to represent each of the seasons, dietary intakes were assessed for six days for each subject. This was done by use of 3-day weighed record method on 3 alternate days, while the three days between them were assessed by the 24-hour recall method (Cameron and Staveren 1988). This combination of the observation and recall methods was applied to enable us to collect food intake data for six days without being too much a burden to the respondents. Food consumption for all Sundays was obtained by the recall method.

During the observation days, all food ingredients were weighed to the nearest gram before cooking using digital display Tefal scales, and at the the end of preparation, the whole dish was weighed before the food was served. The child's portion was weighed separately and any left-overs at the completion of the meal were deducted from the original serving. Snacks and other foods such as fruits which were consumed by the subject outside the main dish were also weighed and recorded to the nearest gram. The measurements were done from around 7.00 am until the subjects had eaten their last meal (usually around 8.00 pm). Foods consumed away

from home or when the assistant was absent were determined by recalls. The measurements were done by well trained assistants recruited from the study areas.

During the 24-hour recalls, the person who prepared the food was asked to describe all the dishes that were prepared in the house during the previous day, as well as all the ingredients that went into each dish. The person was also asked to use the same utensils as in the previous day and measure replicas of similar ingredients like the day before, where possible. The measured ingredients were then weighed on the scales and the quantities recorded to the nearest gram. For liquid ingredients water was used to estimate volume, if the actual ingredient used the day before was not available.

The nutritive value of all the ingredients used in the preparation of the different dishes and for all the foods consumed by the subjects was determined by using appropriate food composition tables mainly those developed by CTA-ECSA for use in East, Central and Southern African countries (West et al., 1987), and those by the Food and Agricultural Organization for use in Africa (FAO, 1970). The nutrients of interest to this study were energy, protein, fat, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C. Nutrient intake of each subject was obtained by averaging the intake of the six days. To determine levels of intake in relation to the recommended dietary intakes (RDI), the subjects' intakes were compared to the RDI by the Food and Agriculture Organization (FAO, 1988), and those of the National Research Council (1989), for children of the same age group.

Statistics

All the data were analysed by the Systat programme (Wilkinson, 1989) using Apple Macintosh computers. The unpaired t-tests were used to compare the Z-scores between boys and girls and between different household size and land size categories, while the paired t-test was used to compare energy and nutrient intakes between different seasons (Snedecor and Cochran, 1980).

RESULTS

A total of 41 children completed the study comprising of 22 girls and 19 boys. They had a cumulative mean age of 32.8 (SD 6.1) months, weight 11.6 (SD 1.8) kg, and height of 87.1 (SD 6.0) cm. The girls were slightly older than the boys by 1.3 months, while the boys were heavier and taller than the girls by 1.0 kg and 2.4 cm respectively, but the differences were not significant.

The morbidity rate was on average of 4.5 (SD 1.8) sick days per month. The most common illnesses included colds and fever, which were slightly higher during the cold months of July and August compared to the other months, however there were no significant differences in the seasonal occurrence of illnesses. There were also no significant differences in the number of sick days between boys and girls.

The mean daily energy and nutrient intakes of the subjects during the different seasons are presented in Table 1. There were significant seasonal differences in intakes of energy ($P<0.01$), calcium ($P<0.003$), vitamin A ($P<0.002$), thiamin ($P<0.001$) and riboflavin ($P<0.01$), between the preharvest months of 1992, and the postharvest months in 1993, but not with respect to protein, fat, iron, and niacin. The differences in intakes of all the nutrients during the postharvest and the lean months in 1993 were not significant except for thiamin which was higher in the lean months of May and June 1993 than during the postharvest months of January and February and in the lean months of 1992.

The subjects satisfied more than 90 percent of their recommended dietary intakes for protein, vitamin A, vitamin C, thiamin, and riboflavin, based on the National Research Council recommendations (1989). The energy intakes were lowest at about 82 percent of RDI during the lean months between June and August 1992, but they remained fairly stable at about 89 percent of RDI per day during the other study months. The dietary intake of iron was adequate from the calculations, but when the values were adjusted to allow for the low bio-availability of plant iron, (FAO, 1988), the dietary iron provided on average a daily intake of 86 percent of the RDI during different months of the study.

Calcium intake was low during most months and ranged from 47 percent to 66 percent of RDI, with a mean intakes of 54 percent per day per month. Similarly, the intake of niacin was also much lower than the recommended dietary intakes and ranged from 63 percent to 79 percent during the study period. However, when calculations for niacin intakes were based on actual energy intakes the niacin intake levels ranged from 73 percent to 88 percent during different months of the study.

Table 1

Energy and nutrient intake of a group of Kenyan preschool children during different seasons †

	lean 1	postharvest	lean 2
n = nutrients	41 june/july 1992	41 jan/feb 1993	40 may/june 1993
kcalories	4.5MJ (1076 kcal) ^a	4.6 MJ (1110 kcal) ^{ab}	5.0 MJ (1204 (kcal) ^{b*}
SD	1.7 MJ (401kcal)	1.8 MJ (429 kcal)	1.4 MJ (344 kcal)
protein	30 (14)	32 (13)	35 (12)
fat	21 (7)	22 (8)	23 (9)
calcium	389 (203) ^a	470 (220) ^{b**}	452 (226) ^{b*}
iron	13 (5)	12 (6)	13 (5)
vitamin A	366 (225) ^a	481 (323) ^{b**}	400 (234) ^{b*}
vitamin C	102 (55)	106 (68)	96 (62)
thiamin	1.3 (1.0) ^a	1.4 (1.0) ^{b**}	1.4 (1.0) ^{b**}
riboflavin	0.8 (0.3) ^a	0.9 (0.3) ^{b**}	0.9 (0.4) ^{b*}
niacin	5.9 (2.1)	5.8 (2.5)	6.1 (1.9)

† means and (standard deviations)

^{ab} means with the same superscripts in the same row are not significantly different

*significant differences, $P < 0.05$, ** $P < 0.01$

Table 2 presents the results obtained when the childrens' energy and nutrients intakes were evaluated by grouping the children according to household size and by season. Children from large households (>7 persons) had higher intakes of all the nutrients under investigation than the children from the medium-sized households (4-7 persons) during all the seasons, although the two groups did not differ in their mean age. None of the children came from small households (<4 persons). The differences in intake were significant for all the nutrients between the two groups in the lean months of 1992 and the postharvest season in 1993, while those for fat and calcium were not. Except for fat, there were significant differences in intakes of all the other nutrients in the 1993 lean season compared to the lean months in 1992.

The weight changes of the children during different months of the study were small at an average of about 182 g/month, but they were fairly stable throughout the study period. There were no wide variations in the seasonal effects on the mean body weights of the subjects. The length of the children increased progressively with time, with the total increase in mean length between baseline values and the second measurement period in January/February being 7.21 cm, which was at the rate of 0.90 cm per month. This was followed by a mean increase in length of 0.80 cm per month during the following 4 months in the post harvest period in 1993.

The monthly weight-for-age Z-scores were calculated for all the subjects, as well as separately for boys and girls. The boys had significantly higher ZWA Z-scores ($p<0.001$) than the girls. The monthly changes in ZWA scores for both sexes are presented in Figure 1. The boys started with much better ZWA scores at baseline (Z-scores > -1.5 SD) compared to those of the girls (Z-scores < -2.0 SD), and continued with higher values through all the study months. The ZWA scores for the girls, improved slightly in August 1992 as a result of improved intakes from the early maturing crops, while those of the boys were observed to improve during the maize harvest months between October 1992 and May 1993. Similarly, the height-for-age, and weight-for-height Z-scores for the boys were found to be significantly higher ($P<0.004$ and $P<0.03$, respectively) than those of the girls.

Table 2
Energy and nutrient intake of Kenyan preschool children by household size and season*

HH size n =	<u>lean 1992</u>			<u>postharvest</u>			<u>lean 1993</u>		
	4 -7 21	>7 20	P-value	4 -7 21	>7 20	P-value	4 -7 21	>7 20	P-value†
kcalories	1001	1223	< 0.001	1071	1246	< 0.001	1157	1273	< 0.001
SD	332	418		453	429		370	275	
protein	28	34	< 0.001	30	36	< 0.001	34	37	< 0.008
sd	13	13		14	13		14	10	
fat	20	22	< 0.001	23	23	NS	22	23	NS
sd	6	7		10	7		9	9	
calcium	373	433	< 0.002	457	481	NS	407	469	< 0.001
sd	181	227		239	222		209	197	
iron	11.2	14.9	< 0.001	10.2	14.1	< 0.001	12.0	13.9	< 0.001
sd	4	6		4.8	5.7		4.9	3.5	
vitamin A	326	455	< 0.001	386	530	< 0.001	359	400	< 0.04
sd	201	218		267	326		186	251	
vitamin C	87	130	< 0.001	94	124	< 0.001	79	112	< 0.001
sd	38	61		62	73		51	79	
thiamin	1.2	1.5	< 0.001	1.2	1.7	< 0.001	1.4	1.6	< 0.037
sd	0.9	1.0		1.1	1.2		1.2	1.1	
riboflavin	0.8	0.9	< 0.001	0.9	1.0	< 0.007	0.8	1.0	< 0.001
sd	0.3	0.3		0.4	0.3		0.4	0.3	
niacin	5.3	7.1	< 0.001	5.5	6.6	< 0.001	6.1	6.4	< 0.054
sd	1.5	2.1		2.0	2.2		2.2	1.6	

*means

sd= standard deviations

† t-test

NS = not significantly different

Table 3 presents the percentages of children falling into the different classes of malnutrition during different seasons. About 51 percent of the children were stunted ($ZHA > -2.0$ and $ZWH < -2.0$) during the lean months in 1992 compared to 42 percent of normal children ($ZHA > -2.0$ and $ZWH > -2.0$). During the postharvest months in January and February 1993, the percentage of the children with normal scores increased to 63 percent while that of the stunted children decreased to 28 percent. The percentage of wasted children ($ZHA > -2.0$ and $ZWH < -2.0$) was low (about 3 percent) during the lean months of 1992 and in the postharvest months, but it was virtually absent in the lean months of May and June 1993, when the final measurements were recorded. On the other hand, the percentage of children who were both stunted and wasted ($ZHA < -2.0$ and $ZWH < -2.0$) increased with time during the period of the study from 5 percent at baseline to 10 percent by the end of the study period.

Table 3

Percentage of preschool children with different types of malnutrition during different seasons*

period	normal zwh & zha > - 2.0 ; > - 2.0	stunted zwh & zha > - 2.0 ; < - 2.0	wasted zwh & zha < - 2.0 ; > - 2.0	wasted & stunted zwh & zha < - 2.0 ; < - 2	n
lean 1992	42	51	2	5	41
postharvest	63	28	3	8	41
lean 1993†	62	28	0	10	40

*based on suggestions by Waterlow (1988).

† 1993 lean season was not a typical lean season (see text)

Table 4 presents the results of the different Z-scores when the subjects were grouped according season, household size, and land size. Although there were no significant differences in the various Z-scores between the seasons, appreciable increases were recorded for weight-for-age

(0.3 SD units), length-for-age (0.4 SD units), and in weight-for-length (0.3 SD units), during the postharvest season compared to the 1992 lean months. It was also observed that the length-for-age Z-scores continued to improve into the 1993 lean season, while those for weight-for-age and weight-for-length had started to decrease by the end of the study period in June 1993.

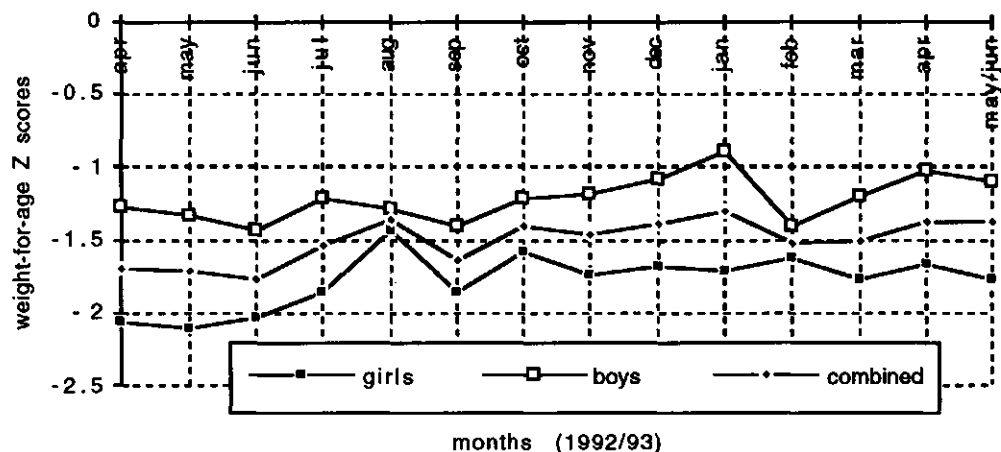


Figure 1 Weight-for-age Z-scores of Kenyan preschoolers during different months

The children from large households (>7 persons) had significantly higher Z-scores for weight-for-age ($p<0.001$), height-for-age ($p<0.05$), and weight-for-height ($p<0.001$), than children from medium sized households (4-7 persons) as shown in Table 4. The curves for weight-for-age Z-scores during different months of the study for the two household size groups are presented in Figure 2. Children from the large households had consistently higher WA Z-scores throughout the study months than the children from medium sized households, inspite of the fact that the ages between these two groups were not significantly different.

When the effect of landholding size on the nutritional status of the children was evaluated by grouping the households according to the size of land owned, no significant differences were found in any of the Z-scores, as shown in Table 4. However, the children from the larger farm households (2-3 acres) had slightly higher WA, HA and WH Z-scores than those from the smaller farm households (<2 acres). The monthly fluctuations in weight-for-age Z-scores were found to be more stable in the larger landsize group, compared to those of the smaller landsize group. The latter group tended to have wide fluctuations in the same Z-scores between different months of the study.

Table 4

Weight-for-age (ZWA), length-for-age (ZHA), weight-for-length (ZWH) by season, household size and land size, sexes combined*

season	ZWA	ZHA	ZWH	n
<u>by season</u>				
lean (1992)	-1.8 (1.1)	- 2.1 (1.2)	- 0.9 (1.0)	41
postharvest	-1.5 (1.1)	- 1.7 (1.0)	- 0.5 (1.2)	41
lean (1993)	-1.6 (1.1)	- 1.6 (1.1)	- 0.6 (1.1)	40
P value	NS	NS	NS	
<u>by household size</u>				
4-7 persons	-1.8 (1.0)	- 2.0 (1.2)	- 1.0 (1.0)	21
> 7 persons	-1.2 (1.1)	- 1.6 (1.1)	- 0.3 (1.1)	20
P level	(< 0.001)	(< 0.05)	(< 0.001)	
<u>by landsize</u>				
< 2 acres	- 1.6 (1.1)	-1.9 (1.3)	- 0.8 (0.9)	11
2-3 acres	- 1.5 (1.1)	- 1.7 (1.1)	- 0.7 (1.2)	29
P value	NS	NS	NS	

* means and (Standard Deviations)

NS = not significantly different

DISCUSSION

Results from energy and nutrient intake show that the subjects on average, had fairly good intakes of most nutrients during all the study months except for energy, calcium and niacin.

The energy and nutrient intake was assessed for 6 continuous days by 3-day observations alternated by 24-hour recalls. According to Beaton et al (1979) 3-day intake record should be able to characterize the individual intake of energy and protein. However, the accuracy of the methods used may have been limited by estimation of portion sizes and their nutritive values, lack of information on losses during cooking, as well as the unavailability of appropriate food composition data bases. That there were hardly any changes observed in the dietary intakes between the postharvest and the lean months of 1993 can be explained by a change of weather which brought rains in January 1993, and which facilitated the production of the early maturing crops that were ready for consumption in May 1993. This caused a delay in the onset of the lean season in that year. It is also possible that the food stocks from the main harvest were not fully depleted by the month of May.

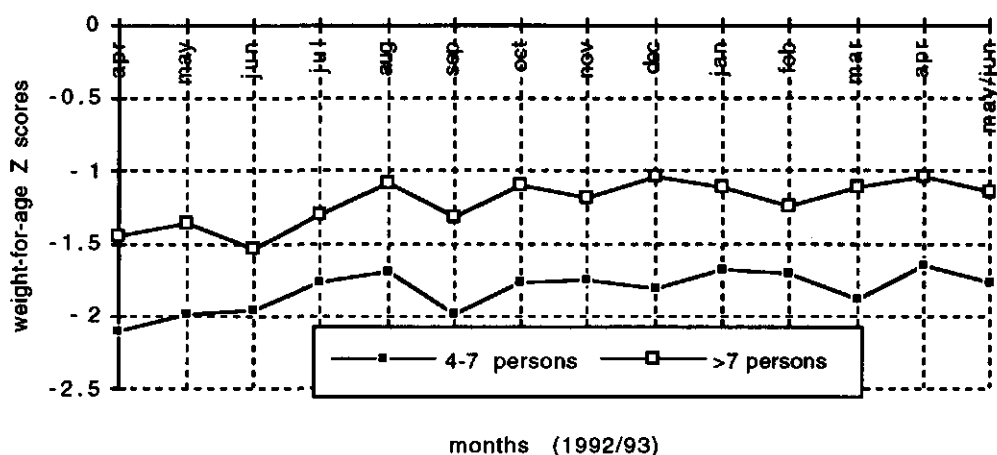


Figure 2 Weight-for-age Z-scores of Kenyan preschoolers by household size

Although the intakes of all the nutrients improved during the postharvest months compared to the lean months, significant seasonal influences were only observed for calcium, vitamin A, thiamin, and riboflavin, but not with the other nutrients. This may be explained by the observation that during the lean season, there was a shortage of green vegetables which are the main sources of vitamin A in the diets of this community. Secondly, intake of the beans which are the main sources of calcium, thiamin, and riboflavin in the diets of this community was low during the lean season. Energy intake was on average about 89 percent of RDI during all the months except in the peak of the lean season in 1992, when the energy intakes were about 82 percent of recommended dietary intakes. The calcium intake was very low compared to the recommended dietary intakes (National Research Council, 1989), and although this low intake may be attributed to the low consumption of milk and milk products, it appears that the recommended dietary allowances for calcium for children of this age group may be too high compared to what the local diets provide.

The low energy intakes of the subjects which were observed even during the postharvest months may be attributed to the consumption of high bulk, low fat diets which may not be highly palatable to young children. The high preponderance of maize in the diet of the subjects suggests poor digestibility of energy, low protein quality, and insufficiency of other nutrients. It is possible that the dietary intake of the children in the study was affected by the quality of the food available, in terms of palatability and nutrient composition, rather than in the quantities consumed.

The mean weight and length changes of the subjects were fairly stable and did not fluctuate much between the lean and the harvest months. The children gained an average of 182 g/month during the 15-month period. The highest weights were achieved towards the end of the study, which may have been due to the fact that the children were older and taller. However, when the monthly weights were converted to weight-for age Z-scores, a seasonal pattern was observed in which the Z-scores improved with increasing food availability during the postharvest months compared to the lean months. The interpretation of length measurements in our study was limited by lack of regularity in taking these measurements, and in the irregular intervals between the measurement periods. Reports from other studies have shown that some nutritional status

measurements are more sensitive to seasonal changes in food availability than others (Brown et al., 1982; Neimeijer and Klaver, 1990; Ategbo, 1993). In these studies, weight-for-length was found to show greater seasonal variability than weight-for-age. Our results seem to support these observations.

A sex difference was observed in the pattern of weight-for-age Z-scores between boys and girls. The boys' Z-scores seemed to respond more positively to household food availability during the maize harvest months, while those of the girls stagnated. The Z-scores for the girls on the other hand, responded positively to improved food availability arising from the harvest of the early maturing crops in July/August 1992, which are of the "soft type", such as potatoes, beans, peas, and green vegetables, while those of the boys did not. Similar observations were made between male and female elderly subjects from the same area (Kigutha et al., 1994: *in preparation*). It may be that females prefer and eat more of the soft type of foods while the males prefer and eat more of the high energy maize diets. The better performance in weight growth of the boys compared to those of the girls cannot be attributed to discrimination in feeding children of different sexes, as and there are no reports from literature with reference to such a practice in this community. Secondly no such biases were observed during the period of the study. As such the differences found in weight growth between boys and girls may be biological rather than environmental.

The children from the large households were better fed as demonstrated by the food consumption data, than those from the medium-size households. This was also reflected in their weight-for-age Z-scores throughout all the study months. This observation is contrary to our expectations and cannot be attributed to chance alone, especially because the number of children from the two groups were almost equal. We do not have additional information to help explain the disparity in these results, but we can make certain guesses. One of the three underlying causes of childhood malnutrition as outlined by United Nations Children Fund (UNICEF, 1992), is lack of adequate child care. It is likely that large households may have had fewer young children and more adults to provide care and attention including feeding, than the medium sized households, who may have had more young children and fewer adults to provide the

necessary care and attention. However, these are just speculations. Further investigations are required to confirm or reject these assumptions.

There was lack of significant differences between the nutritional status of the children when grouped according to landsize categories. This may be due to the fact that our maximum land size of three acres may have been too small, and any further subgrouping into smaller landsize categories may have lost the power to detect any clear differences between the nutritional status of children from different landsized households.

The effects of seasonality on food consumption and the nutritional status of young children are not well documented. The few studies available show that the preschool children are at a greater nutritional risk during times of food scarcity than the older children or the adults. In Bangladesh, Abdullah and Wheeler (1985), found that the energy and protein intake of preschoolers had significant differences between lean and the harvest months. In analysing data from ten African countries, Schofield (1974), found that preschool children fulfilled their energy requirements at a much lower level of 80 percent. A study in Chad (Begin, 1988), found that the height-for-age Z-scores for children was significantly higher and the rate of stunting lower at harvest than during the lean season. In Ethiopia, Branca et al. (1993), reported small but non-significant seasonal changes in weight-for-height Z scores, while height growth showed a strong seasonal pattern with values close to normal when food was available and low values when food was in short supply. Similar findings were reported from Benin (Ategbo, 1993), in which the growth velocity of children aged 2 to 9 years was found to be lowest during the rainy season and highest during the dry season. In the coast province of Kenya, Niemeijer and Klaver (1990), found that children showed a different seasonality pattern than that of adults.

The children had a growth spurt in height during the dry season coupled by lesser weight growth resulting from low food supplies. However, weight growth improved when household food supplies increased. Our study seems to be in agreement with these findings, in that all the Z-scores improved with varying degrees at harvest which were later followed by a downward trend as the food supplies in the households started to decline. There was an exception in relation to height-for-age Z-scores, which showed mild improvements even during the lean season in 1993. Children of comparable age to those of ours in the Ethiopian study (Branca et

al., 1993), seemed to have experienced greater energy and nutrient stress than our subjects, as they showed marked deterioration in their height-for-age Z-scores to levels lower than the entry values at the end of thirteen months of follow-up over the same period.

Individual dietary intake and exposure to infections are two proximal causes of malnutrition in young children for which growth failure is a marker. Anthropometry is non-specific to cause and does not distinguish these two (Allen et al., 1992). Although dietary intake of household members is affected by food availability to the household, for young children, the type of food available in terms of digestibility and palatability, is an important one, as it determines how much food a child is able to consume at any given meal. Children who are continuously fed on high bulk low energy foods may be consuming only small amounts of the food at any given meal, which may not be adequate to supply their energy requirements. In such a situation, malnutrition or lack of growth in children will be caused by poor quality diets rather poor household food availability.

The interpretations of associations between food intake and growth of children is also confounded by the fact that when energy intake is low, the intake of many other nutrients will be inadequate. Fomon et al.(1975), found that children fed high energy, low protein formulas increased their weight significantly, but linear growth was unaffected. In contrast, Gopalan et al. (1973) reported that undernourished Indian children of ages between one and five years increased in both height and weight when their daily diet was supplemented with a high energy, low protein cake for a period of 14 months. The children in our study had adequate protein intake even if it was mainly of plant origin, and when the energy intake improved during the harvest months, there were corresponding improvements in both weight and length.

There are some interesting, although not entirely consistent observations in the literature on the patterns of gains in height and weight. Brown et al.(1988) carried out a longitudinal study in Bangladesh on the growth of children over a period of 14 months. Weight gains were minimal towards the end of the monsoons in August, and as more food became available, the weights reached a peak in February. Height gains were minimal in January and reached a peak in April/May, 3-4 months after the peak of the weight gains. Similar seasonal effects on growth were observed by Nabarro et al. (1988) in Nepal. The growth in height lagged behind growth in

weight by about 3 months. In another study in Gambia (McGregor et al., 1968), both height and weight gains were lowest in the rainy season between June and November, and both increased in December when the dry season began, with no separation in time. Similar findings were reported for six children in Kenya (Wiersinga and van Rens, 1973), in which the peaks and troughs in weight and height velocities coincided.

In rural populations throughout the world, ecological and economic constraints on food availability are frequently reflected in chronic undernutrition and in poor childhood growth. Within these populations, the relationship between agricultural production, income level and nutrition are complex and at present poorly understood. Low socio-economic status however, has been reported to be closely associated with undernutrition of household members (McNeill et al 1988; Wandel, 1989; Branca et al., 1993), and the problems are further confounded by the seasonal variations in the types and amounts of food available to a household at any given time.

Several studies have reported an association between small landsize and the nutritional status of household members particularly of young children (Omawale and McLeod, 1984; Mason et al., 1985; Haaga et al., 1986, Valverde et al., 1977; Victora et al., 1986). In Kenya, Haaga et al. (1986) reported that landless agricultural workers and small holders had roughly the same prevalence of stunting (about 24 percent) while households with greater than 1.5 hectares (> 4 acres) had lower prevalence of stunting than those with less land. In Haiti, Mason et al. (1985), found that farmers with land sizes greater than 1.3 hectares had significantly better nutritional status than those with less land. A study in Guatemala, Valverde et al.(1977) found no significant differences between the amount of land owned and the nutritional status of children. However, there was a lower prevalence of moderate malnutrition in children from families with more land compared to families with less land. The same study reported that the relative risk of having children with moderate malnutrition was 2.3 times greater in families owning less than 1.4 hectares (3.5 acres) than those with more than 1.4 hectares. From these studies, it appears that there is a minimum limit in the amount of land a rural household of low income needs to own in order to be able maintain adequate nutrition for the family members. Three acres of land which was the upper limit in this study may be too small to provide all the food needs of an average sized rural family.

In conclusion, this study has shown that the growth of preschool children in smallholder rural households in Kenya is influenced by seasonal changes in household food supply. Further, we have observed that the level of energy and nutrient intake of the children may be more dependent on the type of diet rather than on household food availability. A positive association between household size and the nutrition status of the children was observed, but since our sample sizes were small, this result needs further investigation with larger samples. Finally there seems to be an association between land size and preschool child nutritional status. This observation too needs further investigation. This study focussed on the low income smallholder households with limited off-farm incomes and a limited amount of land. These results therefore, cannot be generalized for the whole population. However, they indicate the problem for other low income smallholder rural populations in Kenya, who currently form a substantial percentage of the rural population.

ACKNOWLEDGEMENTS

We wish to thank Rudo Niemeijer for the technical assistance during the development and testing of the questionnaires, to the ten enumerators who worked tirelessly throughout the study, and to all the families for their cooperation. We also wish to thank Trudy Wijnhoven for assisting in cleaning and analysis of the food consumption data. The funds for this study came from a grant to the first author from the International Development Research Centre, Canada. Additional financial, technical, and material support was provided by the Food and Nutrition Studies Programme (FNSP), a research project in Kenya which is supported by the Netherlands government through the African Studies Centre, Leiden.

REFERENCES

- Abdullah, M., E.F. Wheeler (1985). Seasonal variations in the intr-household distribution of food in a Bangladesh village. *American Journal of Clinical Nutrition* **41**:1305-1313
- Allen, H. L., A.K. Black, J.R. Backstrand, G.H. Pelto, R.D. Ely, E. Molina, A. Chavez (1991). Analytical approach for exploring the importance of dietary quality versus quantity in the growth of mexican children. *Food and Nutrition Bulletin* **13**: 95-104.
- Allen, L. H., J.R. Backstrand, G.H. Pelto, M.P. Mata, A. Chavez (1992). The interactive effects of dietary quality on the growth and attained size of young Mexican children. *American Journal of Clinical Nutrition* **56**: 353-364.
- Allen, L. H. (1994). Nutritional influences of linear growth: a general review. *European Journal of Clinical Nutrition* **48**(suppl.1): S75-S89.
- Ategbo, E. D. (1993). Food and nutrition insecurity in northern Benin: Impact on growth performance of children and on year to year nutritional status of adults. PhD thesis. Wageningen Agricultural University.
- Begin, F. (1988). Household dietary adequacy and individual nutritional status: Relationships and seasonal effects in a Sahelian community in Chad. *Food and Nutrition Bulletin* **14**(4): 304-313.
- Branca, F., G. Pastore, T. Demissie, A. Ferro-Luzzi (1993). The nutritional impact of seasonality in children and adults of rural Ethiopia. *European Journal of Clinical Nutrition* **47**: 840-850.
- Brown, K. H., R.E. Black, S. Becker (1982). Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural Bangladesh. *American Journal of Clinical Nutrition* **36**: 303-313.
- Central Bureau of Statistics (1991). Fourth Child Nutrition Survey, 1987. Ministry of Finance and Planning, Nairobi, Kenya.
- Chen, L. C., A.K.M.A. Chowdhury, S.L. Huffman (1979). Seasonal dimensions of energy protein malnutrition in rural Bangladesh: The role of agriculture, dietary practices, and infections. *Ecology of Food and Nutrition* **8**: 175-187.

FAO (1970). Food Composition Table for use in Africa. Food and Agriculture Organization, Nutrition Division, Rome.

FAO/WHO (1988). Requirements of vitamin A, iron, folate and vitamin B12. FAO.Rome

Formon, S.J., L.J. Filer, L.N. Thomas, T.A. Anderson, S.E. Nelson (1975). Influence of formula concentration on caloric intake and growth of normal infants. *Acta Paediatrica Scandinavica*. **64**: 17-30

Golden, M. H. N. (1994). Is complete catch-up possible for stunted malnourished children. *European Journal of Clinical Nutrition* **48**(suppl. 1): S58-S71.

Gopalan, C., M.C. Swaminathan, V.K.K. Kumari < D.H. Rao, K. Vijayaraghavan (1973). Effect of caloric supplementation on growth of undernourished children. *American Journal of Clinical Nutrition* **26**: 563-566.

Haaga, J., J. Mason, F.Z. Omoro, V. Quinn, A. Rafferty, K. Test, L. Wasonga (1986). Child malnutrition in rural Kenya: A geographical and agricultural classification. *Ecology of Food and Nutrition* **18**: 297-307.

Hassan, N., N. Huda, K. Ahmad (1985). Seasonal patterns of food intake in rural Bangladesh. *Ecology of Food and Nutrition* **17**: 175-186.

Martorell, R., L. Ketter Khan, D.G. Schroeder (1994). Reversibility of stunting: epidemiological findings from developing countries. *European Journal of Clinical Nutrition* **48**(suppl. 1): S45-S57.

Martorell, R. and R. E. Klein (1980). Food supplementation and growth rates in preschool children. *Nutrition Reports International* **21**: 447-454.

Mason, J. B., T. Ahlers, C. Henderson, I.J. Shorr, Tabatabai (1985). Identifying nutritional considerations in planning a rural development project in N. Haiti. *Ecology of Food and Nutrition* **18**: 1-17.

McGregor, I. A., H.M. Gilles, B. Thompson, W.Z. Billewicz, A.M. Thomson (1968). The growth of young children in a Gambian village. *Transactions of the Royal Society of Tropical Medicine & Hygiene*. **62**: 341-352.

McNeill, G., P.R. Payne, J.P.W. Rivers, A.M.T. Enos, J.J. de Britto, D.S. Mukarji (1988). Socio-economic and seasonal patterns of adult energy nutrition in a south Indian village. *Ecology of Food and Nutrition* 22: 85-95.

Melville, B. F. (1988). Are land availability and cropping pattern critical factors in determining nutritional status? *Food and Nutrition Bulletin* 10: 44-48.

Nabarro, D., P. Howard, C. Cassels, M. Pant, A. Wijga, N. Panfield (1988). The importance of infections and environmental factors as possible determinants of growth retardation in less developed countries. Raven Press. New York.

National Research Council (1989). Recommended dietary allowances. National Academy Press. Washington D.C.

Neimeijer, R. and W. Klaver.(1990). Climatic seasonality and growth: longitudinal research in coast province, Kenya. In: D.W.J. Foecken, A. P. den. Hartog. Eds. Seasons, food supply and nutrition in Africa. Leiden.

Neumann, C., R. Trostle, M. Barksh, D. Ngare, N. Bwibo (1989). Household response to impact of drought in Kenya. *Food and Nutrition Bulletin* 11: 21-33.

Neumann, C. G. and G. G. Harrison (1994). Onset and evolution of stunting in infants and children. Examples from the Human Nutrition Collaborative Research Support. Kenya and Egypt studies. *European Journal of clinical Nutrition* 48(suppl. 1): S90-S102.

Omawale and J. C. McLeod (1984). Food consumption and poverty in rural Jamaica. *Ecology of Food and Nutrition* 14: 297-306.

Pastore, G., F. Branca, T. Demissie, A. Fero-Luzzi (1993). Seasonal energy stress in an Ethiopian rural community:: an analysis of the impact at the household level. *European Journal of Clinical Nutrition* 47: 851-862.

Rowland, M. G. M., T.J. Cole, R.G. Whitehead (1977). A quantitative study into the role of infection in determining nutritional status in Gambian village children. *British Journal of Nutrition* 37: 441-450.

Snedecor, G. W. and W. G. Cochran (1980). Statistical methods. Iowa State University Press. Iowa.

Stephenson, L. S., M.C. Latham, E.J. Adams, S.N. Kinoti, A. Pertet (1993). Weight gain of Kenyan school children infected with hookworm, *Trichuris*, *Trichuria* and *Ascaris lumbricoides* is improved following once or twice yearly treatment with albendazole. *Journal of Nutrition* **123**: 656-665.

UNICEF (1992). Food, Health and Care. New York,

Valverde, V. R., Martorell, V. Mejia-Pivaral, H. Delgado, A. Lechtig and R. E. K. C. Teller (1977). Relationship between family land availability and nutritional status. *Ecology of Food and Nutrition* **6**: 1-7.

Victora, C. G., J.P. Vaughan, B. Kirkwood, J.C. Martines, and L. B. Barcelos (1986). Child malnutrition and land ownership in southern Brazil. *Ecology of Food and Nutrition* **18**: 265-275.

Wandel, M. (1989). Household food consumption and seasonal variations in food availability in Sri Lanka. *Ecology of Food and Nutrition* **22**: 169-182.

Waterlow, J. C. (1994). "Relationship of gain in height to gain in weight. *European Journal of Clinical Nutrition* **48**(suppl.1): S72-S74.

West, C., F. Pepping, I. Scholte, W. Jansen, H.F.F. Albers, Eds. (1987). Food composition table for foods commonly eaten in East Africa. CTA and ECSA. Wageningen.

Wiersinga, A. and M. M. van. Rens (1973). The simultaneous effect of protein-calorie malnutrition on weight and height velocity. *Environmental child Health* Special issue:

Wilkinson, L. (1989). SYSTAT: The System for Statistics. Evanston, IL

CHAPTER 4

MATERNAL NUTRITIONAL STATUS MAY BE STRESSED BY SEASONAL FLUCTUATIONS IN FOOD AVAILABILITY:

Evidence from rural women in Kenya

Hilda N. Kigutha, Wija A. van Staveren, Trudy M.A. Wijnhoven, and Joseph G.A.J. Hautvast

ABSTRACT

The effect of seasonal changes in household food availability on the dietary intakes and the nutritional status of 24 lactating women from smallholder rural households in Nakuru district Kenya, were investigated over a 15-month period in 1992/93 agricultural cycle. Dietary intakes and body weights were measured on monthly basis. Significant seasonal differences were found in intakes of calcium, vitamin A, vitamin C, riboflavin, and niacin respectively ($P<0.01$), as well as in the intake of protein, iron, and thiamin ($P<0.05$), but not with energy and fat intake. Large interseasonal weight losses of 5.6 kg (about 9 percent) at the rate of 1.1 kg/month, were observed between baseline measurements and the peak of the lean months when the energy intakes were 36.7 kcal /kg/day and protein at 1.1g /kg/day. About 50 percent of the lost weight (2.8 kg) was recovered during the postharvest months when energy intakes improved to 41.0 kcal/kg/day, and protein to 1.2 g /kg/day. However, further weight losses of 1.6 kg or 0.5 kg/month occurred in the immediate postharvest months. While much of the weight loss may have been due to reduced energy intake during periods of food scarcity, part of the lost weight may have been due to increased energy requirement as a result of lactation, and to increased physical activity levels. Further investigations are recommended.

INTRODUCTION

The importance of breastfeeding for healthy child growth and development is now widely recognized especially for populations in the developing countries (UNICEF, 1992). Maternal nutrition during lactation is one of the many factors that interact in the production of human milk and there is increasing evidence that sub-optimal maternal nutrition may adversely affect lactation performance by reducing the amount of breast milk a mother is able to produce (Jelliffe and Jelliffe, 1978; Ahn and Maclean, 1980; Butte and Calloway, 1981; Labbok, 1991).

The lactation period is the most energy demanding phase of the human reproductive cycle, because the energy cost of lactation includes not only the nutrients in milk, but also the energy required to synthesize milk constituents (Butte, 1991; van Raaij et al., 1991; Garza, 1993). The total energy cost of producing milk is estimated to be 2930 kJ/day during the first six months of lactation and 2090 kJ/day during the next 18 months. The FAO/WHO/UNU joint expert consultation (FAO/WHO/UNU, 1985) recommends an extra energy intake of 2.1 MJ (500 kcal)/day to meet the energy cost of lactation. This is based on the assumption that the efficiency of conversion of food energy into milk is 80 percent, and that approximately 835 kJ (200 kcal) /day are mobilized from maternal fat stores built up during pregnancy. However, the amount of fat deposited is highly variable among women and depends for a great part, on the pregnancy weight gain (Butte and Calloway, 1981; Garza, 1993).

Studies from the industrialized countries have observed postpartum depletion of maternal energy stores even in well-nourished women (Schutz 1980; Butte et al., 1984; Dugdale and Eaton-Evans, 1989; Krasovec, 1991; Labbok, 1991; Dewey et al., 1993). This depletion is reflected in weight loss. In conditions of low energy intakes, the loss may be due to postpartum depletion and also due to negative energy balance, when the dietary intakes fail to provide adequate amounts of the energy needed by the body. It is possible then, that poorly nourished women who enter lactation without adequate energy stores from pregnancy may need even greater energy intakes or more decreased physical activities, than the well nourished women, to ensure successful lactation without compromising their own health.

The purpose of this study was to investigate the effects of seasonal variations in food availability on dietary intakes and the nutritional status of lactating women from smallholder rural households in Nakuru district, Kenya.

STUDY DESIGN AND METHODS

Background of the study area

The study was carried out in Njoro division within Nakuru district in Kenya which is one of the thirteen districts in the Rift Valley Province. Njoro is situated in the mid western part of the country about 200 kilometres from Nairobi, the nation's capital city. Before independence in 1963, most of the land in the district was owned and farmed by a few white settlers. The local people were hired to assist in farm work and lived in villages situated on the large farms as squatters. After independence in the early 1970s, many families either from the squatter communities or from outside the district formed land-buying cooperative societies which bought these farms collectively and then subdivided them among shareholders, each family getting a portion of land worth the money contributed. The average size of land per household in these areas is about two and a half acres (about 1 hectare). The lean season normally starts from May to October, with June and July being the leanest months in terms of food availability. The maize harvest season starts from November to January, while small harvests of the early maturing crops such as beans, potatoes, and vegetables take place in late July and early August.

Subjects

The study population consisted of lactating mothers selected from four cooperative farms namely, Mutukania, Kamwago, Sosiot, and Kamwaura. Selection of the first group was done after a census was carried out in all the four farms and in which all households with lactating women who were within their first three months of lactation were identified and listed.

However, as the initial list from the census data had very few subjects, additional subjects were recruited into the study at different times, but mostly if they delivered within the first eight months from the commencement of the study. As such the entry point of subjects into the study took place between April and November 1992. All lactating women willing to enter the study were recruited irrespective of age or parity, however, only those lactating women from the smallholder households owning between one and three acres of land were included into the study. The subjects remained in the study as long as they were breastfeeding, but as soon as they stopped lactating they were dropped out after recording their final weights. At the end of the study, we had complete data sets for 24 lactating women.

Study design

The study was carried out over a period of fifteen months from April 1992 to June 1993, covering both the harvest and the lean seasons, and with an overlap of the lean season. Prior to the main project, a pilot study was carried out over a three month period during which time food preparation and consumption questionnaires, as well as appropriate measurement techniques were developed and tested. This was done in twenty five households in a separate farm from those studied, but which had similar characteristics. The pilot phase was also used to train the field assistants in data collection and filling into the questionnaires, as well as in measurement techniques. Pre-coded questionnaires were used to record all the data which included food preparation, food consumption, anthropometric measurements and morbidity patterns.

Anthropometric measurements

The anthropometric measurements taken included weight and height. The height was taken once at entry point into the study. All height measurements were taken by the chief investigator in order to minimize inter-individual variations. Height was measured to the nearest 0.1 cm, with the subject barefoot and standing upright on a wooden board placed on a horizontal surface with heels together, chin tucked in and the body stretched upwards to full extent, with the head in a

Frankfurt plane. Heels, buttocks and shoulders were in contact with the vertical metal bar attached to the wooden board to which a microtoise was fixed.

Body weight was measured to the nearest 0.1 kg using digital display Tefal scales placed on a flat surface. The subjects wore light clothing and stood upright. The body weights were taken every month for the period of the study by trained field assistants. All the measurements were done in the subjects' homes during the morning hours after breakfast and before lunch was taken. The scales were checked regularly with standard weights by the chief researcher. A correction for excess clothing was made on weights by subtracting 0.5 kg from all the weight measurements for all the subjects during data analysis. This was necessary because it was not possible to have uniform minimum clothing for all the subjects because the measurements were done in subjects' individual homes.

Morbidity patterns and the duration of illnesses affecting each subject was recorded from recalls covering the past one week. The morbidity assessment was mainly for illnesses of short duration such as fever, coughs, diarrhoea, vomiting and other conditions which could have affected food intake and body weights of the subjects.

Body Mass Index

From the height and body weight measurements, monthly body mass index (BMI) was calculated for each subject as the ratio of body weight (kg) and height in metres (kg/m^2). Body mass index was used as a method of evaluating the prevalence of energy malnutrition among the lactating women following the criteria proposed by James et al. (1988), and Ferro-Luzzi et al. (1992). A BMI of <16 was regarded as diagnostic of severe chronic energy deficiency (CED grade III); BMI of 16.0 - 16.9 of moderate CED (grade II); and a BMI of 17.0 - 18.4 of mild CED (grade I). Values of 18.5 and above were considered indicative of good energy stores, while those below this value were considered underweight and as nutritionally "at risk". Reference normative data are not available to identify groups of lactating women who are nutritionally at risk. However, in populations in which anthropometric indices such as body

weight reflect food availability, low body weight, skinfold thicknesses, and body circumferences are said to be good indicators of nutritional vulnerability (Butte 1991).

Assessment of dietary intake

Energy and nutrient intake was determined on a monthly basis by the 24-hour recall method for any day of the week except Saturdays and Sundays. In addition at three periods selected to represent each of the seasons, dietary intakes were assessed for six days for each subject, by use of 3-day weighed record method on 3 alternate days, while the three days between them were assessed by the 24-hour recall method (Cameron and van Staveren, 1988). This combination of the observation and recall methods was applied to enable us to collect food intake data for six days without being a burden to the respondents, and also to compare the degree of variation in intakes of the different nutrients obtained by the two methods (Kigutha et al., *in preparation*). Food consumption for all Sundays was obtained by recall.

During the observation days, all food ingredients were weighed before cooking to the nearest gram using digital display Tefal scales. At the the end of preparation the whole dish was weighed before the food was served. The subject's portion was weighed separately and any left-overs at the completion of the meal were deducted from the original serving. Snacks and other foods such as fruits which were consumed by the subject outside the main dish were also weighed and recorded to the nearest gram. These measurements were done by trained assistants throughout the day starting from around 7.00 am, until the subjects had eaten their last meal (usually around 8.00 pm). Foods consumed away from home or when the assistant was absent were determined by recalls. All the assistants were recruited from the local area.

When collecting food consumption data by the 24-hour recalls, the person who prepared the food was asked to describe all the dishes that were prepared in the house during the previous day, as well as all the ingredients that went into each dish. The person was asked to use the same utensils used during the previous day and measure replicas of similar ingredients like the day before, where possible. The measured ingredients were then weighed on scales and the

quantities recorded to the nearest gram. For liquid ingredients, water was used to estimate volume, if the actual ingredient used the previous day was not available.

Food consumption data were converted from household measures into grams after which they were converted into energy and nutrients using appropriate food composition tables, mainly those developed by CTA-ECSA for use in East, Central and Southern African countries (West et al., 1987), and those by the Food and Agricultural Organization (FAO, 1970) for use in Africa. The nutrients of interest to this study were energy, protein, fat, calcium, iron, vitamin A, vitamin C, thiamin, riboflavin, and niacin. Nutrient intake of each subject during observation week was obtained by averaging the intake of the six days.

In the determination of the acceptable intake levels for energy and other nutrients, measured intakes were compared with recommended dietary intakes based on suggestions given by the FAO/WHO/UNU Expert Consultation Report (FAO/WHO/UNU, 1985) and those by the Food and Agriculture Organization (FAO, 1988) for lactating women of known age, weight and height and who are engaged in moderate physical activity. Using these calculations we arrived at recommended energy intake levels of 11.3 MJ (2700 kcals), with which we compared actual intakes of the subjects. The choice of moderate activity in determining the energy requirements using the formulas given by the FAO/WHO/UNU report was arbitrary as we did not have data on physical activity. However, lactating mothers are reported to participate in regular household chores (Schutz 1980), which are considered as moderate.

Statistics

All the data were analysed by the Systat programme (Wilkinson, 1989) using Apple Macintosh Computers. The paired t-test was used to compare body mass index as well as energy and nutrient intakes of the subjects between different seasons (Snedecor and Cochran, 1980).

RESULTS

The characteristics of the subjects are presented in Table 1. Twenty-four lactating women completed the study. The subjects had a mean age of 28.7 (SD 6.4) years, and a parity of 4.8 (SD 2.9). The mean body weight was 58.0 (SD 8.9) kg while the mean height was 157.3 cm (SD 6.0).

Table 1
Characteristics of 24 lactating mothers from rural households in Kenyan

	mean	SD	range
age (yrs)	28.7	6.4	21 - 41
parity	4.8	2.9	1 - 11
body weight (kg)	58.0	13.2	36.7 - 109.7
height (cm)	157.3	5.6	146.8 - 167.6
BMI	23.3	4.4	17.0 - 41.2

Dietary intake

The mean energy and nutrient intakes of the subjects during different seasons are presented in Table 2. When the intakes were compared between seasons the energy intake during the postharvest months was higher than during the lean months, but the differences were not significant. However, significant differences were observed for protein ($p<0.007$), vitamin A ($p<0.003$), iron ($p<0.004$), thiamin ($p<0.01$), riboflavin ($p<0.03$), niacin ($p<0.001$), and vitamin C ($p<0.01$), between the 1992 lean season and the postharvest months in 1993. There were also very significant differences in intakes between the postharvest months and the 1993 lean season for calcium, vitamin A, riboflavin, vitamin C ($p<0.000$) respectively, as well as for iron ($p<0.005$), and niacin ($p<0.03$) intakes. When the dietary intakes between the 1992 and

1993 lean seasons were compared, there were significant differences in the intakes of calcium ($p<0.000$), vitamin A ($p<0.04$), riboflavin ($p<0.04$), and vitamin C ($p<0.003$), with the intakes being higher in the 1992 lean season than in 1993 lean months.

Table 2
Seasonal differences in nutrient intakes of 24 lactating women from Nakuru, Kenya †

nutrients	lean 1992 (june/july)	postharvest (jan/feb '93)	lean 1993 (may/jun)
energy (kcal)	9.3 MJ (2227kcal)	9.9 MJ (2361kcal)	9.7 MJ (2318 kcal)
SD	3.5 MJ (831 kcal)	2.9 MJ (690)	2.6 MJ (611 kcal)
protein (g)	62 a **	68 b	67 b
SD	25	22	21
fat (g)	50	47	44
SD	26	15	13
vitamin A (ug)	824 a **	1044 b	752 c ***
SD	505	703	409
vitamin C (mg)	179 a **	226 b	163 c ***
SD	117	141	86
calcium (mg)	946 a	965 a	815 b ***
SD	374	483	276
iron (mg)	22 a **	26 b	23 a **
SD	9	10	7
thiamin (mg)	2.1 a **	2.9 b	2.7 a
SD	1.4	2.4	2.0
riboflavin (mg)	1.8 a *	1.9 b	1.7 c ***
SD	0.6	0.7	0.5
niacin (mg)	10.6 a ***	13.0 b	11.8 a *
SD	3.9	4.1	2.6

† mean and (standard deviation)

abc means with same superscript in the same row are not significantly different

*significant differences $P<0.05$, ** $P<0.01$, *** $P<0.001$

The energy intake at baseline was 10.9 MJ (2594 kcal)/day which was recorded at the beginning of the study in the months of April/May 1992, when the subjects were in their early stages of lactation. The energy intakes however, decreased steadily in the months between May and September 1992, with the lowest intakes of 8.7 MJ (2079 kcal)/day being recorded in the month of September. This reflected a drop in energy intake of 2.2 MJ (515 kcal) /day from baseline values. From October 1992, the energy intakes increased progressively with higher intakes observed during the postharvest months of January and February 1993. The highest levels of energy intake were recorded in the month of March 1993, when the subjects consumed an average of 11.3 MJ (2705 kcal)/day, which was about 100 percent of the recommended intakes.

The dietary intake of protein, calcium, iron, vitamin A, vitamin C, thiamin, and riboflavin were above two-thirds of the recommended dietary intakes during all the study months (FAO, 1988; National Research Council, 1989). However, the levels of intakes of these nutrients were dependent on the amount of energy in the diet, such that when energy intakes improved, the intake of these nutrients also improved, and vice-versa. The intakes of niacin were below two-thirds of the recommended allowances during most of the study months with daily intakes averaging 60 percent of the recommended intakes. This may have been due to the high prevalence of maize based diets in the subjects' dietary intakes.

Body weight changes

The monthly weight changes, BMI values, as well as stages of lactation for the subjects are presented in Table 3. The highest body weight of 61.3 (SD 15.5), with a corresponding body mass index of 24.8 (SD 5.3), was recorded at the beginning of the study period in April 1992, when the mean stage of lactation was 3.7 (SD 2.1) months. This was followed by a gradual decline in body weight which reached the lowest mean level of 55.7 (SD 8.3) kg, or BMI of 22.5 (SD 2.7) in September 1992. This reflected a mean weight loss of 5.6 kg or 9 percent during those five months from baseline values. This loss in body weight was equivalent to 1.12 kg/month. However, part of the lost weight (about 2.8 kg) was regained in the harvest and the postharvest months between October 1992 and March 1993, with a mean weight gain of 0.56

kg/month. Between March and June 1993 when the study was terminated, the subjects had again lost 1.6 kg from the postharvest values which was at the rate of 0.53 kg /month. By the end of the study, there was a mean net loss of 4.4 kg during the 15-month period of the study.

When the body mass indexes of the subjects were grouped according to the different classes of energy nutrition as suggested by James et al. (1988) and Ferro-Luzzi et al. (1992), an average of 5 percent of the subjects per month (1-2 persons), were found to be have BMI values below 18.5, while the majority (68 percent) were within the ranges of 18.5 - 24.9, which are considered normal. About 22 percent of the subjects per month had BMI values greater than 25.

Table 3

Weight and BMI of 24 lactating Kenyan women in different months and stages of lactation*

month 1992/93	weight (kg)	BMI	Stage of lactation
April	61.3 (15.5)	24.8 (5.3)	3.7 (2.1)
May	59.7 (17.2)	23.9 (5.9)	4.5 (1.9)
June	58.6 (13.7)	23.5 (4.7)	4.8 (2.5)
July	57.8 (13.7)	23.4 (4.7)	5.7 (2.5)
August	58.2 (13.7)	23.3 (4.6)	6.5 (2.5)
September	55.7 (8.3)	22.5 (2.7)	7.7 (2.5)
October	57.5 (12.7)	23.1 (4.2)	8.6 (2.5)
November	57.9 (13.1)	23.2 (4.4)	9.5 (2.5)
December	58.1 (12.8)	23.3 (4.3)	10.4 (2.4)
January '93	58.4 (12.5)	23.4 (4.2)	11.4 (2.2)
February	58.4 (13.3)	23.4 (4.5)	11.9 (2.5)
March	58.5 (14.7)	23.5 (4.8)	12.5 (2.5)
April	58.3 (15.2)	23.4 (5.0)	13.5 (2.5)
May/June	56.9 (14.3)	22.9 (4.7)	14.5 (2.5)

* means and (standard deviations)

DISCUSSION

This study found that lactating women from the smallholder households experience cyclic losses in body weight. Some of these losses may be attributed to energy expended as a result of lactation and part of which may be due to negative energy balance arising from inadequate energy intakes, and possibly also due to changes in physical activity levels. Estimates of maternal energy requirements during lactation are generally based on an average daily milk secretion volume of 750-850 ml providing 67-77 kcal /100 ml produced at an estimated rate of efficiency of 80-90 percent. This translates into an addition of 500 to 550 kcal/day above the needs of a non-pregnant, non-lactating woman.

Dietary intake was assessed for 6 continuous days by 3-day weighed records, alternated by 24-hour recalls. According to Beaton et al. (1979), 3-day intake record should characterize individuals according to their energy and protein intake. However, the accuracy of the methods used may, in the first place, have been limited by estimation of portion sizes during monthly food intake recalls, and the unavailability of appropriate food composition data. Secondly, it was not possible to determine how much of the nutrient losses occurred during food preparation and cooking.

In the early months of lactation, energy intakes were close to recommended intakes at 97 percent, but the intakes decreased to an average of 77 percent in the following 4 months which also coincided with the lean season. The consumption of most of the nutrients was fairly good during most months including the lean months, and although the diets contained somewhat less than the recommended allowance for energy and niacin, they provided more than 90 percent of the recommended allowances for protein, vitamin A, thiamin, riboflavin, and ascorbic acid, and more than 80 percent of the recommended intake for iron and calcium. This indicates a judicious selection of nutrient-dense foods by lactating women in this study.

The body weight changes followed a seasonal pattern with losses observed at the rate of 1.12 kg /month in the peak lean season from May to September 1992, corresponding to energy intakes of 36.7 kcal/kg/day and protein intakes of 1.1 g/kg/day. When energy and protein intakes improved during the postharvest months to intakes equivalent to 41 kcal/kg/day and

protein of 1.2 g /kg/day respectively, the mean weight increased at the rate of 0.70 kg /month. However, the intake of energy did not increase appreciably in the immediate postharvest months of January and February 1993, but much later in the months of March and April 1993, when energy intake reached about 100 percent of the recommended dietary intakes.

Although some of the lost weight may have been due to postpartum depletion, our results show that decreased energy and nutrient intakes during the lean season could have been responsible for some of the weight loss. However, since the differences in energy intake were not significant between the lean and the harvest seasons, increased activity levels during the rainy season (which coincided with the lean months), may have contributed to some of the weight loss. This may explain the sudden weight loss in the months between April and June 1993, since the energy intake during those months did not decrease appreciably, as observed in the food intake data. Farm activities were highest during this period of the year following the long rains.

Body weight changes and other anthropometric indices during lactation have been studied in well nourished women from the developed countries (Butte et al., 1984; Brewer et al., 1989; Dugdale and Eaton-Evans, 1989; Ohlin and Rossner, 1990; Dewey et al., 1993; Spaaij et al., 1993). In a study in which anthropometric and body composition measures were taken between 1-4 months postpartum, Butte et al. (1984), a gradual but steady decline in body weight was observed, in which a mean loss of 3.8 kg in the first month was followed by a gradual reduction of 0.67 kg /month thereafter. In another study involving 56 women, anthropometric changes were monitored 6 months postpartum (Brewer et al., 1989). Weight loss during the first three months averaged 1.6 kg/month for women who breastfed exclusively compared to 2.1 kg/month for women who did not breastfeed, and 1.5 kg /month for those who partially breastfed. In the second part of the 6 month period, the exclusively breastfeeding women lost an average of 0.43 kg/month and the partially breastfeeding lost 0.27 kg/month. Greater weight losses were observed in the women whose pre-pregnancy weight were low and those whose initial postpartum weights were high.

A study in Sweden (Ohlin and Rossner, 1990), monitored weight changes of 1423 lactating women for 12 months postpartum. They found that the women who breastfed exclusively lost

significantly more weight than those who did not. However, the total weight loss between 2.5 and 6 month postpartum was not significantly influenced by the duration or intensity of lactation. In a study conducted among Irish lactating women, Dugdale and Eaton-Evans (1989) reported continuous weight loss between the first and sixth month postpartum which plateaued thereafter. Some of the studies reported that it is possible that some of the losses in body weight observed in well nourished women from the affluent societies may not be due to postpartum depletion alone, but may also be due to energy intake restrictions through dieting and as a result of increased physical activity. As such, it may be difficult to determine what part of the weight lost is due to postpartum depletion and which part is caused by self induced food intake restrictions.

Reproductive women in the Gambia were found to maintain long-term energy balance despite seasonal fluctuations in food availability (Paul et al., 1979). The lactating women lost an average of 0.74 kg/month during the wet season and gained an average of 0.59 kg/month during the dry season. These values are very similar to those observed in our study. However our subjects lost considerably more weight (1.1 kg/month) during the lean season compared to those reported in the Gambian women.

The lactation performance of the Kamba women in Kenya and the Otomi Indians in rural Mexico was reported to be a function of their body size and composition (van Steenbergen et al., 1987; Villalpando et al., 1992). The study in Kenya reported that lactating women with weight-for-height below 80 percent (BMI 18.3) produced 80 g less milk than the women whose weight-for-height were above 90 percent (BMI 23.6). Season was found to affect the milk yields of the low weight-for-height group but not those of the higher weight-for-height. In the Mexican study, the energy intakes of the lactating women were found to be low at 68 percent of the recommended intakes while protein intakes were about 80 percent. The amount of milk produced was negatively correlated with the percentage of maternal body fat, while milk fat concentration was positively associated with maternal body weight, body mass index and the sum of skinfold measurements. The authors concluded that the relationship between anthropometric measurements and lactation performance may have been confounded by other factors such as diet. In Guatemala, Schutz et al (1980), assessed the energy balance of 18

lactating women for the first 10 weeks postpartum, and compared it with 6 non-lactating women. The energy intakes of the lactating women were low at 67 percent of the recommended intakes. Weight loss was found to be 0.37 kg/month at 2 and two-and-a-half months postpartum which was ten times greater than that of the non-lactating group. The lactating women reportedly continued to lose weight a year or more postpartum, but the authors did not state whether dietary intakes remained the same or changed with time.

Maternal weight changes were observed in marginally undernourished women from rural Taiwan over two consecutive periods of pregnancy and lactation (Adair and Pollit, 1985). During the first month of lactation, there was a net gain in weight, which was followed by weight loss at the rate of 0.28 kg/month, and was highest between 3 to 6 months postpartum. Net weight losses over 15 months were 1.23 kg and 1.93 kg in the two lactation periods respectively. These weight losses were much lower than the mean 4.4 kg net weight loss of the subjects in our study over a similar period. However, our subjects would not be considered undernourished for they had a mean body mass index of 23.3, which was within the normal ranges.

Studies on food intake from well-nourished lactating women from developed countries have shown that food intakes rarely meet the recommended energy intakes (Butte et al., 1984; Rookus et al., 1987; van Raaij et al., 1991; Spaaij et al., 1993). Several reasons have been advanced to explain this observation. One of them is that the volume of breast milk produced is overestimated, or that the energy content of the milk is lower than suggested. Alternative explanations have been forwarded, such as a greater efficiency in the conversion of dietary energy to milk (Spaaij et al., 1993), reduced energy expenditure by lowering physical activity levels (van Raaij et al., 1991), and efficient mobilization of body fat accumulated during pregnancy. While the above explanations may apply to well-nourished women in the industrialized countries, some of them may fail to apply to lactating women from the developing countries, especially in conditions where weight gain in pregnancy is minimal and physical activity levels remain high during lactation.

Although most women lose weight during lactation, some women have been found to gain weight especially during the early months of lactation. A study in the Netherlands (Rookus et

al., 1987), found that Dutch women who breastfed for more than 2 months gained more body mass at 9 months postpartum than expected. Similar results were reported in a study in a rural area of Kenya (Kigutha et al., 1989), in which lactating women gained an average of 1.35 kg/mon during the first 10 weeks of lactation, and then lost weight gradually by the end of 18 weeks postpartum. The weight gain during the early postpartum months may explain the high BMI values which were observed in the early months of our study, which coincided with the early stages of lactation.

Results from this study show the subjects were generally quite well nourished throughout the study months with body mass index within normal ranges. However, they experienced large weight losses of about 9 percent of their baseline values which occurred when the energy and nutrient intakes decreased during the lean months. Although activity patterns were not measured, they may have been responsible for part of the loss in weight, as they coincided with the lean season. Some of the weight loss may also have been due to postpartum depletion of maternal energy stores. However, the amount of weight loss due to the postpartum depletion may have been at a minimum by September 1992 because of the advanced stage of lactation of the subjects, whose mean was 7.7 months.

From these results, we can conclude that lactating women from smallholder rural households from unimodal climatic pattern experience large losses in body weight which may arise from seasonal fluctuations in food availability at the household level. The loss is likely to be enhanced by postpartum depletion especially during the early months of lactation, and by increased physical activities. These results however, need further investigation.

ACKNOWLEDGEMENTS

We wish to thank Rudo Niemeijer for the technical assistance during the development and testing of the questionnaires, to the ten enumerators who worked tirelessly throughout the study, and to all the families for their cooperation. We wish to also thank Willem Veerman of the African Studies Centre, Leiden, for assistance in data analysis. The funds for this study came from a grant to the first author from the International Development Research Centre,

Canada. Additional financial, technical, and material support was provided by the Food and Nutrition Studies Programme (FNSP), a research project in Kenya which is supported by the Netherlands Government through the African Studies Centre, Leiden.

REFERENCES

- Adair, L. S., E. Pollit (1985). Outcome of maternal nutrition supplementation: a comprehensive review of the Bacon Chow study. *American Journal of Clinical Nutrition* **41**: 948-978.
- Ahn, C. H. and W. C. Maclean (1980). Growth of the exclusively breastfed infant. *American Journal of Clinical Nutrition* **33**: 183.
- Brewer, M. M., M.R. Bates, L.P.Vannoy (1989). Postpartum changes in maternal weight and body fat depots in lactating vs nonlactating women. *American Journal of Clinical Nutrition* **49**: 259-265.
- Butte, N. F., C. Garza, J.E. Stuff, E.O. Smith, B.L. Nichols (1984). Effect of maternal diet and body composition on lactation performance. *American Journal of Clinical Nutrition* **39**: 296-306.
- Butte, N. F. (1991). Physical status: The use and interpretation of anthropometry in lactating women. USDA /ARS Children's Nutrition Research Centre, Baylor College of Medicine, Houston, Texas.
- Butte, N. F. and D. H. Calloway (1981). Evaluation of lactation performance of Navajo women. *American Journal of Clinical Nutrition* **34**: 210.
- Cameron, M. E. and W. A. v. Staveren, Ed. (1988). Manual on methodology for food consumption Studies. Oxford University Press. New York.
- Dewey, K. G., M.J. Heinig, L.A. Nommsen (1993). Maternal weight-loss patterns during prolonged lactation. *American Journal of Clinical Nutrition* **58**: 162-166.
- Dugdale, A. E. and J. Eaton-Evans (1989). The effect of lactation and other factors on postpartum changes in body weight and triceps skinfold thickness. *British Journal of Nutrition* **61**: 149-153.

FAO (1970). Food Composition Table for use in Africa. Food and Agriculture Organization, Nutrition Division, Rome.

FAO/WHO (1988). Requirements of vitamin A, iron, folate and vitamin B12. Rome/Geneva.

FAO/WHO/UNU (1985). Energy and Protein Requirements. Technical Report Series No.724. Geneva

Ferro-Luzzi, A., S. Sette, M. Franklin, W.P.T. James (1992). A simplified approach of assessing adult chronic energy deficiency. *European Journal of Clinical Nutrition* **46**: 173-186.

Garza, C. (1993) Pregnancy and Lactation. In: Garrow, J.S., and W.P.T. James (Eds). Human nutrition and dietetics. 9th edition. Churchill Livingstone. London.

James, W.P.T., A. Ferro-Luzzi, J.C. Waterlow (1988). Definition of chronic energy deficiency in adults. *European Journal of Clinical Nutrition* **42**: 969-981.

Jelliffe, D. B. and E. F. P. Jelliffe (1978). The volume and composition of human milk in poorly nourished communities : a review. *American Journal of Clinical Nutrition* **31**: 492.

Kigutha, H. N., L.N. Waiyaki, E.I. Karani, D.K. Nassiuma (1989). Breastmilk yield and infant nutrition in relation to early infant growth in Njoro, Kenya. *East African Medical Journal* **66**: 707-714.

Krasovec, K. (1991). The implications of poor maternal Nutritional status during pregnancy for future lactational performance. *Journal of Tropical Pediatrics* **37** (Suppl): 3-10.

Labbok, M. H. (1991). Breastfeeding and borderline malnutrition in women. *Journal of Tropical Pediatrics* **37** (Suppl): 23-24.

National Research Council (1989). Recommended Dietary Allowances. National Academy Press. Washington D.C.

Ohlin, A. and S. Rossner (1990). Maternal body weight development after pregnancy. *International Journal of Obesity* **14**: 159-173.

Paul, A. A., E.M. Mueller, R.G. Whitehead (1979). Seasonal variations in energy intake, body weight and skinfold thickness in pregnant and lactating women in rural Gambia. *Proceedings of the Nutrition Society* 38: 28A.

Rookus, M. A., P. Rokebrand, J. Burema, P. Deurenberg (1987). The effect of pregnancy on the body mass index 9 months postpartum in 49 women. *International Journal of Obesity* 11: 607-618.

Schutz, Y., A. Lechtig, R.B. Bradfield (1980). Energy expenditures and food intakes of lactating women in Guatemala. *American Journal of Clinical Nutrition* 33: 892-902.

Snedecor, G. W. and W. G. Cochran (1980). Statistical methods. Iowa State University Press. Iowa.

Spaaij, C. J. K., J.M.A van Raaij, L.C.P.G.M. de Groot, L.J.M. van der Heijden and J. G. A. J. H. H.A. Boekholt (1993). The effect of lactation on the resting metabolic rate and on diet-induced thermogenesis in well-nourished Dutch women. *American Journal of Clinical Nutrition* 59: 42-47.

UNICEF (1992). Food, Health and Care. New York,

Van Raaij, J. M. A., C.M. Schonk, S.H. Vermaat-Miedema, M.E.M. Peek and J. G. A. J. Hautvast (1991). Energy cost of lactation, and energy balance of well-nourished Dutch lactating women: reappraisal of the extra energy requirements of lactation. *American Journal of Clinical Nutrition* 53: 612-619.

Van Steenbergen, W. M., J.A. Kusin, M. van Rens, K. de With, A.A.J. Jansen, Lactation performance. In: van Ginneken J.K, A.S. Muller (eds) (1987). Maternal and Child Health in Rural Kenya : an Epidemiological study. Croom Helm. London.

Villalpando, S. F., N.F. Butte, W.W. Wong, S. Flores-Huerta, and E. O. S. M. de Jesus Hernandez-Beltran C. Garza (1992). Lactation performance of rural Mesoamerindians. *European Journal of Clinical Nutrition* 46: 337-348.

West, C.E., F. Pepping, I. Scholte, W. Jansen, H.F.F. Albers, Ed. (1987). Food composition table for foods commonly eaten in East Africa. CTA and ECSA. Wageningen.

Wilkinson, L. (1989). SYSTAT: The System for Statistics. Evanston, Illinois.

CHAPTER 5

ELDERLY UNDER NUTRITIONAL STRESS :

A seasonal study on food consumption and nutritional status in Kenya

Hilda N. Kigutha , Wija A. van Staveren, and Joseph G.A.J. Hautvast

ABSTRACT

The effects of seasonal changes in food availability on the nutritional status of elderly subjects living in smallholder rural households in Nakuru district Kenya was investigated over a 15-month period involving 41 subjects (23 women and 18 men), within the age range of 65-74 years. Dietary intakes and body weights were measured on monthly basis. Large interseasonal weight changes were observed, in which the men had a mean weight loss in the lean season of 4.0 kg (about 7 percent of body weight) compared to 1.7 kg (3 percent) in women. The dietary intakes were also found to be influenced by large seasonal changes in household food availability, with significant differences between the lean months (6.9 MJ or 1651 kcal) and the postharvest period (8.8MJ or 2105 kcal). The intake of energy was not enough to maintain energy balance during periods of heavy physical activities irrespective of food availability during the postharvest months. The findings indicate the need to review the levels of energy expenditure in the elderly as the current recommended levels may be too low to meet the energy needs of active elderly populations especially in the developing countries.

INTRODUCTION

In developing countries the annual percentage growth rates of the older segment of the population are high, but considering the total populations of these countries elderly people constitute only a small percentage (Macfaden, 1988). As the elderly populations continue to increase in these areas of the world, it is doubtful whether the countries involved will be adequately prepared to deal with the needs of the increasing elderly population, while they are still struggling to cater for the needs of the predominantly young populations which characterize the demographic picture in these countries.

In most African countries, the population is predominantly rural and the majority of the elderly are found in the rural areas. In these countries it is a common practice for those who retire from active service in government or other formal and informal employment to return to the rural areas where they continue to work in agriculture long into their old age. On the other hand, the young people migrate from the rural areas to the cities and towns in search of employment, thus leaving most of the elderly in the rural areas with sometimes very little social and material support (WHO, 1983). The changes in lifestyle have led to the destabilization of the traditional values that used to sustain people of all ages in a closely knit society and in which the elderly were well cared for. It is not yet known however, how these changes in family and social settings have affected the lives of the older segments of the population, especially with respect to their nutritional, and health requirements.

Due to their continuing high physical activity levels, the elderly populations in the rural areas of the developing countries would be expected to maintain energy and other nutrient intakes at slightly higher levels than their counterparts in the developed countries, in order to maintain energy balance. However, many estimates of energy requirements assume the withdrawal of elderly persons from economic activity and thus to reduced physical activity at the age of 65 years (Macfaden, 1988; Glick, 1992; Prentice, 1992). As such, there might be a need to adjust the energy estimates to cater for the more physically active elderly groups in the developing countries.

There is lack of literature on the nutritional status of the elderly populations in the developing countries especially from Africa. Part of the objective of this study was to gather and contribute information on this topic. The main purpose of this study was to investigate the effects of seasonal food shortages on food consumption and the nutritional status of elderly subjects living in the smallholder areas of rural Kenya.

STUDY DESIGN AND METHODS

Background of the study area

The study was carried out in Njoro division within Nakuru district in Kenya which is one of the thirteen districts in the Rift Valley Province. Njoro is situated in the mid western part of the country about 200 kilometres from Nairobi, the capital city. Before independence in 1963, most of the land in the district was owned and farmed by a few white settlers. The local people were hired to assist in farm work and lived in villages situated on the large farms as squatters. After independence in the early 1970s, many families either from the squatter communities or from outside the district formed land buying cooperative societies and bought these farms collectively and then subdivided them among themselves, each family getting a portion of land worth the money contributed. The average size of land per household in this area is about two and a half acres (about 1 hectare). The lean season normally starts from May to October, with June and July being the leanest months in terms of food availability. The maize harvest season starts from November to January, while small harvests of the early maturing crops such as beans, potatoes, and vegetables take place in the months of July and August.

Subjects

The study population consisted of elderly persons between the ages of 65 and 75 years, selected from four cooperative farms namely, Mutukanio, Kamwago, Sosiot, and Kamwaura. The selection was done after a census was carried out in all the four farms and in which households

with elderly subjects were identified and listed. Besides having an elderly person with the required age, households were included into the sampling frame if they were smallholders owning between one and three acres of land and if the subject(s) or relatives living in the same household did not have regular monthly incomes of more than five hundred Kenya shillings (25 US dollars). A random sample of 45 households was finally obtained from a sampling frame of 240 eligible households.

The selected households were revisited by the researcher who explained the details of the study to the persons concerned and sought approval. During the visit the subjects were interviewed further about their age, health condition, land ownership, and eating arrangements. Households were included only if they met the criteria explained above and if the elderly subject(s) was apparently healthy. An apparently healthy elderly was defined as one who was not bed-ridden, not hospitalized and not suffering from ailments which required constant medication or a special diet. A household was defined as a group of persons sharing one common pot. None of the households refused to participate in the study. Four subjects were disqualified; two because of age, and two because of high income. By the end of the research period we had complete data sets for forty-one subjects.

Collection of data

The study was carried out over a period of fifteen months from April 1992 to June 1993, covering both the harvest and the lean seasons, with an overlap of the lean season. Prior to the main project, a pilot study was carried out over a three month period during which food preparation and consumption questionnaires, as well as appropriate measurement techniques were developed and tested. The pilot study was conducted in 25 households in a separate farm from those studied, but which had similar characteristics. The pilot phase was also used to train the field assistants in data collection and entry into the questionnaires, as well as in measurement techniques. Pre-coded questionnaires were used to record all the data which included food preparation, food consumption, anthropometric measurements and morbidity patterns.

Anthropometric measurements

The anthropometric measurements which were taken included weight and height. The height was measured once at the beginning of the study during the months of April and May 1992. All height measurements were taken by the chief investigator in order to minimize inter-individual variations in measurement techniques. Height was measured to the nearest 0.1 cm, with the subject barefoot and standing upright on a wooden board placed on a horizontal surface with heels together, chin tucked in and the body stretched upwards to full extent, with the head in a Frankfurt plane. Heels, buttocks and shoulders were in contact with the vertical metal bar attached to the wooden board and to which a microtome was fixed. Problems were experienced while measuring the height of only two women due to severe kyphosis.

Body weight was measured to the nearest 0.1 kg using digital display Tefal scales placed on a flat surface. The subjects wore light clothing and stood upright with the head in a horizontal plane. The body weights were taken every month for a period of 15 months by trained field assistants. All the measurements were done in the subjects' homes during the morning hours after breakfast and before lunch was taken. The scales were checked regularly with standard weights by the chief investigator. A correction for excess clothing was made on weights by subtracting 0.5 kg from all the weight measurements during data analysis.

From the height and body weight measurements, monthly body mass index (BMI) was calculated for each subject as the ratio of body weight (kg) and squared height in metres (m^2). The prevalence of energy malnutrition was estimated using the BMI criteria proposed by James et al. (1988), and Ferro-Luzzi et al. (1992). A BMI of <16 was regarded as diagnostic of severe chronic energy deficiency (CED grade III); BMI of 16.0 - 16.9 of moderate CED (grade II); and a BMI of 17.0 - 18.4 of mild CED (grade I). Values of 18.5 and above were considered indicative of good energy stores.

Dietary intake

Energy and nutrient intake was determined on monthly basis by the 24-hour recall method. At three periods selected to represent each of the seasons, dietary intakes were assessed for six days for each subject. This was done by use of 3-day weighed record method for 3 alternate days, while the 3 days between them were assessed by the 24-hour recall method (Cameron and van Staveren 1988). A combination of the observation and recall methods was applied to enable us to collect food intake data for six days without being a burden to the respondents.

During the observation days, all food ingredients were weighed before cooking to the nearest gram using digital display Tefal scales, and at the end of preparation the whole dish was weighed before the food was served. The subject's portion was weighed separately and any left overs at the completion of the meal were deducted from the original serving. Snacks and other foods such as fruits which were consumed by the subject outside the main dish were also weighed and recorded. The measurements were done throughout the day starting from around 7.00 am until the subjects had eaten their last meal (usually around 8.00 pm). Foods consumed away from home or when the assistant was absent were determined by recalls. All the measurements were done by trained assistants recruited from the same areas.

When collecting food consumption data by the 24-hour recalls, the person who prepared the food was asked to describe all the dishes that were prepared in the house during the previous day, as well as all the ingredients that went into each dish. The person was asked to use the same utensils used during the previous day and measure replicas of similar ingredients like the day before, whenever possible. The measured ingredients were then weighed on scales and the quantities recorded to the nearest gram. For liquid ingredients water was used to estimate volume, if the actual ingredients used the previous day were not available. Food consumption for all Sundays was obtained by recall.

Food consumption data were converted from household measures into grams and then into energy and nutrients using appropriate food composition tables, mainly those developed by CTA-ECSA for use in East, Central and Southern African countries (West, et al., 1987), and those by the Food and Agricultural Organization for use in Africa (FAO, 1970). The nutrients of

interest to this study were energy, protein, fat, calcium, iron, vitamin A, vitamin C, thiamin, riboflavin, and niacin.

The levels of energy and nutrient intakes of the subjects were compared to the recommended dietary intakes suggested by the FAO/WHO/UNU Expert Consultation Report (FAO/WHO/UNU, 1985), and those by Food and Agriculture Organization (FAO, 1988), for subjects above sixty years of age, of known weight and height and who are engaged in heavy physical activity.

Statistics

All the data were analysed by the Systat programme (Wilkinson, 1989) using Apple Macintosh computers. The paired t-test was used to compare energy and nutrient intakes of the subjects between different seasons while the unpaired t-test was used to compare the BMI values between the different seasons and between men and the women. The Kruskal-Wallis one way analysis of variance test was used to compare body mass index values for the different household size groups (Snedecor and Cochran, 1980).

RESULTS

A total of 41 subjects (23 women and 18 men) completed the study. The different characteristics of the subjects are presented separately for men and women on Table 1. The men were significantly taller and heavier than the women, but the women had a significantly higher mean BMI during the study period ($P < 0.001$) than the men. When the cumulative morbidity pattern was calculated in terms of number of days sick during each month, there were no significant seasonal or sex differences.

Table 1
Characteristics of 41 Kenyan elderly subjects grouped by sex*

characteristics	women	men
number (n)	23	18
age (years)	68.7 (3.1)	70.4 (2.7)
weight (kg)	50.9 (9.5)	54.4 (9.2)
height (cm)	152.8 (6.0)	162.3 (4.3)
BMI (kg/m ²)	21.7 (3.3)	20.6 (3.2)
sickness (days per month)	5.9 (3.9)	5.1 (2.6)

*means and (standard deviations)

Seasonal differences in energy and nutrient intakes

Significant differences were observed in intake of all nutrients under consideration namely; energy, vitamin A, vitamin C, thiamin, riboflavin, niacin, calcium, and iron ($P < 0.001$), as well as in the intake of protein and fat ($P < 0.05$) between the preharvest months of June/July 1992, and the postharvest months of January and February 1993, as shown in Table 2. The levels of energy and nutrient intake in the lean months of 1993 were equal to or above those of the postharvest months. Carbohydrates contributed an average of 70 percent of the energy intake during all the seasons, while fat and protein contributed 19 percent and 11 percent respectively. The main sources of carbohydrates and proteins were cereals, beans, potatoes and a variety of green vegetables. Nearly all the fat was obtained from cooking oils and fats.

The subjects had adequate intakes of iron, vitamin C, thiamin, and riboflavin during all the the seasons. The mean iron intake was relatively high during all the measurement periods, and when it was adjusted for the low bioavailability of plant iron, the levels of intake were met at 95 percent of the recommended dietary intakes during the lean months of 1992, and at 116 percent during all the postharvest months. The main sources of iron and vitamin C were dark green vegetables which were consumed daily as a relish to the staple dish, *ugali*.

Table 2

Comparisons of daily energy and nutrient intakes of 41 elderly subjects during different seasons†

nutrients	lean 1992 (june/july)	postharvest (jan/feb)	lean 1993 (may/jun)
energy (MJ) (kcal)	6.9 (2.5) ^a 1651 (607)	8.8 (3.3) ^{b **} 2105 (779)	9.0 (3.9) ^{b**} 2149 (939)
protein (g)	42 (23) ^a	62 (30) ^{b *}	62 (31) ^{b *}
fat (g)	38 (13) ^a	44 (18) ^{b *}	43 (21) ^{b *}
vitamin A (ug)	403 (354) ^a	735 (553) ^{b **}	638 (574) ^{b **}
vitamin C (mg)	121 (99) ^a	183 (146) ^{b **}	170 (202) ^{b *}
calcium (mg)	755 (349) ^a	917 (437) ^{b **}	856 (436) ^{a *}
iron (mg)	18 (11) ^a	22 (14) ^{b **}	23 (15) ^{b **}
thiamin (mg)	1.5 (1.1) ^a	1.9 (1.6) ^{b **}	2.1 (1.7) ^{b **}
riboflavin (mg)	1.3 (0.6) ^a	1.7 (0.7) ^{b**}	1.7 (0.7) ^{b **}
niacin (mg)	8.3 (4.3) ^a	10.9 (4.8) ^{b**}	10.9 (5.7) ^{b **}

† mean and (standard deviations)

abc means with same superscript in the same row are not significantly different (paired t-test)

* significant differences $P < 0.05$

** significant differences $P < 0.001$

The mean protein and vitamin A intakes were lower than the recommended dietary intakes (79 percent and 73 percent respectively) only during the lean months of 1992, but the intakes improved to levels above requirements during the postharvest months. The subjects however, did not satisfy the requirements for niacin in any of the three seasons as the intakes ranged from a low level of 48 percent during the preharvest months, to 63 percent in the postharvest season.

When the energy and nutrient intakes were calculated separately for men and women, it was observed that both groups satisfied their recommended dietary intakes for iron, thiamin, riboflavin, and vitamin C, during all the different seasons, while the recommended intakes of some of the other nutrients were only satisfied during the postharvest season. The energy intake of the men ranged from 71 percent during preharvest to 97 percent in the postharvest months, while those of the women ranged from 70 percent to 91 percent during the same periods. The protein intake was adequate for the men during the three periods, but the women met only 79 percent of their recommended intakes during the lean season in 1992, which then improved to levels above the recommended intakes in the postharvest months. The intake of vitamin A for both men and women was low during the preharvest months between May and July 1992. The intakes for the women during those three months were low at 61 percent of RDI, while those of the men were higher, at 88 percent. The vitamin A intakes for both groups improved to levels above the recommended dietary intakes during the postharvest months in 1993.

Considering the month to month fluctuations, the daily energy intakes of both men and women improved with increasing household food availability to levels above 90 percent of the recommended intakes per day, as presented in Table 3.

Seasonal differences in BMI and body weight

The BMI values calculated for all the subjects during different months of the study are presented on Figure 1. There were marked seasonal fluctuations in BMI between different months for both men and women. The lowest BMI values were recorded in the lean month of July 1992, for the women and in November 1992 for the men. The highest values were achieved in the postharvest months of January/February 1993 for both sexes. The cumulative BMI for the women was significantly higher than that of the men ($p < 0.001$), but the seasonal changes in BMI values were not significantly different. The highest body weights for both men and women were achieved in the postharvest months of January and February, with a mean increase of 2.3 kg and 2.8 kg for men and women respectively, from the lowest recorded weight in the preharvest months of 1992. However, this increase was followed by greater losses in the preceding

months so that by April 1993, there was a mean loss of 4.0 kg in men and 1.7 kg in the women compared to the maximum weight recorded in January/February 1993. This loss in body weight occurred within two months, at a mean rate of 2.0 kg/month for the men, and 0.9 kg/month for the women. This sudden weight loss may be attributed to increased physical activity during those months, rather than to decreased energy intakes which remained fairly high during these months, as shown in Table 3. Land preparation normally takes place during this period.

Table 3

BMI and energy intake of Kenyan elderly subjects in relation to RDI and sex (1992/93)*

number (n) month	kcal	<u>women</u> 23			kcal	<u>men</u> 18		
		MJ	percent	BMI		MJ	percent	BMI
Apr/May	1745 (921)	7.3	83	21.7	2560 (908)	10.7	100	20.9
June	1607 (832)	6.7	77	21.5	2327 (788)	9.7	91	20.7
July	1463 (431)	6.1	70	21.2	1809 (647)	7.6	71	20.8
August	1740 (937)	7.3	83	22.0	1986 (430)	8.3	77	20.4
September	1681 (825)	7.0	80	22.0	1951 (476)	8.2	76	20.5
October	1978 (964)	8.3	94	21.6	2122 (611)	8.9	83	20.4
November	1878 (675)	7.9	89	22.1	2298 (973)	9.6	90	20.2
December	1895 (757)	7.9	90	22.4	2391 (860)	10.0	93	21.1
Jan/Feb	1912 (838)	8.0	91	22.5	2484 (748)	10.4	97	21.2
March	1828 (792)	7.6	87	21.6	2483 (1059)	10.4	97	20.7
April	1732 (598)	7.2	82	21.4	2271 (795)	9.5	89	20.1
May/June	1924 (724)	8.1	92	21.6	2459 (932)	10.3	96	20.4

* means and (standard deviations)

The monthly fluctuations in mean BMI values for both men and women are presented in Figure 1. From May 1992, the BMI values for the men decreased steadily reaching their lowest level in November 1992, and then increased progressively for the next three months reaching a high level in the postharvest months of January/February 1993. From July to November 1992, the deviation in mean BMI values for men and women from the group mean assumed different shapes, with those of the women showing an improvement while those of the men showed a downward trend.

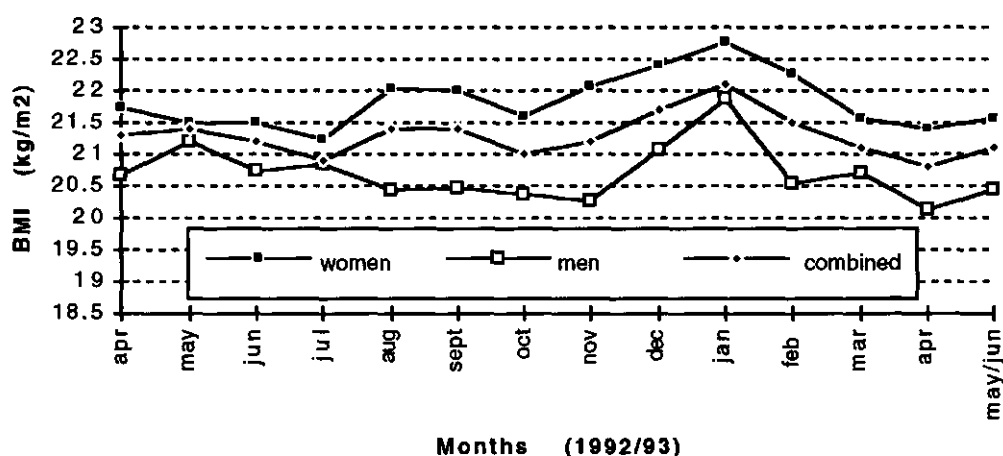


Figure 1 Monthly fluctuations in BMI of Kenyan male and female elderly subjects

Table 4 presents the results obtained when the subjects' BMI were grouped into the different categories of chronic energy deficiency (CED) during different months of the study period. The percentage of the subjects with BMI values below 18.5 which is the cut-off for undernutrition or thinness, was on average 23 percent per month. However, the percentages ranged from 10 percent in postharvest months to 27 percent in October 1992. On the other hand, the percentage of subjects with normal BMI (18.5-24.9), and above normal BMI values (>25) increased with

increasing food availability from a low level of 73 percent in October, to a high level of 90 percent in January/February in 1993.

Table 4
Percentage distribution of BMI of 41 elderly Kenyan subjects during different months†

month (1992/93)	<u>BMI ranges</u>			
	<17	17-18.4	18.5 - 24.9	>25
April	7	17	63	13
May	3	18	67	12
June	8	13	67	12
July	7	17	66	10
August	8	12	68	12
September	10	16	58	16
October	11	16	60	13
November	11	11	64	14
Jan/Feb	5	5	78	12
March	13	8	69	10
April	9	15	67	9
May/June	10	15	66	9

† data for December 1992 were left out due missed measurements

In order to determine the effect of the household size on the nutritional status of the subjects, BMI calculations were done based on household size. The subjects from large households (> 7 persons) had significantly better mean BMI ($p < 0.0001$) than those from small (< 4 persons), and medium-sized (4-7 persons) households. On the other hand, subjects from small households had significantly higher BMI values ($p < 0.004$) than subjects from the medium-sized households. The subjects from medium sized households were in a poorer nutritional status than those from small and large households.

Additional analyses were done to determine the relationship between the amount of land owned by a household and BMI values of the elderly subjects. This relationship was examined

by grouping the households into two landsize categories as follows, those with less than two acres (<0.8 ha), and those with between two and three acres (0.8-1.21 ha) of land. Results showed that the mean BMI values were significantly higher ($P<0.02$), for the subjects from households with bigger land sizes than those with smaller pieces of land. Further, the BMI values for the subjects with more land tended to have less fluctuations between different months than those of the small landsize group. Both groups however, had a peak in BMI values during the postharvest month of January/February 1993, which was followed by a steady decline with the small landsize group having a steeper slope than the larger landsize group.

DISCUSSION

In the present study population, the food consumption and the nutritional status of the elderly subjects did change with season. Significant changes in the intake of all the nutrients under consideration were observed, with the lowest intake levels occurring in the lean season in 1992, and the highest levels during the postharvest months. However, inspite of the improvements in intakes of all the nutrients in the postharvest months, the recommended dietary intakes for energy were not fully met. In considering the results, it should be mentioned here that the group was small, hence they need to be verified with a larger sample. The dietary intake was assessed for 6 continuous days using 3-dayweighed record method alternated by 24-hour recall method. According to Beaton et al.(1979), 3-day intake record should characterize individuals according to their energy and protein intake. However, the accuracy of the methods used may have been limited by estimation of portion sizes during monthly food intake recalls, by the nutrient losses during food preparation, and by the unavailability of appropriate food composition data.

In calculating the energy requirements for the subjects, we assumed that they were engaged in heavy physical activity, and therefore applied the basal metabolic rate multipliers of 2.10 for men and 1.82 for women (FAO/WHO/UNU, 1985). Using these calculations we arrived at 8.8 MJ (2100 kcal)/day for the women and 10.7 MJ (2565 kcal)/day for the men. Calculations based on lower multipliers of BMR, such as those recommended for moderately active men and

women produced values which showed that the subjects met almost all their energy needs during the study months. Since this was not reflected in the weight changes which showed a downward trend in the lean months, the higher BMR multipliers were used as they were thought to be more appropriate for this group.

The seasonal variation in energy intake between the lean and the postharvest months was 1.74 MJ (416 kcal) per day for the men and 1.63 MJ (389 kcal) per day for the women, with a corresponding weight change of 2.3 kg and 2.8 kg in men and women respectively, between the lean months in 1992 and the postharvest months in 1993.

Seasonal variations in energy intake of adult subjects have been described in several countries some of which include Burkina Faso (Brun et al., 1981), Senegal (Rosetta, 1986), Benin (Schultink et al., 1990), Ethiopia (Ferro-Luzzi et al., 1990), and India (McNeill et al., 1988), where the decreases in energy intake during the preharvest season were reported, ranging from 0.54 MJ (130 kcal) /day to 1.67 MJ (400 kcal) /day. Seasonal weight changes have also been reported for adult populations in the same and other studies in African countries (Bleiberg et al., 1980; Brun et al., 1981; Prentice et al., 1981; Loutan and Lamotte, 1984; Rosetta, 1986 ; Schultink et al., 1990; Ategbo, 1993). In Burkina Faso, Brun et al. (1981), found that the seasonal difference in body weight of adult men and women was 4.0 kg and 2.3 kg respectively. In the study in Senegal, Rosetta (1986), found that absolute decrease in weight was lower in women than in men and that older men lost more weight than younger men. The same study reported that men presented very low levels of energy reserves compared to the women, and that the effects of a bad season were felt more acutely with advancing age.

The gender difference in body weight losses observed between men and women in our study with men losing more weight than the women, has also been observed for adult subjects in other communities (Brun et al., 1981; Loutan and Lamotte, 1984; Rosetta, 1986 ; Schultink et al., 1990). Our results seem to be in agreement with most of the findings of these studies, although our subjects seem to have lost much more weight with higher variations in energy intake between the seasons. Considering that our subjects were older than those reported in the other studies, this may indicate that the elderly are likely to suffer greater nutritional stress during

periods of food shortages and physical stress than the younger adults. However, this observation should be confirmed in larger population groups.

The observed response in weight changes of the women to early maturing crops in our study, while those of the men did not respond, may be taken as an indication that women ate more of the "soft type" foods when available, such as potatoes, beans, and vegetables, while the men may have been more interested in the high energy maize diets.

Epidemiological studies in the developed countries have commonly demonstrated that nutrient deficiencies in elderly populations besides energy do occur (Garry et al., 1982; Rudman and Feller, 1989; Vellas, 1992). Surveys of independent dwelling elderly show that the consumption of minerals and vitamins are below recommended daily allowances for up to 50 percent of subjects, and that blood levels are subnormal in 10-30 percent (Garry et al., 1982). Elderly men and women are also reported to consume significantly less than the recommended dietary allowances for energy, niacin, vitamin A, vitamin C, and calcium (Bowman and Rosenberg, 1982; Hart and Little, 1986; Yeung and Imbach, 1988; James, 1989; Mahajan and Schafer, 1993), while some studies have reported more than adequate intake of vitamin A and vitamin C (Hart and Little, 1986). Our results are in agreement with some of these findings in that we found low intakes of certain nutrients such as niacin during all the months of the study while the intake of other nutrients such as calcium and vitamin C, were adequate during all the seasons.

The observed low niacin intakes may be associated with the predominantly maize based diets. However, the determination of the niacin requirements is complicated by the fact that a variable amount of the amino acid tryptophan is converted to niacin in the body (Russel and Suter, 1993). The subjects satisfied their protein intakes during most months, but it was mainly from plant sources which are likely to be low in tryptophan. The low energy intakes observed even during the postharvest months may be due to the low consumption of foods rich in fat, and also due to the bulkiness of the diets which were mainly composed of whole maize and beans. This type of diet may have been difficult for elderly persons to consume adequate amounts.

The nutritional status of the subjects based on body mass index, was found to follow a seasonal pattern with low mean BMI values during the lean season followed by appreciable

improvements during the harvest months when food intake increased. Calculations based on individual subject weights found that an average of 23 percent of the subjects per month had BMI values smaller than 18.5 which is the cut-off for undernutrition or thinness, and around 13 percent had BMI of more than 25. These findings indicate that quite a large number of the elderly had BMI values which constituted a substantial risk to health during most months of the study. Further, we observed that if the BMI values of our study subjects were fitted to the BMI classifications used for western elderly populations, the percentages of the group with low BMI was much higher. The western elderly population is reported to have higher energy intakes coupled with low physical activity levels (Horwath, 1989; James, 1989; Glick, 1992; Prentice, 1992), while a greater part of those from the developing countries live under greater nutritional and physical stress (WHO, 1983).

The body mass index reported for the elderly populations in the more affluent western societies is much higher than that observed in our study (Fidanza and Losito, 1981; Burr and Philips, 1984; Deurenberg et al., 1989), probably as a result of high energy intakes and reduced physical activity levels (Prentice, 1992). This may explain the reasons for the higher cut-off points for underweight and overweight used in these countries in relation to the ones we used in this study. In comparison, the subjects in our study were a group of very active elderly farmers who were continuously engaged in heavy physical activity during most months of the year.

The loss in body weights observed in our subjects even when energy intakes were close to 100 percent of the recommended levels, may seem to indicate that the recommended levels of energy intake by the FAO/WHO/UNU report (FAO/WHO/UNU, 1985) may still be too low to maintain energy balance in elderly subjects engaged in heavy physical work. As suggested by Young (1992), there is a need for more research in the elderly to determine appropriate levels of energy expenditure, so that the current recommended dietary intakes can be adjusted for populations living under different conditions.

The decline in BMI values observed in the subjects coming from the different landsize groups are of interest because of the fact that many low income smallholder households including those of our subjects, depend wholly on the land as the main source of their food and income. Land size therefore, may be an important factor in the determination of the nutritional status of

household members, especially from the low income rural farming communities, and may be an important policy issue. As such this aspect requires further investigations.

In conclusion, the results of this study show that the elderly people living in smallholder rural areas of a unimodal climatic pattern in Kenya suffer from food shortages arising from seasonal variations in food availability at the household level. The results also show that the percentage of elderly subjects with low BMI values and hence at "risk" to their health was very high. There was also a significant difference between elderly men and women in the cumulative mean of BMI values as well as in the annual pattern of body weight fluctuations. It may be that male elderly are much more subject to a food and/or activity stress than the female elderly.

Our results also suggest that there may exist a relationship between family size, land size and the nutritional status of the elderly in the farming communities. However, this relationship and the consequences on health and nutrition of the elderly needs further exploration. The results of this study cannot be generalized for the total elderly rural population in Nakuru district or in Kenya as a whole, because they represent only a small group of the low income smallholder households.

ACKNOWLEDGEMENTS

We wish to thank Rudo Niemeijer for the technical assistance during the development and testing of the questionnaires, to the ten enumerators who worked tirelessly throughout the study, and to all the families for their cooperation. We wish to also thank Willem Veerman of the African Studies Centre, Leiden, for assistance in data analysis. The funds for this study came from a grant to the first author from the International Development Research Centre, Canada. Additional financial, technical, and material support was provided by the Food and Nutrition Studies Programme (FNSP), a research project in Kenya which is supported by the Netherlands Government through the African Studies Centre, Leiden.

REFERENCES

Ategbo, E. D. (1993). Food and nutrition insecurity in northern Benin: Impact on growth performance of children and on year to year nutritional status of adults. PhD thesis. Wageningen Agricultural University.

Bleiberg, F. M., T. A. Brun, S. Goihman (1980). Duration of activities and energy expenditure of female farmers in dry and rainy seasons in Upper Volta. *British Journal of Nutrition* **43**: 71-82.

Bowman, B. B. and I. H. Rosenberg (1982). Assessment of the nutritional status of the elderly. *American Journal of Clinical Nutrition* **35**: 1142-1151.

Brun, T. A., F. M. Bleiberg, S. Goihman (1981). Energy expenditure of male farmers in dry and rainy seasons in Upper-Volta. *British Journal of Nutrition* **45**: 67-75.

Burr, M. L. and K. M. Philips (1984). Anthropometric norms in the elderly. *British Journal of Nutrition* **51**: 165-169.

Cameron, M. E. and W. A. van Staveren, Eds. (1988). Manual on methodology for food consumption studies. Oxford University Press. New York.

Deurenberg, P., K. van der. Kooy, T. Hulshof, P. Evers. (1989). Body mass index as a measure of body fatness in the elderly. *European Journal of Clinical Nutrition* **43**: 231-236.

FAO (1970). Food composition table for use in Africa. Nutrition Division. FAO. Rome.

FAO/WHO (1988). Requirements of vitamin A, iron, folate and vitamin B12.

FAO/WHO/UNU (1985). Energy and protein requirements. Technical Report Series No 724. Rome

Ferro-Luzzi, A., C. Scaccini, S. Taffesse, B. Abera, T. Demeke. (1990). Seasonal energy deficiency in Ethiopian rural women. *European Journal of Clinical Nutrition* **44** (Suppl 1): 7-18.

Ferro-Luzzi, A., S. Sette, M. Franklin, W.P.T. James (1992). A simplified approach of assessing adult chronic energy deficiency. *European Journal of Clinical Nutrition* **46**: 173-186.

- Fidanza, F. and G. Losito (1981). Nutritional Status of the elderly: anthropometry, diet and clinical data from old pensioners in Perugia, Italy. *Bibltuca Nutrition Dieta* 30: 70-80.
- Garry, P. J., J. S. Goodwin, W.C. Gilbert. (1982). Nutritional status in a healthy population: dietary and supplemental intake. *American Journal of Clinical Nutrition* 36: 332-339.
- Glick, Z. (1992). Energy balance in the elderly. In H. Munro, G. Schlierf Eds. *Nutrition of the elderly*. Raven Press. New York.
- Hart, W. D. and S. Little (1986). Comparison of diets of elderly hispanic and caucasians in the urban southwest. *Journal of Nutrition for the Elderly* 5: 21-29.
- Horwath, C. C.(1989). Dietary intake studies in elderly people. *World Review of Nutrition and Dietetics*. 59:1-70.
- James, W. P. T. (1989). Energy. In: Horwitz A., D.M Macfaden, N.S. Schrimshaw, B. Steen, T.F. Williams(eds) *Nutrition in the elderly*. Oxford University Press. New York.
- Loutan, L. and J.M. Lamotte (1984). Seasonal variations in nutrition among a group of nomadic pastoralists in Niger. *Lancet* 1: 945-7.
- Macfaden, D. M. (1988). Aging in the world: facts and figures. National Research Council of Italy. National Institute of Nutrition. Rome.
- Mahajan, K.H. and E. Schafer (1993). Influence of Selected Psychosocial factors on Diet Intake in the Elderly. *Journal of Nutrition for the Elderly* 12: 21-41.
- McNeill, G., P.R. Payne, J.P.W. Rivers, A.M.T. Enos, J.J. de Britto, D.S. Mukarji (1988). Socio-economic and seasonal patterns of adult energy nutrition in a south Indian village. *Ecology of Food and Nutrition* 22: 85-95.
- Prentice, A.M. (1992). Energy expenditure in the elderly. *European Journal of Clinical Nutrition* 46(suppl.3): S21-S28.
- Prentice, A.M., R.G. Whitehead, S.B. Roberts, A.A. Paul (1981). Long-term energy balance in child-bearing Gambian women. *American Journal of Clinical Nutrition* 34: 2790-99.
- Rosetta, L. (1986). Sex differences in seasonal variations of the nutritional status of Serere adults in Senegal. *Ecology of Food and Nutrition* 18: 231-44.

Rudman, D. and A. G. Feller (1989). Protein-calorie undernutrition in the nursing home. *Journal of the American Geriatric Society* **37**: 173-183.

Russel, R. M. and P.M. Suter (1993). Vitamin requirements of elderly people: an update. *American Journal of Clinical Nutrition* **58**: 4-14.

Schultink, W.J., W. Klaver, H. van Wijk, J.M.A. van Raaij, J.G.A.J. Hautvast (1990). Body weight changes and basal metabolic rates of rural Beninese women during seasons with different energy intakes. *European Journal of Clinical Nutrition* **44** (suppl 1): 31-40.

Snedecor, G. W. and W. G. Cochran (1980). Statistical methods. Iowa State University Press. Iowa.

Vellas, B. (1992). Effects of the aging process on the nutritional status of elderly persons. In: A. Horwitz, D.M Macfaden, N.S. Schrimshaw, B. Steen, T.F. Williams, (Eds). *Nutrition of the elderly*. Raven Press. New York.

West, C.E, F. Pepping, I. Sholte, W.Jansen, H.F.F. Albers (Eds). (1987). Food composition table for foods commonly eaten in East Africa. CTA and ECSA. Wageningen.

WHO (1983). The uses of epidemiology in the study of the elderly. WHO. Geneva.

Wilkinson, L. (1989). SYSTAT: The system for statistics. Evanston, Illinois.

Yeung, D. L. and A. Imbach (1988). Geriatric nutrition in Canada: a review. *Journal of Nutrition for the Elderly* **7**(3): 27-45.

Young, V. R. (1992). Energy requirements in the elderly. *Nutrition Reviews* **50**(4): 95-101.

CHAPTER 6

HOUSEHOLD FOOD SECURITY AND NUTRITIONAL STATUS OF VULNERABLE GROUPS IN KENYA :

A seasonal study among low income smallholder rural households.

GENERAL DISCUSSION

The studies presented in this thesis were aimed at investigating the effect of a unimodal climatic pattern on household food security, the dietary intakes, and the nutritional status of three groups of vulnerable household members (children, lactating women, and the elderly), from smallholder rural households with limited landholdings and low cash incomes. The studies were conducted in Nakuru district which is within the Rift Valley province in Kenya. The investigations also evaluated the relationship between land size and household size on household food availability and the nutritional status of the three vulnerable groups.

The results of these studies, together with the possible factors influencing these results are discussed in the following pages.

Seasonality and undernutrition

In countries of the tropical and subtropical zones, seasonal climatic changes determine the agricultural cropping patterns, hence the production and availability of locally produced foods. As such, seasonal fluctuations in food production are important factors contributing to fluctuating levels of food availability in the rural and the urban households in these countries (Chambers et al., 1981; Teokul et al., 1986; Dugdale and Payne, 1987). This also applies to Kenya, a country with varied ecology and environment, characterized by important differences

in agricultural potential resulting in very distinct spatial patterns in food production for different areas of the country (Kliest, 1985).

The seasonal fluctuations in food availability, their influences on energy and nutrient intake, as well as on body weight of both adults and children are well documented in many studies (Paul et al., 1979; Pagezy, 1984; Rosetta, 1986; McNeill et al., 1988; Durnin et al., 1990; Ferro-Luzzi et al., 1990; Schultink et al., 1990; Ategbo, 1993; Branca et al., 1993; Pastore et al., 1993). During this period adults are reported to lose between 2 to 5 percent of their body weights, child mortality rates are high, and sickness is more prevalent (FAO, 1986). Climatic seasonality affects the nutritional status of household members through a number of intervening variables. The most important of these are household food supply, health, and activity patterns. At the community or household level, different socio-economic classes, different age groups, and different genders, may have different exposure to the effects of seasonal variations in food availability (Brown et al., 1982; McNeill et al., 1988 ; Sahn, 1989; Wandel, 1989; Leonard et al., 1993).

Poverty and undernutrition

Undernutrition, lack of education, and illhealth, are basic characteristics common to the poor rural populations throughout the developing countries. In these rural areas, land is the basis of food production, incomes, and employment, and helps to determine the household's access to adequate food, shelter, health services, and educational services. As such, insufficient land or landlessness by a household in the rural areas of these countries would mean that the household will have limited access to food, shelter, health and education services. Because food is a biological necessity for human survival, adequate food intake or lack of it, is a major yardstick in the assessment of rural poverty. However, even among the poor, there are sometimes marked differences in levels of nutrition, health and education levels (FAO, 1986). This indicates that undernutrition is more than a simple problem of food supply. The poor are not always undernourished, but the undernourished are almost always poor.

Household income and expenditure surveys, and nutrition surveys in India, Peru, Bangladesh, Philippines, Somalia, Haiti, Kenya, and Tunisia have shown that undernutrition is largely concentrated among the landless, sharecroppers, very smallholders, and small scale fishermen (FAO, 1986). Particularly vulnerable among those groups, are households with large numbers of dependants, and those with higher young age composition (WHO, 1993).

In Table 1, a relation is shown to exist between landholding size and per capita food consumption, as well as in the energy and protein intake of household members. This table shows that there is a direct relationship between land size and energy and protein intake at the household level. This direct relationship may apply especially for smallholder households who mainly depend on the land for their food supply, and who have limited sources of extra income to purchase additional food.

Table 1

Per capita food consumption and nutrient intake per day in relation to size of land holding

Land size acres	Food consumption grams	Nutrient intake per day	
		energy (kcal)	protein (gram)
landless	694	1925	53.9
0.01 - 0.49	683	1924	52.6
0.50 - 0.99	745	2035	57.7
1.0 - 2.99	785	2193	62.5
3.00 +	843	2375	67.6

Source: FAO, 1986

Results from our study on household food availability (**chapter 2**), showed that due to limited landholdings and a unimodal climatic pattern, the households in the study were food insecure during most months of the production cycle. The mean household food availability from own

production, purchases, and gifts accounted for only 88 percent of the mean total household energy requirements, leaving an energy deficit of about 12 percent unfulfilled. The average daily energy availability per household was lower than the household's requirement by as much 5.7 MJ (1370 kcal)/day when computed for the entire study period. While the food supply to the household from own production fluctuated between months, food purchases remained fairly low and almost stable from one month to the next. Larger energy deficiencies were observed when the households were grouped according to household size, with households having more than seven members meeting only 68 percent of their energy needs from own production and purchases compared to small households (<4 persons). When food availability to the household was calculated on the basis of landholding size in relation household size, it was found that the average land size of 2.5 acres (1 hectare) could only supply 76 percent of the mean energy requirements of the households in the study.

Kenyan rural families are generally large, averaging more than seven members (Greer and Thorbecke, 1986). As such, it is likely that with the limited amount of land, most households may be unable to produce adequate amounts of food to last from one production cycle to another, and would have to depend on other sources for food, such as markets. In this study, food production showed a strong seasonal pattern but, the food purchases did not increase during the lean season as would be expected. This observation was contrary to reports from other studies (Reardon et al., 1988; Neumann et al., 1989; Hoorweg et al., 1991; Foeken and Tellegen, 1992; Leonard et al., 1993; van Liere, 1993), which reported increased food purchases in rural households when home produced stocks decreased. The low food purchases observed in our study may be an indication of the inability of those households to purchase additional foods due to poverty. The households in the study belonged to the low income category. As such they may have lacked the financial resources with which to purchase additional food to supplement deficits when their own produced stocks run out. This observation may be an indication that poor smallholder households are more vulnerable to seasonal food shortages, hence to food insecurity, than households from the same environment, but who have other sources of income. Poverty is said to be a syndrome whose best indicator is consumer expenditure (Schuftan, 1979). Low expenditures on food by the households, even

when their own production did not meet energy needs, may be an indicator of insufficient financial resources and therefore, a possible indicator of insufficient food intakes and undernutrition especially during the lean seasons.

The dietary intakes of the different vulnerable groups within households in our study, showed that the energy and nutrient intakes increased substantially during the postharvest months compared to the lean months. The low dietary intakes during the lean months had direct effects on the mean body weights of the different age groups studied (**chapters 3, 4, and 5**). The anthropometric measurements (weight and height) of the preschool children (**Chapter 3**) showed a seasonal pattern with improvements in all the Z scores for weight-for-age, height-for-age, and weight-for-height, during the postharvest months. While no weight loss was observed in the children during the different months, weight gain was observed to stagnate during the lean months.

The weight loss in the adult groups was high during the lean season, in both the lactating women (**chapter 4**) and in the elderly subjects (**chapter 5**). The lactating women had body weight losses of about 9 percent during the lean season. This weight loss was attributed to three factors namely; decreased levels in energy and nutrient intakes due to seasonal variations in household food availability, postpartum depletion of maternal energy stores, as a result of increased energy demands during lactation, and increased physical activity levels especially during the wet season (**chapter 4**). Elderly men lost about 7 percent of their body weight during the lean season and the elderly women about 3 percent during the same period (**chapter 5**). This seasonal loss in body weight in elderly subjects was slightly higher than the 2 to 5 percent weight losses reported in adult subjects in other studies (Bleiberg et al., 1980; Brun et al., 1981; Prentice et al., 1981; Loutan and Lamotte, 1984; Rosetta, 1986 ; Schultink et al., 1990; Ategbo, 1993). There is lack of data on the effects of seasonality on elderly subjects from the developing countries with which to compare our results.

In the preschool children, the weight-for-age, weight-for-height, and height-for-age Z-scores were low at baseline and during most months of the lean season in 1992. However, these scores improved during the harvest months when the households appeared to be food secure. The energy intake of the preschool children in the study improved during the postharvest

months, but the intakes did not reach the recommended levels (**chapter 3**). The intake of the other nutrients showed the same pattern. In general, the dietary intakes of the prechoolers did not show appreciable improvements during the postharvest months as did the intakes of adult subjects. This observation may be an indication that the food intake by the children was influenced by other factors besides household food availability. The dietary intakes and the anthropometric response of the three vulnerable groups to seasonal changes in household food availability are discussed later in this chapter. In the following pages, the meaning and issues concerning household food security and the nutritional status of household members are discussed.

Household food security and nutritional status

Household food security has been defined in its most basic form, as access by all people at all times to food needed for a healthy life. At the household level, food security has been defined as a state in which households have continuous access to food supplies which can fully satisfy the nutritional and dietary needs of all its members at all times (FAO/WHO, 1992; Maxwell and Frankenberger, 1992; Frankenberger et al., 1993).

Undernutrition is usually measured by growth faltering in children and reduced body mass in adults. There is currently a debate about whether undernutrition is an adequate proxy or indicator of food security. At one point, it has been argued that undernutrition is synonymous with food insecurity. At the other point, undernutrition is said to be independent of food security (Maxwell and Frankenberger, 1992). It has been reported that the immediate causes of households inability to acquire sufficient quantities of food during certain periods of the year revolve around a decline in their income (either in cash or in kind), and an increase in market prices (Sahn, 1989). The fluctuations in income and prices are largely a reflection of the cyclic nature of agriculture. Variations in income and prices represent a threat to food security when a household is not able to save either in the form of food stocks or cash, and when the patterns of the seasonal changes is not predictable, thus introducing an element of risk into household savings and consumption behaviour (Sahn, 1989). The rural poor have traditionally relied upon

in-kind agricultural based savings in form of food stocks. When these households deplete their stocks long before the next harvest, the availability of wage labour becomes vital for their survival. As shown in this study (**chapter 2**), wage labour, especially in the remote rural areas is also seasonally influenced. In areas with unimodal climatic pattern, the availability of on-farm wage labour is limited by the fact that there is only one rainy season and one peak labour period.

Seasonal variations in production and changes in prices of foods are important factors contributing to transitory food insecurity of poor households, which over time can escalate into chronic food insecurity and nutritional deterioration (Sahn, 1989). Sudden changes in incomes and prices affect the ability of households to obtain food that is available in the markets. For example, in this study, the household purchases of fats and oils were drastically reduced when the prices of this commodity more than doubled within a short period, as a result of structural adjustment programmes taking place in Kenya at the time. This led to further reductions in the amount and frequency of fat used in the preparation of the family meals, which were already very low.

Household food security and vulnerable groups

The seasonal effect on household food availability in our study was found to have significant effects on the dietary intakes and the body weights of the adults subjects. However, it had a less substantial effect on food intake and the growth of preschool age children. Although the level of stunting decreased during the postharvest months to 28 percent from 51 percent in the lean season, the prevalence of stunting was still considerably high even during the harvest months. The intake of energy and other nutrients did not reach the recommended levels even during the harvest season, when households were apparently food secure. Moreover, the quality of the diets fed to the children were generally poor in terms of nutrient density and in relation to the nutrient needs of young children.

It has been observed that poor dietary quality is a more common situation affecting growth of children than actual food shortage in less wealthy population groups and countries (Neumann et al., 1989; Allen, 1994; Neumann and Harrison, 1994). A poor quality diet contains few animal

products, fruits, and vegetables, and consists mainly of staples such as cereals, root crops and a limited quantity of legumes (Allen et al., 1991). Such poor quality diets are associated with low intakes of several vitamins and minerals, and poor mineral bioavailability (Allen, 1994).

The chronic type of malnutrition found in the children in our study was thought to be a direct result of low energy and nutrient intake, primarily due to insufficient food consumption. Preschool children were generally fed from the family pot. The basic staple food of the community studied is *Ugali* which is a thick maize-meal dish served with a vegetable or legume relish. An alternative dish is *githeri*, a dish made of boiled maize and beans which are then mixed with potatoes and/or vegetables, when available. These dishes are relatively high in bulk and low in energy content. Because of their small stomach sizes coupled with the low energy content of the commonly eaten dishes, it is possible that the children could not eat sufficient quantities to satisfy their daily energy needs. For many households, there were no in-between meals for the children and they had to wait for the preparation of the family meals which typically were after midday and in the evenings. As such, too few meals per day may have compounded the problem of inadequate energy and nutrient intake of the children. The diets were also low in fat and contained few or no animal products. Consequently, even when the households were food secure in terms of total energy during the harvest season, the diet quality was poor and may not have adequately met the children's nutrient needs for growth and development.

Besides poor diets, morbidity is also likely to cause depletion of several nutrients simultaneously, through anorexia and malabsorption (Allen, 1994). This implies that young children may be nutritionally insecure even when the household food security is achieved, as long as the dietary patterns remain the same, and the morbidity rate remains high. The reported rate of illnesses in this study was on average 4.5 (SD1.8) days per month, with colds, coughs and fever being the most common. As no biochemical data were collected, it is not possible to know the effect of the disease prevalence on the nutritional status of the children. However, it is known that any form of illness affecting a child is likely to depress the appetite, thus affecting food intake.

The immediate determinants of child survival and growth have been identified as adequate dietary intake and health, while the three underlying determinants are household food security, care of women and children, and the presence of adequate health services and a healthy environment (UNICEF, 1992). A family's access to adequate amounts of food is a basic requirement for ensuring household food security. However, a child's nutritional status depends directly on the actual amounts and types of foods eaten, as well as on its health status. In addition the health and nutritional status of the mother has a direct impact on her work capacity and in her participation in the provision and preparation of family meals. Influencing each of the above factors is the seasonal dimension which affects not only the mothers' workload and child care but also household food supplies, feeding practices, and health care practices.

From the above argument, it follows that a deterioration in anthropometric indicators cannot be interpreted on its own as identifying a decline in food intake, let alone in food security. Even if it can, anthropometric results especially stunting, may well reflect a history of past undernutrition, rather than any current nutritional problem (Payne, 1979; Allen, 1994; Martorell et al., 1994). By the same token, acceptable anthropometric results do not necessarily demonstrate adequate food security because the risk levels may be high (Maxwell and Frankenberger, 1992). The implication for food security would seem to be that anthropometry is not a universally reliable indicator of changing food security status, but that it may, in certain circumstances and with information on other factors, be possible to interpret anthropometric data with respect to food security (Maxwell and Frankenberger, 1992; Frankenberger et al., 1993).

The dietary intake of children is affected by food availability in the households, while exposure to infections depends partly on the health of the environment. Both of these are modified by care of the individual child by the care givers, especially the mother. A symptom of poverty is that children have to be neglected as their parents struggle to secure food supplies, income, and health care for the family. A disproportionate amount of this struggle falls on the women, particularly in most African countries, where women are the primary care givers for children and other family members (ACC/SCN, 1990). One other factor associated with child

nutritional status is the educational level of the mother. In our study households, the level of education was low with the majority of the parents (78 percent) having only primary level education or lower. It has been reported that the education level of mothers alone, independent of household income is positively related to better nutritional status of children and to lower infant mortality (FAO/WHO, 1992). The effect of maternal education on child health and nutrition are mediated by better management of household resources. Maternal education is also frequently associated with greater use of health care services, lower fertility rates, and more child centred care giving behaviours (ACC/SCN, 1990; FAO/WHO, 1992; UNICEF, 1992). With increasing education, women have more power to allocate resources for food and other items needed for their children's health and welfare.

A wide range of household and demographic factors are related to caring capacity and to child malnutrition. These include the nature of housing, type and availability of water supply, age at weaning, birth order, and the presence or absence of other siblings (ACC/SCN, 1990; FAO/WHO, 1992). The children from large households (>7 persons) in our study had better nutritional status than those from medium sized households (4-7 persons). As there were no significant age differences between the two groups, the differences in dietary intake and growth might be attributed to the presence of many young siblings in relatively young families who require feeding, care, and attention from already overworked parent (s). This observation needs further investigation. The realization of the important role played by care in relation to the nutritional status of a child has led to increasing recognition of the women's role and status in addressing the malnutrition question. However, in order to give adequate care to the children, women need the physical, financial, and nutritional support, and freedom from stress. In the rural farming communities, this ideal condition may be difficult to achieve as long as the socio-economic hardships remain, and continue to affect large numbers of the rural women.

In most development projects, household food consumption and child anthropometric status are among the indicators commonly used to assess dietary adequacy and nutritional status at the household level. Child growth indices are often the only indicators used to identify malnourished households, to target rural development projects, and to evaluate their impact. Such projects usually focus on agricultural production, household food supply and

consumption. As explained above, these factors do not necessarily affect child nutrition, particularly when infection is also an important determinant of nutritional status (Begin, 1988). Findings from studies in Thailand, Malaysia, and Sudan, indicate that available dietary energy at the household level may not be a precise indicator of children's nutritional status (Kennedy, 1983). In the Philippines, targetting households that did not meet their energy needs captured only a small proportion of malnourished children (Pinstrup-Andersen and Garcia, 1990). In Bangladesh, children and women suffered from moderate or severe malnutrition in energy-sufficient households because of intrahousehold food distribution, and other factors which favoured adult males at the expense of children and women (Hassan and Ahmad, 1986). These reports indicate that in order to ensure adequate nutrition and growth of young children in the less developed countries, many factors have to be taken into consideration due to the multifaceted nature of the problem.

The impairment of growth in children is multifactorial, but the important causal factors have been identified as nutrition, infection, and mother-infant interaction. These on the other hand depend on the socio-economic status, as well as the education level of the family. Data from our study showed that even during the harvest months when the households were apparently food secure, the energy and nutrient intakes of the children did not reach the recommended levels, and the anthropometric measurements improved only slightly. It appears therefore, that child growth indices may not be the best markers to identify population groups or communities at risk of transitory food insecurity.

One of the general objectives of this study was to investigate whether any one of the three vulnerable groups studied, namely; preschool children, lactating women, or the elderly, provides an early warning sign of energy stress during times of household food insecurity. In comparing the seasonal changes in body weight of the adult groups, the elderly subjects exhibited clearly defined fluctuations in body weight and body mass indexes between different months and seasons, which seemed to be sensitive to very slight improvements or decreases in food intake. The male and female elderly subjects were also found to respond differently to seasonal fluctuations in food intake, with the men showing more sensitivity to variations in food availability than the women. The lactating women lost nearly as much weight as the male elderly

subjects. However, the loss was gradual and less defined compared to that of the elderly subjects. Secondly, not all the weight lost by the lactating women was due to seasonal changes in household food availability, since part of the loss in weight during lactation is considered normal, arising from postpartum depletion (Butte et al., 1991).

It is difficult to determine the effect of seasonal food availability in one agricultural cycle on the growth of young children especially in communities with chronic nutritional deficiencies. This is because part of the growth failure such as stunting, may have started long before the period of the study. Secondly, as found in this study, the childrens' diets were not greatly influenced by seasonal changes in food availability, but by the general quality of the local diets. Thirdly, the growth of children is influenced by many other factors besides diet, such as care and freedom from diseases. This makes it difficult to interpret anthropometric measurements of young children without taking into account all the other factors.

Considering the response in the nutritional status of the three vulnerable groups to seasonal household food availability, we can conclude that the weight changes of apparently healthy elderly subjects, especially elderly men, showed an early response to seasonal fluctuations in food availability than the lactating mothers or the children. From this study therefore, we can conclude that the elderly subjects gave an earlier sign of energy stress than the other two groups. On the other hand, we cannot make concrete conclusions on this question from our data because the sample sizes were too small. Secondly, it is known that the elderly comprise of a rather heterogeneous group with many other complications of aging which may affect food intake and hence body weight, even when household food availability is adequate.

In conclusion, results from the studies reported in this thesis show that most of the smallholder rural households in the unimodal climatic areas of Kenya may be food insecure as they do not produce adequate amounts of food to last them from one harvest to the next. This is mainly due to such factors as limited landholdings, seasonality in the rainfall patterns, and large families. The problem of food availability to the rural households is further confounded by general poverty, arising from lack of employment opportunities in the rural areas.

In these studies, the food intake as well as the nutritional status of the vulnerable household members were all affected by seasonal changes in household food availability, leading to weight

loss in adults and poor growth in children. The body mass index of the elderly subjects, especially the males, showed an early response to seasonal changes in food availability and to increased physical activities. However, we cannot conclude from one study, that the elderly subjects would be the best vulnerable group to provide an early warning sign of energy stress in a community. Further investigations involving larger sample sizes would be needed before this question can be answered.

The consequences of seasonal weight changes in the health of the adult population are not yet clear. When weight changes are modest, this may not have any far reaching consequences. However, poor nutritional status affects work capacity and this may be detrimental to the people's capacity for work in the farms, and to secure enough food for their households, thus creating a cyclic nature of nutritional stress. On the other hand, when large seasonal weight changes occur in nutritionally vulnerable groups, such as seen in the elderly subjects and lactating women, the cumulative effect may be harmful to the health of these groups in the long term. In the case of lactating mothers excessive losses in body weight could affect their health and nutritional status and consequently their milk production.

A high rate of stunting was observed in the children even during the harvest season. While the outcome of the high stunting among children on the future generations is still unknown, it has been well documented that becoming and remaining stunted puts a child at an increased risk of morbidity, mortality, and delays in mental and physical development (Golden, 1994; Martorell et al., 1994; Neumann and Harrison, 1994). Stunted children are likely to become stunted adults, and stunted adults on the other hand, have been shown to have below average work capacity (Spurr, 1988).

These results indicate that there is a need for programmes to monitor conditions of the vulnerable groups in the smallholder rural households especially during periods of food scarcity. Of particular concern are the elderly subjects living in the smallholder areas of Kenya. Many of them are poor, lonely and have to work for long hours on the farms in an effort to produce the food they need for their survival. In the case of the children, there is need for concerted effort towards educating the mothers and other child care givers, on proper child feeding practices and on food preparation aspects through community nutrition education

programmes. The smallholders in general need to be assisted to diversify their food base by growing more varieties of food crops to reduce the high dependence on a single staple crop of maize per year. A variety of crops would go a long way in providing variety to the already monotonous diets and would improve the nutritional quality of the diets.

Finally, there is need for policies geared towards improving the food security problems of the rural small farmers in Kenya. The role of such policies is most significant especially because rural poverty is greatest and has increased most among this group as a result of structural adjustment programmes which have pushed up the price of nearly all the basic foodstuffs. Improving small farmer's incomes will help alleviate poverty and increase growth and could play a vital role in helping the vulnerable groups, and families in general, during periods of seasonal food scarcity. The ability of the smallholder agricultural areas to draw on sources of income outside agriculture may be crucial to the success of reducing poverty. There is therefore an urgent need for programmes which geared towards creating employment in the rural areas. Access to earning opportunities outside the agricultural sector could make a great deal of difference especially in a country like Kenya, whose natural resources are already under pressure from the rapid population growth rates. Raising incomes of small farmers will have direct effects on reducing poverty, food insecurity, and malnutrition among this group.

Our data show that a unimodal climatic pattern, coupled with small landholdings and low incomes affect the production and availability of food to the households. The fluctuations in food availability in such households affects the food consumption and the nutritional status of the household members especially the nutritionally vulnerable ones. The studies described in this thesis were from a selective group of rural smallholders households with low incomes. However, as the majority of Kenyan households are to be found in the smallholder areas, further studies will be needed which would examine the effect of different landholding sizes, income levels, and spending patterns, on household food security and nutritional status in these areas, besides seasonality. This information would be used for making adequate policies which would address the food and nutrition situation in the smallholder areas of Kenya.

REFERENCES

ACC/SCN (1990). Women and nutrition. Nutrition policy discussion paper No. 6. Lavenham Press. Suffolk.

Allen, H. L., A.K. Black, J.R. Backstrand, G.H. Peltó, R.D. Ely, E. Molina, A. Chavez (1991). Analytical approach for exploring the importance of dietary quality versus quantity in the growth of mexican children. *Food and Nutrition Bulletin* 13: 95-104.

Allen, L. H. (1994). Nutritional influences of linear growth: a general review. *European Journal of Clinical Nutrition* 48 (suppl. 1): S75-S89.

Ategbo, E. D. (1993). Food and nutrition insecurity in northern Benin: Impact on growth performance of children and on year to year nutritional status of adults. PhD thesis. Wageningen Agricultural University.

Begin, F. (1988). Household dietary adequacy and individual nutritional status: Relationships and seasonal effects in a Sahelian community in Chad. *Food and Nutrition Bulletin* 14: 304-313.

Branca, F., G. Pastore, T. Demissie, A. Ferro-Luzzi (1993). The nutritional impact of seasonality in children and adults of rural Ethiopia. *European Journal of Clinical Nutrition* 47: 840-850.

Brown, K. H., R.E. Black, S. Becker (1982). Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural Bangladesh. *American Journal of Clinical Nutrition* 36: 303-313.

Butte, N.F. (1991). Physical Status: The use and interpretation of anthropometry in lactating women. USDA/ARS Children's Nutrition Research Centre (report). Houston. USA.

Chambers, R., R. Longhurst, A. Pacey, Eds. (1981). Seasonal dimensions to rural poverty. Frances Pinter. London.

Dugdale, A. E. and P. R. Payne (1987). A model of seasonal changes in energy balance. *Ecology of Food and Nutrition* 19: 231-245.

Durnin, J. V. G. A., S. Drummond, K. Satyanarayan (1990). A collaborative EEC study on seasonality and marginal nutrition: the Glasgow Hyderabad (S.India) study. *European Journal of clinical Nutrition* 44(suppl.1): 19-29.

FAO (1986). The dynamics of rural poverty. FAO. Rome.

FAO/WHO (1992). International Conference on Nutrition : Major issues for nutrition strategies. FAO. Rome

Ferro-Luzzi, A., C. Scaccini, S. Taffese, B. Abera, T. Demeke (1990). Seasonal energy deficiency in Ethiopian rural women. *European Journal of Clinical Nutrition* 44 (Suppl 1): 7-18.

Foeken, D. and N. Tellegen (1992). Household resources and nutrition of farm labourers in Trans Nzoia district, Kenya. Report no. 44. Ministry of Planning and National Development, Nairobi, Kenya, African Studies Centre, Leiden, Netherlands.

Frankenberger, T., A. Pena-Montenegro, S. Tilakaratna, N. Velarde, W.B. Eide (1993). Technical issues in rural Poverty alleviation; Rural poverty alleviation and nutrition: IFAD's evolving experiences. International Fund for Agricultural Development. Rome.

Golden, M. H. N. (1994). Is complete catch-up possible for stunted malnourished children. *European Journal of Clinical Nutrition* 48(suppl. 1): S58-S71.

Greer, J. and E. Thorbecke (1986). Food poverty and consumption patterns in Kenya. International Labour Organization. Geneva,

Hassan, N. and K. Ahmad (1986). Household distribution of energy intake and its relationship to socio-economic and anthropometric variables. *Food and Nutrition Bulletin* 8: 3-4.

Hoorweg, J., R. Niemeijer, D. Foeken, W. Okello, W. Veerman (1991). Economic and nutritional conditions at settlement schemes in coast province. Report No.36. Food and Nutrition Planning Unit, Ministry of Planning and National Development, Nairobi, Kenya; African Studies Centre, Leiden, Netherlands.

Kennedy, E. (1983). Determinants of family and preschooler food consumption. *Food and Nutrition Bulletin* 5: 22-29.

Kliest, T. (1985). Regional and Seasonal Food Problems in Kenya. Food and Nutrition Planning Unit, Ministry of Finance and Planning, Nairobi, Kenya; and African Studies Centre, Leiden, The Netherlands.

Leonard, W. R., K.M. Dewalt, J.E. Uquillas, B.R.Dewalt (1993). Ecological correlates of dietary consumption and nutritional status in highland and coastal Ecuador. *Ecology of Food and Nutrition* 31: 67-85.

Martorell, R., L. Ketter Khan, D.G. Schroeder (1994). Reversibility of stunting: epidemiological findings from developing countries. *European Journal of Clinical Nutrition* 48(suppl. 1): S45-S57.

Maxwell, S. and T. R. Frankenberger (1992). Household Food Security: Concepts, Indicators, Measurements. A technical review. UNICEF/IFAD. New York / Rome,.

McNeill, G., P.R. Payne, J.P.W. Rivers, A.M.T. Enos, J.J. de Britto, D.S. Mukarji (1988). Socio-economic and seasonal patterns of adult energy nutrition in a south Indian village. *Ecology of Food and Nutrition* 22: 85-95.

Neumann, C., R. Trostle, M. Barksh, D. Ngare, N. Bwibo (1989). Household response to impact of drought in Kenya. *Food and Nutrition Bulletin* 11: 21-33.

Neumann, C.G. and G.G. Harrison (1994). Onset and evolution of stunting in infants and children. Examples from the Human Nutrition Collaborative Research Support. Kenya and Egypt studies. *European Journal of clinical Nutrition* 48(suppl. 1): S90-S102.

Pagezy, H. (1984). Seasonal Hunger as experienced by the Oto and the Twa women of a Ntomba village in the equatorial forest (Lake Tumba Zaire). *Ecology of Food and Nutrition* 15: 13-27.

Pastore, G., F. Branca, T. Demissie, A. Fero-Luzzi (1993). Seasonal energy stress in an Ethiopian rural community: an analysis of the impact at the household level. *European Journal of Clinical Nutrition* 47: 851-862.

Paul, A. A., E.M. Mueller, R.G. Whitehead (1979). Seasonal variations in energy intake, body weight and skinfold thickness in pregnant and lactating women in rural Gambia. *Proceedings of the Nutrition Society* 38: 28A.

Payne, P. R. (1979). Assessment of nutritional problems: who do we look at and what do we measure? Rapid Rural Appraisal Conference, Institute of Development Studies, Brighton.

Pinstrup-Andersen, P. and M. Garcia (1990). Data on Food consumption by high-risk family members: its utility for identifying target households for food and nutrition programme. International Food Policy Research Institute. Washington D.C.

Reardon, T., P. Matlon, C. Delgado (1988). Coping with household-level food insecurity in drought affected areas of Burkina Faso. *World Development* 16: 1065-1074.

Rosetta, L. (1986). Sex differences in seasonal variations of the nutritional status of Serere adults in Senegal. *Ecology of Food and Nutrition* 18: 231-244.

Sahn, D.E. (1989). Seasonal fluctuations in factor and products markets: Is there a nutritional risk? Cornell Food and Nutrition Policy Programme, Ithaca.

Schuftan, C. (1979). Household purchasing power deficit; A more operational indicator of express malnutrition. *Ecology of Food and Nutrition* 8: 29-35.

Schultink, W. J., W. Klaver, H. van Wijk, J.M.A. van Raaij, J.G.A.J. Hautvast (1990). Body weight changes and basal metabolic rates of rural Beninese women during seasons with different energy intakes. *European Journal of Clinical Nutrition* 44 (suppl 1): 31-40.

Spurr, G.B., Ed. (1988). Marginal malnutrition in childhood: implication for adult capacity and production. In: Collins K.J., Roberts D.F eds. Capacity for work in the tropics. Symposia of the society for the study of human biology. Cambridge University Press. London.

Teokul, W., P. Payne, A. Dugdale (1986). Seasonal variations in nutritional status in rural areas of developing countries: A review of literature. *Food and Nutrition Bulletin* 8: 7-10.

UNICEF (1992). Food, health and care. New York,

Van Liere, M. J. (1993). Coping with household food security: a longitudinal and seasonal study among the Ottomari in North-western Benin. PhD thesis. Wageningen Agricultural University.

Wandel, M. (1989). Household food consumption and seasonal variations in food availability in Sri Lanka. *Ecology of Food and Nutrition* 22: 169-182.

WHO (1993). World Declaration on Nutrition : Plan of Action. WHO.Geneva.

Appendix 1

ASSESSMENT OF DIETARY INTAKE AMONG RURAL COMMUNITIES IN AFRICA: Experiences from Kenya

INTRODUCTION

The World Health Organization study group on diet, nutrition and the prevention of chronic diseases, recommends that individual countries develop a convenient policy for promoting healthy nutrition and create a basis for monitoring progress towards meeting nutritional goals (WHO, 1990). The group also stresses the need to develop dietary assessment methods designed for country and culture specific populations which take into account different food consumption practices. Dissemination of state of the art dietary assessment methods is especially critical for countries experiencing rising incidences of different types of chronic diseases in both the developed and the developing countries. This will provide opportunities to discuss the advantages and limitations of available methods and to address the issues related to specific countries and cultures particularly in non-western cultures, and for groups with different styles of eating.

Improving the health and nutritional status of their populations should be a goal of all countries in both the developed and the developing areas of the world. Nutrition problems continue to be the root cause of major mass diseases that currently impede progress towards health for all. Chronic undernutrition in many developing countries and diseases of affluence in the developed countries are all nutritionally related (Stamler, 1994). The origin of many of the problems of undernutrition affecting populations in many developing countries are already known. These countries need to identify their worst food security and nutritional problems in terms of risk and population groups exposed to them, in order for them to give priority in

tackling them. These risks may be of macro and/or micronutrient deficiencies or diet quality problems (FAO/WHO, 1992).

Because of the nature of the food security problems in many developing countries, the assessment of food consumption for different areas can be particularly useful in helping document the type, severity, location and causes of malnutrition and deprivation among these populations and among groups within these populations. Dietary assessment surveys can provide valuable data for policy making, national and regional planning, and in programme design and evaluation (FAO/WHO, 1992).

Several methodologies to evaluate food consumption at the individual or family level have been published (Beaton et al., 1979; Cameron and van Staveren, 1988; Ferguson et al., 1989; WHO, 1990). The abundance of literature in this field is mainly due to the diversity of food behaviour and food patterns among the cultural and socio-economic population groups in different countries. Each specific society demands a methodology which is adjusted to the economic and environmental factors affecting the families and individuals living there (Cassidy, 1994).

The first part of this chapter describes some considerations which must be made while planning food consumption studies in rural communities in the developing countries. The second part presents data obtained when two methods of dietary assessment were used in collecting food intakes from three vulnerable groups in a rural farming community in Kenya.

Importance of collecting food consumption data from rural communities

Food consumption studies among rural communities in the remote areas of the developing countries are important for two reasons. Firstly, a large proportion of food is home produced, some is gathered, and the remainder is purchased. The diet is usually monotonous and simple because it is dictated by what foods are available locally, either at home or in the markets, and by the food prices. Secondly, health care, educational facilities, as well as other services are limited or even non-existent in some areas. As such dietary intake data can be used to document

particular situations so that programmes and services needed to improve the situation can be introduced, monitored, and evaluated.

The main deterrents to surveying the remote areas are the costs and the time involved in fielding research teams. Secondly, since most of the rural people are generally illiterate or semi-illiterate, it makes it impractical to use either printed information or instructions, or to use methods which require subjects to record their own food consumption. As such only face to face interviews and techniques which rely on observed records are the only ones appropriate in these circumstances.

The response rate to surveys in areas which are remote or have difficult access are generally rewarded by the interest, attention and involvement of the people living in these areas. The high response rate is further improved if the purpose of the survey is well understood and the confidentiality of the data respected. It is particularly appreciated if the people are well informed of the purpose of the study and if it is introduced in a way that overcomes any suspicions the people may have about it.

Implementing dietary assesment studies in rural areas

People from the rural areas are often suspicious about the intention of strangers who are interested in what they eat. In some societies it is even frightening to have a foreigner or a person in apparent authority question the people on what they eat. In other circumstances, questioning provekes shyness and embarrasssment. Thus, one needs to know the attitude of the people towards questioning itself in order to effectively assess the food and diet perceptions of a group of people. To get accurate data researchers must know enough about the society being studied in order to ask the right questions to the right people, using the right language, and approaches.

The research team needs to be sensitive to local customs and practices. They should be aware of the religious, ethnic and local food practices. All field workers should be aware of the expected courtesies, local food taboos, language, and of the rules related to food service, and eating mannerisms and patterns. The researchers as well as the fieldworkers need to be familiar

with local foods, food preparation methods, and food patterns. They should also be aware of the reluctance of people to report the consumption of foods considered to be of low status. They should be able to treat problems associated with poverty, local scarcity of certain facilities such as water, fuel, and food with great sensitivity and understanding.

Culturally sensitive research instruments should be developed by identifying and re-validating those already in existence, and by creating new instruments on site by combining qualitative and quantitative research methods. The development and evaluation of questionnaires for use in various ethnic groups requires special attention as does the function of questionnaires prepared for use across different educational levels within similar groups.

The purpose of the survey must be clearly explained to the people involved as well as the local leaders to avoid wrong messages being spread around. Biases can easily be introduced if people think that they will receive food or financial aid by reporting low food intakes. Alternatively, biases can also be introduced by over reporting of intakes in an attempt to impress the researchers. This latter reaction is sometimes observed when people exaggerate on their food intake during interviews, in an effort to impress the interviewer.

In some communities in Africa, all family members eat from a common pot or plate. Where this is a common method of food service, it may be easier to determine total household food consumption, but may be difficult to measure an individual's food consumption. However, a family could be requested to serve the subject being studied in a separate plate or cup for the purpose of individual dietary evaluation. This on the other hand, may introduce bias in assessing usual intakes of the subject, by either over-estimating or under-estimating usual intakes. In families consisting of more than one household unit, there may be sharing of cooked food, and this may place special demands on the fieldworker while recording intakes from one particular household unit.

Meal frequency and the time of eating is not rigidly followed in most rural communities. The frequency of meals varies from one area to another, and from one season to the next. The seasonal variations in meal frequency is mainly due to increased agricultural work during the wet season when mothers and other household members spend long hours in the fields. During this period, meals for the whole day may be prepared in one period or pot, usually in the

evenings, and parts of it reserved for the following day's breakfast and lunch. During other times however, meal frequency and meal times may be determined by the distances to sources of water and fuelwood. These and many other factors must be taken into account when planning and implementing food consumption studies in rural communities.

The success of the survey will depend very much on the cooperation of the respondents. This in turn depends on the initial approach used by the research team to the community to be assessed. As much as possible, local leaders should be consulted and the objectives of the study explained before the study begins. The local leaders should be given a chance to welcome the team and introduce them to the area and to the local customs. During the period of the study, the local leaders should be updated with the progress and could be utilized to pass important messages to the community and to provide needed information when needed. Their involvement will ensure continued cooperation by the respondents, which will be needed especially for longitudinal studies, as these types of studies put a lot of extra demands on respondents.

The research team should, where possible, be made of individuals who are familiar with the food habits and cultural values of the local people. As such it may be advisable to recruit and train local personnel to serve as fieldworkers since they would be conversant with the local food habits and language. This will avoid the use of interpreters who may introduce bias in reporting.

Choice of assessment methods

It is recognized that more direct methods of study are needed to collect information on food consumption of largely illiterate rural communities, who largely depend on their own production for their daily food. To study such groups, dietary assessment teams have to visit each household and record by weighing, the quantities of all the foods prepared and eaten during a specific period. The multiple day weighed record method based on precise weighing technique, and the 24-hour recall methods are the most widely used methods for assessing household and individual dietary intakes. Because of the low level of literacy, the presence of the field worker in the home for the duration of the survey is often necessary, if reliable data is to be obtained. These methods of dietary assessment may be expensive and time consuming for both the

respondents and researchers, but there seems to be no alternative method appropriate for use in such situations.

In most rural households food is rarely subjected to careful weighing or packaging. Thus, when quantitative information is required, measuring or weighing of food is the only method of data collection available to the researcher. Most rural people have little or no knowledge of units of measurement of weight or volume used internationally, but they are fairly accurate in their use of local measures. Amounts of different foods and drinks are normally expressed in terms of cups, glasses, tin cans, empty bottles, bundles, heaps or numbers. The expertise of the local people can be used to advantage if the study allows the respondents to use locally recognized units or containers which the researcher can re-measure in standardized weights or volumes. The number and variety of containers used in any one household or locality is usually small and stable, so that once a factor of conversion is established, the containers can be given code numbers and can be recorded each time they are used to describe the volume or weight. For some foods such as sweet potatoes, yams, plantains, cassava, or fresh maize-on-cob, a measuring tape may be used to determine the size. However, carefully constructed food models made to represent different sizes and shapes of food items may give a better approximation of actual foods than the measuring tape, as observed in the study described later in this chapter.

The time and cost involved in sending survey teams will be a major consideration of any large-scale dietary survey. Depending on the size and number of areas to be surveyed, it may be advantageous to set up selected survey teams to work independently of the time of scheduling of other teams. It is however important that all such survey teams receive the same training and supervision so that data quality is comparable.

Sufficient survey resources including equipment and questionnaires should be available. In some situations, sleeping and cooking facilities may need to be provided in the locality, to reduce transport costs and to avoid unforeseen delays during periods of bad weather conditions, or due to other unforeseen circumstances. If teams have to walk from house to house, the equipment must be easy to carry and stable to withstand regular movement without losing precision.

The distance between the study areas and the type of transport available will determine the work schedules and the speed with which data can be collected. The time required for travel between households and villages is an important factor to consider in the overall planning of the survey and in the scheduling of the survey teams. The time schedule of research teams working in remote areas needs to provide adequate travel time. It should also be flexible enough to fit within the activity schedules of the respondents.

One characteristic of dietary patterns of most rural communities is that they tend to be simple, monotonous, and with little variation from day to day and from one meal to another (Beaton et al., 1979). This may permit a good representation of food consumption within a shorter period of observation. On the other hand, the correct interpretation of data collected from such studies depends on the availability of up-to-date data bases such as food composition tables appropriate for the different countries or regions. These are lacking in many countries, and where they exist, they may be outdated and most of them have incomplete data. As such, there is a need for the development of up-to-date food composition tables and other computer data bases appropriate for use in different countries or regions which do not have them.

In the following pages, we describe a study in which the effect of seasonality on food consumption and the nutritional status of three vulnerable groups from a rural area in Kenya was assessed by two methods; the 24-hour recall method and the 3-day weighed record method; during three different periods of the agricultural cycle.

Subjects

The study involved 106 subjects comprising of 41 preschool children, 24 lactating women and 41 elderly subjects from 94 households randomly selected from smallholder rural areas in Nakuru district in Kenya.

METHODOLOGY

The study was carried out over a period of 15 months from April 1992 to June 1993, covering both the harvest and the lean seasons. The main objective of the study was to assess the seasonal differences in the intake of energy and nine selected nutrients by preschool children, lactating women, and elderly subjects.

Prior to the main study, a pilot study lasting for three months and covering twenty-five households was undertaken in a different area, but which had similar characteristics as those of the study areas. During the pilot phase questionnaires (forms) were developed and pretested, and appropriate measurement techniques were tried. At the same time local measuring utensils were identified and their weights and volumes determined using different foods and beverages, after which they were given code numbers. Similarly, menus of commonly prepared dishes were collected, standardized, and coded. The pilot phase was also used to train the fieldworkers on the correct interviewing techniques, weighing and recording of data on forms. A field operations manual (or guide book) was also developed and issued to the fieldworkers.

Assessment of dietary intake

During three periods selected to represent the wet (lean) and the harvest seasons, dietary intakes were assessed for six days of the week for each subject, by use of precise weighing technique on 3 alternate days, while the three days between them were assessed by the 24-hour recall method. In practice the fieldworker visited the household on the day of observation (e.g. Monday), recalled the previous day's food preparation and the intake of the subject, and then remained in the household for the rest of the day to observe and weigh the foods prepared and consumed for that day. He/she returned to the same household two days later (i.e. Wednesday) and recalled food preparation and intake for Tuesday, and remained to observe and weigh the foods prepared and eaten on Wednesday. The same procedure was repeated two days later. Food consumption data for all Sundays was obtained by recall. This combination of the observation and recall methods was applied to enable us to collect food intake data for six days

with three days of visits to reduce the burden on respondents. It also intended to compare the levels of intakes of the different nutrients obtained by the two methods.

During the observation days, all foods were weighed before cooking to the nearest gram using digital display Tefal scales. At the end of preparation the whole dish was weighed before the food was served. The subject's portion was weighed separately and any left-overs at the completion of the meal were deducted from the original serving. Snacks and other foods such as fruits, which were consumed by the subject outside the main dish were also weighed and recorded to the nearest gram. All foods consumed elsewhere were estimated from recalls.

When collecting food consumption data by the 24-hour recalls, the person who prepared the food was asked to describe all the dishes that were prepared in the house during the previous day, as well as all the ingredients that went into each dish. The person was asked to use the same utensils used during the previous day and measure replicas of similar ingredients like the day before, where possible. The measured ingredients were weighed on scales and the quantities recorded to the nearest gram. For liquid ingredients water was used to estimate volume, if the actual ingredient used the previous day was unavailable.

In all cases, the mother or the person who prepared and served the food to the study subjects was the one interviewed. The measurements and interviews were conducted by trained fieldworkers with four years of high school education, and who were recruited from the same community. During the observation days, the fieldworkers remained in the households throughout the day, starting from around 7.00 am until the subjects had eaten their last meal (usually around 8.00 pm). This procedure was repeated during three periods selected to coincide with two lean and one postharvest seasons.

Data treatment

All the foods consumed by the subjects were converted from household measures into their equivalent weights in grams after which they were converted into energy and nutrients using different food composition tables, mainly those developed by CTA-ECSA for use in East, Central and Southern (West, 1987), and those by the Food and Agricultural Organization (FAO,

1970) for use in Africa. The nutrients of interest to this study were energy, protein, fat, calcium, iron, vitamin A, vitamin C, thiamin, riboflavin, and niacin.

RESULTS

The intakes of energy and nutrient by the three vulnerable groups, during three different seasons measured by the precise weighing technique and by the 24-hour recall method are presented below. In Table 1 the energy and nutrient intakes of preschool children are presented.

Table 1

Mean energy and nutrient intake of 41 Kenyan preschoolers obtained by weighed records (WR) and the 24-hour recalls (RC)

	kcal	MJ	prot	fat	calc	iron	vit A	thiam	ribof	niacin	vit C
Session I											
WR	1133	4.7	36	24	456	10.5	384	0.8	0.9	5.5	80
SD	430	1.8	15	12	213	4.4	410	0.4	0.4	2.3	58
RC	1177	4.9	36	24	504	11.6	420	0.9	1.0	5.5	87
SD	466	1.9	18	12	327	5.2	576	0.4	0.5	2.4	66
Session II											
WR	1074	4.5	31	22	467	11.4	467	1.3	0.9	5.6	103
SD	425	1.8	13	8	220	5.5	323	1.0	0.3	2.5	66
RC	1138	4.8	33	22	483	12.2	453	1.4	0.9	5.8	106
SD	423	1.8	13	9	238	5.2	275	1.1	0.4	2.0	69
Session III											
WR	1202	5.0	35	23	456	12.8	406	1.4	0.9	6.0	97
SD	352	1.5	12	9	232	4.5	239	1.1	0.4	2.0	63
RC	1234	5.2	36	23	460	12.9	444	1.3	0.9	6.3	108
SD	404	1.7	12	8	242	5.1	276	0.9	0.4	2.0	96

*number of measurements

SD= standard deviations

The energy and nutrient intakes of the children tended to be slightly over-estimated by the 24 hour recall method compared to the precise weighing method during all the three assessment sessions, except for vitamin A which was underestimated by the 24 hour recall during the second session, and thiamin during the third session. The intake of protein, fat and niacin was equal between the two methods during the first session. Similar observations were made in the intake of fat and riboflavin during the second and third sessions respectively.

Table 2

Mean energy and nutrient intake of 24 lactating women obtained by weighed records(WR) and the 24-hour recalls (RC)

	kcal	MJ	prot	fat	calc	iron	vit A	thiam	ribof	niacin	vit C
session I											
WR	2660	11.1	78	57	1003	25.0	726	1.9	1.9	11.5	155
SD	808	3.4	24	25	436	8.5	442	1.0	0.7	3.2	101
RC	2530	10.6	74	54	1027	24.8	823	1.8	1.9	11.2	180
SD	700	2.9	20	21	503	8.1	561	0.8	0.7	3.3	121
Session II											
WR	2343	9.8	67	47	983	25.5	1067	2.7	1.9	13.2	227
SD	684	2.9	22	15	508	10.3	747	2.2	0.7	4.4	155
RC	2375	9.9	69	47	950	25.6	1025	2.9	1.9	12.8	225
SD	699	2.9	22	15	464	9.3	668	2.5	0.7	3.7	128
Session III											
WR	2232	9.3	65	43	780	22.3	719	2.9	1.6	11.6	149
SD	602	2.5	21	24	242	7.5	406	2.2	0.4	3.0	86
RC	2403	10.1	68	46	849	23.3	784	2.4	1.8	12.1	177
SD	613	2.6	20	14	305	7.0	414	1.9	0.5	2.2	85

*number of measurements

SD= standard deviations

In Table 2, the differences in energy and nutrient intakes of lactating women as measured by the two methods varied from one session to the next. During the first measuring session, the

24 hour recall method underestimated the intakes of energy, protein, fat, iron, thiamin, and niacin, while it over-estimated the intakes of calcium, vitamin A and vitamin C. During the second assessment, the recall method underestimated the intakes of calcium, vitamin A, niacin and vitamin C, and slightly overestimated the intakes of energy, protein, and iron. During the third assessment session however, the recall method tended to over-estimated the intake of all the nutrients except thiamin.

Table 3

Mean energy and nutrient intake of 41 elderly subjects obtained by weighed records (WR) and the 24-hour recalls (RC)

	kcal	MJ	prot	fat	calc	iron	vit A	thiam	ribof	niacin	vit C
session I											
WR	2131	8.9	66	44	797	19.7	445	1.5	1.5	9.9	96
SD	960	4.0	35	21	385	11.3	454	0.9	0.7	4.6	111
RC	2021	8.5	63	40	785	18.6	400	1.5	1.5	8.7	91
SD	842	3.5	31	18	383	11.4	379	1.0	0.6	4.0	108
Session II											
WR	2152	9.0	64	44	895	21.8	703	2.3	1.7	11.1	169
SD	829	3.5	35	18	512	13.2	576	2.2	0.8	4.1	118
RC	2105	8.8	62	44	917	22.4	735	1.9	1.8	10.9	183
SD	779	3.3	30	18	437	13.9	553	1.6	0.7	4.8	146
Session III											
WR	2190	9.2	64	43	814	21.3	623	2.4	1.6	11.0	147
SD	780	2.5	28	15	371	9.7	456	2.3	0.7	4.4	109
RC	2156	9.0	63	43	857	23.0	648	2.1	1.7	11.0	172
SD	948	2.6	32	21	441	15.2	578	1.8	0.7	5.8	204

*number of measurements

SD= standard deviations

Table 3 presents the energy and nutrient intakes of elderly subjects during the three assessment sessions. During the first session, the intake of all the nutrients considered in this study tended to be underestimated by the 24-hour recall method compared to the precise weighing method, except for thiamin and riboflavin whose intake equalized between the two methods. By the second session only energy, protein, thiamin and niacin were underestimated, while the intake of the other nutrients was the same between the two methods. By the third assessment session, only energy, protein, and thiamin were underestimated by the 24 hour recall method, while the other nutrients were overestimated by the same method, except fat and niacin, whose intakes remained the same.

DISCUSSION

In an effort to reduce the time, costs and managerial bottlenecks involved in obtaining reliable and accurate dietary intake data of different communities or individuals, researchers are looking for the best dietary assessment methods to apply in different settings. The 24 hour recall method of dietary assessment is reported to be a cheaper and easier method of assessing dietary intakes and can give reliable information if carefully planned and executed (Beaton et al., 1979; Cameron and van Staveren, 1988; Ferguson et al., 1989). The data from our study seem to confirm this observation. The lack of significant differences in intake of all nutrients assessed by the precise weighing method and the 24-hour recall method by the three groups shows that the latter method, if carefully done, can produce reliable data for individuals or groups even in the rural communities. The differences in nutrient intake between the two methods observed in our study may be a true reflection of actual intakes, since they represented different days of the week.

The close comparability of the data collected by the two methods may be attributed to the use of local utensils and similar ingredients during recall interviews when estimating amounts of foods and ingredients used during the preparation and serving the previous day's meals. It should be noted however, that the meals consumed in this community were simple and had

little variation from day to day. As such the recalls were easy to conduct even with illiterate mothers, and the elderly subjects. The situation may be different however, for groups and individuals with complex diets and eating patterns.

The nutrient values were obtained mainly from food composition tables developed by CTA-ECSA for use in East, Central and Southern African countries (West et al., 1987), and those by the Food and Agricultural Organization (FAO, 1970) for use in Africa. However since these tables had missing values, nutrient values of certain foods had to be obtained from other tables.

One of the most difficult, time-consuming, and expensive components of research directed towards assessing the relationship between diet, health, and the nutritional status of different individuals or groups of persons, is the measurement of their food intake. For a variety of reasons, people differ in their food intake, and the same people may consume very different types and amounts of foods from one day to the next and from time to time. Although we are aware that such variations do exist, it is necessary to have precise information on the regular dietary intake, both at the individual, group or community level. Over the last few decades, careful attention has been given by nutrition scientists to the development of reliable and adequate methods for the assessment of dietary intake. There is still a great need for basic information on how dietary intake should be measured in various types of studies under a variety of conditions.

While a lot of quicker methods have been developed and used in studies in the western countries using modern technology, some of these methods cannot be used in the technologically less developed parts of the world, and the time consuming and costly methods are the only choice left to researchers in these areas. As mentioned earlier in this paper, lack of appropriate data bases is one of the bottlenecks to obtaining good and reliable energy and nutrient consumption data in most of the developing countries. There is therefore, an urgent need for different countries and/or regions to develop food composition tables and computer data bases for use by researchers in these countries and regions.

REFERENCES

- Beaton, G. H., J. Milner, P. Corey, V. McGuire, M. Cousins, E. Stewart, M. de Ramos, D. Hewitt, P.V. Grambsch, N. Kassim, J.A. Little (1979). Sources of variation in 24-hour dietary recall data: implications for nutrition study design and interpretation. *American Journal of Clinical Nutrition* 32: 2546-2559.
- Cameron, M. E. and W. A. van. Staveren, Eds. (1988). Manual on methodology for Food consumption studies. Oxford University Press. New York.
- Cassidy, C. M. (1994). Walk a mile in my shoes: culturally sensitive food habit research. *American Journal of Clinical Nutrition* 59(suppl): S190-S197.
- FAO (1970). Food Composition Table for use in Africa. Nutrition Division, Rome.
- FAO/WHO (1992). International Conference on Nutrition: Major issues for nutrition strategies. Rome.
- Ferguson, E. L., R.S. Gibson, S. Ounpuu, J.H. Sabry, (1989). The validity of the 24 hour recall for estimating the energy and selected nutrient intakes of a group of rural Malawian children. *Ecology of Food and Nutrition* 23: 273-284.
- Stamler, J. (1994). Assessing diets to improve world health: nutrition research on disease causation in populations. *American Journal of Clinical Nutrition* 59(suppl): S146-S156.
- West, C.E., F. Pepping, I. Scholte, W. Jansen, H.F.F. Albers.(1987). Food composition table for foods commonly eaten in East Africa. CTA and ECSA.Wageningen.
- WHO (1990). Diet, nutrition, and the prevention of chronic diseases. WHO. Technical report series No. 797.

SUMMARY

Climatic seasonality is now recognized as being a constraint to agricultural production and to household food security in many countries within the tropical regions of the world. In particular, unimodal rainfall patterns which are characterized by one rainy and one harvest season a year, reduce the optimal period for plant growth and thereby oblige the farming communities to engage in short intensive bouts of agricultural activities. The period of intensive agricultural work coincides with the time of the year when food stocks at the household are at their lowest levels. By influencing food availability and activity patterns, seasonality affects energy and nutrients intakes, as well as the energy expenditure. When periods of food shortages coincide with periods of heavy physical work, people experience negative energy balance which cause cyclic losses in body weight of adults and growth faltering in children.

The main objective of the studies described in this thesis was to investigate the effects of a unimodal climatic pattern on household food availability among rural households with limited landholdings and low cash incomes, and how this in turn affects food consumption and the nutritional status of the nutritionally vulnerable household members namely; preschool children, lactating women, and the elderly. The studies were carried out over a 15-month period, involving 94 households in Nakuru district in the Rift Valley Province in Kenya.

Household food availability data was collected on monthly basis by recalls of all the foods harvested from the family farm, purchases and food from other sources, during the past one month. The weight of all the food coming into the household was determined and then converted into equivalent values of mega Joules of energy. The nutritional status was determined by height and weight. Body weight was measured on monthly basis for all the subjects, while height for adults was measured once at baseline. Length for the children was measured during three periods which coincided with the different seasons.

In chapter 2, the influence of a unimodal climatic pattern on household food availability is explained. While seasonality was found to be a major determinant of how often and how much food from the farms was available to the households, it was observed that other factors do play a role in the determination of how much food is available to a household at any given time.

Some of the factors included landholding size, family size, and household income. In general, the households satisfied only 88 percent of their mean energy requirements from own production, purchases and other sources. Large households (>7 persons) had large energy deficits while the small sized households (< 4 persons) more than met their energy needs per capita. The energy deficit of medium sized households (4-7 persons) fell between the two extremes.

The effects of seasonality on food consumption and the nutritional status of the preschool children are presented in chapter 3. Seasonality was found to affect the level of energy and nutrient intake of the children to some degree. However, energy intakes did not reach the recommended levels even when the households were apparently food secure. The failure by the children to consume adequate amounts of energy during the harvest months was attributed to the low quality of the diets which were high in bulk and low in fat and in animal products. Inadequate intakes of energy and nutrients affected weight and height growth of these children as shown by weight-for-height, weight-for-age and height -for-age Z scores. The level of stunting was lowest during the postharvest months, but weight-for-age Z scores were only slightly influenced by seasonal fluctuations in household food availability. Contrary to expectations, children from large households had better weight-for-age Z scores, and consumed significantly more energy and nutrients than children from medium-sized households, although they were of similar age.

The determination of the effects of seasonality on the nutritional status of lactating women is complicated by several factors, such as, the high energy demands arising from milk production, reduced levels of energy intake during the lean season, and increased work load. These effects are explained in chapter 4. The lactating women maintained relatively high levels of body mass index (BMI) with means at about 23 throughout the study months. The subject however lost about 9 percent of their baseline body weight during the lean season, and although some of the lost weight was recovered during the postharvest season, it was lower than that which was lost. Further losses in body weight occurred during periods of heavy physical work, during the period of land preparation and planting, although the energy intake did not decrease.

In chapter 5, the food consumption and the nutritional status of the elderly subjects during different seasons are presented. The elderly were found to exhibit significant fluctuations in the intake of energy and nearly all the other nutrients under consideration, between the lean and the harvest months. The variations in dietary intakes were reflected in the mean body mass index whose monthly curves showed wide fluctuations between seasons. The male elderly subjects had lower mean BMI values than the female elderly throughout the study period. The men had larger weight losses of more than 7 percent during the lean season compared to 3 percent in the women subjects. Increased work load during land preparation in the postharvest months caused rapid weight loss in both the men and women, even when the recommended dietary intake levels for energy were met. Again the weight losses were greater in the men than in the women, indicating a higher degree of vulnerability in the elderly male subjects. The results indicated a need for the review of the current recommended levels of energy intake for elderly population groups, in order to cater for those who remain fairly active into old age, particularly in the developing countries.

In chapter 6, the relationships between seasonality, food availability, food consumption, and the nutritional status of smallholder households are discussed together with other underlying factors associated with household food insecurity. A detailed analysis of the factors affecting child growth and nutritional status is presented. It is being recognized that growth faltering in children is due to a multiplicity of factors rather than to diet alone, as previously thought. One of these factors include care for the mothers so that they too can provide adequate care for their children. Another factor is freedom from illnesses which follows improved sanitation at the household level and availability of health services at the community level. From this study, it appeared that the elderly subjects showed an earlier sign of energy stress compared to the lactating women or the children. However, due to small numbers of subjects involved, concrete conclusions cannot be made.

The discussion chapter concludes with some recommendations. It calls for nutrition education extension programmes to teach mothers on child feeding and health practices and the regular monitoring of the elderly especially those living in the smallholder rural areas. Further recommendations include improvement of the food security status of the smallholder

households through the creation of employment opportunities in the rural areas in order to improve incomes of the rural population in Kenya.

SAMENVATTING

Klimatologische seizoensmatigheid wordt tegenwoordig gezien als een beperkende faktor voor de landbouwproductie en voor de voedselzekerheid van huishoudens in vele landen in tropische gebieden van de wereld. Met name het jaarlijkse patroon van regenval in unimodale klimaten gekenmerkt door één regen- en één oogstseizoen per jaar, verkorten de optimale periode voor plantengroei. Hierdoor zijn agrarische huishoudens gedwongen in een korte tijd intensieve landbouwactiviteiten uit te voeren. Deze periode van intensieve landbouwactiviteit treedt tegelijkertijd op met de periode van een afnemende voedselvoorraad van huishoudens. Door deze beïnvloeding van voedselbeschikbaarheid en activiteitenpatroon, heeft seizoensmatigheid invloed op zowel de energie en nutrient inneming als het energieverbruik. Wanneer periodes van voedseltekorten tegelijkertijd optreden met periodes van zware fysieke arbeid, ondervinden mensen een negatieve energiebalans. Dit resulteert in een cyclische afname van het lichaamsgewicht bij volwassenen en in een groeivertraging bij kinderen.

De doel van de in dit proefschrift beschreven onderzoek was tweeledig. Aan de ene kant richtte het zich op het bestuderen van de effecten van een unimodaal regenval patroon op de voedselbeschikbaarheid op huishoudniveau van plattelandshuishoudens met beperkte landbouwgrond en een laag inkomen tot hun beschikking. Aan de andere kant werd gekeken hoe deze effecten de voedselconsumptie en de voedingstoestand beïnvloedden van voedingskundig gezien kwetsbare leden van het huishouden, te weten jonge kinderen (jonger dan 3 jaar), zogende vrouwen en ouderen (65-74 jaar). Het onderzoek werd uitgevoerd bij 94 huishoudens in Nakuru district in de Rift Valley Province in Kenya gedurende een periode van 15 maanden in 1992 en 1993.

Gegevens omtrent de voedselbeschikbaarheid van huishoudens werden maandelijks verzameld door middel van een recall van alle voedingsmiddelen die geoogst waren op de landbouwgrond van het huishouden, die aangekocht of verkregen waren via andere bronnen in de maand voorafgaand aan het interview. Het gewicht van deze voedingsmiddelen werd vastgesteld en omgerekend in equivalente hoeveelheden energie uitgedrukt in megaJoules. De voedingstoestand werd vastgesteld aan de hand van gewicht en lengte. Lichaamsgewicht werd bij alle

onderzoekspersonen maandelijks gemeten, terwijl de lengte van volwassenen eenmalig aan het begin van de studie werd gemeten. De lengte van de kinderen werd in drie verschillende seizoenen gemeten.

In hoofdstuk 2 wordt beschreven hoe een unimodaal regenval patroon de voedselbeschikbaarheid op huishoudniveau beïnvloedt. Terwijl seizoensmatigheid de belangrijkste determinant bleek te zijn van hoe vaak en hoeveel voedsel afkomstig van de landbouwgrond beschikbaar was voor de huishoudens, werd geobserveerd dat ook andere factoren een rol spelen in hoeveel voedsel er beschikbaar is voor het huishouden. Deze factoren omvatten, onder andere, de omvang van de landbouwgrond, de grootte en het inkomen van het huishouden. Over het algemeen voorzagen de huishoudens slechts in 88 procent van hun gemiddelde energiebehoeftes uit eigen produktie, aankoop en uit andere bronnen. Grote huishoudens met meer dan zeven personen vertoonden grotere energie tekorten vergeleken met huishoudens van kleine omvang (minder dan vier personen) met een voedselbeschikbaarheid die uitkwam boven hun energiebehoeftes per capita. Het energie tekort van middelgrote huishoudens met vier tot zeven leden bevond zich tussen deze twee extremen in.

De effecten van seizoensmatigheid op de voedselconsumptie en de voedingstoestand van jonge kinderen worden behandeld in hoofdstuk 3. Seizoensmatigheid bleek tot op zekere hoogte het niveau van energie en nutrient inneming van kinderen te beïnvloeden. Echter, de energie inneming bereikte nooit het niveau van de aanbevolen hoeveelheden, zelfs niet wanneer de huishoudens ogenschijnlijk voedselzeker waren. Het onvermogen van de kinderen om een voldoende hoeveelheid energie te consumeren tijdens de oogstmaanden werd toegeschreven aan de lage kwaliteit van het dagelijkse eetpatroon gekenmerkt door een hoge inneming van zetmeelrijke voedingsmiddelen en een lage inneming van vet en dierlijke produkten. Onvoldoende energie en nutrient inneming beïnvloedde het gewicht en de lengtegroei van deze kinderen wat aangetoond werd door de z-scores van gewicht-naar-lengte, gewicht-naar-leeftijd en lengte-naar leeftijd. De mate van 'stunting' (te klein voor de leeftijd) was het laagst gedurende de maanden direkt na de oogst, terwijl de z-scores van gewicht-naar-leeftijd slechts in beperkte mate beïnvloed werden door de seizoensmatige fluctuatie in voedselbeschikbaarheid. Tegen de verwachtingen in, vertoonden de kinderen van grote huishoudens een betere z-score van

gewicht-naar-leeftijd en consumeerden significant meer energie en nutrienten vergeleken met kinderen van gelijke leeftijd afkomstig van middelgrote huishoudens.

De vaststelling van de effecten van seizoensmatigheid op de voedingstoestand van zogende vrouwen wordt bemoeilijkt door de aanwezigheid van verscheidene factoren zoals de hoge energie kosten van moedermelk productie, de gereduceerde energie inneming tijdens het seizoen met een lage voedselbeschikbaarheid en de toename in arbeidsdruk. In hoofdstuk 4 wordt ingegaan op deze effecten. De zogende vrouwen behielden relatief hoge waarden van 'body mass index' (BMI) gedurende de onderzoeksmaanden met een gemiddelde van ongeveer 23. De vrouwen verloren tijdens het seizoen met een lage voedselbeschikbaarheid echter ongeveer 9 procent van hun begin gewicht. Hoewel tijdens de maanden direct na de oogst een gedeelte van dit gewichtsverlies werd gecompenseerd, was de totale gewichtstoename lager dan het verlies. Verder namen de vrouwen in lichaamsgewicht af tijdens periodes van zware lichamelijke arbeid, gedurende de periodes van landbewerking en van het planten van gewassen hoewel de energie inneming niet afnam.

In hoofdstuk 5 worden de voedselconsumptie en de voedingstoestand van de ouderen in verschillende seizoenen gepresenteerd. Ouderen vertoonden een significante fluctuatie tussen het seizoen met een lage voedselbeschikbaarheid en de oogstmaanden in de inneming van energie en van bijna alle andere onderzochte nutrienten. De variaties in voedselinneming werden ook weergegeven door de gemiddelde BMI waarvan de maandelijkse curves een grote fluctuatie tussen de seizoenen lieten zien. De oudere mannen hadden een lagere gemiddelde BMI waarde dan de oudere vrouwen gedurende de hele studie periode. De mannen vertoonden een groter gewichtsverlies van meer dan 7 procent gedurende het regenseizoen vergeleken met de vrouwen die 3 procent van het gewicht verloren. De toename in arbeidsdruk tijdens landbewerking in de maanden direct na de oogst veroorzaakten een snelle daling in het gewicht van zowel mannen als vrouwen, zelfs wanneer de aanbevolen hoeveelheden voor energie inneming werden geconsumeerd. Wederom was het gewichtsverlies van mannen groter dan dat van vrouwen, wat een hogere mate van kwetsbaarheid van oudere mannen aangeeft. De resultaten geven de noodzaak aan van een heroverweging van de bestaande aanbevolen hoeveelheden voor energie

inneming voor oudere bevolkingsgroepen waarbij rekening gehouden moet worden met hen die tamelijk actief blijven op oudere leeftijd met name in ontwikkelingslanden.

In hoofdstuk 6 worden de relaties tussen seizoensmatigheid, voedselbeschikbaarheid, voedselconsumptie en voedingstoestand van plattelandshuishoudens met weinig land besproken te samen met andere onderliggende factoren verbonden met voedselonzekeerheid van het huishouden. Een gedetailleerde analyse van de factoren van invloed op de groei van kinderen en de voedingstoestand wordt gegeven. Erkend wordt dat groeivertraging bij kinderen veroorzaakt wordt door een veelheid aan factoren in plaats van door de voeding alleen zoals eerder werd aangenomen. Eén van deze factoren is de zorg voor de moeders zodat zij op hun beurt voldoende zorg aan hun kinderen kunnen geven. Een andere faktor is de afwezigheid van ziektes als resultaat van verbeterde sanitaire voorzieningen op huishoudniveau en de beschikbaarheid van gezondheidszorg op gemeenschapsniveau. Verder liet de studie zien dat de ouderen op een eerder tijdstip symptomen van seizoensmatige stress vertoonden dan zogende vrouwen en kinderen. Echter de kleine omvang van de onderzoeksgroep verhindert hieromtrent ferme conclusies te trekken. De algemene discussie sluit af met enkele aanbevelingen. Het wijst op het belang van voedingsopvoeding en voorlichting programma's voor moeders ten aanzien van kindervoeding en gezondheid, en van een regelmatige controle van met name de ouderen die in rurale gebieden wonen. De aanbevelingen omvatten ook een verbetering van de voedselzekerheid van plattelandshuishoudens met weinig land door middel van het scheppen van mogelijkheden tot het verkrijgen van een inkomen in rurale gebieden met als doel de inkomens van de rurale bevolkingsgroepen in Kenya te verbeteren.

ACKNOWLEDGEMENTS

My interest to join the Department of Human Nutrition at Wageningen arose from a discussion between Professor Hautvast and I, which was held in Papendal in Arnhem, while attending a workshop on infant growth and nutrition in May 1987. Three years later and after many discussions on the topic held in Nairobi, Seoul, and by mail, I was finally able to join the PhD programme in the Department of Human Nutrition in Wageningen. I started the preparatory phase of the study in September 1990. I would like to thank Prof. dr. Joseph Hautvast for helping me realize my dream, and for his continued interest in my work during the period of the study and for his kindness and generosity. I would like to thank him further for sparing a lot of his time including weekends to read and correct my drafts which I seemed to complete almost always on Friday afternoons. Special thanks to Marilou Hautvast for her special interest in the progress of my work, and the dinners she prepared for me and other foreign students in her house.

The research funds for field work in Kenya, fees, and stipend while I was in the Netherlands came from different sources. I would like to thank the International Development Research Centre (IDRC) Canada, for providing most of the funds for the field work and for sponsoring me to the Nutrition Epidemiology course in Southampton in July, 1990. I would also like to thank IDRC for allowing me to extend the period of the study from the initial two to four years and particularly for allowing me to expand the study into a PhD thesis. I would also like to thank the African Studies Centre (ASC), Leiden, for meeting most of my expenses while in the Netherlands, for providing me with a computer and other facilities, and above all for providing me with the technical assistance from its staff during the initial development of the study design, and during data analysis and writing. As a researcher within the Food and Nutrition Studies Programme (FNSP), I received a lot of financial and technical assistance. I would like to thank FNSP for paying the fees, my stipend during the preparatory phase, and for meeting part of the field expenses and salary. I would like to particularly thank Prof. dr. Jan Hoorweg for making it

possible for me to join the FNSP research team, for coordinating the financial support through ASC, and for his valuable and critical reviews of my drafts and his continued interest in my work while in Kenya and in the Netherlands.

Many thanks to Prof. dr. Wija van Staveren, my promoter for her commitment to my work from the early stages of the proposal writing, during the field work, and throughout the data analysis and writing period. Wija, your constant reminder for me to keep within the framework of the research questions in my writing and in the presentation of results and discussions, gave me a lot of insight into the realm of scientific writing. I would also like to thank you Wija for being concerned with my social wellbeing while in the Netherlands, and for taking your time to share some of your spare time with me.

During the field work in Kenya, I received a lot of assistance from different people and places. I would like to thank the Vice-Chancellor of Egerton University, first for giving me leave from my teaching duties to undertake this study, and for allocating me a vehicle and a driver throughout the period of the field work. I would like to express my gratitude to all the field assistants who worked tirelessly for very little pay and whose commitment to their work made it possible for me to complete the study on time. Thanks to Francis Kamau, John Karega, Danson Maina, Francis Mbugua, Alfred Mureithi, Catherine Njeri, Wachira Mwangi, Ruth Wambui, Esther Wanjiru, and Mary Wanjiru. Many thanks to Paul Kariuki for assisting in data entry and to Ngengi Njihia for being such a trusted driver, who was always ready to work beyond the official working hours without extra financial gains or complaints. At the FNSP office, I received and continue to receive a lot of assistance from Rebson Dzala. I would like to thank Rebson for being there for me whenever I needed him for both project related work and for personal errands carried out for me and my family especially during the period I have been away from home. Thanks also to Okumu for assisting with data re-entry at a short notice.

I have received a lot of technical assistance from staff of the African Studies Centre, Leiden. I would like to thank Rudo Niemeijer for the assistance he gave me while designing the study, and also in the preparation and pretesting of the questionnaires in Kenya, and for many discussions we held on the phone. Many thanks to Wijnand Klaver for introducing me to

methodologies of collecting food consumption data and for the field demonstrations conducted for me and the field assistants in June 1990.

I returned from Kenya to the Netherlands with very raw data and with no experience in data analysis. I would like to give very special thanks to Willem Veerman from the ASC, Leiden, for giving me a lot of his time, and for teaching me how to manage the data. Willem, your patience and kind heartedness made my days brighter especially in the early days of the data analysis when I felt like I was in the middle of a deep dark tunnel with no light at the end. Thank you for being there to answer the many questions on phone or fax. Many thanks to my office-mate and friend Inge Brouwer for helping me solve regularly occurring computer problems, and for helping me with transportation whenever needed. Many thanks also to Trudy Wijnhoven for assisting with the analysis and cleaning of most of the food consumption data.

While in the Netherlands many people contributed in one way or another in making me feel at home. I would like to thank Karin van der Kooy and Jo Ottenheim for "rescuing" me from the students flats and the offer of a room in their apartment during the first part of my stay in the Netherlands. To Karin and Jo, I have cherished our continued friendship and for taking your time to show me many places and for helping me to experience many aspects of life in the Netherlands. During the past one year, I have been living in the beautiful and comfortable home of Kier and Eppy Nienhuis. In their home, I found friendship, warmth, and companionship, and although I was separated from my family for a long time, they gave me a home away from home. I would like to thank "auntie" Eppy and Kier for the meals we shared together including the occasional "Groentesoep" on those cold wintry days. Special thanks also to our neighbour and friend Ankie Lamberts for the time we shared together and the weekend outings which served as tonic to my over-stressed nerves.

Life in the Department of Human Nutrition can get lonely at times especially for one who does not speak Dutch. I would like to thank all those who took some time to have occasional chats with me. Thanks to Lidwein for the assistance received since my arrival in the Netherlands and to Grietje van der Zee for organizing my accommodation, visa and shipment of my belongings. To Adel den Hartog for the many corridor discussions we held on the many problems afflicting African countries, and in which we came up with "instant" solutions. To fellow PhD colleagues,

Reggy, Robert, Toine, Annet, Saskia, and Djoko, many thanks for the experiences we shared together. Reggy, thank you for your continued assistance and for being my "on spot consultant" on many occasions. To other colleagues from the African Studies Centre; Dick, Tjailing, Deborah, and Joop, thanks for your encouragement and moral support.

I would not have started or completed this thesis without the full support of my husband Peter Karongo, and my children Josephine Njoki, Anne Mumbi and Henry Kigutha (KK). I have spent many months away from home, but through their support, encouragement, perseverance, and love, the end of the long road has finally come. My love and many thanks to all of you.

CURRICULUM VITAE

Hilda Nyakonyu Kigutha was born in Nyeri, Kenya, on June 15, 1949. After her high school education at Alliance Girls High School, she joined Egerton College (now University) in 1969, for a three-year diploma course in Agriculture and Home Economics, graduating in 1971. She was employed by the Ministry of Agriculture as an Assistant Agricultural Officer in 1972. She resigned from the ministry and joined Egerton College as a teaching assistant in December 1972. In September 1973 she obtained an FAO scholarship to study at the University of the Philippines at Los Banos, where she completed her undergraduate education in 1975 majoring in Foods and Nutrition with a minor in Extension. She returned to Egerton College and was appointed Lecturer in charge of foods and nutrition courses in the Department of Agriculture and Home Economics. In 1980 she obtained a USAID scholarship and joined the University of Maryland at College Park, USA, for an MSc degree in Human Nutrition. She graduated in May 1982 and returned to her teaching job in Kenya. In December 1982, she was appointed head of the Department of Agriculture and Home Economics at Egerton University and continued to hold that position until September 1990, when she was given study leave to start her Phd studies. In 1986, she was promoted to a Senior Lecturer, a position she holds today. Between 1986 and 1989, she was a Kellogg International Fellow in Health, a programme which enabled her to travel widely in different countries, visiting institutions and attending conferences. She is a founder member of the Nutrition Association of Kenya. From 1987 to 1990 she was the public relations officer for the Home Economics Association for Africa (HEAA) and served as its acting president for one year between 1989 and 1990. Between September 1990 and March 1991, she stayed at the Department of Human Nutrition at Wageningen Agricultural University during the preparatory phase of her study. Her field work was carried out in Nakuru district in Kenya, between April 1991 and June 1993. Data analysis and thesis writing were carried out at Wageningen Agricultural University, between September 1993 and September 1994. She returns to her job at Egerton University where she will resume her teaching, and hopes to continue with research.

Hilda is married to Dr. Peter Karongo Kigutha and they have two daughters and one son.