HOUSEHOLD FOOD CONSUMPTION PATTERNS IN RELATION TO DIETARY ADEQUACY OF VITAMIN A AND IRON IN AWASI, NYANDO DISTRICT, KENYA.

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DECLARATION

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

20/12/2004

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DEDICATION

Dedicated to my dear parents, the late Austin Francis Orowe and Bridget Onyango Orowe. With appreciation for all you have done for me.

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EXECUTIVE SUMMARY

A cross sectional study covering all four sub-locations of Awasi location, in Nyando District was carried out in the months of September-October 2002. A total of 304 households were covered by the study. The study aimed at determining the existing food consumption patterns in the area and how they relate to the dietary adequacy of vitamin A and iron.

A structured questionnaire was used to obtain information on the socio- demographic characteristics of households, their food production and food purchasing habits and morbidity and sanitation information. Data on food consumption patterns was obtained using a breastfeeding and weaning questionnaire (for young children). A food frequency questionnaire, which incorporated the HKI method of assessing vitamin A adequacy, was done for all households. A 24-hour dietary recall was done in a sub-sample of 30 households using instruments for weighing and measuring food. Trained research assistants assisted with data collection. Focus group discussions were held in each sub-location with mothers of index children, to give an in-depth picture of consumption patterns.

The female population slightly outnumbered the male population in the households studied and the young population (aged 15 years or younger), formed more than half of the population (58.6%), compared to those who are 36 years and above who form 13.4% of the population. The average family size was six persons, and the dependency ratio of 148 is higher than both the district ratio (99) and national ratio (92).

Household heads were mostly male (88%) and their average age was 37 years. Most household heads have at least some primary education, otherwise the general levels of education attained among household heads is low and very few completed secondary

or post secondary education. Generally, fathers were more educated than mothers were.

Farm sizes are small, with a mean of 5.4 acres, and far from adequate for food production especially due to low rainfall. Food purchase is the main way of providing food for most households. The foods purchased are mostly basic food items, such as maize, *omena*, onions and tomatoes and were generally limited in variety. Most households spent between 500-1000 shillings on food each week. Chicken, cows, and goats are the most commonly kept livestock by 50% or more of the households.

The morbidity rate among young children is high as indicated by the high incidence of diarrhoea (51.7%), cough (65.3%), and fever (79%), in the four weeks preceding the survey. Water, which is critical for maintaining proper hygiene and avoiding water-borne diseases, is limited in both quantity and quality. Toilets, essential for hygiene were non-existent in almost half (47.5%) of the study households.

More than 50% of the index children (aged 3 years or less) were still being breastfed at the time of the study. The mean duration of breastfeeding was 2.7 months. Cows' milk was commonly used to supplement breast-milk. Most of the children (84%) had already been weaned. Common weaning foods included maize-meal porridge, ugali, fish and dark-green leafy vegetables. General food consumption patterns show limited variety in the foods eaten, these include ugali, fish(mainly *omena)*, and dark green leafy vegetables There is a limited consumption of fruits and animal meats. Food is mostly prepared by boiling or stewing. When food is fried very little fat is used.

Both the food frequency and 24-hour dietary recall show inadequate consumption of vitamin A by household members. The calorie intake is below the recommended requirement for most households. Due to the culture of eating *omena (*dagaa*)* in the area the iron and protein intake appears adequate in most or all households. However the bioavailability of these essential nutrients is low, due to diseases such as malaria, diahorrea, and HIV. There is also low consumption of vitamin C rich fruits necessary for iron absorption. The result is a high prevalence of vitamin A and iron deficiency disease, as well as rampant malnutrition.

Food-based interventions aimed at providing adequate vitamin A and iron should focus on integrated methods that will provide adequate vitamin A rich foods and increase the bio-availability of iron in foods. Supplementation is a short term remedy to the problem. Food based approaches offer greater potential of being long term and can be maintained by the community. Since they are based on current consumption patterns they don't require great changes. This can be done by the promotion of agricultural practices which increase production and consumption of indigenous vegetables, beans and the orange fleshed sweet potatoe among others. Livestock farming can be improved and expanded for both domestic consumption and sale. Nutrition education and endemic disease control programmes must be an essential part of the interventions.

DEFINITIONS

Bioavailability: The amount of a dietary nutrient that is absorbed and/ or utilized by the body.

Exclusive Breastfeeding: The practice of feeding with breast-milk only, as recommended by WHO for the first 4-6 months of life.

Food Consumption: Types of food and/or drink ingested by an individual. This includes timed meals or snacks.

Food Security: Everyone has at all times access to sufficient and nutritious food, in order to live a healthy life.

General Malnutrition: Body weight more than 2 standard deviations below or above the mean weight for age, according to WHO standards.

Household: Refers to a person or group of related or unrelated persons who live together in the same dwelling unit(s), who acknowledge one adult male or female as head of household, who share the same housekeeping arrangements and are considered as one unit.

Iron Deficiency Anaemia: Prevalence of hb level less than 12.0g/l in non-pregnant women 15-49 years of age.

Macronutrients: Refers to nutrients required by the body in relatively large amounts usually carbohydrates, proteins, and fats.

Micronutrients: Nutrients required by the body in small amounts, but essential for normal body functions and prevention of micronutrient deficiency diseases.

Recommended Daily Allowance: The amounts of different nutrients needed on a daily basis given in quantitative terms, in order to prevent ill effects due to the deficiency of particular nutrients and to sustain a vigorous healthy life.

Retinol Equivalent (RE): Vitamin A in foods is expressed in retinol equivalents. The carotene or other form of vitamin A is multiplied by an appropriate factor to allow for incomplete absorption and conversion of retinol. Vitamin A is measured in micrograms (*ug*).

Ugali:A ' stiff ' meal of ground maize that is made by mixing the ground maize in boiling water.

Vitamin A deficiency: As a clinical indicator, it means the prevalence of eye changes (night blindness or bitots spots) in pre-school children. As a sub-clinical indicator it means the prevalence of serum retinol $< 0.7\mu$ mol/l in pre-school children.

Weaning: A process in which an infant's diet pattern is gradually changed from liquid foods like breast-milk to cooked solid foods.

ABBREVIATIONS

ARI	Acute Respiratory Infections
CBNP	Community Based Nutrition Programmes
ECSA	East Central and Southern African Region
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
Hb	Haemoglobin
HH	Household
IDA	Iron Deficiency Anaemia
IFPRI	International Food Policy Research Institute
KNDHS	Kenya National Demographic Health Survey
NDDP	Nyando District Development Plan
RDA	Recommended Daily Allowance
RE	Retinol Equivalent
UNICEF	United Nations Childrens Fund
VADD	Vitamin A Deficiency disease
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1: BACKGROUND

Malnutrition continues to affect nearly half of the world's population (UNICEF 1998, FAO 2003). More than 840 million people do not to have access to enough food to meet their basic daily needs and more than one-third of the world's children are stunted, due to diets inadequate in quantity and quality (Combs *et al,* 2000).

Malnutrition is the result of several inter-related conditions. At individual level, malnutrition is manifested by inadequate dietary intake and/or disease. These direct causes are a result of the immediate underlying causes in the child's environment, that is, at the household or community level. These include insufficient access to food, inadequate maternal caring practices and poor or inadequate access to essential services such as water, health, and basic education. Since households are part of the society, the causes of malnutrition at household level are rooted in societal inadequacies such as, limited quantity and quality of human and material resources and their control. The society's culture may also contribute to malnutrition. Societal inadequacies are often times a reflection of a nations political, cultural, religious and socio-economic systems as these determine how the available resources are used, the equitable distribution of resources is even more important in resource strained settings, common in most developing countries. The result of severe malnutrition to the individual is disability or death and to the society and nation, a loss of valuable human resources (UNICEF, 1998).

The view that malnutrition results mainly from insufficient supplies of the macronutrients energy and protein, appears to have underestimated real problems with deficiencies of critical micronutrients; problems now collectively referred to as "hidden hunger ". Iron, vitamin A and iodine deficiencies are the three micro-nutrient deficiencies of greatest public health significance especially in the developing world (FAO, 2003).

An estimated two million people live at risk to diseases resulting from deficiencies of vitamin A, iodine, and iron. Most of these are women and children living in the less developed countries of sub-Saharan Africa, the eastern Mediterranean, South and Southeast Asia, Latin America, as well as the Caribbean and western Pacific. Even in economically developed countries, iron deficiency is estimated to affect more than 20% of women (Combs *et al*, 2000).

Iodine deficiency is prevalent in many regions of the world with an estimated 1,600 million people living in iodine-deficient areas. Nearly 741 million people are affected by goitre and 26 million are mentally retarded because of this deficiency (FAO, 1993 and 2003). Iodine deficiency can also lead to reduced mental function, and increased rates of stillbirths, abortion, and infant deaths. About 6 million infants born annually to iodine deficient mothers develop severe mental and neurological impairment known as cretinism; half of this number is in south Asia (Combs *et al*, 2000).

With respect to vitamin A deficiency, it is estimated that more than 250 million children worldwide are at risk due to this vitamin deficiency. In 1991, nearly 14 million pre-school children (three-quarters from South Asia) were estimated to have the clinical eye disease, xerophthalmia, due to vitamin A deficiency (FAO, 1993). The deficiency causes blindness in between 250,000 to 500,000 children each year; two-thirds of these children die within months of going blind due to their increased susceptibility to infections caused by their lowered immunity due to vitamin A deficiency. Even sub-clinical vitamin A deficiency (VAD), which affects about 40 million children in 60 countries, increases child mortality.

For many years, the problem of vitamin A deficiency in developing countries emphasized the increased risk of xerophthalmia. Although VAD is still the leading cause of preventable blindness in children, clinical forms of the deficiency are now becoming less frequent, and the detection of sub-clinical deficiency is gaining more importance (FAO, 2003). There is compelling evidence that in areas where VAD is a problem of public health significance, it substantially contributes to increased mortality in infants and young children (children less than 5 years), and is associated with the severity of the illness especially measles, diarrhoeal disease and respiratory infections (UNICEF, Sao Tome/1997).

In Kenya, the 1999 National micronutrients survey (Mwaniki *et al*, 2001) estimated acute and moderate VAD prevalence at 14.7% and 62.2% respectively among children, and among women 1% and 29.6% respectively (children and women are most vulnerable to VAD). Men had a slightly lower prevalence than mothers did.

Iron deficiency is the most prevalent micronutrient deficiency affecting over 2 billion people globally, particularly women of reproductive age and pre-school children living in tropical and sub-tropical regions. At least half of the anaemia worldwide is due to iron deficiency. The Global prevalence of anaemia among women is estimated to be

42%. Ranging from about 64% in some developing countries like South Asia to about 20% in developed countries. (ACC/SCN, 1992).

Iron deficiency and anaemia have profound negative effects. These include increased maternal, child and infant mortality, reduced health, and development of infants and children, the limiting of learning capacity in children, impairing of infection defence mechanisms, and a reduction of the working and productive capacity of those affected (UNICEF, 1997).

In Kenya, the results of the 1999 National Micronutrient Survey (Mwaniki *et al*, 2001) estimated iron deficiency of children aged 6-60 months as 19.2% for mild, and 54.2% for moderate to severe. Children below 30 months (2.5 years) had the highest prevalence (76.5%). Irrespective of pregnancy status, half of the mothers were anaemic. Among pregnant mothers, moderate to severe anaemia was higher. The Lake Basin and coastal region showed the highest prevalence rates of anaemia in Kenya. The survey concluded that anaemia is a national public health problem of a magnitude sufficient to retard immediate and future socio-economic development in Kenya.

The high rates of vitamin A deficiency and iron deficiency in parts' of the country indicate a problem of public health concern. No significant progress has occurred to reduce the magnitude of micronutrient malnutrition over the past few decades, despite efforts and investments that have been put into tablet, capsule, and injection based approaches linked to the health care system (FAO, 1993).

Essentially the primary cause of these deficiencies is low dietary intake of specific micronutrients and reduced absorption of the micronutrients, because of factors such as measles, diarrhoea, and parasitic infections. Increased dietary intake of vitamin A and iron is the most natural, efficient and inexpensive solution for the prevention and control of deficiencies. Enthusiasm for food-based approaches, such as, promotion of kitchen gardens and dietary diversification, comes from the prospects that such strategies can be sustainable. They do not depend on the importation of foreign technology nor the maintenance of infrastructure, to deliver an essentially clinical approach to treating nutritional deficiencies. In many cases food based approaches do not require significant behavioural changes (FAO, 1993).

1.2: STATEMENT OF THE PROBLEM.

Forty years after independence, Kenya still bears the burden of vitamin A and iron deficiency. The Kenya government through the national plan of action on nutrition (GOK, 1994) committed itself to ensuring that all citizens attained their right to nutrition, this included the reduction of iron deficiency anaemia in women by one-third, and the virtual elimination of iodine and vitamin A deficiency. Various governmental and non-governmental organisations have made efforts to attain these objectives through food fortification programmes, supplementation, promotion of breastfeeding and increased production of micronutrient rich foods.

Despite these efforts the conclusions of the Kenya micronutrient survey (Mwaniki *et al*, 2001) show that compared to the 1994 vitamin A survey, VAD rates remain relatively unchanged in some areas while other areas had deteriorated. The report also concluded that iron deficiency anaemia remains a major public health problem in most areas of Kenya. These findings conform to deteriorating health indices reported in the demographic health surveys in the 1990's and into the current millennium (KDHS, 1998 and 2003)

The regions with the highest prevalence of VADD and IDD in Kenya are the coastal region, Western Kenya and the lake basin. The CBNP project area, Awasi, in which the study was done, lies in the lake basin region, and is one of the regions with the highest prevalence of acute and moderate vitamin A and iron deficiencies. Children below 3 years as well as pregnant and lactating mothers are the most affected. The effects of both vitamin A and iron deficiencies, was exacerbated by malaria-parasitaemia (children below three years most affected) and hookworm infections (Mwaniki *et al*, 2001).

Integrated food based approaches offer greater potential in solving micronutrient deficiencies than approaches like supplementation alone. However, data on current consumption patterns is inadequate and is necessary for food-based interventions (IFPRI, 2000). This study will therefore make current consumption data in the region available for use in current and future micronutrient interventions, and thus help in reducing VADD and IDD.

1.3: JUSTIFICATION FOR THE STUDY.

The causes of vitamin A deficiency diseases and iron deficiency are rooted in poor diets and infection. The availability of an effective and feasible technical intervention, namely high dose supplements has resulted in the promotion of vertical approaches that rely heavily on donor-dependent supplies and on the existing health infrastructure.

Supplementation coverage has increased with considerable external funding and commitment. What is not clear is whether these short-term successes are sustainable or will be reversed. The major concern here is donor fatigue, especially since the underlying and basic causes of the nutrition problem are usually not addressed. Food based approaches are preferred as solutions to these problems can be "home grown", thus giving communities greater participation in solving their nutritional problems. This study aims at highlighting the problem areas, as well as possible intervention areas as far as consumption and vitamin A and iron deficiencies are concerned.

1.4: PURPOSE OF THE STUDY

The purpose of this study was to determine the extent to which foods consumed in the area provide the required dietary vitamin A and iron.

1.5: MAIN OBJECTIVE

To determine the existing food consumption patterns, and assess the dietary adequacy of vitamin A and iron, as well as other factors which affect vitamin A and Iron status, among households in Awasi, with a view to identifying strategies for intervention.

1.6: SPECIFIC OBJECTIVES

1. To determine the demographic background of the households in the study.
2. To determine the different types of foods produced and consumed in the study area.
3. To assess the adequacy of vitamin A and iron in the diets consumed by households in the study area.
4. To determine the calorie and protein adequacy compared to vitamin A and iron adequacy.
5. To identify other factors which contribute to iron and vitamin A deficiency in the area?
6. To recommend strategies for intervention that address issues of Vitamin A deficiency and iron, based on the study findings.

1.7: STUDY QUESTIONS.

- Which foods and drinks are commonly consumed in Awasi?
- Do the foods consumed by households in Awasi provide adequate vitamin A and iron?
- Which factors contribute to vitamin A and iron deficiency in the study area?
- What are the most appropriate interventions, which can be introduced, to address the vitamin A and iron deficiency problem in the study area?

1.8: EXPECTED BENEFITS

- The main benefit of this study will be to make available baseline data on general consumption for this area, and more specifically on dietary sources and adequacy of vitamin A and iron.
- Information on dietary sources and adequacy of vitamin A and iron can be used by government agencies, non-government organizations and any other interest groups, to plan for appropriate interventions, based on existing food habits.

- The study will also contribute to effective targeting of interventions geared toward reducing iron and vitamin A deficiencies.

- The long-term effects will be reflected in a healthier population and reduced health costs, which in turn will spur national development

CHAPTER 2
LITERATURE REVIEW

2.1 GLOBAL MAGNITUDE OF MICRONUTRIENT DEFICIENCY

The global toll of people affected by micronutrient deficiency is estimated to exceed 2,000 million, that is, nearly half of the world's population (FAO 2001, Mason *et al*, 2001). Micronutrient deficiencies exist even in populations where food supply is adequate as far as meeting energy requirements is concerned. These deficiencies are most prevalent where the diet lacks variety, as is often the case in developing countries. Blindness and goitre are two of the most visible manifestations of micronutrient deficiency, however they present only a fraction of the problem, and sub-clinical deficiencies afflict a much larger proportion of the population (FAO, 2003).

Grave consequences including continued and sustained loss of productivity, permanent mental disability, blindness, depressed immune system function and increased infant and maternal mortality can result from micronutrient deficiencies. The heaviest toll is borne disproportionately by women and children (FAO, 2003).

Nineteen vitamins and minerals are considered essential for physical and mental development, immune system functioning and various metabolic processes. Deficiencies of iron, iodine and vitamin A are the most widespread forms of micronutrient malnutrition with public health consequences.

2.2 VITAMIN A DEFICIENCY

For normal growth and tissue repair all body tissues require Vitamin A. The visual and immune systems are particularly dependent on this vitamin for normal functioning (FAO, 2003).

According to WHO approximately 2.8 million children less than 5 years of age have clinical signs of xerophthalmia. Sub-clinical VADD affects about 256 million (40%) children under five years of age (UN/ACC/SCN, 1992). The highest prevalence of both clinical and sub-clinical VAD were observed in SE Asia and sub- Saharan Africa, where 30% to 40% of preschool children are at heightened risk of ill health and death (Mason *et al*, 2001). The prevalence of night blindness is as high as 20% in some countries of SE Asia (UN/ACC/SCN, 1992). WHO suggested that in populations in which more than 20% of the children have serum retinol levels equal to or lower than 0.7μ mol/L, vitamin A deficiency should be regarded as a severe public health problem; this criterion applies to the populations of these regions (Mason *et al*, 2001). Prevalence of both clinical and sub-clinical VAD by UNICEF region is shown in tables 2.1 and 2.2

Table 2.1: Prevalence and number of preschool children affected by clinical vitamin A deficiency.

Region	Prevalence (%)		Affected (millions)	
	1985	1995	1985	1995
South Asia	1.79	0.95	2.67	1.58
East Asia and Pacific	0.43	0.25	0.66	0.40
Latin America and Caribbean	0.35	0.24	0.17	0.12
Eastern and Southern Africa	1.80	1.60	0.69	0.53
Western and Central Africa	1.40	0.87	0.53	0.45
Middle East and Northern Africa	0.63	0.27	0.24	0.12

Source: Mason et al, 2001

Table 2.2: Prevalence and number of preschool children affected by sub-clinical vitamin A deficiency, 1995

Region	Prevalence (%)	Affected(millions)
	1995	1995
South Asia	35.6	59.5
East Asia and Pacific	18.2	26.6
Latin America and Caribbean	19.6	10.2
Eastern and Southern Africa	37.1	18.6
Western and Central Africa	33.5	17.4
Middle East and Northern Africa	9.8	4.2

Source: Mason et al, 2001.

According to a UN and IFPRI report published in 2000 (UN/ACC/SCN and IFPRI), vitamin A deficiency is a major public health problem of immense proportions, and that the prevalence of VAD is not uniform across countries and regions. WHO estimates that 60 countries have VAD of public health significance, Kenya is one of the countries affected.

2.2.1 Vitamin A Deficiency in Kenya

The 1994 vitamin A survey in Kenya showed the prevalence of clinical VAD as 2%, and the prevalence of sub-clinical VAD as 33% (GOK and UNICEF, 1994 and Mason *et al*, 2001), since the prevalence rate is above the WHO cut-off points of 20% it shows that VAD is a major public health problem in Kenya. Available data given in the micronutrient report (Mason *et al*, 2001) varies in year and survey coverage. The following table shows VAD prevalence in some countries compared to Kenya.

Table 2.3: Prevalence of VAD among pre-school children in some countries

Country	Survey Year	Survey coverage	Prevalence (%)	
			Clinical	Sub-clinical
Kenya	1994	Sub-national	2.0	33.0
Uganda	1991	Sub-national	3.5	-
Tanzania	1984	Sub-national	1.5	45.3
Sudan	1986	National	2.4	-
Ethiopia	1996	National	1.5	38.9
Ghana	1990	Sub-national	1.1	54.9
Burkina Faso	1989	Sub-national	3.9	-
Egypt	1995	National	0.2	11.3
Bangladesh	1983	National	4.6	-
India	1988	National	1.4	-
Indonesia	1992	Sub-national	0.3	57.5

Source: Mason et al, 2001.

The 1994 vitamin A survey (GOK and UNICEF, 1994), showed that severe VAD was prevalent in the following districts; Baringo, Bungoma, Garissa, Kitui, Kisumu, Kisii, Kwale, Mandera, Mombasa and South Nyanza. Moderate Vitamin A deficiency was found in Nyeri, Nakuru, Meru and Kiambu. According to the 1999 survey, the pooled district prevalence of acute deficiency in Kisii, Baringo and Kitui were comparable to those reported from the VAD survey of 1994. However, the rates reported for Kisumu, Bungoma, Garissa and the coastal districts were considerably higher than those reported in the 1994 survey were. In the remaining districts the rates were twofold those reported during the 1994 survey (Mwaniki *et al*, 2001).

Table2.4: VAD survey results for 1994 and 1999.

	Acute (%)		Moderate (%)	
	1994	1999	1994	1999
Children	7.7	14.7	32.9	61.2
mothers	4.3	9.1	19.2	29.6

Source: GOK/ UNICEF 1994 and Mwaniki et al, 2001.

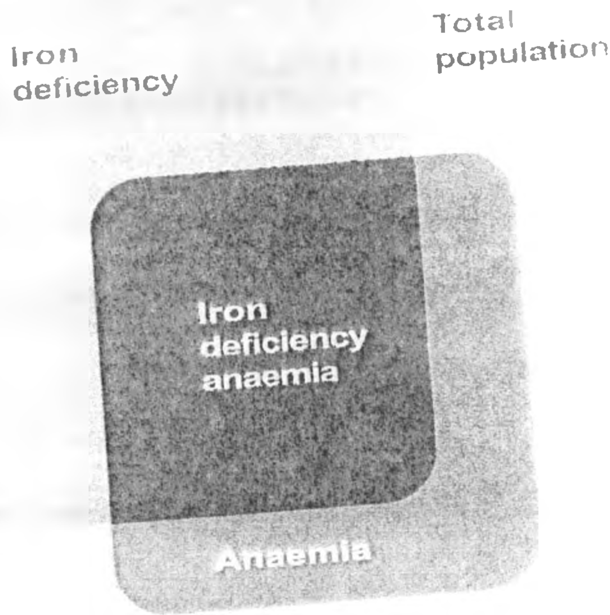
The statistics available thus indicates that on average the prevalence of low serum retinol among mothers and children marks a possible significant deterioration of the VAD status in the country.

2.3 IRON DEFICIENCY.

Iron deficiency leads to several outcomes that compromise function these include anaemia, reduced work capacity, impaired learning ability, increased susceptibility to infections, and increased risk of death associated with pregnancy and childbirth (Combs *et al,* 2000). While anaemia can have multiple causes (including malaria, intestinal parasitism, deficiencies of folate and vitamin B_{12}), it is thought that at least half of the anaemia worldwide is due to iron deficiency (Combs *et al,* 2000). The level of Hb in the blood is the most commonly used indicator to screen for iron deficiency anaemia (IDA). However, the true prevalence of iron deficiency in a population will be larger than the level of clinically detectable iron deficiency anaemia (FAO, 2003), because most individuals are likely to be deficient long before there is a detectable drop in blood haemoglobin levels. This can be detected by using more sensitive tests for individual assessment like serum ferritin or transferring saturation tests among others (UNICEF/UNU/WHO, 2001).

Iron deficiency is estimated to be twice as prevalent as anaemia (Mason *et al*, 2001). IDA is considered a micronutrient deficiency of public health significance, not only because it is widespread, with an estimated 2 billion persons affected, but also because of its serious consequences in both children and adults (FAO, 2003). Iron deficiency is considered to be present in a population when the prevalence of haemoglobin below the cut-off is greater than 5% (UNICEF, 1998).

FIGURE 2.1: IRON DEFICIENCY ANAEMIA PROPORTION WHO, 2001)



Source: UNICEF/UNU/WHO 2001

Table 2.5: Proposed Classification Of Public Health Significance Of Anaemia In Populations

Category of public health significance	Prevalence of anaemia (Blood levels of Hb)
Severe	>or=40
Moderate	20.0 to 39.9
Mild	5.0 to 19.9
normal	< or = 4.9

Source: UNICEF/UNU/WHO, 2001

The World Health Association estimates that about 2 billion individuals, or 40% of the world's population, suffer from anaemia (Ramakrishan *et al*, 2001). In developing countries the prevalence of anaemia is three to four times higher than in developed countries. According to a UN and IFPRI report in 2000(UN/ACC/SCN and IFPRI, 2000) the prevalence in developing countries compared to developed countries is as shown in following table 2.6.

Table 2.6: Estimated percentage of anaemia prevalence (1990-1995) based on blood haemoglobin concentration

	% in Industrialized country	% in non-industrialized country
1. Children (0-4 years)	20.1	39.0
2. School-Age Children (5-14 years)	5.9	48.1
3. Pregnant women	22.7	52.0
4. All women	10.3	42.3
5 Men (15-59 years)	4.3	30.0
5. Elderly (+60 years)	12.0	45.2

Source: UNICEF/UNU/WHO, 2001.

The global prevalence of anaemia among women is estimated to be 42%, this ranges from a high in South East Asia (>64%) to the lowest but still surprisingly high rates (20%) in developed countries (Combs et al, 2000). The most highly affected population groups in developing countries are pregnant women (56%), school aged children(53%), non pregnant women (44%), and pre-school children(42%), (UN/ACC/SCN, 2000). Older adults are also significantly affected. With regard to pre-school children, anaemia prevalence is highest in Asia and Africa. In Asia, the most affected sub-region is South Central Asia. In Africa, the middle part of the continent from the West to the East is the most affected, with anaemia prevalence ranging from 42% to 53 % (UN/ACC/SCN and IFPRI, 2000). Anaemia prevalence is as high as 75% in South East Asia, while in Africa prevalence range from 47% in eastern Africa to 56% in western Africa (UNICEF/UNU/WHO/MI, 1998). Among pregnant women, likewise the prevalence rates are highest in Asia and Africa. The highest rates occur in Southeast Asia (76%) and Africa (50%)

(UNICEF/UNU/WHO/MI, 1998). Kenya is part of the region in which these high prevalence rates occur.

2.3.1 Iron Deficiency in Kenya

A national survey of anaemia was carried out in 12 districts of Kenya from May to October 1999 (*Mwaniki et al*, 2001). The 12 districts were selected to represent Kenya's diverse ecological and altitude sub-regions. Anaemia assessments were based on Hb and clinical presentation. The clinical presentation of anaemia was done by examining all participants for palmar and nail bed pallor, both finger and toe nail beds were examined for Koilonychia (*Mwaniki et al*, 2001), The results of the iron status of the Kenyan population are summarised per region in table 2.7 below.

Table 2.7: Iron status of the Kenyan population in 1999

Region	Children (2-72 months) n=3229	Mothers (av.28 years) n=3163	Adult men (av.36 years) n=1183
Lake basin n=1183	91-94%	66-71%	37-48%
Western Highlands n=1756	49-92%	16-49%	10-30%
Coastal and semi-arid lowlands n=1694	79-98%	66-97%	40-67%
Dry , humid & Semi-arid regions n=1316	57-72%	26-48%	12-35%
Central and mid-western highlands n=1095	27-56%	7-14%	2-17%

Source: Mwaniki et al,2001.

The results show that among children the prevalence of mild and moderate to severe anaemia were 19.2% and 54.2% respectively. Children below 30 months (two and a half years) had the highest prevalence (76.5%), and within this group, half were infants. Among the mothers, half were anaemic irrespective of pregnancy status. The likelihood of moderate-severe anaemia was higher among pregnant mothers. Mild anaemia affected 20% and over of children, men and the elderly.

Based on the observed severity and public health importance of anaemia for mothers and children, the country was stratified into three regions in descending order as follows:

(i) Severe anaemia and highly significant problem region

- The lake-basin and adjacent western highlands, Bungoma district.
- The coastal and semi-arid lowlands
- The semi-arid North-eastern districts including parts of Baringo district.

(ii) Moderate anaemia and moderate to highly significant problem region

- The western highlands including Kisii district area.
- The midlands, including Kitui district and the lower part of Meru district areas.

(iii) Mild anaemia and moderately low significant problem region

- The central and Mid-west highlands, including Nyandarua, Meru and Baringo districts.

The results clearly show that the age group most affected are pre-school children and pregnant mothers. Areas like the lake basin, and the semi arid to arid North bear the larger share of moderate to severe anaemia. Overall moderate to severe forms are more common than mild grades. Hence, iron deficiency in Kenya is a national public health problem.

2.4 BIOAVAILABILITY AND CONVERSION OF VITAMIN A

Vitamin A is available from animal sources in the form of retinol or retinol esters, and from plant sources, particularly dark green leafy vegetables (DGLV), yellow and orange non-citrus fruits, and red palm oil, in the form of provitamin A carotenoids. Vitamin A from plant sources is less easily absorbed and utilized by the human body. It is less bioavailable than the vitamin A coming from animal products (IFPRI, 2001). Vitamin A in the form of retinol is more easily absorbed by the body than carotene and is present in a variety of foods including meat, eggs, milk, and oily fish (FAO, 2003). Consuming dietary sources of fat at the same time can enhance the bioavailability of carotene.

In developing countries most of the vitamin A consumed comes from fruits and vegetables. For example, estimates suggest that more than 80% of dietary intakes of vitamin A in Africa and South East Asia are from provitamin A carotenoids (IFPRI, 2001). Moreover, vitamin A from plant sources is usually found in large amounts in only a few fruits and vegetables, many of which are highly seasonal. This means that low- income populations may suffer from both chronic and mild-moderate VAD, and severe seasonal deficiency (IFPRI, 2001).

There are approximately 50 known active provitamin A carotenoids, of which beta-carotene makes the largest contribution to vitamin A activity in plant foods. Alpha (α)-carotene and β-cryptoxanthin (mainly from fruits) also contribute substantial amounts to some diets (IFPRI, 2001). The efficiency in converting carotene (and other carotenoids) into the active form of the vitamin is now thought to be considerably poorer than previously assumed and is dependent on the source of vitamin A (FAO, 2003). Until recently it was assumed that the activity of beta carotene was one-sixth that of retinol, and the activity of other carotenoids was one-twelfth that of retinol. Underwood proposes a hierarchy of carotenoid bioavailability based on relative ranking of foods rather than on specific conversion factors (IFPRI, 2001). According to this classification, leafy green and yellow or orange vegetables are at the lower end of bioavailability, whereas yellow or green fruit and red palm oil are at the higher end.

The Reference Dietary Intakes (RDI) released by the institute of Medicine (IFPRI, 2001) recommends using the following conversion factors:

Retinol activity equivalent (RAE) = 1microgram (m g) of retinol, 12 m g of β-carotene, 24 m g of α-carotene and 24m g of β-cryptoxanthin.

2.5 BIOAVAILABILITY OF IRON

Dietary sources of iron are present in two forms, haem and non-haem iron. Haem-iron found in animal source foods such as meat fish and poultry has much greater bioavailability (15-35%), than does non-haem iron found in cereals, pulses, fruits and vegetables, where the absorption rates range from 2-20% (FAO 2003, IFPRI, 2001).

Many dietary factors can either inhibit or enhance absorption of iron as follows:

Enhancers of iron absorption include:

- Haem iron present in meat, poultry, fish, and other seafood's.
- Ascorbic acid or vitamin C, present in fruits (especially citrus), potatoes, vegetables such as green leafy ones, cauliflower and cabbage, and some tubers.
- Some fermented or germinated foods and condiments like soy sauce (cooking, fermentation or germination of food reduces the amount of phytates)

Inhibitors of iron absorption include

- Phytates present in cereal bran and grains, high extraction flour, legumes, nuts and seeds.
- Foods with high inositol content
- Iron binding phenolic compounds (tannins). Foods that contain the most potent inhibitors, resistant to the influence of enhancers include tea, coffee, cocoa, herbal infusions in general and certain spices like oregano.
- Calcium, particularly from milk and milk products.

source: UNICEF/UNU/WHO, 2001).

2.5.1 Other factors affecting iron absorption

Iron status: The iron status of an individual is a major influence on the amount of iron absorbed. The percent absorption is inversely related to iron status across a wide range of serum ferritin concentrations (Ramakrishan *et al*, 2001).

Physiological demands: Absorption of iron is known to increase in conditions in which tissue iron is reduced, for example, menstrual losses and during anabolic periods such as pregnancy, or periods of growth (Gillespie *et al*, 1998).

Parasitic infections: Iron maybe lost due to parasitic infections such as malaria and hookworm infection (FAO, 2003). HIV infection is also strongly associated with iron losses. (Gillespie *et al*, 1998). Illnesses accompanied by diarrhoea and fever limit iron absorption and increase risk of developing anaemia (Ramakrishan *et al*, 2001).

Other micronutrient deficiencies: Diets, which are low in animal products, are also low in absorbable iron as well as retinol, riboflavin, folic acid, vitamin B_{12} and other micronutrients.

Vitamin A: Vitamin A is involved in mobilizing stored iron and poor vitamin A status has been reported to be associated with altered iron metabolism and IDA (Gillespie *et al*, 1998). Supplementation of vitamin A deficient individuals with vitamin A alone, increases haemoglobin concentrations by about 10g per litre (Ramakrishan et al, 2001). In several studies, the addition of vitamin A improved haemoglobin response to iron supplements (Ramakrishan *et al*, 2001; UNICEF, 1997; Suharno *et al*, 1993).

Riboflavin: This deficiency tends to both co-exist and interact with iron deficiency. The intake of riboflavin and absorbable iron is usually low when animal product consumption, including milk, is limited. Riboflavin deficiency may exacerbate iron losses, reducing iron by increasing intestinal iron losses, reducing iron absorption, impairing mobilization of intracellular iron, and increasing crypt cell proliferation.

Supplementation trials of riboflavin deficient men and women in Gambia, Guatemala, and Europe reported improvements in haemoglobin levels when riboflavin was added to iron supplements (Ramakrishan *et al*, 2001).

Folic Acid Deficiency: This deficiency produces a megaloblastic macrocytic anaemia, because it is required for the synthesis of erythrocytes (Ramakrishan *et al*, 2001).

Vitamin B_{12} Deficiency: This results in megaloblastic anaemia. Because this vitamin is found only in animal products, and is actively reabsorbed form bile, deficiency has been traditionally associated with long-term consumption of strict vegetarian diets. It involves a defect in the synthesis of gastric intrinsic factor needed for vitamin B_{12} absorption (Ramakrishan *et al*, 2001).

Seasonality: Iron absorption is reduced during seasons when fruit consumption is limited, usually during the dry season (GOK and UNICEF, 1999).

2.6 DAILY REQUIREMENTS AND DIETARY INTAKE.

An individual's daily nutrient requirement varies depending on age, sex, and physiological status. Human dietary requirements are set out in tables of recommended daily intakes (RDI), or recommended daily allowances (RDA) (Gibson, 1990).

RDA's provide a standard against which the nutrients in food eaten by different sections of the community, or a whole country can be assessed. In this way, it is possible to detect any group with a low intake of one or more nutrients. This group may then be investigated, and if clinical or biochemical evidence of deficiency is found, steps are taken to improve their diet or provide a supplement of nutrients (Passmore and Eastwood, 1986). The recommended amounts of vitamin A and iron according to according to WHO are shown in the following tables 2.8 and 2.9

Table 2.8: Estimated Requirements for Vitamin A (mg retinol equivalents per day)

Group	*Age (years)*	*Vitamin A*
Both sexes		350
	0-1	400
		500
	1-10	600
	10-12	
	12-15	
Boys		600
	15-18	
Girls		500
	15-18	
Men		600
	18+	
Women:		
Not pregnant/lactating		500
Pregnant		600
Lactating		850

Source: WHO/FAO, International Agricultural Centre. Wagenigen-2000.

Table 2.9: Estimated requirements for iron (mg per day)

Group	*Age*	iron
Both sexes	0-6 months	6 mg
	7-12 months	10 mg
	1-10 years	10 mg
Males	11-28 years	12 mg
Females:	11-50 years	15 mg
Not pregnant/lactating		15 mg
Pregnant		30 mg
Lactating		15 mg
Both sexes	50+ years	10 mg

Source: WHO, WHO/FAO, 2001.

2.6.1 Assessing dietary intake at household and individual levels

The dietary intake of one or more nutrients may be inadequate either because of a primary deficiency (low levels in the diet), or because of a secondary deficiency; where dietary intakes may appear to be meet nutritional needs, but conditioning factors (such as certain drugs, dietary components or disease states) interfere with ingestion, absorption, transport, utilization or excretion (Gibson, 1990).

Household (HH) food consumption methods measure all food and beverages available for consumption by a HH, family group, or institution during a specified period. The methods used singly or in combination are:

- Food account
- List recall methods
- Inventory methods
- Food records
- Family food scales
- Telephone surveys

Individual methods of dietary assessment include the following:

- 24 hour dietary recall
- Estimated food records
- Weighed food record
- Dietary history
- Food frequency questionnaire (FFQ)

The 24-hour recall or one-day food record is also used to characterize the average usual intake of a large group (Gibson, 1990). In dietary surveys after different foods have been measured, food composition tables are use to calculate intakes of the various nutrients. Comparisons with the recommended intakes allow judgements to be made as to whether these intakes are or are not sufficient to maintain a group in good health (Passmore and Eastwood, 1986).

The best method for assessing the pattern of food use for a group or individual involves using the food frequency questionnaire (FFQ). It provides qualitative, descriptive information about usual food consumption patterns. The questionnaire usually has a list of foods and a set of frequency-of-use response categories. The list of foods may focus on a specific food group e.g. vitamin A rich foods, or it can be extensive to enable estimates of total food intake, that is, dietary diversity (Gibson, 1990).

Data from FFQ's is often used to rank respondents into broad categories of low, medium, and high intakes of certain foods. Food scores can be calculated from FFQ's based on the frequency of consumption of certain food groups (Gibson, 1990).

2.7 STRATEGIES OF ADDRESSING MICRONUTRIENT DEFICIENCIES

For more than a decade now awareness of the magnitude and seriousness of micronutrient deficiencies has been rising, as has the commitment to alleviate these problems. The ICN held in Rome, 1992, clearly defined priorities and strategies that should be followed to reduce micronutrient malnutrition in a sustainable manner (FAO, 1993).

The priority urged was for specific programmes to prevent the deficiency of iodine, vitamin A and iron. This arose from the increasing understanding of their extent and far reaching consequences (UN/ACC/SCN, 1991). The existence of proven and low cost methods for preventing these deficiencies adds powerfully to the case for controlling them widely and immediately. These options are briefly outlined below.

2.7.1 Supplementation

Nutrients are delivered directly by means of syrup or pills in this technical approach. It is appropriate for targeting populations with a high risk of deficiency or under special circumstances, such as during pregnancy or in an acute food shortage. Under normal circumstances, supplementation programmes are used only as a short-term measure, to be replaced with long term, sustainable, food-based, measures such as fortification and dietary modification (FAO, 2003).

Supplementation for all the three critical micronutrients has been carried out successfully in many countries. For iodine deficiency and prevention of IDD, the most favourable method that has been successfully used is fortification of salt with iodine

(UN/ACC/SCN, 1991). Programmes to provide immediate coverage are important while fortification is being established, especially in remote areas. Supplementing with iodized oil administered by injection or orally can protect vulnerable individuals, usually reproductive women. This would protect for a period of 12 months to 5 years, depending on the method of administration (UN/ACC/SCN, 1991).

Deficiency of Vitamin A can and has been tackled by nationwide biannual distribution of vitamin A capsules for infants, young children, and women post-partum, in areas of VAD both short and long-term measures are indicated depending on the circumstances (UN/ACC/SCN, 1991; UNICEF 1998; Sight and Life, 2003).

Iron deficiency anaemia (IDA) is the most widespread micronutrient deficiency with damaging consequences (UNICEF/UNU/WHO, 2001 and Mason *et al*, 2001). Distribution of daily supplements of iron tablets, usually in the form of ferrous sulphate, is widely necessary to reduce the extent of anaemia, especially among women in poor countries where prevalence of 50% or more are commonly observed (UN/ACC/SCN, 1991, WHO 2001). When the prevalence of anaemia among women in a population is over 40%, which is common in many developing and transitional economies guidelines from the INACG, WHO and UNICEF call for urgent action including universal distribution of iron supplements to pregnant women (UNICEF, 1998). It was also recommended that where anaemia prevalence is high, iron supplementation should be given to women of childbearing age, and to children between 6-18 months, under conditions that can assure the intake of the supplements. A technical workshop of UNICEF, WHO, UNU and MI recognized that pilot studies of weekly administration of iron tablets have been promising (UNICEF, 1998).

High levels of coverage for vitamin A capsules were achieved in many countries in the mid 1990's (Mason *et al*, 2001), excluding Latin America and the Caribbean, where vitamin A supplementation is not a common approach. Most countries in South East Asia and the Pacific as well as East, Central and Southern Africa reported high coverage by supplementation, as oppose to medium or low coverage. However the supply of vitamin A capsules from UNICEF is about 10% of what would be needed if all children in developing countries were to be covered (Mason *et al*, 2001).

Regarding supplementation programmes to control anaemia, the MI report (Mason *et al*, 2001), reported that not many countries reported supplementation programmes, indicating a need to expand coverage. There was also poor adherence to supplementation through antenatal care.

Common constraints to supplementation include the following:

- Supply and logistics
- Access to health posts/distribution points
- Training of staff
- Communicating with recipients
- Compliance in the case of iron supplements
- Phasing out of National immunization days poses a challenge to vitamin A supplementation, in order to ensure gains made are sustained
- Donor dependence

2.7.2 Fortification

Fortification strategies are needed in areas where the traditional diet lacks specific nutrients like iodine (FAO, 2001). Micronutrient fortification is the addition during processing, of one or more micronutrients, to foods, that are accessible and widely consumed. This results in delivering the micronutrients to a large population through the daily diet (Mason *et al*, 2001).

Micronutrient fortification corrects and prevents deficiencies and produces enormous human benefits, since a sustainable economy is dependent on a healthy workforce (Sight and Life, 2003). Commonly fortified foods include wheat products fortified with one or more nutrients, usually iron, calcium, riboflavin or thiamine; milk, fortified with vitamin D; fruit juices with calcium and vitamin C among others (FAO, 2003).

Successful fortification requires centralized processing facilities, mechanisms for quality control, social marketing, and public education strategies (FAO, 2003). In many industrialized countries, fortification has been in place for many years with no negative effects (Sight and Life, 2003). The most widespread effort in fortification to date has been the fortification of salt with iodine (FAO, 2003). Iodine deficiency can and has been prevented in most industrialized countries in this way (UN/ACC/SCN, 1991). In developing countries, 66% of the households consume iodized salt, while among the least developed countries 52% of the households consume iodized salt. Worldwide 66% of households consume iodized salt (UNICEF, 2004).

For VAD, fortification of commonly consumed foods is potentially the most cost effective solution to the problem of VAD (Sight and Life, 2003). Fortification of food with vitamin A is technically feasible, for example sugar fortification, but is to be widely adopted in developing countries. In industrialized countries, Fortification of food with vitamin A is not necessary because enough vitamin A is available in the diet (ACC/SCN, 1991).

Currently 39 countries are in various stages of enacting fortification programmes, with 20 countries making good progress in this area (Sight and Life, 2003). Notable examples include Morocco, where the fortification of cooking oil with vitamin A and D is compulsory. In Vietnam, a biscuit product called "bisavit-A" for children aged 6-12 years, is fortified with vitamin A, and given to children in school. In the Philippines, cooking oil and margarine is fortified with vitamin A (Sight and Life, 2003). Fortification of maize with vitamin A is proving successful in Zimbabwe, and the first sugar experience in sub-Saharan Africa is moving forward in Zambia (UN/ACC/SCN and IFPRI, 2000).

Based on the long established experience of many industrialized countries and more recent policies of middle income and poorer countries where, populations are iron deficient, that it is desirable to fortify staples or condiments with iron. (UNICEF, 1998).

The cost of iron supplements and fortificants per individual is low. However as with most public health programmes, when taken to a national scale, and focused beyond treatment to prevention, the overall costs become substantial (UNICEF, 1998).

Several iron fortificants have been used successfully in a variety of national programmes, as shown in the following examples:

- Rice in the Philippines is fortified with a standard ferrous sulphate mix (WHO, 2001).
- Where bread and pasta are abundantly consumed, several iron fortificants have been added successfully during the milling process. (WHO, 2001).
- Salt in India and elsewhere (Mason *et al*, 2001).
- Maize flour in South Africa (Nutriview, 2003).

Challenges to fortification in developing countries include inadequate access, income and infrastructure, for the poor and nutritionally vulnerable. As a result those most in need are less able to purchase fortified foods (FAO, 2003).

2.7.3 Dietary modification

In treating the problem of micronutrient deficiency, food based approaches that focus on improving overall dietary quality, rather than merely delivering a single nutrient, are particularly useful (FAO, 2003).

Support for this approach includes the following.

- There are complex nutrient-nutrient interactions that increase bioavailability when nutrients are consumed simultaneously. For example, iron absorption increases when combined with vitamin C (FAO, 2003).

- New evidence on the protective role of phytochemicals and antioxidants continues to emerge. These protective chemicals are easily obtained by consuming a wide variety of fruits and vegetables (FAO, 2003).
- Scientific knowledge linking nutrition and disease continue to evolve and expand, implicating an even wider range of nutrients with a variety of roles (FAO, 2003).
- The approach may generate income as well as improving overall quality (Sight and Life, 2003).
- There are several low cost, food-based measures that can be promoted at community level (FAO, 2003).

It may be possible to modify local methods of selecting, processing, and consuming foods, within given economic confines; to improve overall iron bioavailability Modifying people's diet may involve imparting new knowledge and changing attitudes and practices of individuals, essentially behavioural modification. The three recommended modifications are (UN/ACC/SCN, 1991) :

- Increasing the intake of haemoglobin iron, usually from animal sources.
- Increasing the intake of vitamin C, along with foods which promote iron absorption, such as acidic and fermented foods.
- Reducing the intake of inhibitors of iron absorption, such as tannins, phytates and polyphenols.

Culturally appropriate dietary modification should be developed to help people identify concrete actions, which can improve both dietary supply and absorption of micronutrients. This information should be disseminated to the public through traditional information channels (FAO, 2003).

Some of the community-based strategies to improve micronutrient status include the following: (FAO, 2003)

- Encouraging exclusive breastfeeding up to six months of age and continued breastfeeding for older infants.
- Identifying and promoting use of culturally appropriate weaning foods rich in micronutrients
- Identifying and promoting use of traditional green leafy vegetables and fruits to add diversity to the diet.
- Preserving micronutrients in fruits and vegetables by using solar drying or canning technologies
- Promoting small scale community gardens
- Rearing small livestock
- Improving year round supply of micronutrient rich foods and including plant breeding where possible. Examples include the promotion of the orange fleshed sweet potato in South Africa and Tanzania (FAO,2003)

Food based strategies usually require complementary public health interventions that can help reduce micronutrient malnutrition. These may include de-worming malaria prophylaxis, improved water and sanitation as well as immunization (UNICEF/UNU/WHO, 2001; FAO, 2003). Successful strategies are those that address all these issues in an integrated and coordinated fashion.

2.8 INTERVENTIONS TO PREVENT VAD AND IDD IN KENYA.

1. Encouragement of exclusive breastfeeding for children aged 0-4 months, and continued breastfeeding alongside weaning diets for children up to 2 years age (Ogutu *et al*, 2001). According to UNICEF (2004), 5% of Kenyan children who are 6 months or less in age, are exclusively breastfed, and 67% of Kenyan children aged 6-9 months are breastfed with complimentary food.

2. Vitamin A supplementation for children between 6-59 months and lactating mothers. This is done routinely as a short-term measure (UNICEF, 2000). It has been largely carried out through the national immunization days (NID's) In Kenya. The vitamin A supplementation coverage rate for 6-59 months old children in 2001 was 90% (UNICEF, 2004).

3. Food fortification with vitamin A such as fat fortification and other appropriate foods (UNICEF, 2000). In Kenya, there is no legislation governing fortification of foods with iron and vitamin A. Legislation only exists for salt fortification with iodine (Mason *et al*, 2001).

4. Increased production and consumption of vitamin A and iron rich foods. Such as the introduction of the beta-carotene rich orange fleshed sweet potato, which is rich in vitamin A (IFPRI, 2001). In a two year research intervention pilot project in western Kenya, carried out by CIP, KARI and CARE, the results showed not only an increase in vitamin A intake, but also in sweet potato yields (UNU, 2000). Hence the orange fleshed sweet potato is seen as an effective entry point for improving vitamin A and calorie intake. Half a cup of the boiled root of this sweet potato can yield 50-100% RDA for a young child (Sight and Life, 2003). A daily

addition of less than 100g of this sweet potato can prevent VAD in children, pregnant women and lactating mothers (CIP, 2001) Another example is the promotion of home, school, and community gardens to grow dark green, leafy, vegetables, and fruits. These increase both production and bioavailability of iron. For example In Nyatike and Nyamira areas of Kenya (South Nyanza) where integrated projects to eliminate VAD has encourage these approaches (Momanyi, 2001; Ogutu, 2001).

5. Public health measures such as immunization activities, control, and management of diarrhoeal diseases, deworming, control of malaria with insecticide treated nets (UNICEF, 2000). According to UNICEF (2004), over 80% of the children aged 1 year in Kenya, have been immunized. Malarial indicators show that only 3% of under-fives sleep under treated bed nets, while 65% of under fives suffered from fever and were on anti malarial drugs (UNICEF, 2004).

6. Nutrition and health education (UNICEF, 2000).

7. Social marketing and advocacy (UNICEF, 2000).

2.9 CONCLUSIONS FROM LITERATURE REVIEW

The prevalence rates of VAD and IDD in developing countries, Kenya included, call for urgent action, both targeted short-term actions as well as long term interventions. Supplementation is a feasible intervention, but is a short-term measure. Supplementation in developing countries has been largely donor funded, leading to heavy donor reliance. Fortification of food with vitamin A and iron requires considerable input, and is being implemented slowly in developing countries.

The Government of Kenya (GOK) in its national plan of action for nutrition (1994) recognises the magnitude of vitamin A and iron deficiency in the country and aims to combat these deficiencies through various interventions. Food based approaches are an essential part of the long-term global strategy to alleviate micronutrient deficiencies but their real potential has not been explored adequately (IFPRI, 2001).

It is clear that preliminary local community data on availability of foods, their economic value, consumption patterns and attitudes, as well as existing feeding behaviour are necessary for effective, sustainable programmes. Since consumption studies have not been done in many areas, and are essential as a preliminary step for providing baseline information, this study aims to contribute towards providing such baseline information and recommendations, on which future interventions may be based.

CHAPTER 3
RESEARCH METHODOLOGY

3.1: STUDY DESIGN.

A cross sectional survey of descriptive nature, with an analytical component was undertaken, amongst households in Awasi location of Nyando district, in the months of September to October 2002.

3.2: THE STUDY SITE. (See location map- appendix 3)

The study was conducted in Nyando district, Nyando division, Awasi location. Nyando district is one of the 12 districts in Nyanza province; it was carved out of Kisumu district in 1998. Nyando district borders Kisumu district to the west, Nandi district to the north, Kericho district to the east and Rachuonyo district to the south. The district has a small shoreline to the Southwest where it touches Lake Victoria.

Administratively Nyando district is divided into five divisions namely, Upper Nyakach, Lower Nyakach, Miwani, Muhoroni, and Nyando. Awasi location, which is in Nyando division, is divided into four sub-locations; Ayucha, Border 1, Border 2 and Wanganga. The study sampled households from each of the four sub-locations of Awasi.

The total population of Awasi location is 15,241 out of which 6,931 are male and 8,310 are female (CBS, 1999). The total number of households in Awasi location is 3,144.

3.2.1: Topography and Climatic Conditions

Nyando district can be divided into 3 main topographic land formations; the Nandi hills, the Nyabondo plateau and the Kano plains. The plains are sandwiched between the two hills. Awasi location lies in the Kano plains and predominantly comprises black cotton clay soils, with moderate fertility and poor drainage. The district altitude ranges from 1800m above sea level in the Nyabondo plateau to 1,100m along the Kano plains. . The mean annual rainfall of Awasi is 560mm which is the lowest rainfall received in the district (GOK, 2002-2008).

Nyando district has two major rivers, namely Sondu-Miriu and Nyando Rivers. The Nyando drains from the Nandi hills, where relatively high rainfall is received, to Lake Victoria through the Kano plains. It is a major cause of persistent flooding along its banks as it approaches the lake, with devastating effects on resources and population settled in these areas. The mean annual rainfall in the district varies from 560mm to 1,630mm, depending on altitude and proximity to the highlands of the Nandi escarpment, as well as nearness to the lakeshore and central portions of the Kano plains.

3.2.2: Crop and Livestock Production

The main food crops produced are maize, cassava, and sorghum. The main cash crops are rice, sugarcane, and cotton. Floods frequently destabilise agricultural production in the region (GOK, 2002).

The main livestock kept in Awasi is cattle, mainly zebus. Information on other livestock like goats and poultry is not indicated in the district development plan. Fish farming and fishing is also limited.

3.2.3: Education.

The district has 316 pre- primary schools, 291 primary and 45 secondary schools. At all three levels of education, boys have a higher percentage of the recorded enrolments compared to girls. However, in adult literacy classes the enrolment of females is higher than males (GOK, 2002). Most primary schools lack classrooms, desks, and some secondary schools lack laboratories.

3.2.4: Health and Sanitation.

Health facilities include one government hospital and nine health centres for the whole district. The doctor to patient ratio is 1:50,000 leading to inadequate health provision. Most people are not able to meet the cost of medical care due to low incomes (GOK 2002). The most prevalent diseases are malaria, URTI, diarrhoea, skin diseases, and helminthic parasites. HIV is a major crisis in Nyando district due to the rising trend of infections GOK, 2002).

The level of access to safe drinking water is low. The district is prone to flooding during the wet season, resulting in contamination of water sources, the result is an upsurge of water borne diseases. The other extreme condition is drought when people have to walk long distances in search of water, or rely on unsuitable water from water ponds shared with livestock. The quality of primary health care is an issue of concern given the effect of floods and drought on water and sanitation, nutrition and anaemic diseases. Also due to low incomes, most people are unable to meet the cost of medical care (GOK, 2002).

3.3: THE STUDY POPULATION.

The study population consisted of households within Awasi location. A representative sample of 304 households with children aged 3 months to 60 months was selected from all 4 sub-locations of Awasi.

3.4: SAMPLE SIZE DETERMINATION.

For the purpose of sample size determination, vitamin A deficiency statistics for Kenya was used to compute sample size. The criteria used are that, since the deficiency rates for vitamin A are lower than those for IDD, a larger sample is required to detect deficiency. The iron deficiency statistics in Kenya are high, with children suffering from severe anaemia at 54.2%, while 50% of mothers' are anaemic irrespective of their pregnancy status (Mwaniki *et al*, 2001). As the total number of households in the study area is less than 10,000, the sample size was determined using Fisher's formula (Fisher *et al*, 1991) as follows:

For population size less than 10,000:

$$n= (z^2pq)/d^2$$

Where

n= the desired sample size when the population is greater than 10,000.

z= the standard normal deviate set at 1.96 corresponding to 95% CI

p= the acute VAD rate of mothers and children in Kenya at 0.3 (Mwaniki *et al.* 2001)

q= 1.0 – p= 0.7

d= the degree of accuracy desired at 0.05

$$\text{Therefore:} \quad n = \frac{(1.96)^2 * 0.3 * 0.7)}{(0.05)^2} = 324$$

324 + 5% attrition = 340.2

Since N (the entire population) is less than 10,000 a final sample is calculated as follows:

nf = n /1+(n/N)

Where:
nf= the desired sample size when the population is less than 10,000.

n= the desired sample size when the population is more than 10,000
N=the estimate of the population size (total HH = 3,144)

nf= 340.2 /1+(340.2/3144) =306 households.

A total of 304 households were sampled in the study

3.5: SAMPLING PROCEDURE.

Awasi location was purposively chosen as it lies within the CBNP project area under whose auspices the study was carried out. All the four sub-locations of Awasi were included in the study to ensure adequate representation.

Multistage sampling was used to select the villages and households in which a structured food frequency questionnaire was administered. The clusters used were the villages within each sub-location. The sampling frame was based on the enumeration areas drawn up during the last national census (CBS, 1999).

In the first stage, the villages whose households were to be sampled were selected using simple random sampling. The total number of households was computed so that each sub-location was proportionally represented.

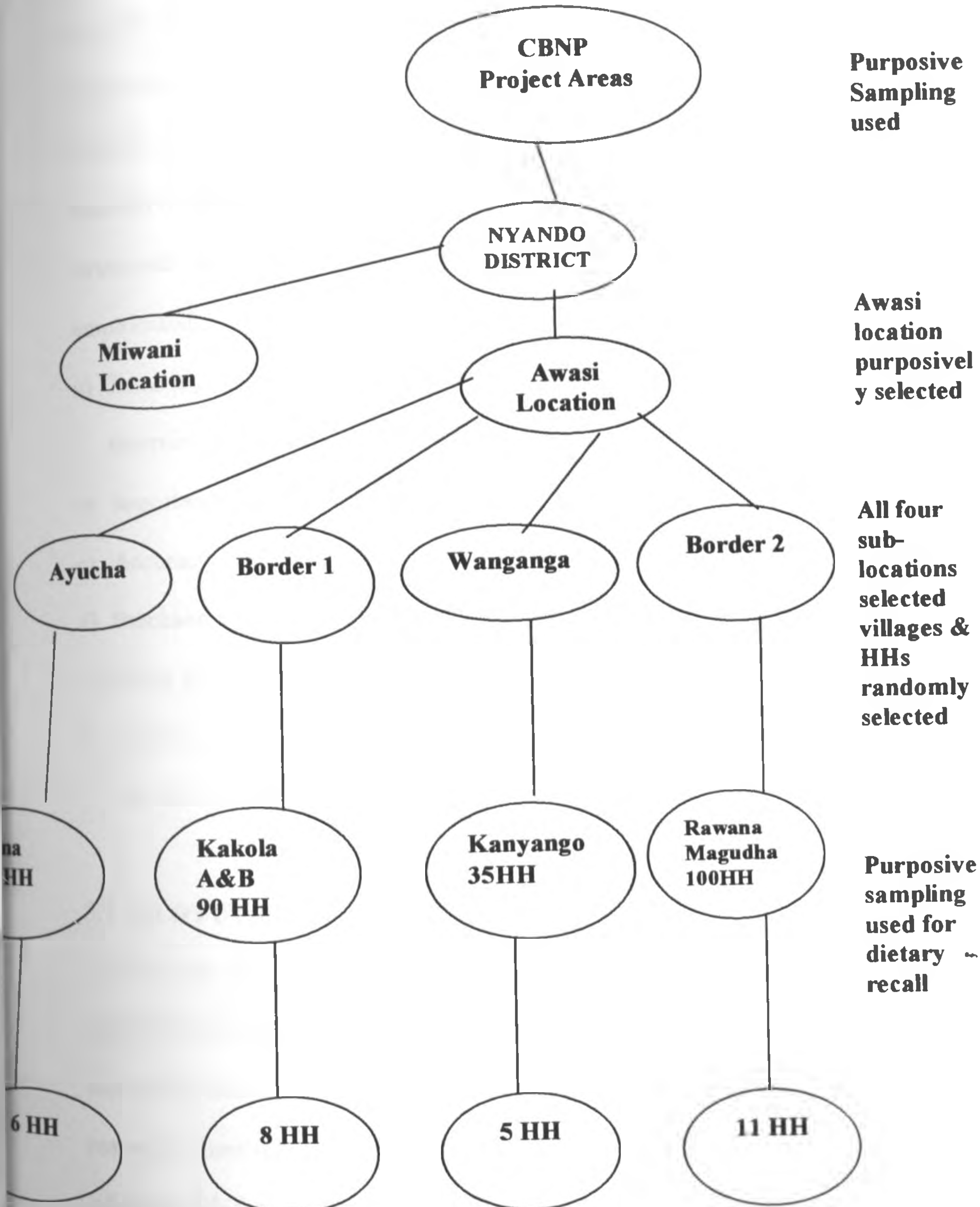
In the second stage, the households to be sampled within the selected villages were obtained using non-probability sampling. This is because time and financial constraints did not allow for the drawing up of a sampling frame, to include all households meeting the study criteria. The starting point in each village was the village centre, a pencil was spun and the direction of the pencil tip used as the starting direction. Once in the selected village all households meeting the required criteria were included until, the required sample size was reached. Where the required number of households in a village was not reached, households from the immediate neighbouring village were included to reach the required sample size.

Of the 304 households, sampled 30 households were randomly selected for participating in the 24-hour dietary recall assessment, which was undertaken in all 4 sub-locations of Awasi location.

Within the randomly selected villages of each sub-location 8-10 mothers having children aged 1- 60 months were randomly selected for the focus group discussion. One focus group discussion was done in each sub-location.

The following figure (3.1) shows how sampling was done at each stage.

FIGURE 3.1: SAMPLING FLOW CHART



3.6: TRAINING OF RESEARCH ASSISTANTS.

Four research assistants with secondary school education, and resident in Awasi location were recruited and trained. During the training session the proper use of all research instruments was discussed and the necessary demonstration given. The structured questionnaire was thoroughly reviewed and the following points emphasized:

a) Ensuring all households meets the inclusion criteria and mothers accept to be interviewed.
b) Importance of clarity when asking questions.
c) Accuracy when filling in structured questionnaire and keen observations.
d) Precision and detail while carrying out the 24-hour dietary recall.
e) Being patient when mothers seem busy, especially for the 24-hour recall.
f) Liaising with other research assistants if something is not clear soon after administering the questionnaire.

3.7: PILOT STUDY.

A pilot study was conducted in 10 households in a village not selected for the main study. The pilot study helped the researcher and her assistants to familiarize themselves with the questionnaire, using the measuring instruments, and allocating reasonable time for each questionnaire. The results of the pilot study were also used to adjust/modify the data collection tools for the study.

3.8: RESEARCH INSTRUMENTS

1. **Questionnaire:** A structured questionnaire was used to obtain information on the socio-demographic characteristics of households, as well as food production patterns. Coded options were given for some of the questions. Information was also obtained on the following through open-ended questions, which were later coded for analysis.
2. **Breastfeeding and weaning:** A Questionnaire on breastfeeding and weaning was administered to mothers of children aged three years or less. The aim was to determine foods eaten by children of these ages and whether the diet was rich in vitamin A and iron rich foods. An infant who is adequately breastfed is assumed to get adequate vitamin A.
3. **Morbidity and sanitation:** The morbidity status of children aged 3 years or less was assessed by asking the mother about the child's health over the previous four weeks. The diseases the mother was asked about included diarrhoea, cough, and measles. Fever, which is a symptom of ill health, was also asked about. The sanitation situation was determined by asking about water sources and latrine use.
4. **HKI food frequency questionnaire:** For the assessment of the consumption of vitamin A rich foods, the weekly food frequency questionnaire developed by Hellen Keller International was used (HKI, 1993). This questionnaire was administered to all households. The HKI consisted of two columns, a list of foods rich in vitamin A in one column, and a set of frequency-of-use responses categories in the other column. Vitamin A rich foods included those that are readily available in the

locality, which were identified through a qualitative market survey. A few food items were replaced based on the criteria suggested by HKI. The final list had 28 foods (see appendix) and was sufficiently extensive to show dietary diversity.

5. **The 24-hour dietary recall:** A questionnaire based on foods consumed in households over the last 24 hours, was administered in 30 households representative of Awasi location. Respondents for this questionnaire were mothers who cook food for their households. The answers gave a detailed account of all foods and drinks consumed by the households, on the day before the questionnaire was administered. Ingredients and quantities were recorded. Measurement tools included kitchen scales, measuring cylinders and cups, measuring spoons, plates, and sufurias. Accuracy was closely observed. The total amount of food consumed by the household was computed by subtracting the leftover food from the amount cooked for each dish prepared.

6. **Focus group discussions:** Four focus group discussions were conducted, one in each of the 4 sub-locations of Awasi. The aim was to gain insight and understanding on household consumption patterns in Awasi, as well as any associated problems. The number of mothers for each group was 7 to 10. The criteria was that mothers should have at least one child aged 5 years or less and living in their marital home, not parents home.

3.9: DATA ANALYSIS.

Data was analysed per household, except for data on breastfeeding, weaning and morbidity, which was based on the index child, this was a child of less than 3 years of age. SPSS for windows (version 10) was used for data entry, cleaning and analysis.

Microsoft Excel was used to draw graphs. Descriptive methods, which include frequencies, means, and chi-square tests of association were used for all the data analysis. Consumption data from the HKI and 24-hour dietary recall were analysed as follows:

HKI: Data from the completed food frequency questionnaires was analyzed to determine whether vitamin A is a pubic health problem in the community. The analysis was determined by either of the two threshold values or dietary scores (HKI 1993):

- ≤ 4 days per week for mean frequency of consumption of animal sources of vitamin A
- ≤ 6 days per week for mean frequency of total consumption of animal and plant sources of vitamin A (weighted by source).

The results of the HKI clearly show the extent of dietary diversity and the scores for animal and vegetable sources of vitamin A consumed in each household and each sub-location.

24-hour dietary recall: Total quantities of food consumed by each household for one full day were computed. To obtain the nutrient quantities of these foods, that is proteins, calories, iron and vitamin A, food composition tables were used (Sehmi, 1993 and ECSA, 1987). The nutrients of interest are vitamin A and iron, since energy and proteins are important basic nutrients their intake was also analysed. The adequacy of vitamin A and iron for households was determined by comparing the amount consumed with the required amounts. For ease of analysis, comparisons were done per sub-location using various statistical tests. The total mean nutrient intake was calculated. In analysing the data 95% confidence interval and regression was used.

CHAPTER 4

RESULTS

4.1: SOCIO-DEMOGRAPHIC FEATURES OF THE STUDY POPULATION

The study population consisted of all members of households who met the inclusion criteria given in chapter 3. Mothers were the main respondents in the study. A total of 304 HH were sampled, four questionnaires were excluded in final analysis due to extreme values, hence the final sample size of 300 households. The 300 households sampled had a total population of 1,671, out of which 841 (50.3%) were female and 830 (49.7%) were male. The household sizes ranged from 2 persons in the smallest family to 12 in the largest family. The mean household size was 6 persons. In the study households, the youngest person was 9 days old whilst the oldest was 79 years. The dependency ratio of the population is 148.

Children aged 5 years or less formed a quarter of the population in Awasi households, with Wanganga sub-location having the highest mean of slightly more than a quarter, and Ayucha having the lowest with less than a quarter. There is no significant difference among children in this age group in all four sub-locations as shown in table 4.1

Table 4.1: Age distribution in Awasi

N=300	Ayucha n=70	Border 1 n=95	Border2 n=82	Wanganga n=49	Mean (Awasi)
Mean mothers age	29.4	27.9	31.2	29.2	29.45
% age group pop					
<5	23.3	27.0	24.2	27.3	25.3
6-15	34.7	28.9	30.9	28.9	30.9
16-45	38.1	40.3	39.1	41.5	39.6
>45	4.0	3.7	5.9	2.4	4.2

According to table 4.1 the majority of study population fall in the age category of less than 45 years, very few (4.2%) fall in the age category of above 45 years. Wanganga sub-location has the lowest number in this age category (2.4%) while Border 2 has the highest (5.9%), F and χ^2 tests done show that there is no significant difference among population groups in each sub-location. Overall, male to female distribution is 1:1.1.

Table 4.1 shows the mean mothers' age as 29.5 years. Among mothers, the youngest was 16 years old while the oldest was 56 years old. Out of the four sub-locations, the mean mothers' age was highest in Border 2 (31.2 years) and lowest in Border 1 (27.5 years). There is no significant difference amongst mothers' ages in each sub-location.

Almost three-quarters (74.2%) of mothers in the study have primary education as shown in the following table 4.2. This decreases greatly at secondary level to a mean of 19.1%. At post secondary level, education among mothers is very low with three sub-locations reporting no post secondary education amongst mothers.

Table 4.2: Education in Awasi

N=300	Ayucha n=70	Border 1 n=95	Border2 n=82	Wanganga n=49	Mean (Awasi)
Mothers educ					
Not attended	5.7	3.2	5.8	2.0	4.3
Primary	72.9	74.5	66.3	89.8	74.2
Secondary	21.4	19.1	24.4	6.1	19.1
Post-sec	-	-	1.2	-	0.3
adult	-	3.2	2.3	2.0	2.0
Education level					
Not attended	2.4	1.6	2.0	1.5	1.9
Primary	56.2	50.8	50.1	53.6	52.4
Secondary	10.6	12.0	15.8	10.1	12.4
Post-sec	-	0.6	0.7	-	0.4
adult	0.2	1.0	1.1	0.7	0.8
preschool	30.6	34.1	30.4	64.1	32.2

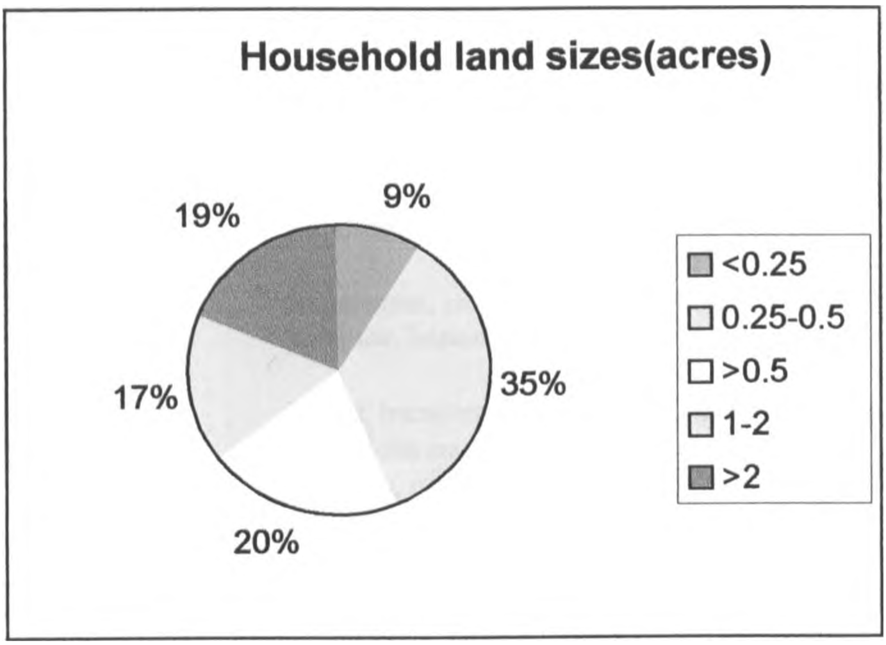
Table 4.2 shows most people in the study have some formal education. Over 50% have primary education. Ayucha sub-location has the highest number of people with primary education (56.2%) while Border 2 has the lowest number of people with primary education (50.1%). Secondary and post secondary education is limited in all four sub-locations. The total mean population with secondary education is 12.4%. Less than 25% of the population have no secondary education in all sub-locations. The mean population with post-secondary education is very low in Awasi and two sub-locations, Ayucha and Wanganga, recorded nil for post-secondary education. F and χ^2 tests indicate no significant difference in education per sublocation at primary, secondary and post secondary education levels.

4.2: FARMING AND FOOD PURCHASE.

A) Farming

Most households (99%) have some land for cultivation. . The average size of these farms is 0.54 acres. The distribution of land sizes is shown in figure 4.1 below

Figure 4.1 : Percent of households land sizes



The results show that most households (99%) have at least some land for cultivation. These small farms locally known as "orundi" represent farming done within or just outside the homestead. The land sizes do not vary significantly per sub-location. Less than 20% of the population have more than 2 acres of land for cultivation.

The results of table 4.3 show foods grown in the home and those purchased. Nearly all households (97.7%) grow maize in Awasi. Sorghum is grown by 73% of the households. Cassava, millet and sweet potatoes are grown by very few households (25% or less). The most common type of DGLV 's grown by Awasi households are cowpea leaves (62.3%).

Table 4.3 Percentage Of Households Growing and/or Purchasing Selected Food Items.

% Household	Foods grown	Foods purchased
> 75	Maize	Fish, sugar, cooking fat, salt.
50-74	Sorghum, cowpea leaves	____
25-49	Sugar cane, cassava, pawpaw, lemons, oranges	Meat, bread, wheatflour.
< 25	Millet, bananas, tomatoes, kales, lemons, sweet potatoes, mangoes, guavas, pineapples.	Milk, rice, beans.

Fewer households (14.3%) grow kales. Fruits grown in the area include paw-paw, lemon, oranges, and guava. These are grown by less than 25% of the households in small quantities. Almost half of the study households grow sugar cane as a cash crop. Foods purchased by over 90% of households HH on a weekly basis include fish, cooking fat, sugar, tomatoes, onions, and salt. Foods such as meat, milk, rice, wheat-flour products, vegetables, fruits, and beans are purchased by very few households. The foods purchased are limited in variety and fruits and vegetables are not purchased, they are mostly grown.

Table 4.4 shows that more than half of Awasi households (54.3%) spend between 250-1,000 shillings on food weekly. Very few households spend more than 1,000 shillings on food per week. There is no significant difference on amount of money spent per sub-location on food.

Table 4.4: Amount Of Money Spent On Food Weekly By Households

Amount(Kshs)	Ayucha	Border1	Border2	Wanganga	Mean %
Mean amount spent					
<250	10.0	14.6	18.6	14.6	14.7
250-500	25.7	18.8	34.9	25.0	26
501-1000	31.4	27.1	24.4	33.3	28.3
1001-1500	18.6	17.7	17.4	4.2	15.7
>1500	14.3	21.9	4.7	22.9	15.3

Apart from crop farming, livestock is kept by many HH in Awasi. Livestock kept by households include cows, goats, sheep, and chicken. Table 4.5 shows that chicken are kept by more than 75 % of the households. The mean number per household is eight chickens. This number varies from Ayucha with the highest mean of 11 per household, to Wanganga with a mean of 3 chicken per household.

Table 4.5: Percentage Household And Mean Number Of Animals Owned Per Household

	Ayucha		Border1		Border2		Wanganga		Total	
	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean
Chicken	84.3	11	82.3	8	82.6	8	85.4	3	83.3	8
Cows	58.6	6	58.3	4	68.6	4	56.3	4	61.0	4
Goats	48.6	4	42.7	4	68.6	4	39.6	4	51.0	4
Sheep	34.3	6	37.5	4	58.1	3	47.9	5	44.3	4
Others	2.9	11	5.2	4	4.7	4	12.5	3	5.7	5

More than 50% of the households keep cattle. The mean number per household is four cows. There is no great variation in numbers and varieties of animals kept per sub-location. About half of Awasi households keep goats, whereas less than half the households rear sheep. Out of the animals reared chicken may be consumed by HH occasionally and milk from cows is also consumed. Otherwise most of the livestock kept are sold only when there is an urgent need for money.

4.3 CONSUMPTION PATTERNS.

4.3.1 Breastfeeding characteristics among index children

Data on breastfeeding and weaning was collected from mothers of all index children. A total of 297 mothers out of the 300 households responded to this questionnaire.

Table 4.6: Characteristics of Index children in Awasi

	Ayucha	Border1	Border2	Wanganga	Mean
Mean age of IC	3.17	3.13	3.4	3.5	3.3
95% CI=	3.1-3.4yr				
% sex dist of IC					
Male	57.1	47.9	46.5	44.7	49.2
Female	42.9	52.1	53.5	55.3	50.8

The mean age of the index children was three years and both male and female children were almost equally represented, though females were slightly more as shown in table 4.6 above. Most of the children fell in the age category of just over three years to three years and four months.

The results for exclusive breastfeeding among index children are presented in the following table 4.7. The majority of mothers (47.6%) stopped exclusive breastfeeding when the child was 6-8 months old.

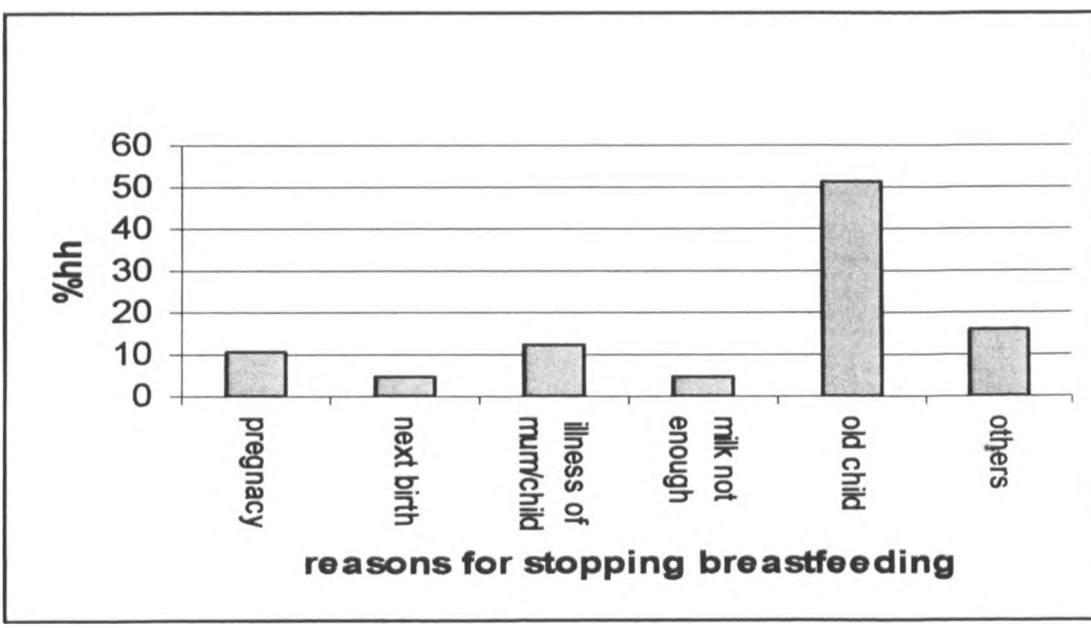
Table 4.7: Length of exclusive breast-feeding in months by percent household

Length of exclusive Bf (months)	Ayucha	Border1	Border2	Wanganga	Mean	Sig χ^2
1-3	12.9	10.8	9.3	4.3	9.8	s
4-6	30.0	44.1	11.6	10.6	26.0	s
6-8	45.7	40.9	51.2	57.4	47.6	ns
>8	11.4	4.3	27.9	27.7	16.6	s

At the time of the study, 52% of the children were still breastfeeding, while 47% had stopped breastfeeding. A third of the mothers said they stopped breastfeeding before the child was 1 year old, 40% of the mothers could not recall when they stopped. About two-thirds of children (62.2%) of children between ages 2-3yrs stopped breastfeeding on the reason that they were too old to breastfeed. There was no relationship between the mothers' education and the length of breastfeeding

($R^{\wedge 2}=-0.001$). The reasons for stopping breastfeeding are presented in the following figure 4.2.

FIGURE 4.2: REASONS FOR STOPPING BREASTFEEDING IN AWASI HOUSEHOLDS



4.3.2 Weaning characteristics of Awasi children.

Most of the index children (84.7%) were already weaned and consumed other foods apart from breast-milk. Cow's milk was used by 73% of the children to supplement breast milk. Maize-meal porridge is a common weaning food and is sometimes enriched (by 58% of mothers) with sorghum and/or millet. The table 4.8 below shows the weaning foods consumed by the index Children. Fish is consumed by 61% of the children and is mainly omena (dagaa). Other foods include ugali, rice, and fruits like pawpaw.

Table 4.8: Weaning foods used by index child by percentage household

	Ayucha	Border1	Border2	Wanganga	Mean (N=252)
Porridge	68.6	51.1	61.6	53.2	58.3
Enriched porridge	74.3	64.9	69.8	68.1	69.0
Milk cow	77.1	68.1	81.4	66.0	73.7
Orange juice	60.0	69.1	70.9	51.1	64.6
DGLV	60.0	59.6	64.0	59.6	60.9
Fish	58.6	63.8	65.1	55.3	61.6
English pot.	-	2.1	22.1	4.3	7.7
Others	40.0	61.7	70.9	63.8	59.6

4.3.3: The 24 hour dietary recall

The 24-hour dietary recall was used to analyse mean nutrient intakes of protein, energy, vitamin A, and iron. The results are given in the following table 4.9

Table 4.9: Mean nutrient intake in Awasi

Nutrient	Ayucha n=7	Border1 n=7	Border2 n=9	Wanganga n=7	Mean N=30	95%CI	p-value
Calories (kcal)	15300	9328	10766	9982	11305	9346-13267	0.129
Protein(g)	554	302	373	317	386	295-477	0.192
Iron(*ug*)	370	249	254	242	277	225-329	0.267
Vit A(RE)	1170	1247	1820	2132	1607	1157-2057	0.385

According to table 4.9, calorie, protein, and iron intake in 3 sub-locations, Border 1, Border 2 and Wan'ganga, is below the mean nutrient intake for the whole location. However, where vitamin A is concerned, two sub-locations Ayucha and Border 1, have below the mean vitamin A intake for the whole location. There is no significant difference in mean nutrient intake per sub-location.

Table 4.10: Proportion of household with intake <100% of recommended intake.

Nutrient	Ayucha	Border1	Border2	Wanganga	Total	Sig X^2
Calories	28.6	57.1	55.6	42.9	46.7	ns
Protein	14.3	0	22.2	0	10	s
Iron	0	0	0	0	0	ns
Vitamin A	100	71.4	88.9	71.4	83.3	ns

X^2=chi-square test

Table 4.10 shows almost half of the households (46.7%) consume less than 100% of the RDA for calories and more than 75% households consume less than 100% of the RDA for vitamin A all the household consume more than the RDA for iron.

Table 4.11: Amount of Money Spent Weekly versus Calorie Intake Adequacy

	Adequate	Inadequate
<250	50	50
250-500	50	50
501-100	22.7	27.3
1001-1500	28.6	71.4
>1500	50	50

There is a slight negative relationship between the amount of money spent by HH weekly and the calorie intake adequacy ($R^{\wedge 2}$= 0.27). This means that spending more money on food by HH does not ensure adequate calorie intake. There is a positive relationship between the amount of calories consumed and the education of mothers ($R^{\wedge 2}$= 0.167). The same is true for vitamin A consumed (($R^{\wedge 2}$= 0.571). This shows that the more education the mother has the higher the calorie and vitamin A intake. There is also a strong positive relationship between HH land size and amount of calories consumed ($R^{\wedge 2}$= 0.990), the same is true for land size and the amount of vitamin A consumed, ($R^{\wedge 2}$= 0.680). Hence, the more land for farming a HH has, the higher the quantities of calories and vitamin consumed.

4.3.4: HKI food frequency

To determine if the community is at risk from vitamin A deficiency, the Helen Keller International (HKI) food frequency method for community risk assessment was used. This questionnaire was administered to all households with children aged 12 to 71 months in the survey area. A total of 277 Households qualified and were assessed using HKI. The results are shown in the following table 4.12.

Table 4.12: Mean frequency of consumption of vitamin A rich foods by sub-location in Awasi.

Sub-location	Animal source Cutoff <=4days	Weighted total Cutoff < or = 6days
Ayucha	1.31	3.67
Border 1	2.38	3.19
Wanganga	1.98	2.90
Border 2	2.39	3.32
Average	**2.01**	**3.27**

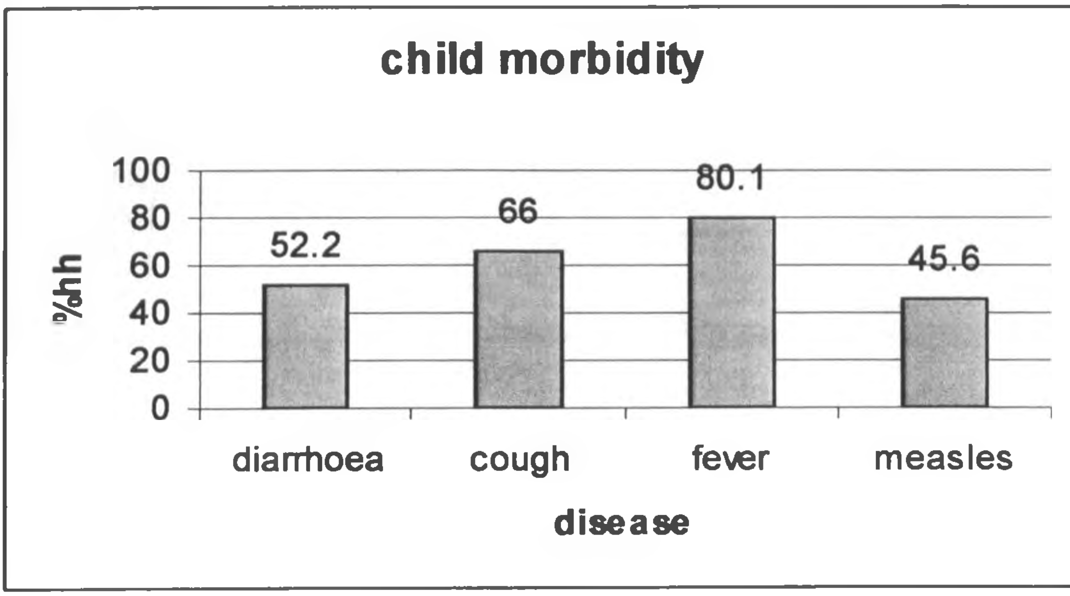
Whether a community has a vitamin A deficiency problem is determined if the value obtained is less than or equal to 4 days per week for animal sources, and less than or equal to 6 days a week for both animal and plant sources (weighted total). The results show that in all 4 sub-locations the consumption of both animal and plant sources of vitamin A is inadequate and therefore the community is at high risk from VAD.

4.4: MORBIDITY AND SANITATION IN AWASI

a) Morbidity

Index children were used to obtain data on morbidity in Awasi. A one month history of diarrhoea, cough, fever and measles was obtained. The children in the study had a relatively high rate of morbidity, with more than 75% having had fever (a symptom of illness), more than 50% of the children had a cough or diarrhoea.

FIGURE 4.3: CHILD MORBIDITY IN AWASI



b) Sanitation

Table 4.13 shows the most common source of water in the study is river water, used by most households (89.4%). Piped water is used by just over 25% of the households. Other sources of water are used by less than 15% of the households. More than seventy percent of the HH's said that the time taken to reach the water source was 30 minutes or less, only 2.7% of the HH's took more than an hour. The main type of toilet used was the pit latrine by 57.5% of the households, while 47.5% reported no toilet use.

Table 4.13: Water sources and sanitation in Awasi.

Water source	Ayucha	Border1	Border2	Wanganga	Mean
Piped	43.5	40.4	19.8	-	28.7
River	24.6	34.0	43.0	-	89.4
Borehole	5.8	-	-	-	1.4
Protected well	11.6	11.7	20.9	10.0	14.2
Open ponds	14.5	13.8	16.3	-	12.5
Use of toilet					
Pit latrine	40.0	61.7	59.3	38.3	52.5
Vip latrine	1.4	-	-	-	0.3
none	58.6	38.3	40.7	61.7	47.5

The risk of having diarrhoea is 1.4 times more among the toilet non-users than the toilet users according to the odds ratio results. The use of a toilet does not necessarily reduce the incidence of diarrhoea.

Table 4.14: The correlation between use of toilet and diarrhoea of index child.

		Child Diarrhoea	
		yes	no
Toilet	Yes	45.8	54.2
Use	no	36.8	63.2

Odds ratio = 1.451

CHAPTER 5
DISCUSSION

5.1: Socio-Demographic Characteristics of the Population.

Most of the socio-demographic characteristics of the study population correspond with those found in recent demographic and health surveys. The age- sex composition, where females slightly outnumber males and where the proportion of the youthful population far exceeds the adult and aged population , are similar to findings of the CBS (1999, 1998, 2004).

The average household size in the study is higher than both the district and national household sizes. This points to a higher fertility rate. It is thus not surprising that the dependency ratio is also higher than the national level. Mothers in the study have a higher mortality rate than in other parts of the country, as indicated by the very low number of mothers in the upper age categories compared to other areas.

The above socio-demographic characteristics have negative connotations for the dietary adequacy of households. Low socio-economic status due to low education levels directly affects foods and quantities consumed especially among the vulnerable groups.

5.2: Farming and food purchase

It is a common practice for most households to grow food-crops. With the main objective being to improve household food supply (FAO, 2003). Hence the findings that almost all households in the study have some land for cultivation is not surprising.

However, the average land size per household is small, especially when considering the low rainfall received in the area. The result is inadequate food production in most households leading to food insecurity. This is similar to information in the NDDP (GOK, 2002), that the agricultural sector is performing poorly leading to low overall food production. Thus the district has to rely on food imported from outside to supplement locally produced food.

The major plant sources for vitamin A in the area are cowpea leaves and bush okra (*apoth*). Both are dark green leafy vegetables (DGLV), which are highly seasonal. *Apoth* often grows wild during the rainy season. The supply of these DGLV's is limited to the wet season.

Cattle, chicken and goats kept by most households are important sources of highly bioavailable vitamin A and iron. However apart from milk and eggs which may be consumed at household level, their consumption is usually limited to occasions and are more likely to be sold for income, especially in emergency situations.

Fruits, which are essential for iron absorption are grown and consumed in low quantities. The findings indicate inadequate fruit consumption. Guavas which are rich in vitamin C, grow wild and are popularly consumed when in season. Guavas offer great potential for improved vitamin C consumption if grown on a larger scale in this area.

Maize and sorghum are the main staples grown to provide the caloric requirements of households, the quantities produced are not adequate. Phytates present in the grains consumed act as potent inhibitors to iron absorption. The fact that no household reported purchasing dry maize (for *ugali),* can be attributed to the fact that the study was done soon after maize had been harvested.

The results indicate that since food production in the area is inadequate, market purchase of food plays an important part in ensuring households meet their daily dietary requirements. The type of foods purchased by most households as well as the amount of money spent, point to low purchasing power. The study findings show the widespread purchase of *omena*, a relatively cheap and highly nutritious source of protein and iron, compared to the more costly and even more nutritious *ngege* (tilapia). A market survey indicated that small white blocks of cheaper cooking fat are more commonly purchased as opposed to the more expensive cooking fats like kimbo, which are also fortified with vitamin A and D.

Food production and purchasing habits in the study indicate that the availability of *omena* ensures adequate consumption of dietary iron. The availability of fruits is low, seasonal and inadequate. The supply and consumption of vitamin A rich foods is inadequate.

5.3 Consumption patterns and dietary adequacy.

Numerous socio-economic and cultural factors influence the decision on patterns of feeding (CBS, 2004). Consumption patterns in the study area reflect this statement.

Most households in the study consumed three meals a day, that is breakfast, lunch and supper. The study coincided with the post-harvest season when more maize is available. Most households consumed maize meal porridge with no sugar for breakfast. A few HH consumed porridge enriched with millet or milk. No HH reported fermenting porridge. The porridge is usually drank alone and rarely is bread or any other accompaniment served with it. A few households have tea for breakfast. Most households consume *ugali* and *omena* for lunch and supper, alternatively DGLV (kales or cowpea leaves) is also consumed with *ugali* when available. The proximity to the lake and fishing activities are largely responsible for the culture of eating fish, a rich source of both protein and iron.

Breastfeeding and weaning: Exclusive breastfeeding in the early months of life is correlated strongly with increased child survival and reduced risk of morbidity, especially from diarrhoeal diseases. WHO recommends that children receive nothing but breastmilk for the first six months of life (CBS, 200). The median duration of exclusive breastfeeding by mothers in the study of 2.7 months is higher than the national level of less than 2 months. However since both these levels are much lower than that recommended by WHO, it implies that unless these children are adequately supplemented with alternative sources of milk they are at high risk to nutritional deficiency diseases and its effects before the age of 6 months. General breastfeeding is almost universal in Kenya as most children are breastfed. On average, children breastfeed until the age of 21 months (KDHS, 2003). In the study more than half the mothers stopped breastfeeding when the child was more than 21 months, this is typical of breastfeeding in the rural areas of Kenya where children are breastfed more than in urban areas (KDHS, 1998 and 2003).

It is common for most mothers to continue breastfeeding as the child is weaned. The use of infant formula in the rural areas is not common in Kenya. This is similar to the findings of this study where no household used infant formula milk to supplement breastmilk; whereas quite a number of households use cow's milk as a supplementary or alternative milk source (KDHS, 1998).

Adequacy of vitamin A, protein, and calories is ensured in diets where young children are adequately breastfed. As these children grow up and milk (breast and others) is reduced, the risk to Vitamin A, protein and calorie deficiency is heightened, unless there is adequate supplementation. Since milk is usually a poor source of iron, the children in the area are likely to be iron deficient soon after their birth iron supplies are depleted unless provided in the diet.

According to the KDHS (2003), complementary foods should be introduced when a child is 6 months old to reduce the risk of malnutrition. Findings of this study correspond with this as before the age of one year most children had been weaned. Most of the children weaned would be assured of adequate iron and protein in the food consumed (especially fish). However the presence of phytates, low fruit consumption and high morbidity rates, most likely compromise their iron status. The vitamin A situation may be worse among weaning children who consume little or no milk, especially as the only other major source of vitamin A is DGLV's, whose bioavailability is usually low compared to those from fruit or animal sources.

Household consumption and dietary adequacy: Both the HKI food frequency and the 24 hour dietary recall clearly bring out the lack of diversity and resultant monotony in the food consumed by households in the study. This lack of diversity predisposes these households to micronutrient deficiencies including vitamin A and iron deficiency (IFPRI, 2001 and FAO, 2003).

The inadequate intake by most households of both plant and animal sources of vitamin A, as seen in the findings, puts them at risk to vitamin A deficiency, which according to the national micronutrient survey (GOK and UNICEF, 1999) is high in the area.

The culture of eating *omena* in the study area greatly enhances iron consumption and hence adequacy, as it is a rich source of highly available iron. It is a poor source of vitamin A mainly due to the fact that *omena* has no fat to aid vitamin A absorption. It appears that the reason for inadequate iron are largely non-dietary or indirect, and are serious enough to cause the high deficiency rates found in surveys carried out (Mwaniki *et al*, 2001, and CBS, 2004). Other factors which influence iron and vitamin A adequacy are indicated in the next section.

5.4: Other factors influencing dietary adequacy.

Information and reports found in demographic health surveys, Nyando district development plan and some daily publications indicate that the study area falls in the district that has one of the highest morbidity rates in the country (CBS, 1998, CBS,2003, GOK, 2002). The study results also indicate a high prevalence of fever, diarrhoel disease and cough among index children.

Malaria is endemic in this area while acute respiratory infections (ARI) are listed in the NDDP (GOK, 2002), as being among the major illnesses affecting children in this area. Poor hygiene, including poor faecal matter disposal as seen in the study findings contribute to the spread of disease, especially diarrhoea. The trend of rising HIV infections is a big problem in the area.

The high rate of morbidity has had a negative effect on dietary adequacy. The agricultural sector, which is a key sector has been adversely affected resulting in low agricultural production. According to the NDDP the HIV scourge especially targets the age bracket that provides labour for the agricultural sector (GOK, 2002). Another effect of morbidity is that sick children and adults reduce their food intake due to appetite loss. Because of eating less they often fail to meet their dietary requirement including vitamin A, iron, calories and protein. Diahorrea which may be due to unclean drinking water or infections results in massive nutrient losses. It also reduces appetite and leads to poor nutrient absorption.

It is thus essential that for households attain dietary adequacy, there must be effective disease control.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS.

6.1: Conclusions.

Food produced from own farming is limited in quantity and variety. Purchasing food is important but most households have limited purchasing power, the risk to food insecurity and vitamin A and iron deficiency is high. Suitable farming methods and crops which can improve food security including vitamin A and iron status need to be considered. Livestock and poultry farming seems to have potential in this area and may be an important source for addressing the existing vitamin A and iron problem.

The diets are extremely monotonous. *Ugali* and *omena* and sometimes *ugali* and *sukuma* (kales) was consumed in almost all households once or twice a day. Fruit consumption is inadequate and should be increased to improve iron and vitamin A status. The morbidity levels are unacceptably high and affects vitamin A and iron status, especially for children and women of childbearing age.

Intregrated community based interventions should address the problem of micronutrient (vitamin A and iron) and macronutrient deficiencies (calories), both directly and indirectly (underlying causes). Food based strategies have a high chance of being successful if integrated with other activities in the health, education and agriculture sectors

6.2: Recommendations.

Interventions to reduce micronutrient deficiencies should be both long and short term, be well integrated with different sectors, include all development partners and be community based with full community participation. The following interventions are recommended.

1) Since most households have small farm sizes, ways of carrying out communal farming should be explored and implemented. There should be an emphasis on the growing of fruits to provide vitamin C as well as vitamin A rich foods which can grow easily in the area, for example guavas. The growing and consumption of high yielding crops requiring less rainfall should be encouraged. There is also a need to introduce improved animal husbandry methods as a way of increasing the availability of vitamin A and iron. The cultivation of rice should be looked into with a view to re-introducing it, this would contribute to increased calorie intake.

2) The study area is food insecure due to low overall food production. Improving food security through the use of appropriate technologies such as solar energy for food preservation can contribute greatly to reducing food insecurity. Some crops which grow quickly when it rains, like cowpea leaves and bush okra (also rich in beta-carotene and popularly consumed), can be grown in larger quantities and the excess dried for use in the lean season. This would also contribute to diversifying the diets of households in the area.

3) Improved sanitation and hygiene through:

a) The establishment of water projects including community water projects for the provision of adequate and safe water. Water is a problem during the dry season (inadequate) as well as the wet season (flooding). Such projects will help to reduce the high incidence of water-borne diseases such as diarrhoea and also provide an alternative to the widespread use of untreated river water.

b) Improved disposal of human faecal matter. Since a high proportion of the study households have no way of proper disposal, due to the experience of collapsing latrines and poor hygiene habits, the area would greatly benefit from research into suitable latrines or toilets. Diarrhoea incidences are highest during the rainy season due to this problem.

4) A short-term intervention, like supplementation, is needed to address the problem of vitamin A and iron deficiency, especially for the vulnerable mothers and children, as the other interventions need time to be put in place.

5) Health interventions to control endemic diseases like malaria and diarrhoea. The study findings indicate a high morbidity load which is detrimental to the general health as well as the vitamin A and iron status of the population.

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APPENDIX 1: QUESTIONNAIRE

SECTION I: CONSUMPTION OF VITAMIN A AND IRON RICH FOODS IN AWASI-HH QUESTIONNAIRE.

Questionnaire No. ____________________

HH No. ____________________

Interviewer's Name: ____________________

Date of Interviewer: ____________________

Sublocation: ____________________ Village: ____________________

1. Name of HHH: ____________________ Sex _____ Age _______
2. Name of respondent/Mother: ____________________
3. No. of years in homestead: ____________________

Serial No.	Name (First name only)	Sex	Age	Relation to HHH	Marital status	Religion	Education
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Relation to HHH	**Marital status**	**Sex**	**Religion**	**Education**
Husband=1	Single-1	Male=1	Catholic=1	None= 0
Wife =2	Married= 2	Female= 2	Protestant= 2	Preschool= 1
Daughter=3	Divorced= 3		Muslim= 3	Primary= 2
Son= 4	Widowed= 4		Other= 4	Secondary= 3
Other=5	Separated= 5			Beyond sec.= 4
Not related= 6	Not applicable= 6			Adult literacy= 5

Sublocation **Ayucha= 1** **Border 1= 2**

Border 2= 3 **Wanganga= 4**

SECTION II RESOURCES, PRODUCTION, AND OTHER CHARACTERISTICS

1. Do you have your own farm? Yes = 1 No = 2
2. (if Yes) What is the size in acres? _________
3. What crops do you grow?

Food Item		Size in acres	For HH Consumption (Q5)
Maize			
Sorghum(Bel)			
Millet			
Cassava (Michogo)			
Sweet potatoes			
Vegetables:			
Sukuma			
Cabbages			
Cowpea leaves			
Others: tomatoes			
Fruits: Bananas			
Pawpaws			
Quavas			
Oranges			
Lemons			
Oranges			
Sugarcane			
others			

4. **Do you keep any livestock? Yes = 1** No = 2

Livestock Kept.

Type of Livestock	Number	For HHC/sale
Cows		
Goats		
Sheep		
Camels		
Pigs		
Donkeys		
Chicken		
Ducks		
Turkey		
Rabbits		
Others		

5. **Which of the crops/Livestock? Are used for Household Consumption?**

6. **Which food items do you purchase from the market/shops:?**

Fish	
Cooking oil	
Sugar	
Tomatoes	
Onions	
Salt	

7. **Approximately how much do you spend on purchasing food per <u>week</u>**
Ksh.______________

SECTION III: BREASTFEEDING AND WEANING QUESTIONNAIRE (FOR MOTHERS OF CHILDREN UPTO AGE 3 ONLY)

1. Name of child_______________________________

2. Sex (M/F) ____

3. Age (months/years) _______

4. Are you breastfeeding your child? Yes = 1 No = 2 ___

***If no go to question 6**

5. If yes when did you start breastfeeding?
   i) Immediately after birth ______
   ii) 1-3 days after birth _________
   iii) Later (specify) __________________

7. When did you stop breastfeeding?

8. For how long was the child exclusively breastfed?

8. Why did you stop breastfeeding

   1. Pregnancy
   2. Birth of next-in-line child
   3. Illness of mother/child
   4. Insufficient breast milk
   5. Child too old
   6. Other (specify)

9. Are you giving your child any food or drink other than breast milk? Yes = 1_
   What foods are you giving?
   No=2

Type of food	Age
1 Porridge	
2 Porridge with Wimbi/Millet etc	
3 Milk	
4 Orange/Lemon juice	
5 Green vegetables	
6 Fish	
7 Others (Name them)	

SECTION IV: MORBIDITY, SANITATION AND HYGIENE (To be answered by mothers or caretakers of child)

1. Name of child ______________________________
2. Sex of child (M/F) ______________________________
3. Age of child (months) ______________________________
4. Has the child had diarrhoea in the last 4 weeks? Yes = 1 Yes = 2
5a) If yes for how long did the child have diarrhoea (days)
5b) Has any other member(s) of the HH had diarrhoea (days) in the last 4 weeks?
Yes = 1 No = 2
6a) Has the child had a cough in the last 4 weeks? Yes = 1 No =2 ____
6b) If yes, for how long did the child have the cough? (in days) _____
7a) Has the child had fever in the last 4 weeks Yes = 1 No= 2
7b) If yes, for how long? (in days) _____
7c) Has any other HH member had fever in the last 4 weeks Yes = 1 No = 2
8a) Has the child had measles in the last 4 weeks Yes = 1 No = 2
8b) If yes, for how long? (days) ____
9 What are the sources of water used in the HH?
   1. Piped water in the house 2. Piped water outside the house
   3. River 4. Bore-hole 5. Protected wells
5. Others specify ________________
10. Distance from house to water source (in km) __________
11. Do you use a latrine Yes = 1 No = 2
12. Type of latrine used?
   1. Pit latrine 2. VIP Latrine 3 Septic 4 Others (Specify)

SECTION V HKI FOOD FREQUENCY QUESTIONNAIRE

(Interviewer, interview mother/caretaker about HH members)

For each food listed in the table below, ask the following question in the order that the food items are listed.

Q How many days, in the past seven days did HH members eat___ (specific food item)

Name of food item	Number of days eaten per week	
	Y/N	How often
Maize meal (uji) Fermented		
-Maize meal (ugali)		
-millet		
-Dark Green leafy vegetables (DGLS)		
-Milk		
-Carrots		
-Ripe mango		
-Pumpkin		
-Spinach		
-Ripe papaya		
-Eggs		
-Fish (liver intact)		
-Fingelings (omena)		
-Peanuts		
-Yellow/orange sweet potato or yam		
-Chicken or other fowl/aluru		
-Amaranth (Apoth)		
- liver		
-Pumkin leaves		
-Beef (or sheep/goat meat)		
-Butter/Ghee		
-Margarine (fortified with vitamin A foods.		
-Dengu		
-Guavas		
-Food cooked with oil/fat		
-Weaning food fortified with vitamin A/Iron		
Beans		
Matumbo (tripe and organ meat)		
Sorghum		
Cassava		
Avocado		

SECTION VI: 24 HOUR DIETARY RECALL
(To be done only in selected households)
HH No. _________

Q. Let me know the foods consumed in the last 24 hrs in this household, their amounts, ingredients, the amount served to the relevant age groups and the leftovers.

Time	Dish	Name Of cooked dish	Name of ingredients used	Amnt of ingredient	Consumed by No.	Amnt. L over
Breakfast						
Snacks all day						
Lunch						
Supper						

APPENDIX 2: FOCUS GROUP DISCUSSION GUIDE

Household food consumption patterns in relation to dietary adequacy of vitamin A and Iron in awasi, Nyando district, Kenya

Date of interview ....
District ....
Location ....
Village ....
Name of moderator ....
Name of recorder ....

Introduction

1. facilitator observers and note takers names- am from University of Nairobi purpose of discussion and introduce topic on food and consumption
2. Clarify, it is not a test, it is a discussion, and there are no right or wrong answers. – "We would like to know how you, s a community normally grow buy and cook for food and any other observations and opinions you have on food".
3. Length of time of discussion- about one hour
4. Will have a guided discussion so everybody gets a chance to talk/ avoid many people talking at once.
5. Explain reason for note taking.
6. Check understanding and make necessary clarifications.

Topic	**Discussion/Transition**	**Probes**
Introduction (Warm up)	Please introduce yourselves and tell us something about yourself what you do, your family etc	Employment, income generating activities
Food security	How do you obtain food for use in the households within this community	Self production Purchases Food aid/gifts
	Does the community experience any food shortages	Seasonality Rainfall Droughts/floods
	What causes food shortages in this community?	Accessibility to farm inputs Storage problems
	How do families in the community cope with food shortages	Purchases Labour/ migration Sale of assets Unusual foods Groups at risk
Health and nutrition	What are some of the common diseases affecting young children in the community What do you think causes them	Vaccination Malaria Diarrhoea

Are there any children/adults suffering from VAD/IDD?

Who is most affected by the above VAD/IDD

What to your opinion ca be done to help alleviate these problems

Any related questions you would like to ask

Coughs

Skin problems

Water availability

Nutrition knowledge

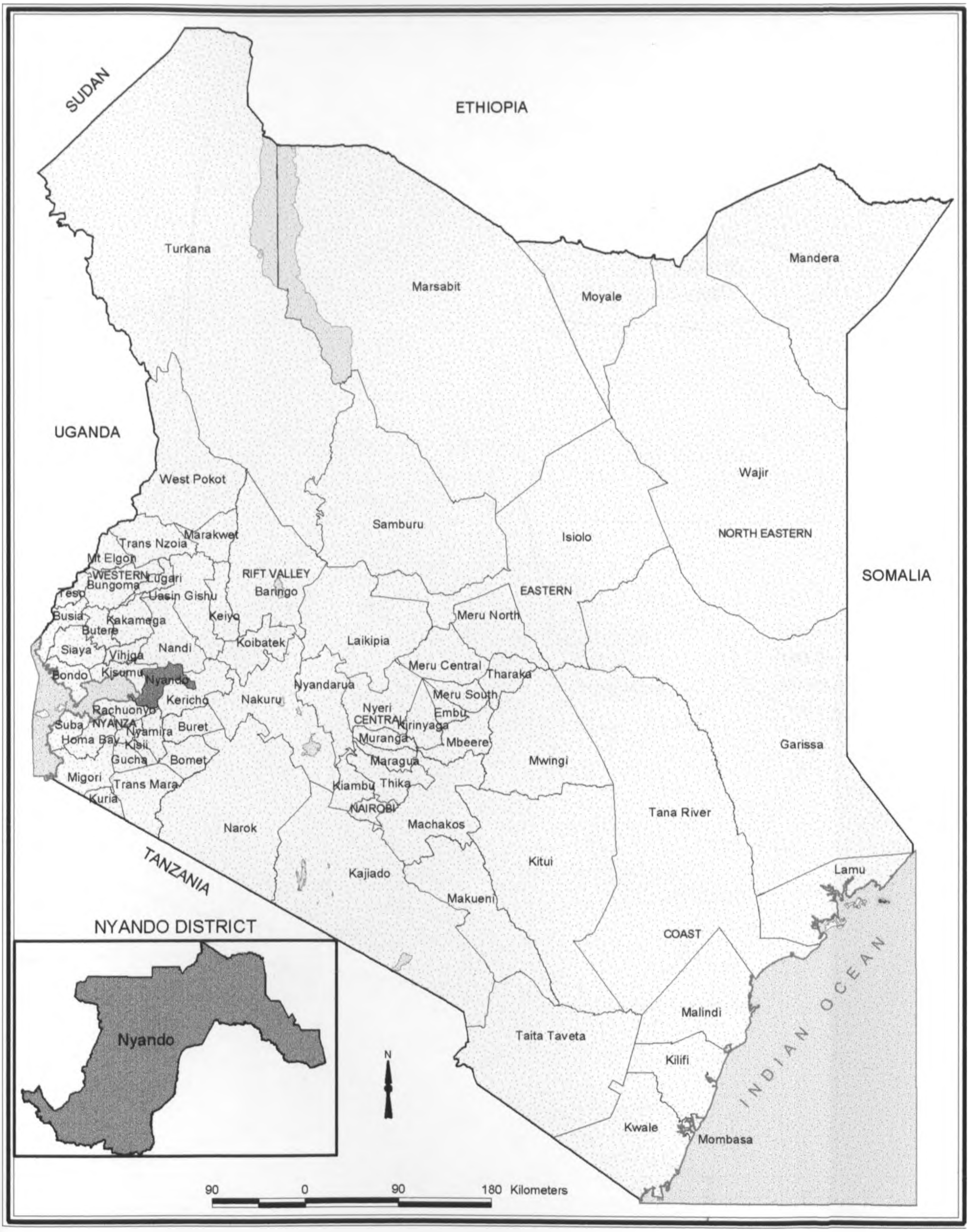
Groups of individuals

Community action

How to increase food production

Appendix 3

LOCATION OF NYANDO DISTRICT IN KENYA



APPENDIX 4: CONCEPTUAL FRAMEWORK

Conceptual Framework of Nutrition (UNICEF 1992)