

# Food & Nutrition

## Security for Health and Development

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Proceedings of the  
**Inaugural National  
Nutrition Congress  
(INNC)**

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Editors : A. O. Makokha • A. Wangalachi



# FOOD AND NUTRITION SECURITY FOR HEALTH AND DEVELOPMENT

PROCEEDINGS OF THE INAUGURAL NATIONAL NUTRITION CONGRESS  
21ST - 23RD FEBRUARY 2005, NAIROBI, KENYA

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ISBN 92-1-131619-7

HS/631/01E

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## ACKNOWLEDGEMENTS

The organizers of the INNC acknowledge with gratitude, the generous financial, material and moral support of the following:

- Food and Nutrition Technical Assistance (FANTA)
- Food Security Analysis Unit (FSAU)
- Christian Children's Fund (CCF)
- Unilever Kenya Ltd
- United Nations Children's Fund (UNICEF) Kenya Country Office
- Coca Cola Nairobi Ltd
- Kenya Horticulture Development Programme (KHDP)
- DAAD
- African Institute for Capacity and Development (AICAD)
- Regional Centre for Quality Health Care (RCQHC).
- United States Agency for International Development (USAID)

# CONTENTS

1. Under and over Nutrition in Sub-Saharan Africa: the big challenge-Key note Address, Sigot J.	
Foreword from the KCAN Chairperson	
1. Food Security	
2. *The Impact of Economic Depression on Food Consumption Patterns Among Students in A Nigerian University, Uko-Aviomoh E.E*	4
3. The Potential of Horticulture in Alleviating Hunger and Micronutrient Deficiencies in Kenyan Households, Rutto L.K and Wamocho.S.L.	
4. The Role of Post Harvest Management in Food Security A Mango Case Study, Wangalachi A.M., New S. and Humphrey	11
5. Sedentarization of the Maasai and its Impacts to Household Food Adequacy: A Case Study Within a Child Survival Area, Namelok, Kajiado District, Muthoka S., Kogi-Makau W. and Mwadime R.N.	15
6. Socio-Demographic and Anthropometric Characteristics of Institutionalized Street Children Living in Shelters in the Vaal Triangle, Gauteng, South Africa, Salami L.I., Zotor F.B., Oldewage-Theron W.H. and Venter. C.S	26
7. *Livelihoods and Food Security Projects in Central Rift Kyalo K. and Karani C.W.	32
8. The Role of Christian Children's Fund (CCF) in Promoting Traditional Food Preservation Methods to Alleviate Food and Nutrition Insecurity In Arid and Semi-Arid Areas of Kenya, Lepoora J.M. and Jordan .E.	
9. The Coping Strategies in Kitui and Mwingi Districts During Drought, Ngala .S. and Imungi J.K.	45
10. Watershed Management For Water and Food Security in Kaiti Water Catchment of Makueni District, Anthony N., Wambua K. and Mwangi G.	
 Nutrition Programming	
11. Integrating Human Rights into Nutrition Programs in Kenya, Opiyo R.	50
12. CCF-Kenya Program Brief	61
 Nutrition throughout the Lifecycle and lifestyle	
13. Food Consumption Patterns And Nutrient Intake By Women And Under Five Years Old Children In Wetlands Of Lake Victoria Basin, Waudo J.	71
14. Maternal Characteristics and Child Undernutrition in Three Different Socio-economic Groups in Ibadan, Nigeria, Olukemi .F.S	80
15. The Elderly and Health: A Case Study from Sharperville, South Africa, Oldewage-Theron W.H., Salami L.I., Zotor F.B., Matiwane N. and Venter C.S.	
16. Muslim and Christian mothers as frontline right to food duty bearers for children aged 6-36 months, in Kibera slums of Nairobi, Kenya - J. Wema Adere, Wambui Kogi-Makau and E.G. Karuri	
17. Prevalence of Malnutrition Among Children Aged 6-59 months Living in Different Sections of a Slum Environment in Kenya, Charamo G.D., Kogi-Makau W. and Karuri E.G.	

# CONTENTS

18. Nutritional Status of Children Participating and Those not Participating in School Feeding Programme in Korogocho Slums in Nairobi, Kenya, Kimiywe .J. and Mbithe .D.
19. The Impact of enrichment of Staple Foods on the Nutrient Intake of Pregnant Women in the Vaal Triangle, Gauteng, South Africa, Kesa .H.
20. Nutritional Status and Socio-Demographic Profile of Primary School Children as Indicators for the Development of a Breakfast Product in an Informal Settlement in the Vaal Triangle, Gauteng, South Africa, Napier.C., Kearney.J. and Oldewage-Theron .W.

## Emerging Issues in Nutrition

21. Opportunities and Challenges Posed by the Functional foods, Mokokha. A.O.
22. Functional Foods-Relevance to Kenya, Mahungu. S.M.
23. Scientific Substantiation of Health Claims on Foods-European Situation, Verhagen H., Smith .M. and Verschuren P.M.
24. Application Of The Food Multimix (FMM) Concept As An Adjunct To Community Nutrition Support In Food Insecure Economies, Zotor, F., Amuna, P. and Oldewage-Theron
25. Potential of Yellow Oleander (Theساتيا peruviana Schum), Orange and Yellow Flowering Varieties as Possible Sources of Edible Vegetable Oils and Protein in Kenya, Odhiambo P.O., Gachanja A.N., Keriko J.M., Shitanda D., Ojijo N.K., Ochora J.M. and Makobe M.N.

## Capacity building

26. Community Capacity Support Programme, Webale A.
27. Strategies For Capacity Development For Poverty Reduction In Africa: Initiative By International Communities and AICAD- A.B.Gidamis
28. The Joy and Challenges of Capacity Building for Better Nutrition in Africa. The Experience of the Applied Nutrition Programme, University of Nairobi, Kenya, Kogi-Makau W., Mwangi A.M., Mwikya S. M., Ngala S., Sehmi J.K., Obudho E. and Mugo J.
29. The Socio-demographic Profile and Identification of the Training Needs of the Caregivers Participating in the Home Garden Project in the Vaal Triangle, South Africa, Selepe .M., Makhado.L., Hendriks .S. and Rutungwe .R.

# CONTENTS

## Food quality and safety

30. Production Of Tricothecenes And Zearalenone By Fusarium Species Occurring In Equatorial Barley (Hordenium Vulgare L.) Grown In Kenya, Mbae K.M., Kiiyukia C. and Kenji G.M.
31. Bacterial Contamination Of Beef From Butcheries In Nairobi, Kenya, Ngondi M. G., Kariuki S., Waiyaki P. G. and Kiiyukia C.
32. Effects Of Training Kenyan Small-Scale French Bean Farmers On The Modern Food Safety Management Systems, Nyaga R., Kiiyukia C. and Kenji G. M.
33. Levels of Fluoride in Soils and Water in Some Parts of Eastern and Central Province of Kenya and Their Implication to Human Health, Ochieng' J.K., Kenji G.M., Njoroge C.K. and Makokha A.O.
34. Nutritional Status and Socio-Demographic Profile of Primary School Children as Indicators for the Development of a Breakfast Product in an Informal Settlement in the Vaal Triangle, Gauteng, South Africa, Napier.C., Kearney J. and Oldewage-Theron .W.

## Nutrition, Immunity and HIV/AIDS

35. Birth Outcome of Women of Known HIV Status, Kamau-Mbuthia E. and Elmadfa I.

## Micronutrient Nutrition

36. Potential of Kitchen Gardening in Alleviating Micronutrient Malnutrition in Ngong' Division, Kajiado District, Kenya, Kiige L.W., Mwangi A.M., Mbugua S.K. and Musoke R.N.
37. Utilization of Orange Fleshed Potato Flour in the Development of A Weaning Food, Omwamba M., Jackline N. Nanua and. Shalo P. L.
38. Impact of Fermentation on the Bioavailability of Zinc in some Selected Foods Commonly Consumed in Kenya.
39. Can Rosemary Spice (Rosmarinus offinalis) Stabilize b-carotene in a Protein-b-Carotene –Rich Soybean –Based Product? Oiyee. S.O., Imungi. J. and Mwangi A.M.

## EXECUTIVE SUMMARY

The beautiful city of Nairobi played host to the region's first ever-National Nutritional Congress, a long-held dream of the regional nutrition coalition's founders. KCAN had for the past few years been strategizing on how to best bring the region's best practitioners in programming, research, academia and private sector to share their work experiences while formulating a collaborative fool-proof plan for driving the nutrition agenda forward in their respective countries. This is because it has been shown that malnutrition in the region is either increasing or stagnating and there is a felt need for advocacy for nutrition in governments / other fora including the media.

A core team of KCAN members networked extensively and consulted widely as the INNC began to take shape. Those approached prepared excellent presentations, around the Congress theme "Nutrition for Health and Development," which formed a good starting point for generating strategies for mainstreaming nutrition in the region's development agenda. The sub-themes were: Food Security; Nutrition in the Lifecycle and Lifestyle; Capacity Building; Nutrition Programming; Nutrition, Immunity and HIV/AIDS; Food Safety; Micronutrient Nutrition and Emerging Issues in Nutrition.

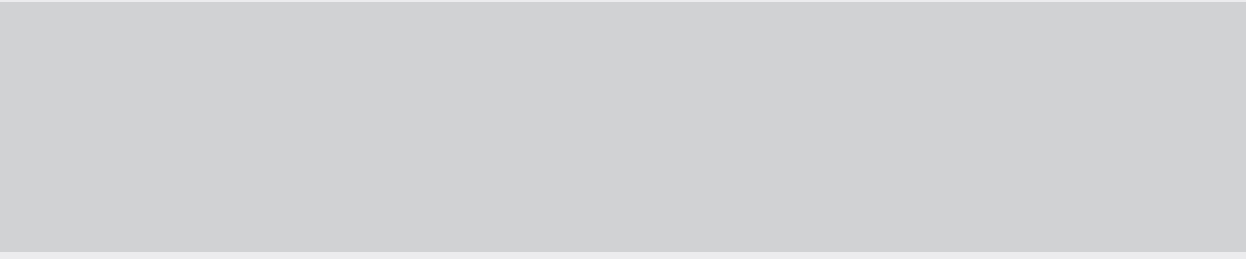
The INNC was well attended with more than half of the over 300 delegates having been drawn from the rest of Africa, Europe, and the Americas – truly representing great diversity in origin as well as specialization. Dr Alice Mwangi, the KCAN Vice Chair as well as the INNC Committee Co-Chair, and Faith Thuita, the KCAN Chair officially welcomed the participants, giving a background to the congress organization as well as communicating KCAN's expectation from the same. The opening ceremony was officiated by Dr Abiud Omwega, one of KCAN's founding members and a senior lecturer at University of Nairobi's Applied Nutrition Programme.

There was thematic play as well as keynote remarks by various prominent nutritionists. They included: Prof Tola Atinmo, a Professor of Nutrition at the College of Medicine, University of Ibadan, Nigeria and Executive Council Member, International Union of Nutritional Sciences (IUNS) who delivered a keynote speech on the Role of IUNS in Africa and Addressing Food and Nutrition Insecurity in Africa within the Context of the UN MDGs; Prof. Asenath Sigot of Maseno University addressing Over and Under Nutrition in East Africa: The Big Challenge; John Owuour, the National Food Security Advisor at the Office of the President with "Strategies and Challenges in Addressing Food Security at National and Household Level"; Prof. B.A Gidamis, the Executive Secretary of the African Institute for Capacity Development (AICAD) who outlined the role of AICAD in enhancing capacity development for poverty reduction in Africa; Dr Assumpta Muriithi of WHO Kenya Country Office; "Food Processing to Consumption: The Role of the Food Industry in Addressing Food Safety in Developing Countries. Other keynotes included Dr. Robert Mwadime of the Regional Centre for Quality of Healthcare, Uganda who addressed the daunting task of mobilizing resources for nutritional programming in East Africa. In his presentation, Dr. Mwadime observed that nutrition resources were not openly "nutrition" but were hidden in other titles such as HIV/AIDS and called upon nutritionists to look out for these opportunities. Noreen Prendiville, the coordinator of FAO's Food Security Analysis Unit-Somalia, delivered a lecture on combating Food and Nutrition Insecurity in the Face of Conflict and Crisis.

The public health concern of micronutrient malnutrition was addressed by Dr. Linda Ethangatta of

UNICEF's KCO Nutrition Section with her presentation on "Addressing the Micronutrient Problems: Nutrition Programmes in East Africa" while Louise Sserunjogi, the USAID-MOST Regional Food Fortification Advisor for Africa discussed the opportunities for involving industry in the fight against micronutrient malnutrition in East Africa. Maniza Zaman, the Head of Nutrition Section at UNICEF Kenya Country Office gave a detailed analysis on the Rights-based Approach to Nutrition Programming. In her presentation she observed the child's valid claim to proper nutrition and posed the challenge





Addressing the Micronutrient Problems in East Africa: - Opportunities for Involving Industry.  
21-23 February 2005, Nairobi, Kenya Louise Sserunjogi  
MOST-The USAID Micronutrient Project

Strategies for Capacity Development for Poverty Eradication in Africa: Initiatives by International Communities and AICAD  
A.B. Gidamis  
Executive Secretary  
The African Institute for Capacity Development (AICAD)

Strategies and Challenges in Addressing Food Security  
John Owuor  
Ministry of Planning and National Development

Food and nutrition security in the face of conflict and crisis – facing the challenge  
Noreen Prendiville  
FAO/FSAU

Rights Based Approach Programming  
Presented by Maniza Zaman  
UNICEF Kenya Country Office  
at National Nutrition Congress, Nairobi, Kenya  
February 2005

Addressing the Micronutrient Problems: Nutrition Programmes in East Africa  
Presented By Linda Ethangatta, PhD  
Project Officer, Nutrition, UNICEF Kenya

Raising Resources for Nutrition in Africa  
Robert Mwadime (MPH, PhD)  
FANTA/AED

# UNDER AND OVER NUTRITION in sub-saharan africa: The Big Challenge

21ST - 23RD FEBRUARY, 2005 NAIROBI, KENYA

Asenath J. Sigot, Ph.D Western University College of Science & Technology, Kakamega, Kenya.

## 1. INTRODUCTION

Commitments made at the Millennium Summit of the United Nations in September 2000, translated into a series of Millennium Development Goals (MDGs). Nutrition Community are being challenged to assist in accelerating the attainment of the MDGs. However, the role of nutrition in development goes far beyond providing an indicator of progress towards the MDGs. Reducing malnutrition is central to the achievement of the MDGs since nutrition is linked with other development outcomes. The 5th report on the world nutrition situation contains good and bad news. The good news is that malnutrition is being reduced steadily in much of the world and that several countries in Sub-Saharan Africa have been able to reduce malnutrition rates under difficult circumstances. The bad news is that the rate of decline in malnutrition outside of Sub-Saharan Africa is slowing and that for Sub-Saharan Africa, at a regional level, nearly all the nutrition indicators are moving in the wrong direction [1]. Hence, the challenge before us is immense.

Malnutrition is the underlying cause of half the deaths for children under 5 years of age; it weakens the immune system and makes illness worse. Malnutrition and poor sanitation are dominant hazards responsible for almost a quarter of the global burden of disease [2]. By the year 2020, about 150 million children worldwide will be underweight. Malnutrition especially in young children may be traced to low birth weight, and to low body mass index (BMI) in women and poor weight gain during pregnancy. Thus, we need to look at antenatal care in order to avoid the huge handicap that arises from low birth weight.

There is no simple solution to the elimination of malnutrition. If we are to tackle this big challenge, we must formulate coherent strategies in relation to the magnitude of the problem and the whole population. This presentation provides an analysis and thinking of under and over nutrition from practice, theory and research. It is meant to stimulate discussion and inform policy setting toward the achievement of MDGs.

## 2. KEY CONCEPTS

Malnutrition means bad nutrition and is a term used to refer to both under nutrition and over nutrition – conditions of both deprivation and excess which impair health, intellectual activity, adaptive behaviour, education, productivity and wellbeing, and can induce death.

Under-nutrition denotes conditions of inadequate nutrition. It refers collectively to stunting, underweight, wasting, low body mass index (BMI), and foetal growth retardation. Over-nutrition on the other hand denotes, conditions of excess nutrition. It refers collectively to overweight, obesity, high body mass (BMI). Low Birthweight (LBW) refers to a body weight at birth of less than 2500 grams which is often used as a proxy indicator to quantify the magnitude of Intrauterine Growth Retardation (IUGR) in developing countries. IUGR is a condition where foetal growth has been constrained due to inadequate

nutritional environment in the utero.

Malnutrition may also be categorized as chronic or moderate. Chronic malnutrition is severe form of under nutrition also known as protein – energy malnutrition; kwashiorkor and marasmus. It is a consequence of early malnutrition that is more noticeable between 8 and 20 months of age. Individuals who experience childhood malnutrition survive and reach adult age.

The worldwide problem of malnutrition is related to the consumption of deficient and monotonous diets that are based on cereals. Children have symptoms and clinical signs of severe protein energy or micronutrient malnutrition. The vitamins and minerals needed to prevent micronutrient malnutrition are present in a variety of foods [3].

Under-nutrition in children is classified by height-for-age and weight-for-height. Low height-for-age (stunting) is much more prevalent than low weight-for-height (wasting).

In Adult undernutrition, BMI, MUAC (Mid-Upper Arm Circumference), and clinical signs are used to screen adults at the population level. BMI is known to vary with age and body shape. It is calculated from weight and height measurements using the formula  $BMI = \text{Weight (in kg)} / \text{height (in m)}^2$ . In normal circumstances ratio of the weight to the square of height is roughly constant, and a person with a low BMI is underweight for their height. There is an increasing body of evidence that low BMI is related to both increases in morbidity and mortality, and in women increases the chances of having low birth weight babies [4].

## 3. IMPORTANCE OF NUTRITION IN DEVELOPMENT

Nutritional status has been recognized as a key MDG indicator of poverty and hunger and it is the first step in recognizing that strategies, policies, programmes and processes that increase leverage for an acceleration of malnutrition reduction have a role to play in global development.

### 3.1 Malnutrition and MDGs

#### Goal 1 : Eradicate extreme poverty and hunger

Malnutrition erodes human capital, reduces resilience to shocks and reduces productivity (impaired physical and mental capacity). Early child malnutrition is partially irreversible and intergenerational with consequences for adult health and increased risk of chronic disease.

#### Goal 2 : Achieve universal primary education

Malnutrition reduces mental capacity. Malnourished children are less likely to enroll in school, or more likely to enroll later. Current hunger and malnutrition reduces school performance. Malnutrition may disable.

#### Goal 3 : Promote gender equality and empower women

Gender inequality increases risk of female malnutrition. Better – nourished girls are more likely to stay in school and to have more

control over future choices. Dealing with malnutrition empowers women more than men.

**Goal 4 : Reduce Child Mortality**

Malnutrition is directly or indirectly associated with more than 50% of all child mortality. Malnutrition is the main contributor to the burden of disease in the developing world. Micronutrients are key to child survival.

**Goal 5 : Improve Maternal Health**

Maternal health is compromised by an anti-female bias in allocations of food, health and care. Malnutrition is associated with most major risk factors for maternal mortality. Deficiencies of several micronutrients are associated with pregnancy complications.

**Goal 6 : Combat HIV/AIDS, malaria and other diseases**

Malnutrition hastens onset of AIDS among HIV positive. Malnutrition weakens resistance to infections and reduces malarial survival rates [1].

The summary above shows that good nutrition underpins progress towards each of the first six MDGs. An acceleration of malnutrition reduction is needed, especially in Sub-Saharan Africa, where trends in child malnutrition, household food insecurity and poverty are all moving in the wrong direction. The following are some of the trends:

**3.2 Trends in Malnutrition**

- Low birthweight: 14% of all babies born at term in Sub-Saharan Africa.
- Maternal underweight: Of 10 African countries with nutrition trend data, only three show decline in the rate of severe maternal malnutrition (BMI less than 16).
- For Sub-Saharan Africa, the prevalence of pre-school underweight is increasing and will continue to do so unless strategic moves to improve the situation are implemented. Preschool stunting shows similar patterns.
- The prevalence and numbers of wasted (low weight-for-height) preschools are projected to increase in every African region.
- The preschool malnutrition trends in Africa reflect the deteriorating situation in many Sub-Saharan African countries, where the poverty rate has increased, HIV/AIDS has devastating impacts, conflict persists and gains in agricultural productivity as a key driver of overall economic growth remain elusive.
- The highest levels of stunting are estimated for Eastern Africa where on average, 48% of pre-school children were affected in 2000, up from 47% ten years ago. This trend is further amplified by the high population growth rates in this region, hence, the number of stunted children continues to increase each year.
- The Sub-Saharan Africa child malnutrition picture is not all bleak. Some countries show improvement under difficult circumstances (for example, Nigeria, Niger, Angola, Ghana, Malawi, Madagascar and Tanzania).
- Food insecurity: As measured by FAO, Central Africa are posting the largest increases in the number of food insecure individuals.
- Malnutrition, mortality and morbidity: Malnutrition is the largest contributor to disease in the world. Childhood and maternal underweight alone are responsible for 9.5% of the global burden of disease.

**4. UNDER NUTRITION**

**4.1 Under nutrition and the lifecycle approach**

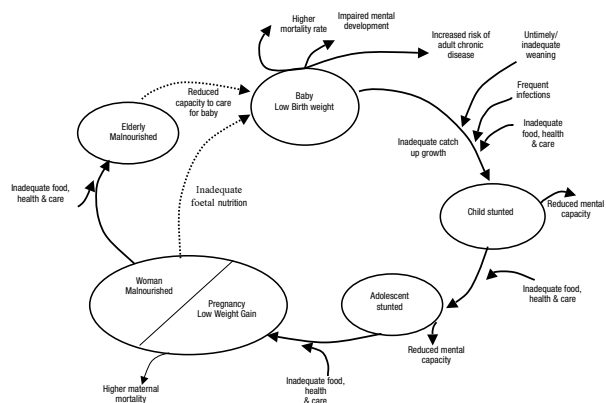
Over the last nine years, major international commitments have been made to reduce under nutrition. These were : World Summit for Children in 1990, the International Conference for Nutrition in 1992, and the World Food Summit in 1996. These conferences emphasized the reduction of under nutrition as part of a broader strategy to eliminate poverty. However, the causes and effects of under nutrition are complex and best considered within the lifecycle conceptual framework (See Figure 1). Poor nutrition often begins in the intrauterine environment and extends throughout the lifecycle [5]. Low birth weight is an intergenerational problem where low birthweight infants grow up to be undernourished and stunted children and adolescents and, ultimately, undernourished women of childbearing age, and undernourished pregnant women who deliver low birthweight infants. This tends to amplify risks to the individual's health and perpetuates the cycle of poverty, under nutrition and disease.

**4.2 Under nutrition and low birth weight**

Birthweight is a powerful predictor of infant growth and survival. Infants born with a low birth weight begin life immediately disadvantaged and face extremely poor survival rates. Approximately every ten seconds, an infant from a developing country dies from a disease of infection that can be attributed to low birthweight. Each year approximately 17 million infants are born with low birthweight in developing countries. It is estimated that four million infants die each year but those who survive lead a diminished quality of life. Many of those who survive suffer cognitive and neurological impairment (See Table 1).

Under nutrition, manifested by decreased maternal height (stunting), and below-normal pre-pregnancy weight and pregnancy weight gain, are among the strongest predictors of delivery of a LBW

**Figure 1. Nutrition throughout the lifecycle**



Source: Commission on the Nutrition Challenges of the 21st Century (2000) Final report to the ACC/SCN [1].  
 infant. The lifecycle is further taken account by Barkers hypothesis that states ... foetal under nutrition are critical periods of development in the intrauterine environment and during infancy leads to permanent changes in body structure and metabolism. These changes result in increased adult susceptibility to coronary heart disease and non-insulin dependent diabetes mellitus.

There is also evidence that those adults with low birthweight suffer an increased risk of high blood pressure, obstructive lung

disease, high cholesterol and renal damage. Hence, a poorly growing foetus is an undernourished foetus prone to reduced growth, altered body proportions and a number of metabolic and cardiovascular changes. These changes are adaptations for foetal survival in an inadequate nutritional environment, and that these changes persist post-natally, contributing to adult chronic disease when nutrients are plentiful.

### 4.3 Under weight in Children

Globally, over 150 million children are underweight; however, substantial progress has been made in reducing stunting in all regions of the world except Sub-Saharan Africa [6].

Recent simulation by IFPRI/IMPACT projecting progress to the year 2020 suggests that continued progress, over what is quite substantial period of time, will only be modest [7]. The nutrition community has not confronted this problem in a coherent way, and it is now time to rethink the basis on which we set out analyses and plan action for way forward.

It is estimated that 22% of children below 5 years of age in Kenya are underweight. Since malnutrition reduces a child's resistance to infection, underweight children are more likely to become sick and eventually die. It is further estimated that in Kenya, 38% of child

mortality is caused by protein – energy – malnutrition. This is the single greatest cause of child mortality. Using PROFILES, it has been estimated that if there is no improvement in the prevalence of underweight over the next 11 years, 270,000 children would die due to underweight. However, with successful interventions that can reduce the prevalence of underweight by 50%, then 68,000 lives can be saved over the same period [5].

There are two main patterns of under nutrition found in children. These are stunting and wasting associated with functional consequences.

### 4.4 Stunting and Wasting

Under nutrition in infants results in stunting. Stunting, that is, being too short for age, occurs when children are not adequately fed, in-terms of both quantity and quality, during their first two years of life. The damage caused by stunting at two years is irreversible. Almost 40 per cent or about 184 million of the developing world's children under age five (outside of China) have stunted growth due to inadequate nutrition. Although the worldwide prevalence of stunting is declining by about 0.5 of a percentage point each year, more than half the children in Sub-Saharan Africa are far much shorter than normal [6].

In 1995, stunting affected 54 percent of children under age five in

**Table 1 : Percentage of Infants with Low birth weight [9]**

Countries	% of infants with low birthweight	Countries	% of infants with low birthweight
Benin	16	Mozambique	14
Botswana	10	Namibia	16
Burkina Faso	19	Niger	17
Burundi	16	Nigeria	12
Cameroon	11	Rwanda	9
Cote d'Ivoire	17	Senegal	18
Ethiopia	15	South Africa	15
Gabon	14	Sudan	31
Gambia	17	Swaziland	9
Ghana	11	Tanzania	13
Guinea	12	Togo	15
Kenya	11	Uganda	12
Lesotho	14	Zambia	10
Malawi	16		
Mali	23		
Sub-Saharan Africa	14	World	16

South Asia, 39% in Sub-Saharan Africa, 38% in South-East Asia, 28% in Mexico, Central America and the Caribbean, 22% in the Near East and North Africa, and 13% in South America. Currently, about 38% of all two-year olds in Kenya are moderately or severely stunted. Stunted children grow up to become stunted adults. One of the most significant consequences of adult stunting is reduced productivity.

Studies show that, productivity of physical labor declines by 1.4% for every 1% reduction in adult height. If current levels of stunting remain unchanged, the present value of productivity losses in our country over the eleven year period is estimated at 15 billion shillings [8].

Globally, stunted growth declined from 49 percent of children under age five in 1980 to 40 percent in 1995. However, all the regions in the developing world made some progress in reducing stunted growth except for Sub-Saharan Africa. Stunted growth in Sub-Saharan Africa climbed by 0.13 percent a year during the period. Of the 25 countries in the Sub-Saharan region with data available, 13 made substantial progress but in 12 countries, the rate of stunting got worse.

**Wasting :** In children, acute nutritional deficit and/or disease such as diarrhoea produce wasting. Characterised by a reduction in weight-for-height or arm circumference, or both. Low-weight-for-height is usually defined as less than – 2 SDs of the NCHS/WHO reference median of weight-for-height. At present no clear definition of wasting in adults is available.

#### 4.5 Maternal Undernutrition

In some communities, the basis for undernutrition starts before birth, with mothers of low body mass index (BMI) on average giving birth for babies of low birth weight. Although this direct relationship between maternal weight and birth weight is not a new finding, the nutritional state of women, both before pregnancy and during pregnancy, is something that should be given more emphasis especially by major policy makers [2].

There is need to look at antenatal care in order to avoid the huge handicap that arises from low birth weight in maternal underweight. The consequences of adult malnutrition extend beyond those of maternal risk of underweight babies. The ability of women to sustain work and their sheer physical capacity to cope are markedly dependent upon their body mass. Illness and handicap in terms of sickness, days off work, days sick in bed and death rates, all increase with increasing malnutrition [2]. This is a big challenge that we must deal with. It is a new dimension in malnutrition, which previously was not incorporated in our thinking. Undernutrition in women, with its links to low birth weight, inability to sustain work, and reduced capacity to care for the family, is a challenging phenomenon that we must turn our attention.

#### 4.6 Some consequences of Undernutrition : The Big Challenge

Consequences of undernutrition in children include –

- Impairment of their mental and cognitive development that results in poor performance in school.
- Micro-nutrient deficiency disorders such as iodine deficiency, vitamin A deficiencies, and iron deficiency anaemia.
- Massive numbers of infant and child deaths.

The consequence of adult malnutrition extends beyond those of maternal risk of underweight babies.

- The ability of women to sustain work and their sheer

physical capacity to cope are dependent upon their body mass.

- Illness and handicap, in terms of sickness, days off work, days sick in bed and death rates, all increase with increasing malnutrition.
- Malnutrition in women, with its links to low birth weight, inability to sustain work, and reduced capacity to care for the family is a major challenge.
- Huge losses in economic productivity.

### 5. OVER NUTRITION

#### 5.1 Obesity and Overweight

Many people in developed countries suffer from diseases of over nutrition. While staggering numbers of people in less developed countries end each day without enough to eat, many die of starvation. Over nutrition results in over weight and if it is not controlled it becomes obesity. Obesity is a major challenge and while some sectors of the population are aware of its dangers, others have grown with it and have no idea of the consequences to their lives.

Being overweight increases the risk of diseases such as diabetes, heart failure and cancer. It can also lead to depression and low esteem among those ridiculed for being obese. While obesity related complications are wiping out the future generation in the developed world, under nutrition is cutting millions of lives short in the developing world. In 1997, the World Health Organization officially declared obesity to be one of the most serious health problems facing mankind.

While in Sub-Saharan Africa over nutrition is not so much a problem and there are few statistics, people should know they aren't safe. The fast food industry has invaded major towns and the fallacious tactic in the advertising industry is posing a challenge. It is common to find the lunch boxes for children getting more and more filled with sweets and non-nutritious snacks. The greasy fried chicken, cheeseburgers, sugary drinks and ice cream are all on display to attract the children's palate.

Playing grounds are shrinking and to a large extent, schools are no longer concerned about sports for pupils and students. The commercial gyms sprouting in the major cities are a good idea but the cost is still limiting even though we know exercise is the best way to deal with weight problems.

The challenge of over weight may be greater in the developed world but the developing countries need to take it seriously in order to avoid consequences of obesity. (See Table 2). The lower energy requirements characteristic of aging, associated with loss of lean body mass and less physical activity contribute to over nutrition. Because nutrient needs do not decrease proportionally, with energy needs, older adults need to choose nutrient-dense foods and avoid high-fat and high cholesterol foods. This will certainly prevent excessive weight gain in adults.

#### 5.2 Childhood Obesity

The changing nature of food supply, increased reliance on packed meals reliance on foreign foods, neglect of traditional foods, as well as advertising and promotion of non-nutritious foods have all promoted eating habits that have led to overweight and obesity in children.

Time is increasingly becoming an important factor in determining the types of foods eaten in most homes. The food service industry has responded by increasing the number of fast food outlets, operating longer hours at convenient locations such as petrol stations, supermarkets and shopping malls, with some especially in the cities,

delivering the food to the clients. Furthermore, there are vending machines providing snacks and drinks that are non-nutritious.

More and more families are eating meals outside home, most of which are fried and highly sweetened, such as cakes, mandazi, biscuits, French fries and crisps with very little fibre and minerals. Studies have found a correlation between consumption of sugar-sweetened drinks and childhood obesity. The most prevalent immediate consequence for obese children are social isolation and peer problems that can have negative impact on their academic performance.

Our greatest concern is the risk that the excess weight during childhood will persist into adolescence and adulthood increasing the prevalence of high blood pressure, diabetes, respiratory disease, orthopedic and psychosocial disorders. According to the World Health Organisation, these chronic conditions account for 60 percent of deaths globally and are a big drain on the economy.

Although under nutrition remains a serious problem especially in rural areas, rates of obesity in the population of urban children warrant close monitoring so that preventive measures can be taken in time. Preventive measures targeting children and adolescents might be one long-term approach to dealing with the problem of obesity.

### 5.3 Consequences of Over Nutrition

The challenge in over nutrition is what to eat and what not to eat.

Some of the consequences of over nutrition include

- increased risk of diseases such as heart failure, type 2 diabetes and cancer.
- depression and low esteem
- social isolation especially in school age children
- increased risk of osteoarthritis, hypertension
- death

## 6. THE WAY FORWARD

In order to meet the big challenge, priorities for action need to be set

to reduce maternal underweight, low body weight, numbers of underweight, and stunted children and all the issues related to diet-related chronic disease. Furthermore, the priorities need to be set in relation to the magnitude of the problem and the level of population risk. This approach has been applied to the major micronutrient deficiencies.

The following are some of the areas that need action:

**Micronutrients:** Vitamin A, Iron and Iodine are very crucial. Policies and programmes need to be developed and implemented to ensure year round access to and consumption of adequate variety and quantity of good-quality, safe, micronutrient rich foods. Dietary diversification and food fortification.

**Maternal Under nutrition:** avoidance of low birth weight.

**Adult malnutrition:** Household food security.

**Obesity:** Maternal nutrition; physical activity; diet and major intersectoral policies.

**Cardiovascular disease:** Major dietary policies in addition to nutrition education.

**Cancers:** Increased consumption of fruits and vegetables.

**Nutrition:** Priority, integrated approach and development of coherent policies.

**Community involvement:** Community-wide weight-gain prevention programmes for young adults especially those who are at risk.

**Weight-reduction treatment:** Programmes geared toward order adults. Treatment procedures to lessen or correct the health consequences of obesity.

Monitoring of life styles.

**Table 2 : Rates of adult overweight a and obesity b [9].**

Country	Sex	Year Survey Began/Ended	BMI ≥ 25 %	BMI ≥ 30 %
Gambia	Both sexes	1995	10.40	2.30
Ghana	Both sexes	1987/89	11.20	3.10
	Male	1987/89	5.30	0.60
	Female	1987/89	18.10	6.10
Lesotho	Female	1993	50.10	23.00
South Africa	Both sexes	1998	45.10	21.60

Notes: a BMI ≥ 25 b BMI ≥ 30

Research: To gain knowledge of obesity prevalence and incidence in defined communities by gender and age group. This will enable health planners and professionals to identify and prevent those at particular risk from developing the condition and experiencing its associated health and economic consequences.

Development. UNICEF, New York.

## 7. CONCLUDING REMARKS

For Sub-Saharan Africa the progress made on the first six MDG goals will be negligible for many decades if current trends persist. A few countries in the region are making progress in reducing the prevalence of under nutrition but should continue to monitor the challenges of over nutrition. Guidance cited in this discussion indicates that nutrition plays a fundamental role for the achievement of MDGs but many of the strategies employed in the name of meeting the MDGs make little or no reference to nutrition. However, it is a well known fact that good nutrition helps accelerate progress towards the MDGs. Reduction in malnutrition promises improvement in health, education, productivity, empowerment and survival.

In order to accelerate the progress in tackling malnutrition, adequate food, health, and care must be ensured throughout the lifecycle. Good nutrition during pregnancy reduces the likelihood of low birth weight and improves pregnancy outcomes. Promotion of growth and development in the young infant and child leads to a well-nourished, school-aged child who can participate fully in the educational process. Good nutrition during adolescence, especially for girls, is important for their growth, development and wellbeing and eventually for their children.

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### Summary

The concept of capacity development came into existence with the growing realisation that poverty and sustainable development in Africa could not be addressed through technical and economic solutions alone. This paper pursues some of the conceptual understandings of the capacity development itself and some strategic initiatives taken in realization of capacity development for food security in Africa. AICAD was established as one of the strategic initiatives for capacity development in Africa through TICAD Process following the Second Tokyo International Conference for African Development (TICAD II). The establishment of AICAD was also in line with the Millennium Development Goals (MDGs) formulated during the Millennium Summit of the United Nations held in New York in September 2000 and with African initiatives through the New Partnership for Africa 's Development (NEPAD). By developing human resource capacity through research, training and information sharing, AICAD attempts to empower African people to solve the problems of Africa through utilizing existing knowledge and technology, creating and utilizing new appropriate technologies, building a bridge between institutions creating technology and the communities using it, developing and utilizing the potential capacity of local expertise, exchanging experiences and practices. AICAD is committed to pursuing this approach and hopes to make good its contributions towards human capacity development for poverty alleviation in the communities in Africa.

### Background

The term "capacity development" is often defined as a process by which individuals, groups, institutions, organizations and societies enhance their abilities to identify and meet development challenges in sustainable manner [1,2,3]. In this respect, Capacity development refers to investment in people, institutions, and practices that will, together, enable countries in the region to achieve their development objectives [4]. The terms 'capacity development' and 'capacity building' are often used interchangeably, but strictly taken, capacity development, the more recent term, emphasises the notion of an 'on-going process' which takes account of existing capacities rather than focusing solely on 'building' new capacities. In the field of development, the term capacity development is relatively new, emerging from in 1980's [5].

The concept of capacity development came into existence with the growing realisation that poverty and sustainable development could not be addressed through technical and economic solutions alone[2]. Organisational theory and development management, as well as sociology, political science, and economics have influenced thinking around the term. Capacity development is generally understood to be an endogenous process through which a society, changes its rules, institutions and standards of behaviour, increases its level of social

capital and enhances its ability to respond, adapt and exert discipline on itself [2]. Thus, 'capacity development' is broad and it attempts to be all-embrasive. It addresses development at different levels of society, it deals with entities of different size and scope, and it deals with the different stages of the development process. It attempts to link previously isolated approaches, such as organisational development, community development, integrated rural development and sustainable development, into one umbrella concept [6].

Lavergne and Saxby [7] identify a set of so-called 'core capacities' which individuals, organisations or society as a whole need to possess in order to realise their human and social potential to the highest possible level. They recognise the importance of technical skills, knowledge and human resource development, but go beyond that by addressing also intangible capacities such as managing and resolving conflicts, or building networks and relationships. Governments, donors and NGOs have started to embrace the concept of capacity development. However, there is a tendency to emphasise different elements of the concept resulting often in conceptual and operational confusion in terms of what it is we are aiming to achieve and how we aim to get there. While trying to agree on a common definition may prove elusive, there is the risk that the concept remains "fuzzy" losing meaning, and applied merely as a slogan to describe activities rather than emphasising a new way of approaching development work.

Capacity development is seen as complementary to other concepts as used in the past four decades. These concepts include: institutional building, institutional development/strengthening, human resource development, and development management/administration [8]. The same authors grouped the definition of the capacity development into four approaches as organizational, institutional, systems and participatory. The term capacity development thus related to the approach used. Drawing from Lusthaus et al., [8] the following approaches can be broadly distinguished:

### The Organisational Approach

This approach sees an entity, an organisation, or a set of organisations as the key to development. It focuses on identifying and developing the elements or components of capacity within an organisation, such as skills, systems, leadership, etc. Building on the systems approach, most organisational development literature discusses both the internal working of an organisation, as well as its relationship to the external environment. Organisations are seen as processing systems that change individual and group capacities into organisational results. This approach is closely related to the well-developed theory on organisations and organisational change. It has been valued for its use within the context of organisational change processes, but also criticized for its too narrow focus.

## The Institutional Approach

The institutional approach aims to develop the capacity to create, change, enforce, and learn from processes and rules that govern society. It deals with more than organisations. The institutional approach stimulates the creation of knowledge of and access to the formal and informal “rules of the game” and puts a stress on elements such as laws, regulations, attitudes, etc. It adopts a macro perspective and deals with the issues, which underlie most development problems, such as norms, cultural values, incentive systems and beliefs. The problem with the approach is that the boundaries between ‘institutional change’ and ‘capacity development’, which puts a stress on the change of a society’s rules, institutions and standards of behaviour, cannot always be clearly distinguished.

## The System Approach

The system approach provides a multidimensional idea on capacity development: society is viewed as multilevel, holistic, and interrelated systems, in which each system and part is linked to another. Thus, it approaches capacity development as intervening at multiple levels and actors, in power relationships, linkages and processes. This systemic approach is explained in Bolger [9], which suggests four levels of capacity (the individual, organisational, network/sectoral and the enabling environment) and stresses the need to be cognizant of, and responsive to, the relationships among them. The advantages of this approach are that it is comprehensive and flexible, it emphasises linkages and recognises processes, and it uses a broad conceptual and theoretical framework. On the other hand, this makes it difficult to distinguish capacity development from general understanding of development. Working with this approach normally requires further conceptual clarification, depending on the respective capacity development interventions and change process.

## The Participatory Process Approach

Unlike the other approaches, which focus on a specific entity for capacity development, this approach stresses the means used to achieve development goals. This approach is based on the view of people-centred, non-hierarchical development that calls for capacity development which is participatory and empowering, and in which ownership is a central element. The use of foreign models should be abstained and attempts should be made to identify and use local expertise, to work from the grassroots and to develop a domestic model. The approach embraces change and learning through participatory processes - primarily at the individual level - as core values. The risk is that not sufficient consideration is given to quantitative and qualitative changes brought about by capacity development. The participatory process approach may overlap with the organisational, institutional and systems approaches.

## Development Of Capacity At Different Levels

Capacity can be said to depend on the presence of: Viable institutions, Leadership and vision, Financial and material resources, Skilled human resources, Effective work practices, including systems, procedures and appropriate incentives. There are different levels or scales (e.g. national, sectoral, community) at which capacity can be addressed. One can also make a distinction between the capacities of different stakeholder groups; the public sector, private sector and civil

society. Hence the question; ‘capacity for whom’ ?.

Capacity has to be linked to function and performance. This is the capacity ‘to do what’ issue. Capacity (as an outcome) cannot be said to exist in the absence of any visible or verifiable evidence of a positive change in performance of some function or activity. This assumption had implications for monitoring and evaluation. Clarifying the mandate, roles and responsibilities of the entities in question can help address this question. Any useful approach to capacity development has to take into account the political, social, cultural, technical and financial aspects of the issue. This was especially important for being able to separate the causes and the symptoms of a lack of capacity. An “enabling” environment, which provides appropriate incentives, is essential for mobilising and utilising capacities. This notion can be applied at all levels (individual, organisations, country). The enabling environment can include many things – some more concrete than others. Many participants referred to governance issues in general, others to specific policies or laws, or resource endowments, others referred to questions of behavioural norms and attitude, and to the impact of donor interventions [6].

The concept of partnership should be reviewed to reflect the appropriate position of African countries and institutions in the definition of the development agenda and the process towards its realisation. External institutions should facilitate rather than direct the process and African institutions and individuals should be fully involved in the design and management of the overall programme. The main stakeholders, including the donors, must agree upon, specific interventions in a participatory manner. In this respect, the process and activities must be transparent and made known to all parties. To develop real capacity there must be a paradigm shift within the donors to allow for real political dialogue. Donors must facilitate the utilisation of African expertise by showing confidence in African experts and relying less on their own internal expertise. If African expertise is not readily available now, it should be granted time to develop. Providing substitute technical assistants in order to get the job done fast is counter-productive to the process of developing local capacities. The role of African governments is to ensure good governance, transparency and accountability, and to create space for a more active role of civil society. This was considered to be a pre-condition for effective capacity building [2]. The issue of capacity development in Africa has received a lot of attention from many development partners.

## World Bank and Development in Africa

In 1996, the African Governors to the World Bank presented a report to the President of the World Bank impressing the importance of human and institutional capacity building to the future of Africa [4]. The report calls on both African nations and their development partners to take up this challenge and requests the World Bank to mobilise international assistance. The initiative set in motion the conduct of national capacity assessments in a number of African countries. More widely, the need for capacity is recognised by governmental and non-governmental organisations and donors. Traditionally, interventions have focused on classic capacity building areas such as individual and organisational strengthening, and project preparation and implementation. Efforts have also tended to focus on certain sectors or certain agenda’s such as poverty alleviation, AIDS, environmental concern, and decentralisation. Bilateral donors are especially engaged in these types of activities. Now, one faces the challenge to go beyond these levels, to adopt more holistic and integrated approaches. Both the scale - nation-wide - and the complexity - multi-dimensional and multi-sectoral - of national capacity building calls for an integrated approach and sustained coordination. Conceptual and methodological

clarity are important inputs to achieve this. It became clear that many countries lacked the capacity to implement these complex reforms. The call for improved incentive structures, measures to stop brain drain and to retain senior staff emerged. Evaluations of aid effectiveness further indicated institutional constraints and the negative role that aid could play; technical assistance often eroded existing capacity. Capacity development is today increasingly seen as an all-encompassing concept. It should be an integral part of development activities [4].

## Millennium Development Goals (MDGs) and African Development

Poverty in Africa is still the major cause of many sufferings of mankind. The poverty levels are rising with almost 40% of the population living on less than US\$ 1 per day and that at least one-third of its population is undernourished and the number is growing [10,11]. At present Africa is the only region of the world where poverty is projected to continue rising if adequate measures are not urgently taken. In recognition of this situation, the international community has recently shown increasing interest in the development of Africa. The Millennium Summit of the United Nations held in New York in September 2000 delivered the resolution as a way of resolving African problems by committing themselves to support Africa and to assist Africans in their struggle for poverty eradication and sustainable development [12]. The Millennium Summit of the United Nations held in New York in September 2000 formulated eight Millennium Development Goals (MDGs) as to: Eradicate extreme poverty and hunger; Achieve universal primary education; Promote gender equality and empower women; Reduce child mortality; Improve maternal health; Combat HIV/AIDS, malaria, and other diseases; Ensure environmental sustainability; Develop a global partnership for development [13]. Of these MDGs, seven are mutually reinforcing and directed at reducing poverty in all its forms. Achievements of these goals are at different levels in Africa with each country trying to achieve certain level of success through the Poverty Reduction Strategy Paper (PRSP) initiatives [12,13,14] in reviewing the extend of achievements of the MDGs in countries in the Economic Community of West African States (ECOWAS) and in African countries concluded a daunting situation in each country. Shrimpton, [12] was of the opinion that the likelihood of achieving the goals for 2015 seems very remote unless serious change of approach to development is adopted in the region. Similar scenario can be said to be the case for countries in Sub Saharan African where poverty levels are persistently on the increase [3]. Vandemoortele, [15] in reviewing the global initiatives for poverty reduction gave pros and cons of the interventions and challenged the global approaches by questioning them if they are really reducing global poverty.

## NEPAD Process and Development in Africa

Following this Millennium Summit of the United Nations, the African countries formulated the NEPAD: New Partnership for Africa's Development by their own initiatives, seeking the construction of new partnership between Africa and international community. NEPAD as adopted by the African Head of States, is an initiative in which the leaders pledged a common vision and a firm and shared conviction that they have a pressing duty to eradicate poverty and to place their countries both individually and collectively on a path of sustainable growth and development and at the same time to participate actively in the world economy. NEPAD, still in its infant stage, has taken different initiatives towards capacity development in Africa. More prominent are

its initiatives through sectoral approach in agriculture and environment [16].

## TICAD Process and Development in Africa

Prior to these initiatives, the Government of Japan established what is now referred to as the TICAD Process by holding the First Tokyo International Conference on African Development (TICAD) in 1993 and the Second TICAD (TICAD II) in 1998. The TICAD III was held in September 2003. During TICAD II, the discussions were focused, among others, on development experiences of Japan and other Asian countries as providing relevant clues to Africa's efforts [17]. Discussions prioritized such areas as human development through education and health, women's participation and empowerment, agricultural development and private sector development. The main purpose of the TICAD II was to reaffirm the commitment of African countries and their development partners to co-operate to improve people's life, and promote peace and stability, through self-help of Sub-Saharan countries (partnership) and co-operation with their development partners (partnership) [18].

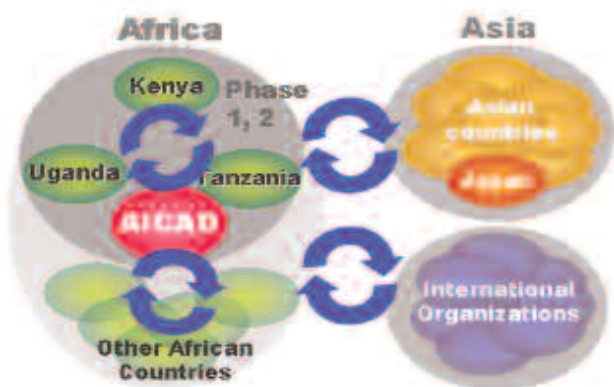
## Establishment of AICAD

Following the TICAD II, attended by Heads of State from Africa and Leaders world over, the African Institute for Capacity Development (AICAD) was established in August 2000 as a result of consultations involving the governments of Japan, Kenya, Tanzania and Uganda. The original idea as mooted during the TICAD II was to establish a Base for African Human Capacity Building (Africa Hitozukuri Keikaku). An observation made during the TICAD II was that, over the years since African countries became independent, several interventions have been made to reduce poverty. However, the continent is still lingering in poverty despite the fact that the continent has abundant resources [19]. One of these resources is the human capital and it was agreed during the TICAD II that development of this resource is the way forward to assist the continent to reduce poverty and this formed the basis for establishing AICAD. AICAD is therefore a product of the TICAD Process. The establishment of AICAD came as a result of higher level negotiations and commitments that led to signing of Records of Discussion and Memorandum and Articles of Association by the three governments of East African countries and Japan. Following these agreements, AICAD was established on the 1st August 2000 on the guiding principles of ownership and partnership among the three Governments of East African Countries of Kenya, Tanzania and Uganda and the Government of Japan through JICA. AICAD is now an autonomous regional international institute that attempts to cater for the needs of the human capacity building for Africa. AICAD has its Headquarters in the campus of Jomo Kenyatta University of Agriculture and Technology in Juja, Kenya.

## Objectives of Establishing AICAD

The primary goal for establishing AICAD is to achieve poverty reduction in African communities through human capacity development from grassroots level through active participation in research and development, training and extension programmes and sharing of information, practices and experiences.

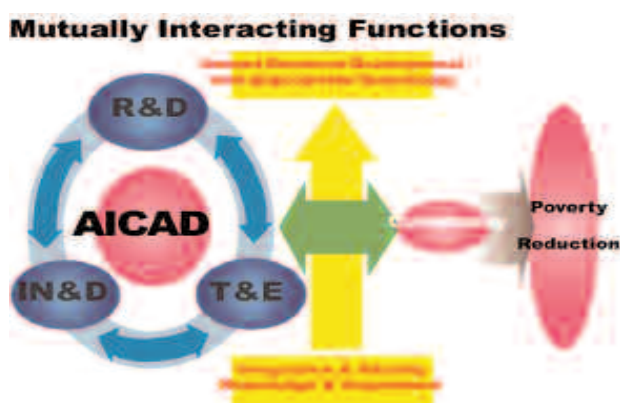
**Figure 1. Current AICAD Member Partners And Future Expansion**



In order to realize this objective, AICAD has defined its unique approach that requires active participation and collaboration amongst participating countries in Africa and Asia. This collaboration between African and Asian countries through the South-South Cooperation will enhance Africa's capacity in fighting poverty by sharing information, knowledge and experiences in all issues related to socio-economic development. This is also in line with recent African initiative for New Partnership for Africa's Development (NEPAD), which seeks new partnership between Africa and the international community. The ultimate goal of AICAD is to achieve poverty reduction and social economic development by facilitating the African people to solve the problems in Africa. At present AICAD programmes are limited to Kenya, Tanzania and Uganda. It is however, hoped that the programmes will gradually expand to other Africa in future (Figure 1).

The focus of AICAD is on poverty alleviation and socio-economic development at the local community level through its three functional divisions of Research and Development (R&D), Training and Extension (T&E) and Information Network and Documentation (IN&D).

**Figure 2. AICAD functional structure**



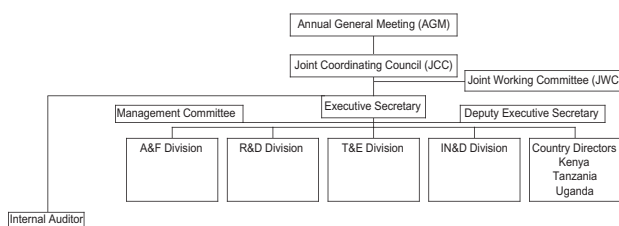
The fourth division is the Administration and Finance (A&F), which supports the functional divisions (Figure 2). The Training and Extension division formulates training courses based on both existing and newly generated information by the Research and Development. Similarly, the needs generated during the training could also be researched on.

The Information, Network and Documentation division is supporting the activities of two functional divisions in the collection, storage and dissemination of the information through the network built amongst the participating institutions. These functional divisions are therefore complementary to each other.

### AICAD Governing Organs and Membership

AICAD is governed through the Joint Coordinating Council (JCC), which is the highest decision making body. The members of the Council are the Vice Chancellors of the public universities, Permanent Secretaries of the Ministries of Education and Finance in the East African region and representatives from JICA. The decisions made by JCC are endorsed during the Annual General Meeting (AGM) held once every year. Under the JCC is the Joint Working Committee (JWC), which is mainly responsible for setting the grounds for the JCC meetings. Within the AICAD Secretariat is the Management Committee (MC), which is responsible for overseeing day-to-day activities (Figure 3).

**Figure 3: Organizational structure of AICAD**



The members of AICAD are currently the public universities in the East African Region; six universities in Kenya, five in Tanzania, and four in Uganda. Other members are the Ministries of Education and Finance in the three countries (Table 1). Phase III will start from August 2007 to July 2014 and would include other African countries.

### AICAD 's Approach to Capacity Development for Poverty Reduction

AICAD aims at achieving poverty reduction and socio economic development in Africa by facilitating the indigenous people to solve the problems of Africa through such means as:

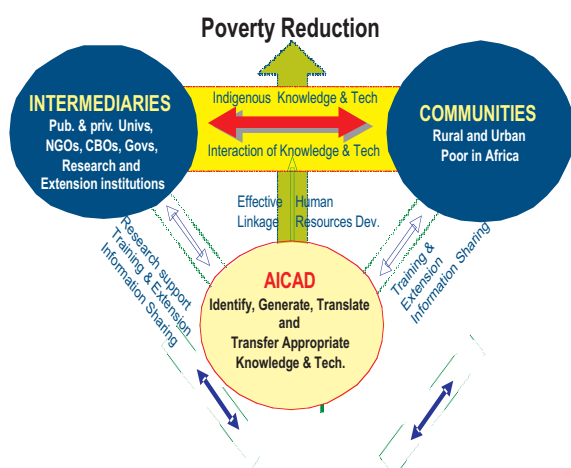
- Utilizing existing knowledge and technology,
- Creating new technology suitable for local conditions,
- Developing and utilizing the potential capacity of local expertise,
- Building a bridge between institutions creating technology and communities using it,
- Exchanging information, experiences and practices and sharing human resources and information in the region and beyond.

**Table 1. AICAD Membership in East African Countries**

Country	Members
Tanzania	<ul style="list-style-type: none"> <li>University of Dar Es salaam</li> <li>Sokoine University of agriculture</li> <li>Open University of Tanzania</li> <li>Mzumbe University</li> <li>State University of Zanzibar</li> <li>Ministry of Science, Technology and Higher Education</li> <li>Ministry of Finance</li> </ul>
Kenya	<ul style="list-style-type: none"> <li>University of Dar Es salaam</li> <li>Sokoine University of agriculture</li> <li>Open University of Tanzania</li> <li>Mzumbe University</li> <li>State University of Zanzibar</li> <li>Ministry of Science, Technology and Higher Education</li> <li>Ministry of Finance</li> </ul>
Uganda	<ul style="list-style-type: none"> <li>Makerere University</li> <li>Mbarara University</li> <li>Kyambogo University</li> <li>Gulu University</li> <li>Ministry of Education and Sports</li> <li>Ministry of Finance, Planning and Economic Development</li> </ul>

By following this approach, AICAD attempts to evolve the education and research functions of African universities and research institutions with more practical perspectives and to accelerate human capacity development in the region. AICAD recognizes the fact that institutions of higher learning, mainly universities and research centers are the hubs of knowledge generation in any country, hence there is need to enhance the capacities of these institutions so that they play their rightful role for the society. However, due to limited resources, AICAD will coordinate network where these institutions will share information through joint research efforts so that there will be economical use of the limited resources. The knowledge generated through the intermediaries will be transferred to the communities with the AICAD support in terms of training, extension and information sharing. The intermediaries will also integrate indigenous knowledge from the communities for the purposes of improving the livelihoods (Figure 4).

**Figure 4. AICAD's approach concept**



**AICAD Activities**

AICAD approaches the implementation of its activities through its functional divisions of R&D, T&E, and IN&D (Table 2). AICAD started to implement its activities in phases. The First Phase was the preparatory phase, which started from August 2000 to July 2002. Phase two is the operational phase and started from August 2002 and will continue up to July 2007.

**Training and Extension Activities**

During the phases II, and I AICAD conducted six In-Country and three Regional Training courses on irrigation and water resources management. In Country training courses were conducted in each country whereas the Regional ones were conducted at the AICAD headquarters (Figure 5). So far over 290 trainees benefited from these training programmes (Table 2). This training targets smallholder farmers who are leaders in their rural set ups.

**Table 2 Summary of AICAD Training and Extension Activities**

Country	Number of In-Country Training Course(ICT)	Trainees Regional Training Course (RTC)	Total ICT and RTC
Tanzania	60	41	101
Kenya	56	56	98
Uganda	60	39	99
Total	176	122	298

**Table 3: Future Training Themes**

Sector	Theme selected
Agriculture, Food and Nutrition	<ul style="list-style-type: none"> <li>Marketing</li> <li>Value addition and food processing</li> <li>Public Education</li> <li>Diversification of production</li> </ul>
Environment and natural resources	<ul style="list-style-type: none"> <li>Environmental conservation, rehabilitation</li> <li>Alternative energy sources</li> <li>Policy, legislation and environment</li> <li>Poverty and environment</li> </ul>
Industry	<ul style="list-style-type: none"> <li>Business Skills in Small and Medium Enterprises (SME) and Micro finance</li> <li>Institutions (MFI)</li> </ul>

As the trainees are leaders in their own set ups, AICAD expects that they will train other farmers resulting into technology or skills diffusion and hence the multiplier effect. These ICTs are conducted based on the priority set by each country in its Poverty Reduction Strategy Papers (PRSP). The focus on future training themes are as given in Table 3.

Figure 5 The In country and Regional Courses



Figure 6. Socio-economic impact through research initiatives



### Research and Development Activities

In the preparatory phase, AICAD started by supporting 14 research projects in eight public universities in the region. These pilot research projects were to lay foundation for the subsequent projects. Based on the experiences gained in pilot phase projects, the second and third calls for research projects were made.

During these phases, AICAD research portfolio grew by supporting additional 26 projects in 2002 and 41 projects in 2003, making a total of 78 projects on the ground. These research projects are distributed amongst twelve public universities in the East African region (AICAD 2003). In all the three cases, the research projects were selected based on the themes (Table 5) identified through need analysis that was carried out previously [20].

Revision on the themes was done after the poverty reduction strategy workshop held in June 2003, involving a wider range of stakeholders. The research themes were then increased to eight (Table 5) from the original selected list. In line with this, AICAD is establishing linkages with other stakeholders on experience exchange on effective dissemination methodologies such as the SUA method (Rutatora et al., 2000) for incorporation in the research strategies. The research projects supported by AICAD are multidisciplinary and are based on community needs so as to bring about socio-economic impact to the societies (Figure 6).

Table 5. Research Themes and Number of Selected Research Projects by Country

Calls for research Proposals	Selected research themes	Kenya Tanzania Uganda		
Pilot phase	<ul style="list-style-type: none"> <li>• Food production and processing</li> <li>• Socio-economic aspects of development</li> <li>• Development of low cost housing</li> <li>• Water resource management</li> </ul>	8	2	1
Second call	<ul style="list-style-type: none"> <li>• Food Security</li> <li>• Development of SMEs</li> <li>• Environmental Conservation</li> <li>• Community Development</li> <li>• Water Resource Management</li> <li>• Health Equity</li> </ul>	16	7	3
Third call	<ul style="list-style-type: none"> <li>• Food Security</li> <li>• Development of SMEs</li> <li>• Environmental Conservation</li> <li>• Community Development</li> <li>• Water Resource Management</li> <li>• Health Equity</li> <li>• Industrialization processes</li> <li>• Policy and Implementation</li> </ul>	18	14	14
Total		42	23	14

### Information Network and Documentation Activities

AICAD's target in information dissemination is to facilitate exchange resource and sharing which are essential for increasing knowledge about poverty and strategies for its reduction. In order for information to be disseminated it must be available first. It must be gathered, processed, stored, retrieved and disseminated. There must also be adequate manpower and equipment to enable information gathering, processing, storage, retrieval and dissemination. Information dissemination requires appropriate media (channels) through which it can be carried across to users.

Figure 7. Integrated information gathering and dissemination (AICAD hub)



AICAD has put in place some of the necessary channels and at present they include: web site publishing, multi-media production, print media, human interaction (workshops, seminars, conferences and training courses) and human networks (professional/experts). AICAD by its nature acts as a hub of information on poverty reduction to facilitate research and training. This role is being recognized and emphasized by AICAD stakeholders. AICAD should collect information on research activities from member institutions and other relevant sources in the region and be a hub of dissemination of such information (Figure 7). Information disseminated from AICAD comprising mainly research findings from AICAD and other institutions, experts and professional profiles, universities courses, private, governmental and non-governmental activities in communities. The information disseminated from AICAD will be passed down to the grassroots through training and extension, accessing internet and multi-media materials carried down to the community grassroots by AICAD researchers, trainers, private, governmental and non-governmental stakeholders. In the processing and disseminating information, AICAD acts as a hub and in this way the relevant information on poverty reduction reaches the rural communities.

### Challenges Ahead and Way Forward

Africa is currently undergoing socio-economic changes. These changes have far reaching implications to institutions like AICAD: The requirements of our stakeholders are changing; our sponsors are demanding more value for money; demand for lower operational costs per unit and the stiffening inter-institutional competition just to name a few. In the face of these changes and challenges occurring both regionally and globally, AICAD considers it of utmost importance to chart out its future direction and develop strategies that will allow it to play an even more pronounced role in human capacity development in Africa (Bolger, (2000). It is in this spirit that AICAD has finally put in place this strategic Plan that clearly articulates its course and strategic objectives and indicates where AICAD wants to be five years from now and beyond.

### AICAD Strategic Plan to 2009 and Beyond

In developing its Strategic Plan, AICAD has assumed the continuous existence of a dynamic and uncertain environment and therefore has devised strategic strategies of action that will be regularly updated to respond to changes in our operating environment. AICAD has carried out a comprehensive situation analysis, and evaluated ways in which different developments may influence the dynamics of strengths, weaknesses, opportunities and threats (SWOT) during the course of pursuit of its mission. The general approach emphasized active participation and ownership of all key AICAD stakeholders. This Strategic Plan to year 2009 and beyond is expected to strengthen AICAD's capability to contribute significantly to the socio-economic development in the African region by playing a leading role in human resource capacity development for poverty reduction through research and development, training and extension and information networking. The Strategic Plan will therefore act as a compass for all activities, enabling AICAD to focus its resources on the strategic activities to realize the envisaged vision.

### AICAD Vision, Mission and Core Values

AICAD has clearly set its vision in building human resource capac-

ity for poverty reduction through research, training and information networking with a unique approach by strengthening linkages between knowledge and applications. AICAD's vision statement constitutes what it aspires to be within ten years. AICAD Vision is: To be the leading African institution in building human capacity for poverty reduction. This vision will be steered by its Mission: To link knowledge to application in order to reduce poverty within poor communities in Africa. This mission statement will guide the institute in realizing its medium-term (5 years) measurable aspirations. AICAD has put in place its fundamental values through which its aspirations of strengthening linkages between communities and the intermediaries such as universities, NGOs, CBOs, local governments and related institution can be realized. AICAD will strive to realize its aspirations through partnership, equity, empowerment, excellence and responsiveness. During the implementation of its Strategic Plan, AICAD will undertake the following five key result areas in delivering on its mission (Table 6).

**Table 6. Key Results Areas (KRA) identified for the implementation of the AICAD Strategic Plan to 2009 and Beyond**

KRA 1	Identify and generate Knowledge and Technology packages with potential for impact on community-based poverty reduction.
KRA 2	Translate poverty reduction focused knowledge and technology into appropriate dissemination packages for knowledge and technology transfer.
KRA 3	Transfer appropriate knowledge and technology packages for impact on community-based poverty-reduction.
KRA 4	Expand AICAD activities in the African region and promote cooperation with other countries and communities in other regions.
KRA 5	Strengthen AICAD's institutional capacity

### Major Sectoral Areas for the Implementation of the AICAD Strategic Plan.

AICAD identified areas for its activities based on the needs assessment study conducted in 2003 and reviewed in 2004 as; Agriculture, food security, water resource management, industrialization processes, enterprise development, value addition, environment conservation, health equity, and community development. It also focuses on gender issues and policy & implementation as cross cutting issues. Those themes will be further re-examined during the implementation of the strategic action plan. For smooth implementation of its strategic plan and for smooth delivery on its mission, AICAD will put in place its requirements in human resources, governance, financial planning, monitoring and evaluation. The development of this Strategic Plan marks a significant turning point in the growth of AICAD and its efforts aimed at building human capacity that will enable the participating



countries to take on some of the development challenges in their efforts to reduce poverty. This strategic plan represents a significant thrust on the strategic interventions aimed at reducing poverty in the region. The planned interventions represent important and desirable improvements on the previous state of art of AICAD in terms of framework, strategies, resources and stakeholders

## Conclusions

AICAD has put its resources in support of human capacity development as its efforts towards poverty reduction in the region. AICAD aims at achieving poverty reduction and bringing about socio economic development by facilitating Africans to solve the problems of Africa through among others by utilizing existing knowledge and technology, creating and utilizing new appropriate technologies, building a bridge between institutions creating technology and the communities using it, developing and utilizing the potential capacity of local expertise, exchanging and sharing information, experiences and practices. AICAD will play a leading role in providing necessary leadership to guide Africans through these goals to translate them into tangible realities so that they can live dignified and meaningful life. For this to happen, development of human resource capacity is a necessity whereby people themselves will play an active role. Economic development is dependent on people and for this reason human capacity building is a priority if poverty is to be reduced. Poverty itself may be a consequence of a model of development that may be entrenching relentless exploitation and other forms of disempowerment to people. AICAD will strive to explore alternative paradigms so that the current trend of underdevelopment in human capacity and poverty in Africa is reversed.

## Acknowledgements

AICAD wishes to register its appreciation for the strong support it is receiving from the stakeholders. The progress and modest achievements realized are as a result of their support. The author wish to extend his sincere and deep appreciation to them all, in particular the Governments of the United Republic of Tanzania, Kenya, Uganda and Japan, members of the governing bodies of AICAD institutions and individuals who have made contributions to AICAD in one way or the other. May this commitment and willingness to support lasts for AICAD to meet its objectives. Finally the author wishes to thank the INNC Secretariat for the opportunity availed to AICAD to have this presentation to the INNC fraternity.

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ADDRESSING THE MICRONUTRIENT PROBLEMS: NUTRITION PROGRAMMES IN EAST AFRICA

Presented By Linda Ethangatta, PhD  
Project Officer, Nutrition,  
UNICEF Kenya

Paper presented at the Regional Congress of Kenya Coalition for Action on Nutrition Feb 21-13 2005, Nairobi, Kenya.

Quote from 5th World Nutrition Situation:

“Nutrition status is a key Millenium Development Goal (MDG) indicator of poverty and hunger and is the first important step in recognizing that policies, programmes and processes to improve nutrition outcomes have a role in global development”

One of the national objectives for supplementation :

To increase coverage of Vitamin A routine supplementation (two doses) for children 6-59 months from (32%) 42 to 80% in 3 years (Kenya)

Direct Link to MDG: Eliminate Vitamin A deficiency by 2010

Vitamin A as an indicator towards achievement of MDGs (Goal 4: Reduce child mortality)

Linking Goal 5 with Micronutrients: Improve maternal health

Programme intervention is to reduce

Deficiencies of several micronutrients (iron, vitamin A, folate, iodine, calcium) which are associated with pregnancy complications

(5th Report on the world nutrition situation, 2004).

Overall status

Kenya

**CHILDREN BELOW FIVE YEARS:**

Infant Mortality Rate: 79/1,000

Under five Mortality Rate: 123

Underweight: 20%

Severe Underweight: 4%

Stunted: 31 (moderate and severe)

**ANAEMIA:** Mothers & U5, Ref: National Data: 1999 Survey

Overall Prevalence (Under 5) : 73%

Among women (Reproductive age):55%

Iron Deficiency Anemia: 43% (Both under fives and mothers)

Prevalence of VAD (National Survey 1999)

Under 5 years :

Acute 14.4%

Mild to Moderate: 70.2%

Pregnant Mothers: 9.1%

Lactating Mothers: 29.6%

Associated Factors: Malaria, Anaemia,

Hookworm, Malnutrition

Kenya Supplementation

6-59 months age group

**CAMPAIGNS**

1999: 90% NIDS

2002: 91 % MEASLES CAMPAIGN

Kenya Supplementation: Routine

ROUTINE COVERAGE

1998: 42% DHS

2000: 42 % (MICS RPT)

2002: 42 % MOH

2003: 32% DHS

Uganda Vitamin A Deficiency situation

Vitamin A Supplementation Uganda

2004

	May	Nov
# districts reported	46	42
Average coverage(%)	55	71
Additional coverage%	13	29

NB. In Nov. 2003 round Child Days coincided with a national measles campaign (Vit A coverage 100%)

\* Baseline – 42%

Tanzania

Campaigns Vs Routine coverage

Supplementation as an intervention and coverage rates:

Kenya, Uganda, Tanzania (as part of regional group) have a three year accelerated intervention on vitamin A coverage “Post NIDS” to improve routine coverage

Campaigns give high coverage but not sustainable

Develop long term strategies that are sustainable based on individual situation in each country

Example: Child Health Action days are becoming an option for delivering vitamin A capsule but rely on the strength of integration in creating packages (Vitamin A, deworming, delivering ITNs or re-treating old nets etc). There are cost implications but good success stories are emerging from this strategy.

Other Interventions

National or limited level interventions are ongoing with variety of success.

Several Strategies have been adopted to eliminated Micronutrient Deficiencies

In all the countries, multiple strategies are in place. Some have better results than others also countries differ.

Supplementation (Mainly Vit A, Fe/Folate, occasionally multiple micronutrients)

Fortification (Staples, selected commodities etc)

Food Based approaches (Food diversification)

Public Health measures

Advocacy, communication, IEC materials (use of innovative local approaches).

Supplementation programmes are well structured:

Guidelines from WHO/UNICEF

Supplementation

Vitamin A :

Children

6-11 months : 100,000 IU Two doses 4-6months apart

12-59 Months: 200,000 IU Two doses 4-6 months

Post partum mothers

200,000 IU up to 6 weeks post partum

Value adding to Strategies Commonly used

Improved delivery and distribution of vitamin A Capsules

Capacity building at all levels (to all districts teams, and community structures)

Advocacy and social mobilization at different levels.

Training on data management

Improved monitoring of supplementation at district level

Provision of supplies and logistics support

Short-Term Strategies

Stepped up support (logistical and Vit A distribution transport systems)

Capacity Building for Health Care Personnel

Community mobilization and Involvement

Collaboration with partners in support of Action days “Child/Vitamin A/micronutrient) Link with other government departments (malaria,

EPI, reproductive Health etc) . Other partners are NGOs, CBOs, CORPS (Especially at district level)  
 Accelerated Monitoring of Coverage and data Management  
 Development of IEC materials to step up advocacy at all levels.  
 IRON AND FOLATE Supplementation  
 Supplementation (Iron/Folic acid)  
 If 6 months not attainable continue into post partum  
 Where 400 mcg of folic acid are not available, an iron supplement with less folate can be used  
 Iron dosage is based on 2mg iron/kg body wt per day  
 It is important to appreciate the importance of other micronutrients (vitamin A, C other B complex)

#### Iodine Deficiency Control

Intervention for IDD are based on fortification of salt  
 In East Africa.  
 (Other countries in some parts of Africa still use iodized oil capsules as a supplement because national level salt iodization has many challenges).  
 Still Kenya is using 1994 data

Deficiency of iodine is associated with:

IDD can lead to many abnormalities  
 Miscarriages  
 Stillbirths  
 Impaired intellectual development  
 Impaired physical development and performance  
 Endemic cretinism  
 Goitre  
 Universal Salt Iodation  
 Salt fortification in Kenya is considered a success story.  
 Few Manufacturers : we coordinated (KESAMA)  
 Quality of iodized salt considered here with exception of fluctuation of potassium iodate in salt.  
 Legislation is in place  
 Ongoing monitoring (National Urinary Study in progress)  
 Follow up on changing level of iodization to meet WHO/ICCIDD criteria  
 Over 90% of HHs consume iodized salt (DHS, 1998, MICS, 2000).

#### Double Fortification of Salt

With Iron and Iodine  
 New strategy to combat both iron and iodine deficiencies.  
 Use of good lessons from salt iodation to improve iron interventions  
 Currently efficacy study in progress.  
 Lessons Learnt and major constraints  
 Lack of a community level policy on vitamin A supplementation makes advocacy lengthy, expensive and time consuming.  
 Vitamin A supplementation benefits not fully understood by health professionals at all levels. Nutrition still associated with "NUTRITION" and not health sector-wide in importance. This has implication on funding. e.g. Hardly any government funds sent aside to improve vitamin A supplementation.

#### Other Related Issues

In the fortification industry  
 Continued collaboration between public and private sector, improved industrial technology (both human and no human)  
 Importance of duty waivers for premixes and dosing equipment as incentive for commitment  
 Development of standards, guidelines and policies  
 Investment in advocacy especially making vulnerable groups understand the importance of consuming fortified foods.  
 Conclusion  
 Supplementation with vitamin A for 6-59 months age group moving

progressively well in East Africa an acceleration is stepped up.  
 Kenya: 62% in 2004  
 Uganda : 70 (2004)  
 Tanzania: 90%  
 Sustainability  
 Programmes must be integrated in national workplans  
 Funding must be committed at national level and avoid donor reliance  
 Advocacy should continue at policy, programme and community levels  
 Communication at all levels need greater emphasis in programmes.

#### Iron and Folate or Multiple micronutrients

The benefits of multiple micronutrients should strengthen the understanding of expanding iron/folate supplementation to include zinc and other important B complex vitamins all showed in research as important in the control of anaemia.

THANK YOU FOR YOUR  
 ATTENTION!

Raising Resources for Nutrition in East Africa:

By Dr. Robert Mwachime  
Regional Centre for Quality of Healthcare,  
Kampala, Uganda.

Why should we invest in nutrition?

We need to get more resources for nutrition, because malnutrition kills. It deprives the affected of their right to health and full productive life.

For example:

Vitamin A related deaths in Tanzania 1999-2007, there will be 170,000 child deaths- 1 out of every 5 children affected will die.

Maternal Deaths in Kenya (2000-2010) due to Anaemia will be 48,000

In Uganda -65,000 cretins, 94,000 severely or moderately mentally retarded

Percent change+ in underweight in preschool children during the 1990s

Why these trends?

Eroded capacities at all levels, caused by:

- Σ Declining social sector spending
- Σ Increased Poverty
- Σ The HIV/AIDS pandemic
- Σ Conflicts/emergencies (including poor weather)
- Σ Significant declined investment in nutrition

We Can achieve the same with other micronutrients

Reduce VAD by 80%

Are there resources for nutrition?

They are plenty. However money has been hidden under other titles:

- Σ Food security
- Σ HIV/AIDS and infectious disease
- Σ Relief and emergency
- Σ Rural development

Do we have the capacity to access the resources?

- Σ Positioning of Nutrition in Governments
- Σ PRSP
- Σ GAIN
- Σ Global Funds
- Σ PEPFAR

**Case study: Kenya**

Σ Economic Recovery Paper + M&E-some indicators related to nutrition.

Σ Sector budgetary lines (MTEF)-the current one has a line for nutrition

Σ Repositioning of Nutrition in the MoH (=division)-it's a very great success story

Σ PEPFAR funds for Nutrition-2-3 times the amount of money as the first round

**Case study: Uganda**

Σ Global funds for nutrition + HIV/AIDS

Σ Budgetary lines in MoH

Σ Nutrition in National AIDS Control Program-very few countries have a nutritionist in AIDS programmes. Uganda has.

Key Ingredients to Accessing Nutrition Resources?

Σ Leadership-it should be pro-active. We need a special crop of leadership. The people who make decisions are not nutritionists, they are economists.

Σ Advocacy-Package the story. Go out with them, make noise to the right people, and make a story. Get the opportunity and tell. We need these skills, they aren't taught in School. Use the skills. We are very shy when it comes to nutrition. Know your message, your mission.

Σ Public – private partnerships-The fear of the private sector has to end.

Σ Other skills in nutrition-Use your mouth, negotiate, brave. Nutrition is not obvious.

Σ Institutionalization of gains made :

Nutritionists in Africa-People live Kenya for FANTA or FAO. We need to make sure that people are there to take up from where the last leaders took left. We need to create the leaders who come after us. We need to live it.

Σ We need to Act now! Coalitions need to make leaders. Don't be shy. Call a spade a spade if we have a bad leader in nutrition. Coalitions are not the voice of one person; we need to build these skills.

Strategies and Challenges in Addressing Food Security

Presented by:

John Owuor

Ministry of Planning and National Development

Presented at National Nutrition Congress 20th – 23rd February 2005 at Kenya School of Monetary Studies, Nairobi.

**Food Security**

Most of us know what food security is all about: all people, at all times having Physical, Economic and Social Access (World Food Summit 1996) to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life

**Conditions for Food Security:**

- Σ Food Production should not destroy the environment from which it comes:
- Σ Food Utilization- ability to use food consumed for health and nutrition
- Σ Food Availability- Produce sufficient food for consumption and income generation without depleting natural resource base
- Σ Getting the produce into markets for sale
- Σ Food Access- Income to purchase the food and Social networks which are making it possible to access food.

**Causes of Food Insecurity:**

- Σ Poverty is going up .56% of Kenyans live below the poverty line, hence accessing food is a problem
- Σ Climatic Shocks-they are being brought about by droughts
- Σ Low food production, hence it can not feed all Kenyans
- Σ Mothers lack of education
- Σ Poor water and sanitation

**Chronic Food Insecurity:**

It is caused by:

- Σ Macroeconomic decline
- Σ Poor infrastructure
- Σ Marketing constraints
- Σ HIV/AIDS

**Episodic Food Insecurity:**

It is Widespread in Arid and Semi-Arid areas, due to climatic and economic shocks.Its caused:

- Seasonal droughts
- Fragile ecosystems
- Narrow livelihood base etc

NB: Food security or Under nutrition–Vulnerability (risks of households falling into food insecurity or poverty) e.g. as was the case in 2001, when millions of Kenyans were affected. US \$240 million was used to help remedy this situation.

Last year particular areas went into a state of drought-like conditions and the government appealed for more money for relief food. Once we become dependent on relief food ,then it becomes a big problem. We need to pull our people out of this environment.

**Strategies at National Level:**

- Σ Promote integrated policy approach to food security, e.g unhealthy water sources can be a cause.
- Σ Increase budgetary allocation to agricultural sector and nutrition. Overtime money has been reduced.
- Σ Build of human and institutional capacity-many are trained in Kenya but improvement has only gone from 33 to 30% in the last Demographic Health Survey ,but this at national ,not on the ground.
- Σ Strengthen agricultural and nutrition research
- Σ Strengthen early warning systems at national and local levels
- Σ Develop efficient and effective marketing systems

**Strategies at Household Level:**

- Σ Improve natural resource (soil health, water management etc)
- Σ Intensify and diversify food production, for example we need to move to other foods rather than relying on maize only
- Σ Diversify on-farm enterprises with high value products
- Σ Enhancing agricultural extension services
- Σ Promote mother and infant malnutrition
- Σ Reduce micronutrient deficiency
- Σ Reduce prevalence of diseases that cause malnutrition

**Challenges**

- Σ Increasing levels of poverty
- Σ Low budgetary allocation supporting food security and nutrition-we need to advocate for more funding or else nutrition will suffer.
- Σ Developing mechanisms for fostering linkages and coordination of food and nutrition security in related activities of different sectors
- Σ Providing accurate, relevant and comprehensive information on :
  - v WHO are the food insecure?
  - v WHERE they are located?
  - v WHY they are insecure or vulnerable?
  - v Putting nutrition policy on decision makers agenda
  - v Developing effective technologies suitable for resource poor farmers

**Conclusion**

- Σ Food insecurity is a complex phenomenon attributable to several factors: socio economic and political, performance of food economy, care practices, health and sanitation
- Σ Partnership at national and community levels is a key tackling underlying causes of food insecurity.
- Σ Identification of priority interventions for local conditions
- Σ The private sector is a major player and should participate in the development and implementation of policies that promote food security.

Food and nutrition security in the face of conflict and crisis – facing the challenge

INNC Nairobi, Kenya

22 February 2005

FAO/FSAU Nutrition project

Food Security Analysis Unit (Somalia) – 10 years

Nutrition information component – last 4 years

FSAU - Primary source of information on food security, livelihoods and nutrition in Somalia

Informing decision making on short and medium term interventions / early warning

Operational research, guideline development, technical support, capacity development

Regional initiatives

Overview

Greater Horn of Africa / sub-Saharan Africa

One of the few areas in the world where acute malnutrition has not decreased

Both chronic and acute (episodic) food insecurity

Crises / 'shocks' - natural and man-made

Need for specific strategies both during and outside periods of crisis

Horn of Africa – common nutrition themes

Acute malnutrition rates of over 15% (Z scores) not uncommon outside times of acute food security

'Chronic vulnerability'

Civil insecurity, underdevelopment, inadequate investment in education, health, food production causing almost constant movement from crisis to recovery to vulnerability to next crisis

Labels - Crisis, emergency, chronic emergency, complex emergency

Not all emergencies are sudden and unexpected

Natural disasters and climatic 'shocks' become an emergency when the capacity to cope fails among particular population groups or government.

Emergency response required when no response is made to early warning signs.

Horn of Africa – challenges related to conflicts and civil insecurity

Conflict both a cause and an effect of food insecurity

Civil insecurity, politics and policies posing a major challenge to longer term investment

Food insecurity and malnutrition addressed through short-term strategies

Only acute crises are addressed and insufficient attention given to chronic issues

Conflict introduces added dimensions of humanitarian access, negotiations with opposing sides in conflict, emphasis on 'do no harm' principle.

Nutrition during 'recovery'

- between crises

Short recovery period reducing resilience and capacity to deal with next crisis

Inability to recover - increasing destitution

Most evident in failure of some populations to ever reach acceptable nutritional status

Facing the challenges

Evidence based information and analysis

Understanding livelihoods and nutrition

Pro-actively linking information to decision making

Using regionally available human and material resources

Information on nutrition = information about people

Prompts exploration of wide variety of issues that influence human wellbeing (incl. FS)

Promotes inter-sectoral information sharing and analysis

Often the only indicator of human well-being during periods of crisis

Nutrition information

in food security context

Nutrition information promotes:

identification and questioning of deficits in baselines (outside crisis)

understanding of behavioral responses to food insecurity

understanding of the human cost of coping strategies

study of food quality and food diversity issues

focus on the human impact of 'hunger period'

understanding of resilience, existing vulnerability and capacity to withstand a crisis

Information and analysis

What information required – whose responsibility?

Anthropometry – use and abuse e.g. high levels of malnutrition required as evidence of food insecurity

Non-anthropometric data – food consumption and coping strategies

Information management e.g. archiving raw survey data

Malnutrition and dietary intake

Seasonal dietary issues

Livelihoods and nutrition

Use of livelihood based analysis allows us to understand:

How populations maintain livelihoods and welfare before a crisis

Vulnerability

Coping strategies

Interventions most likely to be effective to strengthen livelihoods

Linking information to decision-making

Know who needs what type of information and in which language. (Donors, academics, private sector, NGOs)

Aim to ensure that information is placed where it can be used for action.

Present clear messages with confidence.

Ensure consistency. (Consensus on recommendations)

Document the process – make it better next time.

Influencing decision making

More specific recommendations

Awareness and adherence to international standards

Active networking

Documenting and publicising experiences

Drawing on historical data

Nutrition actions in crisis situation

(or in crisis prone populations)

Food production and diversification

Access to food

Household food utilization

Health, water and sanitation

Caring practices

Community-based growth monitoring and promotion

Food and nutrition education

Training and extension

Food aid

Capacity development

Meeting the challenge

Information systems in place in crisis prone populations (before crisis)

Adequate baseline information available

Historical data available to decision makers

More experienced persons involved in decision making

Humanitarian access possible even in the presence of security constraints

Information and capacity development

Awareness and use of standards



SPHERE

SMART

Closer links with academic, private sector

Operational research / joint research initiatives

Regional networking

Support links among food security, health and other sectors

Focused capacity development (management, communication)

Thank you

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UNICEF Kenya Country Office Nutrition Section, P.O. Box 44145, Nairobi, Kenya, Tel: 622759/621051  
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Address by Maniza Zaman, Head, Nutrition Section, UNICEF Kenya Country Office, on 22nd February 2005, at the Inaugural National Nutrition Congress, Kenya School of Monetary Studies, Nairobi, Kenya.

Distinguished colleagues, ladies and gentlemen

It is indeed an honour to be here, representing the United Nations Children's Fund, to deliver an address on the topic of Rights Based Approach to Nutrition Programming. When I was first approached by the organizers of the congress about this presentation I was humbled at the realization that I was given the task of demystifying a sometimes abstract topic in front of such a learned and rich audience. I have taken up that challenge and hope that I do justice to the choice of speaker for this session.

The United Nations is founded on the principles of peace, justice, freedom and human rights. When the Secretary General launched the UN reform agenda in 1999, it was made very clear that all major UN activities should be guided by human rights principles. UNICEF as the agency charged with protecting the rights of children has embraced this strategy very strongly with pioneering work being done in the Eastern and Southern African Region.

In the context of UNICEF programme of cooperation with member states the key rights of the Child and the Convention Against All Forms of Discrimination against Women. Kenya has moved further than signing onto international conventions and has indeed domesticated these. The 2001 Children's Act is probably the key document underlining accountabilities of different levels of society to the children of Kenya.

We then have the Millennium Development Goals – 8 goals which are to be reached by 2015. Many countries have aligned their strategic national development plans to these goals. When you examine these goals which include the eradication of poverty and hunger, achievement of universal primary education, promotion of gender equality, reduction of child mortality, improvement of maternal health, combating HIV/AIDS, malaria and other diseases, you will note that nutrition is a thread that runs through most of the goals. Without an improvement in nutritional status and investment in this sector, the other goals cannot be achieved. So we really do need to pay attention to programming approaches that can potentially change the way we do business and make a difference.

I would like to steer this address by outlining what is meant by a Human Rights Based Approach to Programming and then relate it to a specific example for nutrition interventions. I will end by summarizing some of the key lessons so far in the region in applying such an approach.

For those who are experts in the subject I beg their forgiveness if I will tend to simplify the components of HRBAP – however I was informed that there would be many in this audience for whom this topic may be relatively new and thus I must strike the balance between becoming too abstract and being able to convey key ideas.

Let us start by noting key human rights principles. Human rights are:

- (a) universal – they are claimed by every human being
- (b) non-discriminatory – enjoyed without discrimination
- (c) indivisible and interdependent

- (d) inalienable – they cannot be taken away

In what I have said so far the key word for programming is 'claim' – every individual has rights to CLAIM. The realization of these rights is an obligation on the part of a DUTY-BEARER or several DUTY-BEARERS. In a rights based approach we do not talk any more of 'meeting needs' – we talk of realizing rights (fulfilling or protecting rights) of CLAIM-HOLDERS. Needs do not imply duties and obligations – they can be met through will, charitable actions and benevolence – BUT as soon as you start talking of a child's rights you MUST be looking at the duties and obligations of many who are part of that child's world. For example it is not that a child needs good nutrition but rather a child is born with an undisputable right to proper nutrition.

Thus the first task at hand is to look at the world and fellow human beings in a very different way – the very idea of rights is based on ethics and principles and individual conviction of such an approach is central to applying a rights based approach to programming.

A rights based approach to programming invests in process and is not SOLELY driven by outcome. We are all too familiar with outcome driven programmes – quick results, usually top-down, initial heavy investments, and then quite often nothing is left when the 'donor' withdraws. In a rights based approach rigorous attention to and investment in PROCESS is inherent. A high quality process means participation, local ownership, empowerment and sustainability. Colleagues from the NGO sector may say 'so what is new' and yes many of you have been following process oriented models of development but how many have been able to go large scale with significant outcomes? The issue here is the BALANCE – using a process that has a strong potential for achieving good outcomes.

The basic process that is proposed and expanded on in HRBAP is the Triple A process that many in the nutrition sector are familiar with. This is ASSESSMENT, ANALYSIS AND ACTION. It is a way for rational decision making. Strengthening the capacity of all actors to engage in this triple A process is at the heart of a human rights approach to development.

Capacity of whom? It is argued that since manifestations of human rights violations are most visible in household and communities, we should focus on community-centered capacity development. In essence HRBAP aims at developing capacities for community empowerment while recognizing the relationships communities have with higher levels of society.

So what are the key steps in this capacity development?

- (a) step 1 – causality analysis; before a problem can be addressed it must be recognized as such at some level of society. Once recognized there must be consensus on the CAUSES of the problem otherwise there is not likely to be agreement on the solutions. A causality analysis can be helped by a CONCEPTUAL framework that looks not only at the immediate causes of the problem, but also the underlying and basic ones. (I would like to draw your attention to the handout on the conceptual framework for the causes of malnutrition). This type of analysis can be done at different levels, from community to national, though the level of aggregation will be different. At the end of the analysis you will have a list of rights that are either being violated or at risk of being violated and the causes of these violations.

(b) step 2 – role / pattern analysis; in simple terms this is a "who is who" and how are they related in contributing to the problem and potentially solving it.

Let me illustrate by an example. Babies are the first level claim holders for breastfeeding. The mother is usually the immediate duty-bearer. BUT she is not the only one – the father, extended family, community members also have a duty to ensure that the mother is supported to do this. Further the local health worker has a duty to provide the correct information about breast-feeding; at the district level the district nutritionist has a duty to ensure that peripheral staff have adequate knowledge and resources to provide the outreach that is needed; and so on ...when we come to the State there is a duty to allocate sufficient resources to the sector, develop supportive policies and ensure their enactment, legislate the Code of Marketing of Breastmilk Substitutes, introduce mother-friendly labour laws and so on. The message is that we are all inter-related through these universal rights – we have obligations to others and others to us.

(c) step 3 – Capacity Analysis. Now that we know who claims a right and who should be realizing that right for the child we need to find out WHY that right is being violated or is at the risk of being violated. So why is the newborn being introduced to other fluids after 1 month? Why is the mother not exclusively breastfeeding? Is it a matter of motivation, physical problems, or does she not have the authority to pursue exclusively breastfeeding because the husband and mother-in-law are telling her to start feeding the infant with other fluids? What about resources – does she have organizational resources such as a family support system after childbirth that frees her from other chores so that she can be there to breast-feed on demand? To what extent is the community informed of the benefits of exclusive breastfeeding in terms of the wellbeing and health of their children and thus organize themselves to support a new mother? So all these are CAPACITY elements. Without such an in-depth understanding we would be unable to pick up the CAPACITY GAPS – those critical factors that are contributing to the baby not being exclusively breast-fed. So, for example, perhaps many of us have been investing in training district level personnel on infant feeding but somehow not much is changing in the exclusive breast-feeding indicators – we are then most likely not addressing the key capacity gaps at the right levels of duty bearers.

(d) step 4 – Identification of priority actions – these are those actions that will contribute to closing or narrowing the capacity gaps so that rights can be realized. In our breastfeeding example, candidate actions may include catalyzing the formation of mother-support groups, supporting community resource persons to visit and counsel new mothers – this may mean providing a bicycle if transport is an issue, parenting education initiatives through early childhood centres with a focus on including men and extended family members and also supporting national level mass communication efforts to promote breastfeeding. Responses are needed at all levels of society – those at the policy level must be aimed at directly or indirectly contributing to community capacity development.

(e) step 5 – design of programme. At this point priority actions should be put together to form projects and programmes. Commonly though you will find the reverse – programmes are divided into projects which are then divided to activities. What HRBAP proposes is that priority actions are translated into activities; these activities are clustered into projects which are then clustered into a programme. Let us remember that one single agency may not have the mandate to, enough resources for, or the comparative advantage in addressing the whole

range of selected priority actions. Partnerships and clear division of labour is critical here.

(f) Step 6 – monitoring outcome and process

A HRBAP demands that both the outcome of rights fulfillment and the quality of process needs to be monitored and evaluated. Monitoring quality of the process implies looking at issues of non-discrimination, partnership, ownership, dignity and empowerment. The work on this is evolving.

At this juncture I would like to briefly share some key experiences that UNICEF has had in applying HRBAP in Tanzania, Zimbabwe and here in Kenya. Comments are limited to process experiences – offices such as Mozambique have had notable successes in their malaria control programme by applying HRBAP/CCD – other offices are either in the process of evaluating outcomes or will be soon.

Notable are:

- Σ A better understanding of the role of all actors, including UNICEF's, to support the realization of children's rights (TNZ, ZBW)
- Σ Healthy to realize that UNICEF and its staff members also have duties and that we need to be both conscious and accountable for what we do and how we do it
- Σ Solutions do not necessarily have to be more resources or better training but that better communication and understanding can make the difference
- Σ On outcomes HRBAP forces us to focus sharply on results (TNZ)
- Σ This framework has helped to develop more appropriate communication strategies based on dialogue and consensus rather than 'message transmission' (TNZ)
- Σ Rights approach facilitates integration of activities at district and lower levels by sectoral departments (KEN)

## Challenges

- Σ Rights work can be viewed as legal reforms, condemnation of State parties or a form of conditionality imposed by developed world
- Σ Looking at all rights for all children everywhere can appear daunting
- Σ For some there was a worry that all programming achieved prior to adopting HRBAP had lost significance and they would have to start afresh
- Σ Process takes time – there may be a temptation to adopt more rapid but less empowering processes.
- Σ Sustaining community motivation and commitment requires visible changes in their situation and a perception that yes, they are capable of making changes happen (ZBW)
- Σ Access to quality information is important – a flawed assessment and/or analysis can lead to inappropriate actions (ZBW)
- Σ Resistance to decentralization and multisector approaches can hamper progress – while district level capacities have improved the same is not within sectors which continue with vertical programme management making coordination and integration difficult at lower levels (ZBW)

Ladies and gentlemen, now come to my concluding remarks. Over the years we have not made a dent in the levels of malnutrition in Kenya and one out three children is stunted - a gross violation of their rights to survival and development as stipulated in the 2001 Children's Act. The reduction of malnutrition requires multidisciplinary action and commitment at all levels. HRBAP gives us a strategy to determine why the situation is what it is, what needs to be done, by whom and at what

levels and how to empower them to take action. May I leave you with this thought – what is your duty, as a civil servant, an academic, a development partner, a fellow citizen, a member of a community and a family member, to that child whose right is not being fulfilled? Are you aware that you have a duty and do you feel accountable? My sincere hope is that you do feel accountable and if that is the case then we have made a start.

Thank you for your attention.



# The Impact of Economic Depression on Food Consumption Patterns Among Student in a Nigerian University

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

During the oil boom period students meals in Nigeria's tertiary institutions were highly subsidized by the government. The meals were of high quality as they were supervised and served through the cafeteria system. With the onset of economic depression from the early 80's till date, the cafeteria system was abolished, meal subsidies removed and students now cook their meals under deplorable conditions. This study was carried out to determine the effect of economic depression on the food consumption pattern of university of Benin students, (1999-2003). One thousand (1000) students were used for the study. The study was guided by seven research questions. Questionnaire were used as instrument for the study. Data collected were analysed using simple percentages and standard error of mean was calculated where necessary. Results showed an increase in the prices of food and services between 1999 and 2003. An increase in cost of living as well as increase in students expenditure on food was also observed. Economic depression was found to affect students food consumption pattern such that some students had to skip breakfast (or other meals), others resorted to eating cheap snacks of low nutritive value. The Students' feeding pattern was not found to be significantly ( $P>0.5$ ) affected by seasonality of food although an increase in the intake of fruits and vegetables was observed in the lush season.

Economic depression was also found to contribute to reduced nutrient intake by students. Students should be exposed to more nutrition education to enable them plan their meals. Also low cost protein enriched foods should be sold in the universities. The government should help students by restoring meal subsidy and the cafeteria system of feeding.

## Background of study

Food consumption patterns are usually developed from home and expected to be adhered to for life. However, several factors including: religion, culture, weather conditions (seasons of the year) peer group influence, social class aspiration, foreign travel, advertising, changing economy and stage of development on the individual, (Taylor and Pye, 1976, O Reilly Wright 1980, Uko-Aviomoh and Salami, 2000, Uko-Aviomoh 2001, Salami and Uko-Aviomoh 2004) are reported to influence food consumption pattern.

In Nigeria, the economic situation was very rosy in the 70 s. This period coincided with the period of oil boom and abundant foreign exchange earning. Nigerians then depended more on imported foods at affordable prices. Students meals in tertiary institutions of learning were highly subsidized and of good quality. Nigeria has experienced long military rules and epileptic democratic leadership since independence. The oil boom period of the 70 s to early 80 s coincided with the military rule. From the early 80 s the country underwent and is still undergoing serious economic hardship. With the down turn of the economy from the early 80 s till date, the cafeteria system of feeding was abolished and meal subsidies were completely withdrawn by the government.

Students in higher institutions of learning were and are still made to cook under very deplorable conditions in the hostels without cooking facilities. Alternatively, private individuals operate eating centers on campuses without supervision. The aftermath of these is that students eat just for satiety, depend on snacks and less nutritious meals.

It is very important that students eat good and nutritious meals. Research studies have also reported that a relationship exists between nutrition, intelligence and academic achievement (Nwosu and Nwaduawesi 1975, Ughamadu 1990).

Balanced diets supply the necessary nutrients required by the brain to function properly. It is only when a student is well fed that he can listen attentively and understand what he or she is being taught by the teacher.

Too little or too much of the food nutrients can have detrimental effect on the body (Nwabah 2000).

Apart from adequate nutrient intake, the food pattern must be regular on a daily basis to ensure good health i.e. Breakfast lunch, dinner should be eaten at the correct time. Breakfast is one of the most important foods that must not be skipped or toyed with. According to Owie (2003), eating of breakfast everyday, having 6-7 hours of sleep daily, moderate use of alcohol, absence of tobacco and absence of stress are among the seven factors identified and demonstrated to be highly related to good health and longevity.

Students in higher institutions of learning require balanced diets served three times a day with delicious snacks in between meals. The present democratic government started in 1999 till date. During the period of study (1999-2003). The fuel pump price and other petroleum products were increased (three times). This has led to a corresponding increase in food stuff, domestic fuel (kerosene, firewood, coal and gas, accommodation fee, transport cost, school fees, books and other writing materials. Such increase could lead to decrease in pocket money and feeding allowance given to students by the parents/guardian and increase in the amount of money, students spend on food.

## Objective of the study

This study is intended to find out the effect of the present economic hardship on students food consumption pattern. The specific objective of the study therefore was to:

- i. Study the food consumption pattern of University of Benin students.
- ii. Determine the effect of economic depression on the amount of feeding money given to University of Benin students by their parents/guardian.
- iii. Compare the food budget of students to standard food budget.
- iv. Determine the effect of peer group and social class aspiration on the feeding pattern of University of Benin students.

- v. Determine the effect of seasonality on the feeding pattern of University of Benin students.
- vi. Ascertain the level of nutrition education the student have received.
- vii. Develop strategies that will enhance the food consumption pattern of the students.

To achieve the objectives of the study, the following research question were raised:

- a. Does economic depression have any effect on the food consumption pattern of university students?
- b. Does the feeding pattern of University of Benin students conform to the recommended feeding pattern?
- c. Does economic depression affect the amount of money that parents/guardians give their wards for feeding?
- d. Does the students food budget conform to the recommended standard for food budget?
- e. Does seasonality affect the food consumption pattern of University of Benin students?
- f. Does peer group and social class aspiration affect the feeding pattern of University of Benin students?

## Methodology

### Population of Study

The full time students of University of Benin (UNIBEN) made up the population of study. There were a total of 15, 197 students (fifteen thousand, one hundred and ninety seven students) during the period of study.

### Sample and Sampling Procedure

One thousand (1,000) students were selected from the ten (10) faculties of the university. Six hundred males (600) and four hundred (400) female students made up the sample. The sampling procedure used was the stratified random sampling. One hundred (100) students were randomly selected from each of the 10 faculties (i.e. 60 male and 40 female students per faculty). The students used for the study were admitted into the University in 1999/2000 session. This period coincides with the beginning of the president Obasanjo's democratic government.

### Research Instrument

The research instrument used for this study was a well structured questionnaire. The questionnaire was made up of two parts the first part was designed to provide demographic information that will help provide answers to the research questions. The research instrument was validated using face validity. The test retest method was used to test the reliability of the instrument.

### Administration of Instrument

The questionnaires were distributed to the students from the 10 faculties based on sex and year of admission into the university through the help of research assistants.

### Method of Data Analysis

The data collected was analysed using simple percentages, and mean scores were determined and analysis of variance (where neces-

sary) was determined (after computing the data into means) using Duncan multiple range test described by Steel and Torrie (1966).

## Data Analysis and Discussion of findings

The results of the study is shown on table 1.8. Table 1 shows the demography of respondents. Results show that 800 out of the 1,000 respondents are adolescents (18-25 years), 144 respondents were between 26-33 years and 56 above 33 years of age (table 1). Results also showed that unmarried students ranked highest in number (792). This was closely followed by students who are married (158) while divorced students were 50.

Further discussion of the study was carried out by answering the research questions.

Question One: Does economic depression has any effect on the food consumption pattern of the students?

The answer to question one is provided in Tables 2 and 3.

Table 2 shows students feeding pattern in 1999 and 2003. In 1999, 672 (67.2%) of the respondents were able to include breakfast in their meals while only 400 (40%) of the respondents could afford to eat breakfast in 2003. When the frequency of lunch consumption was considered, results showed that 520 (52%) of the students ate lunch in 1999 while 320 (32%) of the respondents could afford lunch in 2003.

Snacks consumption followed another pattern as 600 (60%) of the respondents were reported to be eating snacks in 1999 against 776 (77.6%) in 2003. Nine hundred (90%) were found to have eaten dinner in 1999 while only 720 (72%) respondents ate dinner in the year 2003.

Results also show that fruit consumption was higher in 1999 (48%) than in the year 2003 (28%).

Table 3 shows the distribution of meals per day among respondents. In 1999, 480 students (48%) could afford to eat 3 meals a day while only 200 (20%) respondents ate 3 meals a day in 2003. Respondents who ate 2 times a day only scored highest (38%) against 10.8% as recorded in 1999. Other respondents score in descending order for 1999: & for those who eat twice a day plus snacks. Snacks only 3 times a day (8%), snacks a day only (6%), once a day + snacks (4%) and snacks alone 2 times a day (3.2%).

Table 2 and 3 showed that economic depression has effect on the food consumption pattern of University of Benin students. In 1999, more students (67.2%) could afford breakfast when compared to year 2003 40%. Fewer number of students were also found to eat lunch and dinner in the year 2003 compared to year 1999. The same trend was also observed in the consumption of fruits as fewer number of students (28%) could afford to include fruits in their menu compared to 1999 (40%). This is due to the increase in the price of food following the increase in fuel pump price coupled with the decrease in the average amount of money students receive for their upkeep after fuel pump price increase.

More students were found to eat snacks in the year 2003 than in the year 1999 because snacks are cheaper. According to Okeidiran (2000), most students sold in Nigerian University campuses and on the streets are nothing but just foods with very poor nutritive value. They are mainly filled with calories (i.e sugar + flour + flavour).

### **Question Two: Does the feeding pattern of University of Benin students conform to the recommended feeding pattern?**

Tables 2 and 3 shows that students feeding were not consistent with the recommended pattern. Although breakfast has been identified to be very important to intellectual development among children (Sunday Guardian 2004), longevity and well being (Owie 2003), yet any 40% of the respondents indicated that they eat breakfast in 2003. In the year 1999, a high percentage (67.2%) of the respondents were found to eat breakfast. This may be due to the initial salary increase (Living Wage) introduced by the current regime before eroding the effect off with recurrent fuel price increase which cleaned off the cushioning effect of the so called Living Wage, parents could afford to give their wards more money and food stuff were relatively cheap and fuel pump price was N22.00 per litre against N34.00 that was sold in the year 2003. Thus, economic depression was found to affect the level of students ability to eat breakfast.

Breakfast was also reported (Sunday Guardian 2004) to help students concentrate in their studies as the sugars needed for proper functioning of the brain is released slowly but steadily during digestion of food. Taking fruit drinks and other carbonated drinks as breakfast has been proved by scientist to result in direct release of sugar into the blood stream resulting in quick metabolism and absorption. This may not sustain proper working of the brain.

Also, in the year 1999, 48% of the respondents could afford 3 square meals a day but in 2003 when economic depression had intensified, only 20% of the respondents could afford 3 meals a day. This observation indicate that economic depression has imparted negatively on the feeding pattern of the students. Also, students were found to be eating snacks (14.4%) in 2003 when compared to 8% in 1999. This could be attributed to the cheapness of snacks sold in the campus coupled with the increase in students population with overcrowded nature of the hostel accommodation which makes cooking a nightmare in the hostels. Cheap snacks are synonymous with low nutritive value.

### **Question 3: Does economic depression affect the amount of money that parents/guardians give their wards for feeding/upkeep?**

Tables 4, 5 and 6 provide answers to this question. Table 4 shows the mean scores for upkeep money provided by parents/guardian in 1999/2003. In 1999 results show that more students were given N5,000 per month than in 2003 thus the number of students given N5,000 were significantly higher ( $P < 0.05$ ) in 2005 than those given N5,000 in the year 2003. This could be due to increase in fuel pump price during this period that resulted in a general increase in cost of living. The total cost of running a family increased and the impact was felt by students whose upkeep money was reduced. Students whose parents/guardian were giving them an average of N17,500 and N20,000 per month respectively were significantly lower in 2003 than in 1999. Although there was no significant difference in the students given N7,500 and N12,500, results show that fewer students received these amounts in the year 2003 than in 1999. This again could be due to economic depression which forced parents/guardians to effect a downward review of their wards upkeep money. Thus increase in the number of students given lower amount for upkeep money and decrease in the number of students given higher upkeep money as an indicator of effect of economic depression could be an adjustment and survival strategy on the part of parents/guardians especially when one

realizes that the fuel pump price was increased 3 times between 1999 and year 2003.

Results on the students expenditure of food shows that (Table 6) there was a marked increase in students expenditure on food in 2003 when compared to 1999. For all categories of upkeep money (except those provided N6,000 per month), results showed a significant ( $P < 0.05$ ) expenditure on food in 2003 when compared to 1999. Results showed that students were given less amount of money for their upkeep yet they spent more money on food. The only way most students could cushion the economic hardship was to decrease the number of meals they eat per day, exclude fruits from their diet or supplement food with cheap snacks. This certainly will affect food intake, household - security and students well-being.

### **Question 4: Does the students food budget conform to the recommended standard for food budget?**

Table 4 shows that students budget on food did not conform to the recommended standard for food budget. Students were found to spend between 40-48% of their total upkeep money on food in 1999 and between

60-70% in the year 2003. This shows an increase of about 20% in the year 2003. Thus the amount of money students spend on food was found to be higher than the recommended standard of 20-30% (Ukpore 1993). The trend observed may be due to the high cost of living that resulted from several increase in fuel pump price which has led to high increase in food prices.

### **Question 5: Does Seasonality affect the food Consumption pattern of University of Benin Students?**

Results show that there was an increase in the intake of all the food from all the classes studied (carbohydrates, proteins, fruits and vegetables) during the lush season and wet season. Such increase

was highest during the lush season. This could be due to the ready availability of these food substances during the lush season which forces its price downward thereby encouraging more students to eat them. However, the increase in the different food intake observed was not significant. This could be due to inadequate knowledge of nutrition as well as lean pocket.

### **Question 6: Does peer group and Social class aspiration affect the feeding pattern of University of Benin Students?**

The effect of peer group and social class aspiration on the feeding pattern of respondents is shown on table 8. Results showed that 48% of the respondents still retained their family feeding pattern, 40% copied the feeding pattern of their peers, 20% eat only snacks in order to belong to a high campus social class and 72% do not cook their food at all. Out of the 72%, 52% did not cook because there is no conducive environment for cooking in the hostel, while 20% of the students did not cook their meals themselves because it is not convenient. This implies that 72% of the respondents eat in the bukas or sometimes



**Table 1: Demography of Respondents:**

(a) Faculty	Number of Respondents				
	Total Number of student			Males	Females
	M	F	Total		
Art	119	215	334	15	10
Agriculture	105	95	200	15	10
Education	2483	2642	5125	15	10
Engineering	2950	636	3586	15	10
Law	730	742	1472	15	10
Medicine	997	611	1608	15	10
Science	172	146	318	15	10
Social Science	348	297	645	15	10
Pharmacy	838	779	1617	15	10
Dentistry	173	119	292	15	20
<b>Total</b>	<b>8915</b>	<b>6282</b>	<b>15,197</b>	<b>150</b>	<b>100</b>

Source: Educational Planning Unit University of Benin (2003)

Ages in years	Number of Respondents	
	Males	Females
	8 - 25	480
26 - 33	80	64
33 and above	40	16
Total	600	400

**(c) Marital status**

Marital status	Number of Respondents	
	Males	Females
	Married	80
Single	512	280
Divorced	8	42
Total	600	400

Mice/rats & cockroaches	42	24.7
Mice/rats, cockroaches & ants	30	17.6
Mice/rats & ants	10	5.8
Other	25	14.7
<b>Respondents on pension</b>	<b>170</b>	<b>100</b>
<b>Period of pension</b>	<b>170</b>	<b>100</b>
6-12 months	4	2.3
1-3 years	13	7.6
> 3 years	153	90.1
<b>Partner employed</b>	<b>7</b>	<b>4.2</b>
<b>Total household income per month</b>	<b>161</b>	<b>100</b>
< R500 (76 US\$)	1	0.6
R501-R1000 (78-154 US\$)	106	65.8
R1001-R1500 (155-231 US\$)	34	21.2
R1501-R2000 (232-308 US\$)	12	7.5
R2001-R2500 (309 – 385 US\$)	2	1.2
> R2500 (386 US\$)	6	3.7
<b>Number of people contributing to household income</b>	<b>161</b>	<b>100</b>
1	116	72
2	37	23
> 2	8	5
<b>Household member responsible for household money expenditure</b>	<b>170</b>	<b>100</b>
Father	12	7.1
Mother	53	31.2
Grandfather	93	54.7

A structured questionnaire was used to collect information on socio-demographic and socio-economic characteristics as well as childcare practices. Observation and Focus Group Discussion guidelines and key informant interview schedules were also used in the data collection.

Analysis of diet was done using Statistical Package for Social Sciences (SPSS) version 11.

### Results

The total population in the 320 households was 1313 persons with 652 (49.7%) Muslims and 661 (50.3%) Christians. The mean Christian and Muslim family size was  $4.1 \pm 1.2$  and  $4.1 \pm 1.2$  respectively. There was no significant difference between the family size in the Christian and Muslim households ( $t = -.4$ ;  $P = .7$ ). (Table 1). The females constituted 682 (51.9%) of the study population, which was slightly more than the male population of 631 (48.1%). There was no significance difference between the two sexes in the Muslims and Christians. ( $\chi^2 = 1.6$ ;  $P = 0.7$ ). Majority of the households were male headed (88.5) while 11.6% were female headed. The mean age of household heads was  $31.4 \pm 8.1$ , with a range of 18-66 years. The mean age of adults in the study population (18-80 years) was  $28.7 \pm 8.1$ . There was no significant difference between the female-headed households in Muslim and Christian households ( $\chi^2 = 2.1$ ;  $P = 0.2$ ).

The mean of the index children's mothers was  $25.2 \pm 4.9$  while that of the fathers was  $30.9 \pm 6.7$ .

Table 1: Persons distributed by age in the study population

	Muslim	Christian	Total
<5	212 (32.5%)	222 (33.6%)	434 (33.1%)
5 to 15	101 (15.5%)	119 (18.0%)	220 (6.8%)
16 to 25	145 (22.2%)	145 (21.9%)	290 (22.1%)
26 to 50	177 (27.1%)	170 (25.7%)	347 (26.4%)
>50	17 (2.5%)	5 (0.8%)	22 (1.7%)
Total	652 (100%)	661 (100.0%)	1313 (100%)

There was a high literacy level the study population; only 3.1% of residents in Makina (above five years of age) had no education, 51.79% attended primary education, whereas 29.9% and 10.8 % had attained secondary and post secondary level of education respectively. Only 4.4% of the residents had attended Madrasa. The difference in level of education attained between the Muslims and Christians was statistically significant ( $\chi^2 = 43.05$ ;  $P = 0.00$ ). However, there difference between the literacy levels between the two religions was not statistically significant ( $\chi^2 = 3.8$ ;  $P = 0.148$ ).

Slightly less than a quarter and about one fifth (24% and 20.6%) of the study population above five years were employed and student's respectively. Those who engaged in businesses and casual labourers were 15.5% and 11.3% respectively whereas 28.7% were unemployed. The proportion of males who had occupations was significantly higher compared to their female counterparts ( $\chi^2 = 265.2$ ;  $P = 0.00$ ), however this difference was statistically insignificant with respect to Muslim and Christians ( $\chi^2 = 5.02$ ;  $P = 0.286$ ).

The majority of the study population was Nubian, who constituted 37.0%. Luyias, Luos, Kikuyus, Kambas, Somalis and Kisii constituted 21.6%, 17.0%, 5.3%, 4.9%, 2.5% and 2.5% respectively. There was a statistically significant difference between the ethnic distributions in the two religions ( $\chi^2 = 1005.8$ ;  $P = 0.0$ ).

**Table 3** Health indicators

Variable		%
<b>History of chronic diseases in family</b>	<b>170</b>	<b>%</b>
Skeleton disease (painful joints)	120	70.6
Ear, nose and throat (ENT) infections	123	72.4
Heart disease	59	34.7
Respiratory & chest disease	55	32.4
GI abnormalities	37	21.8
Genital abnormalities	28	16.5
Mental disorders	23	13.5
Headaches, chronic	82	48.2
High blood pressure medication	69	40.6
<b>Activity levels</b>	<b>170</b>	<b>100</b>
Heavy/rigorous	16	9.4
Moderate	74	43.5
Light	47	27.6
None	33	19.5
<b>Experience of weight loss during the past month</b>	<b>49</b>	<b>28.8</b>
<b>Experience of a recent change in appetite</b>	<b>51</b>	<b>30</b>
<b>Experience chewing problems</b>	<b>53</b>	<b>31.2</b>
<b>Experience problems with swallowing</b>	<b>24</b>	<b>14.1</b>
<b>Often experience of nausea</b>	<b>32</b>	<b>18.8</b>
<b>Often experience of diarrhoea</b>	<b>26</b>	<b>15.3</b>
<b>Often experience vomiting</b>	<b>15</b>	<b>8.8</b>
<b>Often constipated</b>	<b>33</b>	<b>19.4</b>
<b>Experience of fatigue</b>	<b>170</b>	<b>100</b>
Always	30	17.7
Sometimes	103	60.7
Never	37	21.6
<b>Hearing/speech/sight defects</b>	<b>110</b>	<b>64.7</b>
<b>Use of chronic medication</b>	<b>95</b>	<b>55.9</b>
<b>Type of health facility visited</b>	<b>140</b>	<b>100</b>
Traditional healer	6	4.3
Private doctor	28	20
Clinic	94	67.1
Hospital	12	8.6
<b>Access to health facilities</b>	<b>151</b>	<b>100</b>
On foot	100	66.2
Taxi	51	33.8

**Table 7: Meanscore of the effect of seasonality on food consumption pattern of students**

Seasons of the year	Type of Meals			
	Carbohydrate based	Protein based	Vegetables	Fruits
Dry Season	6.53	6.62	6.91	7.00
Wet Season	6.73	6.68	7.23	7.32
Lush season	7.01	7.02	7.25	7.40
SEM	0.67	0.65	0.62	0.59

*Values with the same letter are not significantly different P > 0.05*

Table 8: Effect of Peer Group and Social Class Aspiration on Feeding Pattern of Respondents

Respondents opinion on their feeding pattern	Frequency of Respondents (F)			
	YES (F)	%	NO (F)	%
i. I am retaining my parents feeding pattern.	480	48	520	52
ii. I eat more snacks than food due to peer group influence	400	40	600	60
iii. I eat more snacks than food so that I can belong to a high social class.	200	20	200	80
iv. I cannot cook because there is no comfortable cooking place in the hostel.	520	52	120	48
v. I cannot cook because cooking is a tedious job.	200	20	800	80

Table 9: Sources of Nutrition Education of Respondents

S/N	Sources of Nutrition Education	Frequency of Respondents (F)			
		YES(F)	%	NO(F)	%
(a)	Family education	200	20	800	80
(b)	Pre-primary education	00	00	1000	100
	Primary education	80	08	920	92
(d)	Secondary education	120	12	880	88
(e)	University education	120	12	880	88
(f)	Social/Youth clubs	60	06	940	94
(g)	Mass Media	24	24	460	46

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(e)	University education	120	12	880	88
(f)	Social/Youth clubs	60	06	940	94
(g)	Mass Media	24	24	460	46

depend on snacks. The snacks may be taken along with drinks for girls or alcohol for boys. This result points to the fact that majority of the students depend on snacks because of several reasons. This is very disturbing especially when one takes into consideration the nutritional value of snacks sold in the campus. Efforts should be made to ensure that quality snacks are sold on campus to ensure that students eat and benefit nutritionally from the snacks.

**Question 7: Have these students received any form of nutrition education?**

Table 9 shows the level of nutrition education respondents have been exposed to at different educational level. Results showed that non of the respondents ever received nutrition education at the pre-primary level. However, sources of nutrition education received include: Youth club and Social forums (6%), primary school level 8%, mass media 24% and University level 30%.

Efforts should be made to increase the level of awareness of University students on nutrition. Nutrition education can be included in the package normally delivered to students during the orientation exercise for freshers. It can also be incorporated into general studies curriculum. Students should be encouraged to continue to receive nutrition education from the mass media and youth fora. More efforts should be made to include nutrition education at the introductory stage at the family, pre-and primary levels of education.

**Conclusion/Recommendation**

University students are saddled with several problems that affect their reading, health and well being. Food intake and feeding pattern of students depend on several factors namely the amount of money available, time available for, cooking, cooking facilities available, nutritional knowledge and peer group influence. Economic depression was found to significantly ( $P < 0.05$ ) affect the amount of money given to students for upkeep/food by their parents/guardian. The long term effect may be very unpalatable if drastic steps are not taken to redress the situation.

Parents should be encouraged at Parents Teachers Association (PTA) meetings to continue to give their wards nutrition education. Efforts should be made to market low cost protein enriched foods on the campuses e.g. soy ogi, soy garri, soy fufu etc. Students should be exposed to nutrition education at the point of entry into the University. Government should increase funding to Universities so that more modern hostels with cooking facilities could be built. Efforts should be made at controlling the quality of snacks and food sold on university campus. Nigerian government should work towards reinstating the cafeterial system of feeding to save the health of students and increase their reading hours for better academic performance.

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# The Potential of Horticulture in Alleviating Hunger and Micronutrient Deficiencies in Kenyan Households

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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1966.

## Abstract

Kenya is one of the leading exporters of horticultural produce in Africa and the world. In addition to the direct sales to supermarkets all over Europe, Kenya now commands a significant share of the flower trade in the Dutch auction markets. Vegetables and fruits in that order, also contribute to the now multi-million shilling business that export horticulture has become.

However, export horticulture accounts for only 5% of total horticultural production and a majority of the products are traded-in and consumed locally. Still, Kenya is one of the countries where hidden and intermittent absolute hunger is commonplace. Children, especially in rural areas still show classic symptoms of micronutrient deficiency and even among adult populations, poor nutrition is one of the main causes of early death. This has recently been compounded by the HIV pandemic, which is more lethal in those who are already weakened by malnutrition.

Fruits and vegetables contain most of the micronutrients that are necessary for disease prevention and the normal functioning of the human body. They also provide antioxidants and other compounds that rejuvenate the body and are ordinarily recommended in healthy diets. Recently, there has been a boon in the production and consumption of indigenous foods and herbs as these have been found to be both nutritive and therapeutic.

It is observed that while there is a wide variety of vegetables and fruits in Kenyan 'urban' markets throughout the year, with an increasing component comprising of indigenous vegetables, the rural dwellers do not have access to similar all-year supply. Some of the reasons responsible for this state of affairs include the over-commercialization of horticulture, poor infrastructure, cultural obstacles to balanced nutrition and lack of proper education on human nutrition

In this paper, the discussion of the above problems and recommendations are made targeted at mitigating micronutrient deficiency through better management of horticulture and horticultural produce.

Key words: micronutrient deficiency, horticulture, human nutrition

## Introduction

Micronutrient deficiency is a massive and rapidly growing public health problem among nearly all poor people in many developing nations, affecting about 40% of the world's people [1]. In Kenya, a significant percentage of the people who suffer from micronutrient malnutrition are among the resource poor small-scale farmers, who comprise about 85% of the total population. The rapid increase in people afflicted with micronutrient malnutrition during the last three decades coincides with the expansion of "green revolution" cropping systems in developing nations. This pernicious, but preventable human health crisis calls for a new agenda for agriculture, an agenda that no longer focuses the agricultural community only on staple food production as

the primary goal, but one that also recognizes the urgent need for agriculture to pay attention to producing enough food of high nutritional quality and diversity to satisfy a balanced diet for all people thereby ensuring healthy and productive lives. Global food systems must be changed in ways that will ensure that communities can take advantage of the locally available resources to satisfy their own nutritional needs.

The recent spread of "green revolution" cropping systems is correlated with micronutrient malnutrition in many of the developing countries. For example, in South Asia, the introduction of modern wheat and rice production practices which resulted in about a 200% and a 400% increase in rice and wheat production respectively over the past 40 years is associated with time trends in the growth of iron deficiency anemia among non-pregnant, premenopausal women, and negatively related to time trends in the iron density (mg Fe per kcal of available food) of diets. The same types of negative associations are also found in data collected from China, Sub-Saharan Africa, South America, Middle America/ Caribbean, and Southeast Asia [2].

What are the causal factors responsible for this worrisome trend in global nutritional health, and has agriculture unintendedly contributed to massive increases in micronutrient malnutrition globally? There is no way of knowing with any certainty, but certain changes in crop production systems could be contributing significantly to the growing problem of micronutrient malnutrition (i.e., "hidden hunger").

The use of modern cereal cropping systems in many developing nations has been paralleled by decreased per capita production and consumption of traditional foods having higher micronutrient density (e.g. legume seeds and pulses). This has resulted in lower availability of foods rich in micronutrients for the poor at least in some regions of the world. For example, in Bangladesh between the years of 1978 and 1996, per capita rice and wheat production kept pace with or exceeded population growth while total pulse production dramatically declined during this entire period. Obviously, the agricultural changes that occurred in Bangladesh during the past three decades have resulted in increased rice and wheat production at the expense of pulse and legume production. The actual reasons responsible for this trend are not known, but they may be related to government policies and subsidies that promoted the expansion of cereal crops without considering the effects of such policies on pulse and legume production.

The situation outlined above is similar to the Kenyan situation where maize has gradually taken over as the staple food. However, there is still significant production of legumes, a situation that has been improved by the expanding horticulture industry, and the gradual intensification and diversification of agricultural production.

Legume seeds and other fresh vegetable and fruit products are richer sources of micronutrients in diets than are cereal grains for two reasons. First, most commonly eaten pulse seeds (beans, lentils, chickpeas, peas, etc.) contain higher concentrations of micronutrients when compared to whole rice and wheat grain. Second, pulse seeds and other horticultural products are normally prepared and eaten without processing while both rice and wheat grain are normally processed



(i.e., milled and/or polished) before cooking and consumption which removes various grain parts (e.g., the germ and aleurone layer) that are rich sources of micronutrients. Thus, a combination of decreased availability and consumption of pulses, and an increase in consumption of the less micronutrient-rich milled rice and other refined cereal grain products could be contributing to the growth in micronutrient malnutrition seen in many nations of the developing world.

The consequences of micronutrient deficiencies are profound and insidious. They diminish the health, livelihood, and well being of all those afflicted and the productivity and stability of the societies in which these people live in ways that are not always obvious [3,4]. It has, in fact been argued in some quarters that one of the main reasons why Africa lags behind the rest of the world in almost all development areas is due to disease and ignorance exacerbated by chronic malnutrition. Agriculture's commendable struggle to end global hunger has unfortunately coincided with the rapid growth of "hidden hunger" among the world's poor - a clear case of a failing global food system.

Apparently, agriculture's primary focus on producing more cereals rich in calories to meet growing energy demands from population pressures has resulted in reduced food supplies high in micronutrients, especially for the world's poor. We are now faced with a growing world population that is not starving in great numbers from energy deprivation, but that is becoming more malnourished with every passing day. The magnitude and profound consequences of micronutrient malnutrition to human health and well being demands a new "greener" revolution. This new revolution should explicitly link agricultural production to human nutrition and health with the goal of eliminating "hidden hunger" globally and providing dietary nutritional balance to all in sustainable ways.

### The state of the horticulture industry in Kenya

Horticultural production in Kenya dates back to colonial times when the arrival of missionaries, and Indian conscripts during the building of the Kenya-Uganda railway led to the establishment of kitchen gardens. Horticultural production was further catalyzed by the 1st world war when Kenya was selected as one of the regions to supply food for armed forces. Designated projects were established in Karatina, Nyeri, Naivasha and Kitale for this purpose [5].

Recognizing the importance of horticulture, the government of Kenya by an act of parliament set up the Horticulture Crops Development Authority (HCDA) in 1969 to develop and regulate the industry.

Horticulture grew rapidly with the advent of direct exports of fresh produce to European and Middle East markets. By 1996, the area under horticultural production was estimated at about 178,000 ha. Since then, it has continued to expand rapidly at an estimated annual growth rate averaging 15-20%. Horticulture is now the fastest growing agriculture sub-sector and contributes close to 13% of the national gross domestic product (GDP). The main producers who account for more than 80% of total production are rural small-scale farmers who farm on less than one acre of land.

Presently, the sub-sector is a multibillion industry with a total value of about 54 billion Kenya shillings. The export market accounts for over 133000 metric tons of produce valued at 28 billion Kenya shillings, while domestic consumption and agro-processing account for approximately 2666000 and 400000 metric tons respectively, valued at 26 billion Kenya shillings [5].

Some of the vegetables, spices and fruits exported from Kenya are shown in Table 1 and 2 along with trends and volumes in Fig. 1 and 2.

### The potential of Kenyan horticulture to alleviate hunger and micronutrient deficiency

Agriculture and horticulture in particular have the potential to supply almost all the micronutrients and vitamins necessary for normal human development (Table 3 and 4). The various sources of vitamins and micronutrients listed show that agricultural and horticultural products are capable of providing most of the micronutrients and vitamins necessary in human diets. The main edibles are fresh fruits, fresh vegetables, herbs, spices, root and tuber crops, and nuts. These are known to contribute different micronutrients and vitamins.

Kenya is mainly an agricultural country and large volumes of horticultural products are cultivated mostly for export. From the data provided in Table 1 and 2, it can be seen that Kenya exports large quantities of a very wide variety of fruits, vegetables, herbs and spices. A great majority of the vegetables are produced specifically for designated export markets and are rarely considered as potential sources of food for the domestic market or even for the producing households. Kenyan diets generally limit themselves to the few common vegetables and fruits even in cases where there is documented evidence on the nutritional and therapeutic advantages of some of the less common medicinal vegetables, herbs and spices. The situation has however not remained the same and some of the export vegetables and fruits are gradually finding their way into domestic markets.

Another component of horticulture that can contribute to the alleviation of hidden hunger is well managed production of indigenous vegetables fruits and other traditional foods. There is now increasing awareness on the nutritional benefits of traditional and indigenous foods that were initially harvested from their natural habitats. As a consequence, these wild plants are gradually being domesticated, produced commercially and made available at the market place throughout the year. This is however only true for the urban consumer. Rural consumers who are also the most vulnerable group in relation to micronutrient and vitamin deficiency still depend on natural sources and these products are available only seasonally.

Hunger and micronutrient deficiencies common in most families within both urban and rural areas of Kenya can to a greater extent be eliminated by the consumption of indigenous and locally produced horticultural crops which include fruits, vegetables, herbs, spices, tubers and roots. Most of these products provide considerable ample amounts of micronutrients required by the body. According to [6], these vegetables may supply much of the required vitamins especially vitamin A, B and C, minerals, carbohydrates, fiber and proteins. For example Black nightshade (*Solanum nigrum* L.) is a popular traditional vegetable in East Africa that is a rich source of nutrients in the rural as well as urban areas. It supplies much of the required vitamin A, B and C along with essential minerals, fiber, carbohydrates and proteins. Green vegetables are the cheapest and most abundant sources of proteins as they are able to synthesize amino acids [7].

The consumption of exotic vegetable and fruits should also be maintained. Vegetables like carrots are good sources of vitamins A and other nutrients while brassicas like kales, collards and cabbages along with spinach are good sources of vitamin B and C. Consumption of aromatic spices such as coriander, dill, fennel, asparagus, parsley and celery contributes nutritional and therapeutic qualities to food while improving the eating quality of other horticultural products including indigenous vegetables. Vegetable alliums are also used as condiments thus improving the flavor of food.

Legumes are produced and consumed in large quantities in

Kenya. This should be encouraged even more because legumes are richer sources of micronutrients in diets than are cereals grains. French beans lentils, chickpeas, peas and snow peas contain higher concentrations of micronutrients compared to whole rice and wheat grains. Pulse and legume seeds are normally prepared and eaten without removal of seed parts while both rice and wheat grains are normally processed (i.e.) milled and or polished) before cooking and consumption which removes various nutrients. The germ and aleurone layer) that are rich sources of micronutrient are removed during cereal processing and it is likely that a combination of decreased availability and consumption of pulses and an increase in consumption of the less micronutrient rich milled rice and other refined cereals grains products could be contributing to the growth in micronutrients malnutrition seen in many nations of the developing world Kenya being one of them

The commercial nature of horticultural production means also that the produce has higher value than other agricultural products. It has been shown that engagement in horticultural production can alleviate poverty and can be recommended as one of the strategies of empowering rural communities. Horticulture can thus indirectly contribute to micronutrient and vitamin deficiency by availing more disposable income to rural families. It is hoped such vulnerable groups will invest some of the earnings from horticulture in micronutrient and vitamin rich plant and animal products.

### Social and policy issues that need to be addressed

As it is now, domestic horticulture has been overshadowed by export horticulture, and though very large volumes of produce are traded in and consumed locally, there is no clear policy framework for promoting and safeguarding local horticulture through standardization monitoring and quality control. There has also been no attempt to single out horticulture as a potential solution to some of the micronutrient and vitamin malnutrition problems prevalent in the country. There are also some horticultural crops that are produced purely for the domestic market. These products that comprise of indigenous vegetables, fruits, some herbs spices and medicinal plants need to be singled and special programs developed for their improvement, promotion and marketing.

There is now no comprehensive, systematic germplasm collection of indigenous vegetables that have been made and very little research on agronomic problems have been carried out. There is poor resource utilization in production in terms of fertilizer amount and area which leads to sub- optimal yields.

Most of these vegetables have not benefited from research on selection and breeding for improved palatability. While trying to narrow the gap between population growth and food supply, attention has been focused on exploitation and utilization of other plant materials for food [8]. One of the biggest constraints to the nutritional exploitation of these species is the presence of certain anti- nutritional and toxic substance such as nitrates, oxalates and saponins which may impair the health of consumers. The presence of oxalates in foods has been implicated in reducing the bioavailability of essential minerals such as calcium. Some leafy plants and some root crop contain markedly high levels of soluble and insoluble oxalates, which when consumed can bind calcium and other minerals.

Research therefore needs to be done on processing methods to remove the anti-nutrients and make the vitamins and micronutrients more available. There is also need with regard to indigenous herbs, spices and medicinal plants to identify and quantify the active ingredients, and to also determine their availability.

The research should also go hand in hand with continuous public education on nutrition, nutritional requirements, and foods and supplements to satisfy these requirements. Rural dwellers amongst whom are the most vulnerable groups to micronutrient and vitamin malnutrition should also be educated and encouraged to diversify their dietary inputs.

In Kenya like in many other African countries, there are some communities where the social values and taboos related to foods may sometimes have a negative impact on nutrition. Children and women who are the most vulnerable groups are usually the target of such dietary restrictions. Such practices need to be eliminated through education and empowerment [9]

### Conclusion

For purposes of alleviating hunger and micronutrient deficiency, we believe there is need to recognize domestic horticulture as one of the sectors that should receive more support in terms of planning and technical expertise. Of special concern should be the setting and enforcement of industry standards and a code of practice to protect consumers, and the popularization of horticultural products as part of rural diets. The background to the need for the promotion of domestic horticulture is the necessity to recognize nutrition as a strategic part of national development. Proper human nutrition especially at the critical formative stages is crucial for raising a healthy and more productive citizenry. National policy should therefore recognize domestic horticulture as an important sector in agriculture that is crucial for both economic growth and nutrition.

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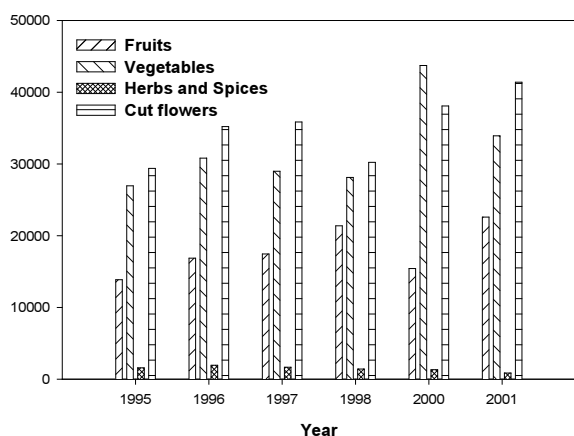
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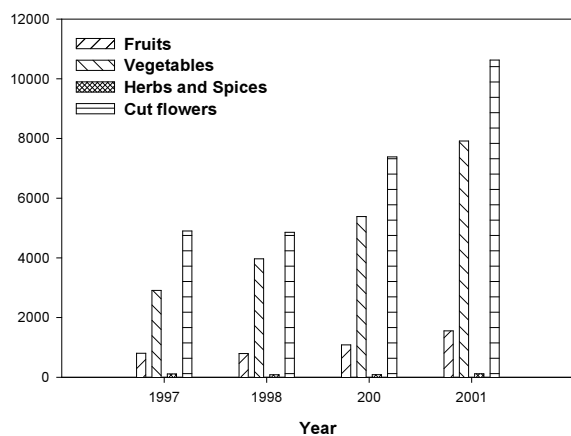
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**Fig. 1. Volume of fresh fruits, vegetable and cut flower exports from Kenya by air and sea. (Source, Ministry of Agriculture and Marketing, Horticultural Division Annual Reports).**



**Fig. 2. Value of exports for fresh fruits, vegetable and cut flowers from Kenya by air and sea. (Source, Ministry of Agriculture and Marketing, Horticultural Division Annual Reports).**



**Table 1: Fruit types exported from Kenya**

Common name	Botanical name
Apple	<i>Malus domestica</i>
Avocado	<i>Persea americanum</i>
Banana	<i>Musa spp</i>
Betel nuts	<i>Areca catechu</i>
Bixa	<i>Bixa orellana</i>
Cashewnuts	<i>Anarcadium occidentale</i>
Coconut	<i>Cocos nucifera</i>
Currants	<i>Ribes spp</i>
Custard apple	<i>Annona squamosa</i>
Gooseberry	<i>Embllica officinalis</i>
Grape fruit	<i>Citrus grnadis</i>
Groundnuts	<i>Arachis hypogea</i>
Guava	<i>Psidium guajava</i>
Horned Melon	<i>Cucumis metuliferus</i>
Lemon	<i>Citrus jambhiri</i>
Lime	<i>Citrus limon</i>
Litchi	<i>Litchi sinensis</i>
Macadamia nuts	<i>Macadamia integrifolia</i>
Mango	<i>Mangifera indica</i>
Melon	<i>Cucumis melo</i>
Oranges	<i>Citrus sinensis</i>
Passion fruit	<i>Passiflora edulis</i>
Papaya	<i>Carica papaya</i>
Peaches	<i>Prunus persica</i>
Pears	<i>Malus domestica</i>
Pineapple	<i>Ananas comosus</i>
Plums	<i>Pyrus communis</i>
Raspberry	<i>Rubus spp.</i>
Sour sop	<i>Annona muricata</i>
Strawberry	<i>Fragaria x ananassa</i>
Tamarillos	<i>Cyphomandra betacea</i>
Tangerines	<i>Citrus reticulata</i>
Yellow passion	<i>Passiflora edulis var. flavicarpa</i>

**Table 2: Vegetable species exported from Kenya**

Comon name	Botanical Name	Indian vegetables
Asparagus	<i>Asparagus officinalis</i>	Chora
Aubergines	<i>Solanum melongena</i>	Dudhi
Baby corn	<i>Zea mays</i>	Gisoda
Beans	<i>Phaseolus spp</i>	Gunda
Beetroot	<i>Beta vulgaris</i>	Guwar
Broccoli	<i>Brassica oleracea italica</i>	Palak
Cabbage	<i>Brassica oleracea capitata</i>	Papri
Capsicums/chillies	<i>Capsicum annuum</i>	Patra
Cassava	<i>Manihot esculentus</i>	Ravaya
Cauliflower	<i>Brassica oleracea botrytis</i>	Saragwo
Celery	<i>Apium graveolens dulce</i>	Turia
Chives	<i>Allium schoenoprasum</i>	Tuwer
Coriander	<i>Coriandrum sativum</i>	Valore
Courgettes	<i>Cucurbita pepo</i>	
Cucumber	<i>Cucumis sativus</i>	
Dill	<i>Anethum graveolens</i>	
French beans	<i>Phaseolus vulgaris</i>	
Garlic	<i>Allium sativum</i>	
Ginger	<i>Zingiber officinale</i>	
Kales	<i>Brassica oleracea acephala</i>	
Karella	<i>Momordica charantia</i>	
Leeks	<i>Allium</i>	
Lettuce	<i>Lactuca sativa</i>	
Marrow	<i>Cucurbita evifera</i>	
Cooking_banana	<i>Musa spp</i>	
Miraa	<i>Catha edulis</i>	
White button mushrooms	<i>Agaricus spp</i>	
Okra	<i>Abelmoschus esculentus</i>	
Onions	<i>Allium cepa</i>	
Parsley	<i>Petroselinum crispum</i>	
Peas	<i>Pisum sativum</i>	
Snap peas	<i>Phaseolus vulgaris</i>	
Snow peas	<i>Phaseolus vulgaris</i>	
Potatoes	<i>Solanum tuberosum</i>	
Pumpkins	<i>Cucurbita pepo</i>	
Radish	<i>Raphanus sativus</i>	
Spinach	<i>Spinosa oleracea</i>	
Sugar cane	<i>Taraxacum officinale</i>	
Sweet corn	<i>Zea mays</i>	
Sweet potatoes	<i>Ipomoea batatas</i>	
Tomatoes	<i>Lycopersicon esculentum</i>	
Turnips	<i>Brassica napus subsp. napus</i>	
Yams	<i>Dioscorea batatas</i>	

**Table 3: Micronutrients necessary for human health and their possible agriculture (horticultural) sources**

Element	Rich Food Sources
Arsenic	fish, grain* and cereal products
Boron	Non-citrus fruits, leafy vegetables, nuts, and pulses
Chromium	processed meats, whole grain products, pulses, and spices
Copper	organ meats, seafood, nuts and seeds
Fluorine	tea, marine fish consumed with bones
Iodine	seafood, iodized table salt; milk
Iron	meats, eggs, vegetables and iron-fortified cereals
Manganese	whole grain and cereal products, fruits and vegetables, tea
Molybdenum	milk, beans, breads and cereals
Nickel	chocolate, nuts, dried beans, peas and grains
Selenium	seafood, organ meats; meats; cereal grains, Brazil nuts.
Silicon	unrefined grains, cereal products; root and tuber crops
Vanadium	shellfish, mushrooms, black pepper, dill seed
Zinc	red meats, cheese, legume seeds and pulses

**Table 4: Vitamins necessary for human health and their possible agriculture (horticultural) sources**

Vitamin	
Water soluble	
Ascorbic acid (vitamin C)	citrus fruits; potatoes; peppers; broccoli; spinach;atoes, green leafy vegetables
Biotin	Rich Food Sources
Cobalamin (vitamin B12)	
Folates (folic acid)	liver, yeast, leafy vegetables, legumes, some fruits
Niacin (nicotinamide)	meats, milk and eggs
Pantothenic acid	animal tissues, whole cereal grains, legumes
Pyroxidine (vitamin B6)	chicken, fish, kidney, liver, pork, eggs, unmilled rice, soy beans, oats, whole wheat, peanuts, walnuts
Riboflavin	meats, poultry, fish, dairy products, green vegetables
Thiamin	unrefined cereal gains, brewer's yeast, organ meats, lean cuts of pork, legumes, seeds and nuts
Fat soluble	
Vitamin A (retinoids)	liver, fish liver oils, whole milk, eggs,carrots, dark-reen afy vegetables (e.g., spinach)
Vitamin D (calciferol)	eggs, fortified foods including milk, butter and margarine
Vitamin E (tocopherols & tocotrienols)	common vegetable oils (e.g., soybean, corn , cotton seed and safflower), wheat germ, nuts, green leafy vegetables
Vitamin K (phylloquinone & menaquinones)	green leafy vegetables (e.g., spinach, broccoli, brussels sprouts, kale, & turnip greens), milk, meats, eggs, cereals; fruits and other vegetables

# The Role of Post Harvest Management in Food Security

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Attaining food security for the world's population remains an elusive goal, in the face of decreasing arable land availability, increasing poverty, tremendous postharvest food losses as well as high population growth rates. Africa's food production is largely rain-fed and characterized by seasonal gluts and shortages, often resulting in famine. A holistic approach to the food system addressing food production through distribution to consumption is required to address food insecurity problems related to qualitative and quantitative food losses. Over the years many technologies have been developed to address productivity challenges, with resultant increases in food production. However, these gains made have not been fully translated into increased food security as postharvest food losses have remained high, between 30 and 40% in certain areas. This is particularly true for horticultural produce, one of Kenya's most important sources of income for rural populations. Losses occurring during postharvest operations particularly transportation, storage and processing may be addressed through capacity building of all those involved in postharvest food handling. Adequate levels of postharvest management, particularly processing, will go a long way in ensuring that the safety, quantity and quality of food produced and consumed sufficiently meets the food and nutrition security needs of the African population.

This paper will explore some of the challenges and requirements unique to the African postharvest food system, while focusing on specific interventions carried out in Kenya to reduce some of the losses. Of particular significance is the role of capacity building for postharvest handling in contributing not just to food security but to overall development.

**Key words:** capacity building, food security, processing, posthar-

vest management, mango

## Introduction

The Horticulture Development Centre is a USAID-funded programme to implement the Kenya Horticulture Development Project (KHDP). The project is managed by the agribusiness firm Fintrac Inc. Its objective is to increase rural household incomes, and therefore increase food security for rural families, through increased production of horticultural crops and products. The project has three strategic pillars and five target product categories. The three strategic pillars are: EurepGAP and product traceability; product development and domestic market opportunities while the product categories are: fresh and processed passion fruit, chilli products, vanilla and spices, cashew and mango, smallholder flowers and local market vegetables. These products were found to be specifically suitable for smallholders, who can develop a competitive advantage in their production.

An analysis of the major constraint to the HDC activities and target product shows that the constraints have both pre- and post harvest components (Table 1). Post-harvest management is a key component of the project activities, both to retain value through optimization of wastage, and value addition through processing. This report will

**Table 1: Major constraints to development for HDC activities and target products**

Activity	Pre-harvest issues	Post-harvest issues
<b>Eurepgap and Traceability</b>	+++	+
<b>Domestic Market Systems</b>	+++	+++
<b>Product Development:</b>		
• <b>Mango</b>		+++
• <b>Cashew</b>	+++	+
• <b>Passion fruit</b>	+++	++
• <b>Chilli products</b>	+++	++
• <b>Vanilla and spices</b>	+++	
• <b>Smallholder flowers</b>	++	+++



focus on mango from the Tana River area as a case study in post-harvest management.

### Analysis of the problem

About 26% of Kenyan mangoes are produced in Coast Province [1, 2]. Estimates show that at least 15,000 tonnes of these grow along the Tana River, a relatively remote area north of Malindi with no electricity and poor roads [1]. As a result, attempts to attract investment in processing, or to increase utilisation in other ways have been unsuccessful, although the massive wastage of mangoes from the Tana is well-known [1, 3]. Numerous reasons have been given for the high wastage levels: over-production; exploitation by brokers (marketing); bad handling; inadequate processing capacity (postharvest systems); impassable roads (infrastructure); and sometimes unsuitable varieties (production).

### Marketing constraints

A market analysis showed that:

- (a) For most of the year, processors and fresh fruit traders are unable to obtain sufficient fruit to meet local market demand [1].
- (b) The world demand for mango pulp is growing and that Kenya could compete with traditional suppliers such as India [4].
- (c) Local market prices are well above costs of production and marketing for most of the year (Figure 1) [5].
- (d) Brokers do not take an unreasonable share of the price relative to the commercial risks which they take (Table 2) [1, 6].

Source: Ministry of Agriculture, 2004

### Handling systems and infrastructure issues

Observations and data collected during the 2004/2005 season between the Tana Delta region and Milly Fruit Processors in Mtwapa (near Mombasa) showed that lack of handling facilities and impassable roads during heavy rains created a minimum of 12% wastage under optimum conditions and up to 100% when consignments of over-mature fruit were held up by road flooding [1, 6]. Other factors such as tall trees, incorrect harvesting, multiple handling, over-heating and overloading also contribute to wastage.

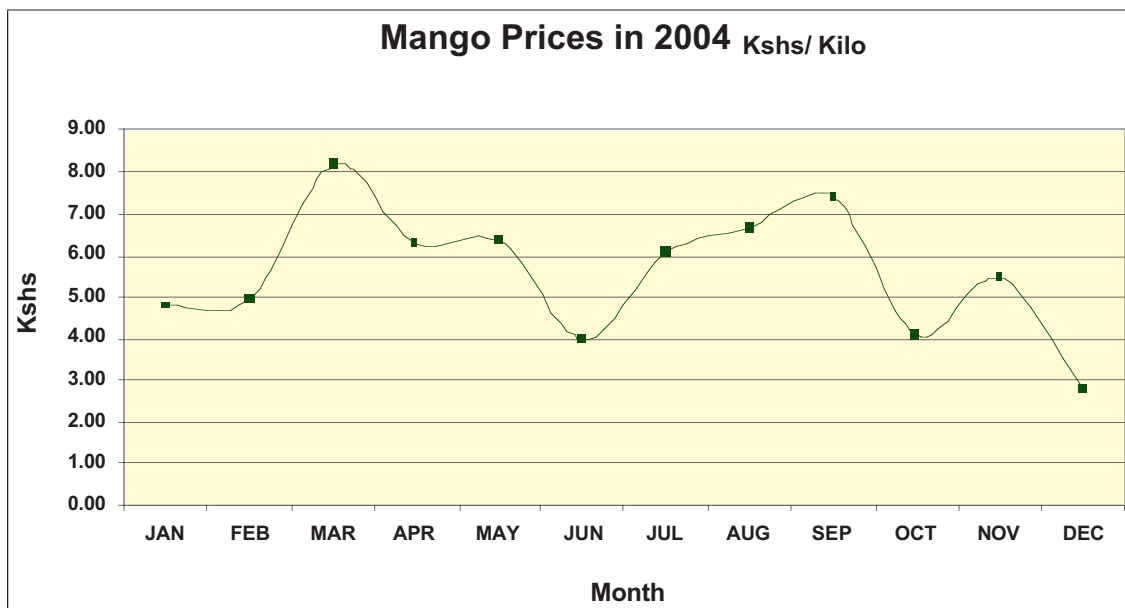
Overall the most important factor contributing to wastage was uncoordinated collection and delivery of fruit to customers. Since neither processors nor traders send their own transport or provide product specifications, growers have little information on the type of fruit required. They have no incentive to grade fruit to improve the market quality. Since there are no contracts, and the same price is paid to all suppliers, brokers and transporters are unmotivated to take measures which would improve quality and utilisation.

The net result is that growers sell on weight basis alone, with no attention to quality, and the primary buyers protect themselves against high risks and high costs, by paying as low a price as possible. Nevertheless, as has been seen from Table 3, their margins are relatively low [1, 6].

### Production issues

Although many trees are old and tall, which makes harvesting difficult; this is not a major constraint at present. Growers are experienced in harvesting from tall trees to reduce bruising, and the age of trees is not yet a critical factor in reducing yields to uneconomic levels. Furthermore, the predominant varieties, Ngowe and Apple,

Fig. 1: Monthly Mango Prices for the Nairobi Fresh Market



**Table 2: Cost distribution in mango value chain.**

Cost category	Cost/ price per kilogram	Percentage
Market price	8.00	100
(processing)		
Grower	2.50	31
Transport	2.44	30
Wastage	0.90	11
Overhead and margin	2.16	28

accounting for 95% of available fruit, have excellent flavour and juice content – ideal for both fresh market and processing [1]. The Tana Delta is unique in that there are two distinct production seasons, with the trees receiving water all year round, since they are adjacent to the river banks [1].

## Conclusions and recommendations

Change can only take place after a reorganisation of the marketing arrangements to provide incentives for growers, brokers, transporters, processors and traders to implement more efficient systems. This involves, for example, the adoption of product specifications, supply contracts and quality incentives, with the resultant handling changes necessary to increase utilisation taking place. Additionally, several stretches of access roads must be improved to remain passable throughout the mango season.

To address these specific problems HDC has:

- negotiated contracts and specifications to be implemented between processors and three target groups in the Tana Delta
- provided equipment for low-cost road maintenance by the growers
- constructed low-cost collection centres by the river where fruit can be graded and consolidated for collection at Chara , Ozi and Wema locations
- initiated a training programme in post-harvest handling to meet processor specifications

If the programme is successful, over an eight-month harvesting period, an additional 3,000 tonnes of mango will be utilised per annum providing income of at least KSh 13 million to 2800 low income families through influencing the processors to increase the price per kilogram of mango received. This will be as a result of programmed deliveries of quality product on a consistent basis, which meets factory specifications. In this way, HDC will have contributed to the global goal of improving food security through simple, cost-effective and specific actions.

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# Sedentarization of The Maasai and its Impacts to Household Food Adequacy: A Case Study Within a Child Survival Area, Namelok, Kajiado District

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Background:** A cross-sectional survey on food adequacy among the Maasai was conducted in 191 rural households within a Child survival project area, Namelok, Kajiado District.

**Objectives:** The study was to determine the factors likely to predict household nutrient adequacy and food variety; investigate the activities geared towards household access to food; determine the household resource base and food purchases and preschoolers nutritional status.

**Methodology:**Data collection was by : Interview questionnaire, 24 hour recall questionnaire and anthropometric measurements of pre-schoolers.

**Results:** Access to food was dependent on the male household head control of resources. Household food adequacy was predicted by household wealth, number of pre-school children and expenditure on food. Nutrient adequacy per consumer unit for energy and iron were 73% and 45 % of requirement, respectively. Protein and Vitamin A were adequate. One-third of the households had energy adequacy of < 60 % of requirement and at risk of being food insecure. Prevalence of stunting was at 60%, 28 % underweight and 9% wasted.

**Conclusion:** Intervention is needed to address the food consumption and dietary patterns; sensitization to improve health and sanitation and initiate activities geared towards improving the income of women to improve access to food within the household.

## Introduction

Among the pastoralists, efforts to improve livestock production have achieved little success. They are herdsmen or shepherds and attach great importance to the number of their stock rather than their productive efficiency [1]. Most efforts call for a change in their pastoralic lifestyle, a life that they have skillfully perfected, both socially, economically and with a pattern closely associated with constraints imposed by the environment [2]. Notwithstanding, some developmental efforts encourage the Maasai pastoralists in Kenya to enter the cash economy through the sale of animals and introduction of crop production especially where the climate allows[1]. Some factors that have led to this are: (i) increase in family size, due to improvement in health care; (ii) government's emphasis on sedentarization coupled with improved communication networks and infrastructure to improve marketing, accessibility to education, water and health services; (iii) inability to support the growing population, particularly during droughts thus necessitating relief food. It is assumed that the shift from pastoralism to agricultural production will improve their access to developmental services, infrastructure and self sufficiency in food. However, with increase in family size within an environment of limited resources and carrying capacity, it is expected that the household access to food may be a serious constraint unless the households have adopted alternative means of acquiring food.

The objectives of this study were:

(i) To determine the factors likely to predict household nutrient adequacy and food variety among the households participating in child survival project in Namelok.

(ii) To investigate the activities geared towards improving household access to food.

To determine the nutritional status of pre-school children.

## Methodology

One Hundred and ninety one (191) households from six clusters within the study region were selected using systematic random sampling. Data collection tools were: one questionnaire for general household characteristics, demography, information on food production, food frequencies, monthly food purchases and income generating activities and another for 24 hour food recall which was conducted twice at a monthly interval. Qualitative data was collected from two focus group discussions and key informant interviews.

Results were analysed using statistical packages d-BASE III and SPSS; in which both descriptive and multivariate analyses were performed.

## Results And Discussions

Factors likely to predict household food adequacy and food variety were household wealth, household expenditure on food and the number of pre-school children in the house. (Table 1).

Increase in real wealth contributed significantly to the nutrient adequacy by increasing food production and purchased food by 20% and 5% respectively. The number of pre-schoolers coupled with wealth also improved dietary intake adequacy by 16%. This was due to the relief food and Unimix provided. Unimix rations were based on the number of pre-schoolers in the household with those having at least two pre-schoolers better off in their dietary intake adequacy compared to those with only one. Unfortunately, the UNIMIX was shared by the whole family thus reducing the amount available to the children and may have consequently contributed to the children's poor nutrition and well-being.

Household energy intake adequacy was inadequate in 2/3 study households with intakes of <80 % of requirements. This indicates worse times for the Maasai if the conditions persist. However, the unexpected low energy intakes may be due to over estimation of RDA values used [1,3,4], since the Maasai's are generally less active and would have lower requirements than expected RDA.

Contributions from own produce, in form of calories and proteins comprised 19 % and 31% of requirement, respectively. This implies that their dietary intake would have been much lower were it not for relief food. Food consumption as analysed from the 24 hour food

recall, for nutrients, energy, Vit. A and iron are shown in Table 2. Their energy intakes are still lower than those of agrarian population [5]. High Vit A intake was from available milk during wet season and fortified vegetable oil provided with food ration. Low iron intakes were due to low consumption of meats and vegetables. Low consumption of vegetables was an attitudinal factor. This implies there may be high risk of anaemia and other micronutrient deficiencies.

Increase in household income is expected to improve access to food [6]. However, in this study this was not the case. Probable explanation being who controls and decides on income expenditure. Income was controlled by the male household head who also purchased the food. The cultural aspect of sharing seemed to limit amount of food purchased especially if the money to be spent was little.

**TABLE 1. Step-wise regression of nutrient (Energy) adequacy, from farm produce, food purchase and dietary intake, with selected variables.**

Variable	Nutritional wasting	status stunting	underweight
Household size	-0.1656* (0.022)	0.1543* (0.033)	-0.0815 (0.263)
Own produce food	0.2166** (0.003)	0.1750* (0.015)	-0.1134 (0.118)
Sex (male)	-0.0589 (0.418)	-0.0749 (0.303)	-0.1468* (0.043)
No. of children /hhd	-0.1677* (0.020)	0.1677 (0.020)	-0.0667 (0.359)
energy intake adequacy	-0.3660** (0.005)	0.1590 (0.223)	-0.2388 (0.071)
Income	-0.0626 (0.390)	0.1096 (0.131)	-0.0214 (0.769)
Purchased food	-0.1884** (0.009)	0.1354 (0.062)	-0.1137 (0.117)
Age	-0.2075** (0.004)	0.1415 (0.051)	-0.0867 (0.233)
Illness	0.3799*** (0.000)	-0.2526*** (0.000)	0.2474*** (0.001)
Wealth	0.0627 (0.398)	0.0397 (0.593)	0.1142 (0.123)

\* significant at p<0.05.  
 \*\* significant at p<0.01.  
 \*\*\* significant at p<0.001.

Poor production per acreage was attributed to low mechanization, inadequate technical support and wildlife menace. The Maasai, now undergoing sedentarization from pastoralism are yet to familiarize themselves with farming practises and therefore engaged the Chagga from Tanzania as farm hands.

Income generating activities improved household wealth but with

little contribution to household access to food, since the male household heads controlled income and a small portion of it was spent on food while the rest was diverted to other luxury items [1,7,8].

Nutrition status and health condition of preschoolers were mainly influenced by caloric intake and illnesses. (Table 3). Prevalence of wasting was 9.0%, underweight 28.0% and stunting 56.7%. This indicated worsening nutrition well being of the children over the years [8,9,10] with the boys worse of compared to their female counterparts. Contributing factors were the decline in the national economic growth in the early 1990s, rise in food prices and poor utilisation of health services as a result of the government restructure, and the Structural Adjustment Programme.

Increase in household size affected children nutritional status negatively with the larger households having more malnourished children. Probably due to reduced food allocation in the household or type of weaning foods and feeding frequency [11].

Results indicated a covariation between both malnutrition and disease (Fig.1) with the younger children of ages 12-24 months, experiencing more episodes of illnesses; diarrhoeal diseases and vomiting,

poor feeding during teething, eating of dirt during crawling and exposure to poor sanitary environment. At later ages , 47 –60 months, the relationship between malnutrition and disease were reversed indicating malnutrition attributed to inadequate dietary intake.

## Conclusion

The results of this study can not be generalized to the whole pastoral population as the study focused on pastoralists who are currently undergoing sedentarization and other changes in their lifestyles. However, they indicate problems likely to be experienced among those turning to agro-pastoralism and commercial trade due to reduced grazing area as a result of land subdivision and increase in populations.

## Recommendation

Intervention is needed to address the food consumption and dietary patterns; sensitisation to

improve health and sanitation and initiate activities geared towards improving the income of

women to improve access to food within the household.

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**TABLE 2. Mean household nutrient intake, (cu/day), by source and the nutrient adequacy**

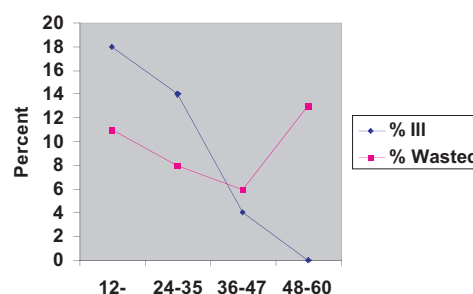
Nutrient	mean	SD	estimated RDA	adequacy of RDA	% consuming < 80% RDA	
<b>Protein</b>						
animal		219.05	( 73.0)			
plant		30.47	( 13.98)			
<b>TOTAL</b>	<b>249.52</b>	<b>(171.18)</b>	<b>60</b>	<b>415</b>	<b>0</b>	
<b>Energy (Kcal)</b>						
animal	814.37	(662.13)				
plant	1130.95	(524.47)				
<b>TOTAL</b>	<b>1945.32</b>	<b>(808.16)</b>	<b>2660</b>	<b>73</b>	<b>67.2</b>	
<b>Vitamin A (g)</b>		<b>1520.34</b>	<b>(826.83)</b>	<b>960</b>	<b>158</b>	<b>15.5</b>
<b>Iron(mg)</b>		<b>17.92</b>	<b>( 7.44)</b>	<b>40</b>	<b>45</b>	<b>98.4</b>

**TABLE 3. Pearson correlation between nutritional status of the children with selected variables.**

Variable	Nutritional wasting	status stunting	underweight
Household size	-0.1656* (0.022)	0.1543* (0.033)	-0.0815 (0.263)
Own produce food	0.2166** (0.003)	0.1750* (0.015)	-0.1134 (0.118)
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\* significant at p<0.05.  
 \*\* significant at p<0.01.  
 \*\*\* significant at p<0.001.

**Fig. 1. Relationship between malnutrition, Wasting and Illness, among the pre-school children by age.**



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# Socio-Demographic and Anthropometric Characteristics of Institutionalized Street Children Living in Shelters in the Vaal Triangle, Gauteng, South Africa

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Introduction:

Millions of children worldwide live on the streets or in shelters. This phenomenon is currently generating concern in South Africa where it is viewed as a result of economic hardship and its attendant problems. The majority of these children are black and studies have shown that there is a high prevalence of malnutrition among them.

## Objectives:

This study was designed to determine the socio-demographic and anthropometric characteristics of street children in four selected shelters in the Vaal Triangle. Although children in the fifth shelter were not included due to lack of cooperation of the caregiver, it is assumed that their conditions will be same.

## Methods:

The sample size was 67, consisting of 45 boys and 22 girls. Socio-demographic information was collected using a structured pre-tested questionnaire. Anthropometric measurements included height, weight and body mass index (BMI). Data obtained were analysed using percentiles, means, standard deviations (SDs) and Student's t-test.

## Results:

The mean ( $\pm$ SD) age of the children was 13.79  $\pm$ 3.44 years with 13.83  $\pm$ 3.13 years for the boys and 13.75 $\pm$ 4.01 years for the girls. The children either had non-existent or ineffective families. Sixty one percent had knowledge of at least one member of their families and 58.5% knew their mothers. In all cases, relatives had never visited them. The range of stay of the boys on the streets before they were recruited to the shelters was two months to ten years and for the girls from six months to eight years. All the children were in school, although in lower grades compared to others of their age. Anthropometric results showed no significant differences in height but there were significant differences in weight and BMI between the genders. The mean ( $\pm$ SD) weight for the boys and girls were 42.88  $\pm$ 12.62 kg and 46.07  $\pm$ 13.24 kg respectively. Sixty four percent of the boys were underweight and 27% of the girls were underweight. Thirty one percent of the boys and 45% of the girls had normal BMIs. Meals consumed by the respondents were mostly bread/tea for breakfast and maize meal porridge with vegetables for lunch and dinner. The children employed various coping strategies such as skipping meals and eating smaller portions or go hungry during periods of food insecurity in the shelters. More boys than girls had to skip meals, cut portion size or went hunger which may explain the large percentage of underweight among boys

**Keywords:** Street children, anthropometry, socio-demography, body mass index

## Conclusion:

The studied subjects showed significant differences ( $p < 0.01$ ) between boys and girls with respect to weight and BMI. These children undoubtedly may be vulnerable to a range of risks. The government should become more active in assisting these children since individuals and non-governmental organisations may not be able to deal with the challenges and needs of these children.

## Introduction

The phenomenon of street children is global and affects both the developed and developing countries. Its roots may be in the issues of poverty and income distribution [1,2]. The number of street children worldwide may be difficult to estimate, but UNICEF states that there are approximately 100 million with the number constantly growing. It is estimated that Africa has about 10 million of these children, especially in the urban centres which are faced with the process of rapid and unplanned urbanisation and industrialisation, family disintegration due to health or death, neglect, abuse or abandonment, poverty and social unrest [3,4]. This is further compounded by the outburst of population growth. Children now constitute half of the population with an estimated six out of ten urban dwellers likely to be under the age of 18 in 2005 [5]. The term "street children", coined in the 1970s, refers to several different kinds of experiences of children [6]. These are children for whom the street is home and the family non-existence or ineffective [7,8,9,10]. The United States Agency for International Development (USAID) has classified street children into four categories; namely a "child of the streets": children who have no home but the streets with no family support. They move from place to place, living in the shelters and abandoned buildings. A "child on the street": children who visit their families regularly and might even return every night to sleep at home, but spend most days and nights on the street because of poverty, overcrowding and sexual or physical abuse at home. "Part of a street": Children who live on sidewalks or city squares with the rest of their families. They may have been displaced due to poverty, wars or natural disasters. The families often live a nomadic life carrying their possessions with them. Children in institutionalized care: These children come from a situation of homelessness and are at risk of returning to a life on the street [8].

In South Africa (SA), the picture is not different from the global one. Baker [11] reported that the upsurge of street children in SA is a result of apartheid and its social and economic legacies, for instance, unemployment is high and has been steadily increasing since the 1960s with a decline in employment generation coupled with an annual population growth rate of 2.4%. SA also compares poorly with other middle income countries (Thailand, Poland, Chile, Brazil and Malaysia) in terms of other social indicators. A further factor in the growth of street children is the tragic HIV/AIDS pandemic. There is a legitimate fear that AIDS orphans will swell the ranks of the country's street children over the coming decades [11]. The poverty and economic status in Gauteng, a province in SA, has not been translated into broad-based



income redistribution and poverty alleviation. Levels of economic inequality and unemployment as measured by the Gini Coefficient, increased by 3% between 1995 and 2000 to 0.61. Such a high correlation is indicative of the effect of unemployment on economic inequality. Growing inequality has been most pronounced within the black population. The number of households with a monthly income below R1200 (200 USD) also grew by 8% between 1999 and 2000. A Human Sciences Research Council (HSRC) report estimated that about 48% of children lived in poor households [12] which could cause an increase in street children.

## Problem statement

The number of street children is growing at an alarming rate and these children have a right to a life of good quality. Without traditional homes and support systems, they often do not enjoy social and health services, among others. The 1989 Convention on the Rights of the Child clearly states

That children are a vulnerable group that deserves the protection of society [4,15]. Institutionalizing these children may well ensure that they are given the basic needs of life such as shelter, food, education and access to health so as to attain their potential and become fully functional adults [13,14]. Much of the research done to date on street children is largely quantitative using surveys with a social undertone [11]. Such studies provide limited information on the anthropometric profile of these children. Anthropometric profile is widely used in the assessment of the nutritional status of individuals and populations [16,17,18,19]. The majority of street children are black and studies have shown that there is high prevalence of malnutrition among black SA children. Therefore, improving the nutritional status of children in any community is one of the principal goals of nutrition and development programmes [16]. Furthermore, valid, sensitive and accurate assessment of the nutritional status of growing children is necessary for policy formulation to assist those in need [17]. Thus, the aim of this study was primarily concerned with examining the socio-demographic and anthropometric characteristics of street children living in shelters in the Vaal Triangle. Street children in this study were operationally defined as those children driven to the streets but now living in shelters in the care of social services or volunteer caregivers. Such children are assumed to be vulnerable to malnutrition.

## Subjects and methods

### Subjects

The study consisted of four out of a total of five shelters (Sebokeng, Sharpeville, Vereening Alliance and Emfuleni) in the Vaal Triangle, Gauteng. All these shelters are registered as Non Profit Organisations (NPOs). The objectives of the study and the voluntary nature of participation were explained to the caregivers and to each child. The consent of the caregivers was obtained and no incentives were offered to the children for participation. Agreeing to participate in the study was interpreted as obtaining consent from the children.

### Sample

The sample size for the study was all the children (67), consisting of 45 boys and 22 girls in four shelters (80% of shelters in the Vaal Triangle).

## Research instruments

All data were collected by the researchers to protect the quality of the data and to ensure that the responses were provided by the individual subjects without consulting the caregivers for answers.

### Questionnaire

A 28 item demographic questionnaire was administered by the researchers and completed with the assistance of the volunteer caregivers in the shelters. Information was gathered on education, gender, home language, duration of and reasons for stay on the streets, reasons for and period of stay in the shelter, parental knowledge if any, contact with parents and any source of income while in the shelter.

### Anthropometry

Weight and height were used to calculate body mass index (BMI) as weight (kg) divided by height (m) squared. A Philips electronic bathroom scale, model HF350 (135kg/100g) with a two point decimal precision was used to determine the weight of the children in loose clothing and barefoot. The standing height of all the children was taken in centimetres using a stadiometer, provided by Scales 2000, Durban. The average of two readings was used to the nearest 0.1 cm.

### Personal interview

The caregivers were interviewed by the researchers on the following:

- a. Background history of the shelter
- b. The source of income to manage the shelter
- c. The mode of acquiring the children
- d. General comments on the shelter and the children.

### Data analysis

Data were analysed using percentages, means and standard deviations. Student's t-test was also carried out to test the level of significance of differences between the boys and girls.

## Results

Four of the caregivers were volunteers with no formal training in handling children while one was trained as a social worker.

### Background history of the shelters

All the shelters participating in this study were founded by concerned citizens, although they had to be registered with the governmental Welfare Department. All the shelters were primarily established as a transit camp for children to be united with their families, but the caregivers often discovered that there was unwillingness by either the children or the families for such unity.

## Funding

All the shelters relied primarily on donations from individuals, churches and some businesses. Only one of the shelters in this study received funds from the government, although not on a regular basis.

## Mode of acquiring children

Some of the children (18%) opted to be residents on their own, others (22%) were brought in by the police while others (60%) were recruited by the caregivers.

## General comments on the homes and children

Caregivers complained about the over crowded nature of the homes and the unreliable nature of funding to run the homes. They were often concerned about controlling the adults amongst the residents who in some cases were 20 years and older.

## Socio-demographic profile

Sixty seven subjects, consisting of 45 boys and 22 girls participated in the study. Table 1 shows the findings on the selected socio-demographic characteristics of the street children in shelters studied. All the children in the study were black and attending school, but the majority of them were in lower grades compared to others of their age.

Regarding their stay on the streets before they were recruited into the homes, the results show that the boys had stayed longer (2-120 months, mean 38±2.1) on the streets than the girls (6-96 months, mean 23±1.0). The boys had stayed in the shelter from 4-168 months for a mean of 48±38.4 and the girls for 2-108 months (55±40.6 months). There was high disparity in the stay period of the children in the shelter because the recruiting process is continuous.

Of the total of 41 children that had knowledge of any member of their families, 62% were boys and 59 % (13) girls. The mother was the most known of the family members. Thirty six percent of the boys (17) knew the whereabouts of their mothers while 31% (7) of the girls had such knowledge. However, none of these children had been visited by any family members while in the shelters.

**Table 1: Socio-demographic characteristics of street children living in shelters**

Characteristics	Boys N=45	Girls N=22
Race		
Black	45	22
Education		
Number attending school	45	22
Stay on the street (months) before recruited	2-120	6-96
Mean ±SD	38± 2.1	23 ± 1.02
Period (months) already spent in shelter	4-168	2-108
Mean ±SD	48 ± 38.4	55 ± 40.6
Knowledge of any family member	28	13
Parent most known		
Mother	17	7
Father	9	2
Other	2	4
Number of visits by family	0	0
Any source of income	0	0

## Anthropometric profile

Table 2 shows the results of the anthropometric variables measured in the study. The mean (±SD) age for the boys was 13.83±3.13 years and 13.75±4.01 years for the girls. There were no significant differences (p>0.05) in the ages between the groups. The mean weight of the boys (42.88±12.62kg) differed significantly (p<0.01) from that of the girls (46.07±13.24). Height was 1.54±0.17m and 1.45±0.16m for the boys and girls respectively. There were no significant differences in the height of the boys and the girls. The mean BMI values were 17.81±3.27kg/m<sup>2</sup> for the boys and 21.36±4.71 for the girls. There was a significant difference (p<0.01) between the boys and the girls.

Table 3 shows the periods of residence and the BMI of the children. The children initially reacted positively to being resident in shelters but soon showed a decline in their BMI values. This pattern was same for both boys and girls.

**Table 2: Anthropometric characteristics of street children living in shelters**

Characteristics	Means	Standard deviation	p-Value Boys vs Girls
Ages (years)			
Boys	13.83	3.13	>.05
Girls	13.75	4.01	
Weight (Kg)			
Boys	42.88	12.62	<.05
Girls	46.07	13.24	
Height (m)			
Boys	1.54	0.17	>.05
Girls	1.45	0.15	
Body mass index (BMI)			
Boys	17.81	3.27	<.01
Girls	21.36	4.71	

**Table 3 Periods of residence and body mass index**

Characteristics	Boys Mean ±SD	Girls Mean ±SD
Average period of residence (months)	48±38.48	55±40.64
Body mass index (BMI)		
Periods of residence		
Less than 12 months	16.76±2.3	19.12±0.19
12-48 months	18.11±3.95	22.11±5.43
48-120 months	17.27±1.62	20.98±4.0
More than 120 months	15.82±1.4	21.13±0.24
Mean BMI	17.81±3.27	21.36±4.71

## Discussion

Findings from this study indicate that the average age for the boys was approximately 14 years and 12 years for the girls. This finding agrees with that reported by Le Roux [20] in Pretoria, SA. From his investigation, the average age of SA street children is approximately 13 years, predominantly male African origin and may have lived on the streets for 3 years or longer. All the children interviewed had lived on the streets for 2-120 months, although they could not cite the main motivating factors for leaving home. Their inability to remember may be connected to the fact that they had lived in the shelters for long

periods.

Although the findings of this study indicate that all the children in the study group are currently enrolled in schools, all were in lower grades than other children of their age. Street children suffer from a lack of educational opportunities [21]. This study confirmed the findings of other studies that the majority of street children are blacks as 100% of the children were black and 33% were girls compared to 67% boys. Boys are more prone to be on the streets than girls. Other studies done in Latin America and SA have confirmed that 10-15% of street children are girls with black and mixed race children over-represented among street children [11,20,23]

Some of the children in the current study reported knowledge of a member of their families, although they had never been visited. This gives credence to the findings of other studies that street children come from problematic family backgrounds [21].

The anthropometric characteristics of the children were based on weight and height. The girls in the study were within the normal weight range as indicated by their BMI, while the boys were under-nourished [22]. When the BMI values of the children were matched against the period of residence, there were increases, but these declined with time. The initial increase might have been a result of the drastic change from being uncared for on the streets to the care given in the shelters. The subsequent decline may be due to adjustments to the living conditions. Children rely on physical support from others and caring capacity which otherwise may act on weight as a causal model of malnutrition. These findings may be due to the support of donor groups to the shelters and may not necessarily reflect long term results. Ayuku et al. [19] reported that homelessness and absence of family support do not necessarily have adverse implications for physical development of children especially in difficult circumstances.

## Conclusion

Children in this study either had non-existent or ineffective families. Even in cases where the children had knowledge of their family members, they were never visited. Some of the children in this study stayed up to 10 years on the streets before they were recruited to the shelters.

Limited information is available in the literature about interventions that address the problems faced by street children in Gauteng, SA. All the children had varying ranges for BMI. Findings from the present study suggest that sheltering of street children may have positively improved their anthropometric profile hence the nutritional status. However, the present study did not compare street children in shelters with those currently on the streets. The anthropometric indices of the children upon admission to the shelters were also not known. There is a need for these findings to be validated by other studies using larger samples. If these findings are confirmed in future, shelters for street children should be vigorously pursued by government involvement instead of being left in the hands of individuals or philanthropic and non-governmental organisations. Efforts must be planned to improve the stability of families with its attendant problems so as to prevent children from going to live on the streets.

## Acknowledgements.

Our appreciation goes to the respondents for their cooperation and the Vaal University of Technology for funding this study and also to Prof. L. Greyvenstein, who did the language editing.

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Christian Children's Fund is Non-Governmental Organisation



# Livelihoods and Food Security Projects in Central Rift

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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assisting children in difficult circumstances. The mission of the organisation is to create an environment of hope and respect for needy children of all cultures and beliefs in which they have full opportunities to achieve their full potential, and to provide practical tools for positive change - to children, families and communities. CCF's position is therefore to ensure parents recognise and take responsibility for their children's development and growth. This responsibility includes the parents' role in providing the environment for growth and development of the children. The achievement of this ideal is only possible where the parents are able to achieve sustainable livelihoods.

The approach to the sustainable development is people centred. It starts with analysis of people's livelihoods and how these have been changing over time; involving communities fully and respecting their views; focuses on the impact of different policy and institutional arrangements upon people/households and upon the dimensions of poverty they define (rather than on people/households or overall output per se); working to support people to achieve their own livelihood goals.

CCF works for well being of children by supporting locally led initiatives that strengthen the families and communities, helping them overcome poverty and protect the rights of their children. Health and Nutrition are among major program areas through which CCF makes lasting and meaningful changes in children lives in spite of the fact that national efforts to reduce malnutrition are working, progress is slow and malnutrition is still a major cause of childhood morbidity and mortality [1]. For years CCF has allocated substantial resources to address the nutrition needs and problems of children in communities CCF serves.

## Food Security- A Key Component of CCFs Nutrition Program

Building food security is a key factor in proper nutrition and children's health. CCF's food security program targets population with malnourished children and those at risk of being malnourished. These programs fit into traditional food security components of availability, access and utilisation focusing on :improving agriculture; providing income generating activities; encouraging natural resources management and creation of related infrastructure. CCF recognises KARI as a strong partner in food security initiatives in various sites in the country where CCF is serving the community.

CCF has assisted communities implement the following programs in its project areas:

### Kitchen Gardening

Using the technology of organic farming, the livelihoods and food security program has initiated demonstration kitchen gardens where members of the community converge for training in Nakuru (Nakuru district) and Morop sites (Baringo central district). With support from

the program, members of the community replicate the projects within their homesteads. Currently we have 16 households preparing plots to initiate kitchen gardens within their compounds in Nakuru. In Baringo 30 groups are carrying out kitchen gardening. Some of the interviewed group members said that they use some of the vegetables for home consumption hence and they sell surplus to the local communities.

The bio intensive gardens do not use any chemicals. Locally available materials are used to make manure, pesticides and disease control supplies. With an aim to improve nutrition and food security at the household level, a wide range of indigenous and exotic vegetables are grown.

### Dairy Goats Project

The program has also considered the need to equip families with livestock breeds that are cheaper to keep while accruing maximum gains. We are currently training the farmers on dairy goat management as a prelude to distributing the goats. This is mainly in Kabito site (Keiyo), Morop site (Baringo Central) and Nakuru site (Nakuru district). 50 parents have undergone dairy goats management training and will be issued with goats in the between the month March and July 2005. A total of 70 goats will be purchased for the selected farmers. This will be a pilot project before they are introduced to the rest of the community.

Research has shown that goat milk is more nutritious than to cow milk. In addition, goats are cheaper to keep; they require less space; multiply faster due to shorter gestation period; feed on a wide range of plants as compared to cows. Many of goat's characteristics lead them to play a special role in alleviating poverty among the poorest in developing countries.

In the arid lowlands of Baringo central and Koibatek districts, lies the Marigat project site. Due to the harsh climatic condition and the delicate nature of the dairy goat, communities in this area have been supplied with the local small East African goat. These are beef goats that farmers can cull and sell to cater for other household expenses.

### Dairy Cows Project (Heifer to heifer project)

CCF Kenya years used provision of heifers, goats and pigs to help risk families build their assets base. The community identifies those most needy and determines the order of the receipt of the animal. The repayment for the gift or legacy is the return of an offspring so that the next on the list can benefit. This is an excellent example of program sustainability and one that encourages individual civic responsibility. Notwithstanding the risks involved in such endeavours it has been used to a certain degree of success by various institutions. Careful program design, training of recipients and monitoring will help avoid many pitfalls.

This has been implemented in various sites among them the high altitude site of Morop in Baringo central district. Income from sale of

milk helps meet household expenses. In the past years 62 heifers were provided by CCF and these has benefited 133 families. In the current year the Morop project has issued 11 households with heifers. Our target for this financial year is to issue 26 households with the animals.

## **Food Crop Farming**

The program has also organized for community members in the predominantly urban locale of Nakuru to hire tracts of land along the Mau Narok escarpment where food crop farming is done. The commonest types of crops cultivated include wheat, maize and beans. Harvests are either shared among households for domestic consumption or converted into cash to meet other domestic budgets. 178 households are participating in farming activities.

## **Tree and Fruit Nurseries**

Every community's livelihood is threatened where the environment is depleted. Planting trees is one way to ensure that our environment is stable to ensure that various ecosystems thrive to keep food webs and food chains in place. In Baringo central (Morop and Marigat sites), Keiyo (Kabito site) and Marakwet district (Lagam site), the program has initiated tree and fruit nurseries. During the rainy season, seedlings are distributed to communities for planting. Fruit trees do not only conserve the environment but also provide fruits, which are a rich source of vitamin C. Currently, the tree seedlings count at the various sites is as follows: Morop project has close to 20,000 tree and fruit seedlings, Kabito in Keiyo has 5,000 and Lagaam in Marakwet 6,000. In the Morop project 5 groups have established nurseries. Currently the project is working with more groups to establish nurseries.

## **Project Income Generating Activities.**

Due to ever stretching financial demands, project sites have been compelled to device methods of fund raising. In Central Rift, we have a hotel and lodgings in Morop site, a bookshop in Marigat site, a nursery school in Nakuru site and guest houses in Lagam site that are currently under construction.

In addition, project farms in Marigat, Morop, Kabito and Lagam sites generate income through sale of seedlings, bananas, pawpaws, cow milk, eggs, mangoes, oranges, vegetables and chicken. Proceeds from these projects are mainly used to support the bursary fund for post primary education.

## **Small Enterprise Project**

Community members in urban and peri-urban settings of Nakuru, Marigat and Morop sites engage in small-scale business enterprises. The program has supported individuals with small amounts as capital to put up small businesses.

More so, the program has helped link community members in business with micro finance institutions where they can acquire business loans. A good example is KADET, a World Vision sponsored micro finance project in Marigat and Kabarnet (Morop site)

# The Role of Traditional Food Preservation methods to alleviate food and nutrition in arid and semi-arid areas of Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

\*J. Lepoora and J. Epatt

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## About Christian Children's Fund (CCF)

Christian Children's Fund (CCF) is a child sponsorship agency championing the rights of the children across the country. Its mandate and scope is assisting children in difficult circumstances. The organization has its international headquarters in Richmond USA and its national office based in Nairobi, Kenya.

The organization has eleven clusters across the country with forty eight (48) child affiliated projects spread over eleven (11) clusters in thirty one (31) districts serving a total of forty eight thousand (48,000) children and impacts on an additional 200,000 in communities living in 31 districts in Kenya. The major programs of intervention are education, health and nutrition, ECCD, water and sustainable livelihoods.

## Overview

In traditional African communities, food preservation was done during rainy season when there was enough local food supplies. Local food preservation methods were widely used in many traditional African communities to alleviate food insecurity. Food preservation is aimed at conserving the abundant food resource in its original state for a long time without being affected by time span or weather changes.

During the rainy season in the ASAL districts of Kenya forage nourishes and nomadic herds increase in milk yields. In these areas, milk is the main staple food and meat is eaten less often than not especially during the rainy seasons. At such times, the nomadic communities preserve surplus animal products for future use during the dry season

when livestock give little or no milk at all.

In the wake of today's culture of over dependence on relief food donations, Christian Children's Fund is approaching problems to food insecurity in a different dimension.

The organization has recognized and is promoting indigenous drought coping mechanism, which have all along been negated with time. Before the colonial period pastoral indigenous communities had naturally survived in their environments without depending on external support as is the case today.

CCF strongly believes that the re-current food shortages among the Nomadic communities in Kenya can be averted if appropriate traditional methods of food preservation are adopted. CCF is promoting this idea through education in its areas of operation.

The CCF therefore believes that indigenous drought coping mechanisms are sustainable solutions to food insecurity at the household level. In this regard, the organization is undertaking community sensitization "barazas" to urge pastoral communities to adopt traditional methods of managing disasters.

In this sensitization exercise, CCF recognizes and promotes the use and preservation of indigenous foods and wild fruits in various regions across the country. For instance, the communities living around lakes and rivers are encouraged to preserve fish while those with livestock to preserve and use animal products. The organization also advocates the planting of seeds of edible wild plants and collection use and preservation of edible wild fruits.

This idea has been derived from the fact that since the advent of relief food distribution, various solutions to food insecurity have been explored, but none has borne any meaningful gain. It is on such grounds that CCF is viewing relief food aid as mere treatment of symptoms and not the real problem, because over and over again, the problem recurs, and whenever it recurs, it is bigger in magnitude and attracts more casualties.

Two main foods milk and meat were preserved. Edible fruits such as those of duom palm were also preserved for future consumption to supplement the animal products.

Other traditional drought coping strategies include: -

Ghee preparation and preservation.

Honey harvesting and storage.

Timing of livestock births

Consumption of hides and skins as the last resort.

In this discussion, we are going to look at how milk, meat, fish and some wild fruits are traditionally preserved.

## Milk

Milk yields increase during the rainy seasons such that the household cannot consume all. In such cases, the surplus milk is preserved using the following procedure



## Step 1. Fermenting Fresh Milk

Put fresh milk into gourds, leave it to ferment.

You can speed up the process of fermentation by putting the gourds or jerry cans in the sun.

Remember not to shake the contents while undergoing fermentation

Fill the gourd, to ¾ full to allow fermentation and shaking

Leave to ferment for about three days i.e. for the gourds used for the first time.



A woman shaking fermented milk to extract fat

## Step 2. Fat Extraction And Preservation

After milk has fermented, hang the gourd by the branch with a rope, at an appropriate height and distance for the person, then shake the sour milk vigorously until round lumps of fat form.

Shake the milk vigorously for about 1 hr or so, opening the lid to release building pressure and checking fat formation in the process of shaking.

Consume the sour milk directly or mix it with fresh milk to give a better taste.

When fat has formed in the milk, empty it in a calabash and remove floating fat (ngorno/akidedet) using a spoon.

To speed up fermentation and formation of more fat in the fresh milk return a little milk and fat in the gourd and ferment only for 1-2 days.

After using the gourd four times, wash with water and small round stones then put fresh milk and leave to ferment for 2 days.

Put fat (ngórno/ Akidedet) into ebur/ nyabur and store for a maximum of 1 week.

After storing ngórno for 1 week, melt it and boil for sometime. When heating, do not put a lot of heat. Reduce heat towards the end.

Cook until a brown residue collects at the bottom of the fat (emurr/raganya)

You can put a small piece of meat to give it the smell of meat fat

After heating ngórno, it becomes Lkisch (ghee). Lkisch is put into nyabur and it can be stored for about 1 year without going bad. NB/ Ngórno is found in and it can be produced from milk from all livestock except camel milk, which has little.

During drought, Lkisch is used to supplement other foods e.g animal products and wild fruits supplemented with Lkisch being given to children.

When drought persists, blood is drawn from animals and supple-

ment with Lkisch to be given to children.

When Lkisch is over, slaughter a sheep and give children soup to drink, some meat is eaten and some preserved.

When drought worsens and food situation becomes grave; slaughter a cow or camel to be eaten for along time. Much meat is preserved.

Lkisch is also supplemented with other preserved animal products such as Nkaya (rumen), sirikan (biltongs), lailelek and bones.

Water is added to preserved nkaya, biltongs, lailelek and bones then boiled.

Add Lkisch while boiling and stir (Aipir), then serve the soup and store the preserved animal parts. Before you add Lkisch, remove the preserved animal parts and store them safely somewhere in the house for re-use later.

You can eat one cow for over one month this way without slaughtering another.

Also, skin at the neck of an animal (abolibol) is removed, burnt to remove fur and stored for later use. When you want to use, beat and put in the pot, add Lkisch and boil. Drink its soup and store the skin for re-use later. You can also stir (Aipir) with sagaram (acacia fruits) soup and give children to drink.

Fat (Lkisch) is stored away for future use.

The surplus sour milk is stored for future use as follows

## Step 3. Fermenting Sour Milk (Ngakibuk / Kamanang)

Put the surplus milk into gourds each and every time there is more than enough for the family to consume until the gourds are almost full.

When the gourds are ¾ full let them ferment for another 4 to 5 days.

You can speed up the rate of fermentation by putting the gourds in the sun.

Remember not to shake the contents while undergoing fermentation.

## Step 4. Separating /Filtering

When milk is fully fermented, it curdles and water separates itself automatically from the curdle (edikae).

Water is poured or filtered out carefully into calabashes or other containers.

The water filtered out from the curdled milk is not wasted but consumed with fresh milk.

## Step 5. Cooking

Empty the curdle into clean sufurias and cook thoroughly until all moisture is removed from it.

Stir while cooking to avoid over burning

The cooked curdle forms pieces of dried milk particles.

Cook the curdle until it dries completely and turns yellow in colour.

## Step 6. Drying

Empty the cooked curdle pieces in a clean drying surface that is raised from the ground.

Spread them in the sun to dry for 1 – 2 days.

Beat or break down the sliced particles into even finer particles in order to enhance complete drying.

Remember to keep on turning over the milk particles while drying in the sun to enhance even drying.

### Step 7. Storage

After drying, collect the dried milk into air- proof sacks for storage purposes.

The sacks should be stored in moist free area preferably in a raised place in the house.

### Step 8. Use

Take any quantity of the powdered milk and mix up with fresh water or milk.

Add water or fresh milk

Cover and let it soak for a moment until it forms paste like mixture. Note that the dried milk particles swell when milk or water is added.

Keep on adding water or milk to the milk powder every time the dough mixture absorbs it, until it has softened for consumption.

Add a little sugar, ghee or fresh milk to the dough to taste, and then serve the dough.

Points To Note

The water filtered from the curdled milk is not wasted but is mixed with fresh milk and consumed.

Remember not to shake the milk while undergoing fermentation until after the filtration process is completed i.e. when is separated with milk curdles.

The dried up milk curdles should not contain any signs of dampness or wetness.

Food expiry is speeded up by certain insects that enter and destroy food.

Since traditional food preservation is done manually CCF encourages the communities through training checks and verifications are needed to determine the exact life span of the food preserved food while observing high hygiene.

Ensure high standard of hygiene are observed both at processing and preservation stages.

## 2. Meat

There are two methods of preserving meat among the nomadic community

Frying Method

Drying Method

### Deep Frying Method (Lakuli / Lokuli)

#### Procedure

There are three main steps to be followed when preparing lakuli/ Lokuli

1) Cooking of non fatty meat

Meat is separated from the bones and fat.

It is then cut into tiny pieces

Add water and boil until water is over and meat is well cooked. Caution should be taken not to over burn it.

2. Fat extraction process

Fatty meat is cut into bigger pieces

Water is added and then boiled until it is over, the meat melts into liquid fat.

Separate by decanting fat from its residue of fatty meat and keep in separate containers.

The fat residue is ready for consumption

Making the Lakuli

The liquid fat is mixed well with the cooked meat and boiled for a short time

(about 30 mins)

Keep stirring while boiling until the fat and meat properly mix together or until meat is dark brown in colour.

You can tell whether the meat is ripe from its good strong smell

Remove from fire and cover for a short time then empty it into storage containers

The storage container should be dry, with tight lid and not leaking.

Every time you require using Lakuli, scoop it with a clean dry spoon and replace the lid tightly after use.

### Drying Method (Biltongs / Sirikan / Ngátoosa)

#### Procedure

Separate meat from the bones and fat

Cut meat into thin long rolls (Biltongs)

Put salt in the meat and hang it with ropes in an open place with enough shade to dry

Let it dry out in the shade for almost 1 week

Ensure that the meat rolls are completely dry by beating them hard and looking for possible moisture inside the rolls

If you notice any signs of moisture, keep them in the open for another 2 to 3 more days

When the rolls dry out completely, store them in insect proof containers or sacks for future use. This kind of meat can be stored without going stale for about 6 months

It can be consumed either by boiling, roasting or eaten raw.

In case you boil, serve it hot and drink the soup or make ugali using the soup.



Biltongs hang in the house to dry for preservation purposes

### 3) Wild Fruits

#### A) Lpulee:

##### Procedure

- Collect ripe lpulee fruits (Yellow in Colour)
- Put in sufuria
- Add water
- Boil until top cover goes
- The next layer is another coat
- Pour it down in a freshly dried hide
- Beat gently with a flat and round grinding stones
- Children continue eating the next layer of the fruit while being beaten
- When the fruit breaks, the seed comes out
- Put the seed in a pot (Moti/amot)
- Add a lot of water and boil
- Put a stick inside the boiling seeds (at the center to allow oil circle at one point)
- Cook until water is over
- Continue adding water, until the fourth time when water changes in colour and fat forms out and moves round the stick
- Reduce the amount of heat as oil forms out
- Scoop the oil with spoon from the top of water
- When completely cooked seeds shrink and fat comes out
- When you finish removing oil, stir seeds and boil over and over again to extract more oil- about 3 times until oil extraction is exhausted from the seeds and seed ripen.
- The oil extracted from lpulee seeds is still poisonous because it can cause diarrhoea, so, put the oil in another sufuria and boil while washing cooked fruit with cold water 3 times.
- Cook the oil for short while or until remains /residues collect at the bottom of the sufuria and separates itself from fat, then leave the liquid all cool
- After cooling, decant slowly to separate the oil from the remains
- Oil is stored in Nyaburs
- After the seeds have been washed 3 times, they are safe for consumption
- So give children seeds mixed with oil to eat
- Lpulee oil is also used for medical purposes e.g it can be used for the treatment of coughs and skin diseases.
- When you want to prepare, follow the above process.
- N.B Rain water removes more fat than other ground water
- 5 kg of Lpulee fruit can extract 1litre of oil.

#### (b). Duom Palm (Eeng'ol / Loka):

##### 1st Process

- Collect duom palm fruits
- Leave them to dry completely in the sun.
- They are then slightly beaten to remove the top cover the sweet flesh is beaten even much harder after the top cover has been removed in order to separate it from the fruit itself.

It is then stored for later use. It can be taken with fat, animal blood, milk, water, or eaten dry

##### 2nd Process

- Collect the fruit.
- Peel slightly to remove the top bitter cover, (the top cover can be used to make traditional liquor.)
- Using a wrist knife peel the flesh.
- Collect the extracted flesh and store in sacks for future use
- The top bitter cover is mixed with acacia fruits and fed to animals during the dry season.



Naturally preserved Duom palm fruit flour ready for use or sale

#### C). Elamach /Serichoi

- Collect the ripe fruits.
- Beat gently to remove seeds.
- Soak the seed overnight in water.
- Decant the next morning and add water then boil in a lot of water.
- Every time it boils, pour out the water and put some other water.
- Do this for about 8-10hrs until the bitter taste disappears
- You can tell whether it is ready or not from the colour (from deep green to light green) of the form or the taste of water.
- When the seeds are ready, you can enrich with ghee, milk or meat.
- You can also dry it in the sun to preserve for future use.
- Keep turning while drying to enhance even drying.
- When completely dry, store in waterproof sacks.
- When you want to use the preserved elamach /edung /serichoi, soak it and boil together with millet/sorghum. You can add ghee or milk to enrich then serve.

#### D). Sagaram/Ng'itit (Acacia fruit)

- Collect the ripe dry fruits from sweet trees
- Grind the fruits in a mortar and pestle to make flour
- Separate acacia seeds from the flour.
- Store the flour in sacks for future use
- When you require using, mix the flour with milk and ghee (fresh animal blood can also be added).
- Then serve
- Or

Collect the fruits

Boil in a pot to make soup

Decant the soup from the fruit

Add ghee or animal fat or milk to the soup (traditionally, blood was also used).



Ripe acacia fruits ready for manual processing to make flour for later use

Then serve.

E). Other significant wild fruits that can be preserved include Lposan, Lpupo, Lerendei, Santait, Sitet etc.

The preparation and preservation of the above wild fruits is almost similar

#### Procedure

Collect the ripe fruits from respective plants.

Let them dry in the sun or naturally.

Store them in damp proof containers.

When you want to use, put the preserved fruits in sufuria and boil with lailelek to make soup.

Separate the soup from the fruits.

You may add ghee or any animal fat to enrich the soup.

Stir the soup and serve.

NB/You can re-boil the bones or lailelek for over 10 times before disposing.

These fruits can be boiled separately or can be boiled together in one pot as one wishes.

CCF recommends that boiling the fruits in one pot is more nutritious.

#### 4) Fish Preservation

There are three methods of fish preservation

Drying method

Smoking method

Frying method

#### Drying

Catch fish

Cut the fish open and remove all internal organs

Sprinkle iodized salt into the fish and put in the open sheds until it is completely dry.

Collect the dried fish fillets and store for future use, or sell.

It can be eaten raw when it is dry or it can be fried with onions, tomatoes, fat and other additives to make mboga for ugali or any other meal. Its soup is very nutritious.



A fisherman splitting the fish open for drying purposes at lake Turkana

CCF recognizes and promotes the use of indigenous foods in various regions depending on the availability e.g. for those people living around lakes and rivers are encouraged to preserve and use fish while those living in areas with edible wild fruits are encouraged to preserve and use them as a survival strategy.

#### Challenges

As we undertake this initiative, it is not without challenges, the various challenges noted when undertaking this initiative are not only our concern but the concern of everybody. The identified challenges are as follows: -

Restoring the fast disappearing edible wild fruits, plants through planting of seeds of edible wild trees in our nurseries and distributing the seedlings to communities.

2.CCF invites researchers to:-

i).Carry out studies on nutritional values of preserved indigenous foods and wild fruits.

ii).Determine exact life span of preserved indigenous foods and wild fruits

iii).Recommend the best food combinations to achieve the desired food nutrients.

iv).Look for ways and means of maintaining nutritional content of preserved foods for long.

3.CCF is concerned with hygienic conditions in which indigenous foods are prepared or preserved. In this case, it works with the relevant ministries to give guidance on the way forward in ensuring that hygienic conditions are observed in the process of making or preserving indigenous foods.

The tree planting programme, the running and establishment of tree nurseries undertaken by CCF across the country is facing one big challenge of water inaccessibility especially in the ASAL districts.

The diminishing livestock and indigenous plants population especially in ASAL districts has interfered with the survival mechanisms of the people in those areas. The disappearance of indigenous plants can be attributed to both human and natural activities such as charcoal

burning, indiscriminate cutting of trees for fencing, the changing weather conditions which have seen recurrent droughts and famine in formally self reliant ASAL districts and instilled in the people a foreign culture of overdependence on relief food aid.

Insecurity at the common borders of some ASAL districts has left large tracts of land idle with little or no use at all. Water accessibility is also a big problem in these areas. There is therefore an urgent need to address the issue of water and insecurity so that such idle tracts of fertile lands can be put into meaningful use.

## Glossary

Aipir (Sam)	Akipir (Turk)	-	To stir
Ng'orno (Sam)	Akidedet (Turk)	-	Fat extracted from sour milk
Lkisish (Sam)		-	Ghee / cooked fat
Nyabur (Sam)	eburr (Turk)	-	Ghee storage container.
Emurr (Turk)	raganya (Sam)	-	Residue that collects at the bottom of milk fat after cooking
Sirikan (Sam)	Ng'atoosa (Turk)	-	Biltongs or long rolls of meat
Lailelek (Sam)	Ng'imolokony (Turk)	-	The lower part of animal limbs
Abolibol (Turk)		-	Dewlap
Sagaram (Sam)	Ng'itit (Turk)	-	Acacia Fruits
Edikae (Turk)		-	Milk curdle
Ngakibuk (Turk)	Kamanang (Sam)	-	Sour milk
Lakuli (Sam)	Lokuli (Turk)	-	Fried meat mixed with animal fat and preserved for later use.
Lpulee (Sam)	Pulee (Turk)	-	A plant whose fruits can be used to extract oil.
Moti (Sam)	Amot (Turk)	-	A pot
Eeng'ol (Turk)	Loka (Sam)	-	Duom palm
Elamach (Turk)	Serichoi (Sam)	-	A plant with bitter fruits that can be boiled several times to make it edible.

# The Coping Strategies in Kitui and Mwingi Districts During Drought

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Objective:** To determine the methods of presentation for drought and the coping strategies.

**Design:** A cross-sectional study of Kenya

**Setting:** Kitui and Mwingi districts of Kenya

**Subjects:** The study population consisted of 491 and 485 households with children 6-59 months in the Kitui and Mwingi districts respectively. Multi stage sampling procedure was done. The first stage sampling was purposive sampling of the districts. The second stage was selection of divisions by simple random sampling, the same went for location, sub location and finally clusters (village).

**Main outcome measures :** Preparation for and coping strategies during drought.

**Results:** Stocking of relief food as a method of preparation for drought was the most quoted by most with 38.90% and 40.82% in Kitui and Mwingi districts.

The coping strategies quoted by most was cash for work by 39.4% and 36.5% in Kitui and Mwingi districts respectively.

**Conclusion:** The methods of preparation for drought and strategies for coping with drought were inadequate.

## Introduction

All over the world, and Africa in particular, economic conditions are deteriorating.

In Kenya, it is compounded by poor rainfall leading to inadequate food production and depleted pasture for animals, and hence the living standards have deteriorated. People have then had to adapt strategies to cope and thus adjust accordingly.

According to [1], due to poverty certain ancient traditions are violated. The author observes that, seasonal variations worsen conditions which are already deteriorating. In Kenya, between December and May, there is extreme reduction of food stock while employment opportunities and income are at the lowest. This leads to men mostly engaging in seasonal migration to towns, other farms (bigger ones for example tea farms) or to centres, where they can find work [1]. Some researchers have quoted direct food cuts as coping strategies during food shortage [1]. This entails practices such as reducing number of meals to one or two, diluting meals with water or drinking gruels.

Another coping strategy involves sending children to school so that they can partake in school meals (where it is offered during times of drought). In some areas children are withdrawn from schools which are far from homestead to conserve energy and save school related expenses. Children could also be farmed out that is, being sent to live with various family members or distant friends.

Another means of coping is dependence on relief food, or programs introduced as interventions in schools, hospitals and communi-

ty level [1]. Other coping strategies include gathering of wild fruits and vegetables, insects and trapping rodents. The fruits and vegetables appear in the market places for sale. Skins and hides have also been boiled for soup during such periods [2]. Other coping strategies made available by the government and NGOs' by providing relief food, or programs introduced as interventions in schools, hospitals and at community level [1].

## Materials And Methods

The study was conducted in Kitui and Mwingi districts, which were purposively selected, for having suffered drought in 1997. The study tools used were a structured questionnaire, which had been pretested. The questionnaire was designed to collect information on demography, household coping strategies and methods for preparation for drought. Some questions were structured while others were open-ended. Coping strategies:

respondents were asked how they predicted the coming of drought and how they prepared for drought.

A three day training for district nutritionists, nurses and community technicians in the two districts who were to serve as field assistants and enumerators, was conducted by staff from the Applied Nutrition program (ANP) University of Nairobi. The enumerators visited the households in twos for this purpose and they took turns in interviewing of the respondents.

Field assistants who were not conversant with kamba, the local language, were accompanied by a local person to act as interpreter. The starting points for each cluster in Mwingi were shopping centres while Kitui had various centres, primary schools, trading centres (shopping centres), hospitals and public transport stages.

The principal investigator closely supervised and spot-checked on the enumerator from time to time to check their performance. The data was validated (checking for omissions). It was then entered using statistical package for social science (SPSS) the 4th release. Data analysis was done using the same software.

## Results

### Preparation for drought and coping strategies:

A significantly higher ( $P = 0.002$ ) number of respondents in Kitui district (27.5%) than in Mwingi district (23.0%) reported that they made no preparations, (Table 1) for drought. Methods quoted by households were:

Stocking of relief food by almost a similar proportion of house hold in both districts (38.9% and 40.8% in Kitui and Mwingi district respectively) (Table 1). However, it was noted that there was no significant difference in nutritional status due to lack of preparedness (at  $P = 0.05$ ).

Sale of livestock to buy food and

Saving money for buying food in the two districts at 24.8% and 8.8% in Kitui District, 11.7% and 24.5% in Mwingi district.

**Table 1. Distribution of households by methods of preparation for drought**

Methods of preparation for drought	% of HH reporting use of the methods	
	Kitui District N = 419 No.(%)	Mwingi District N = 392 No.(%)
No preparation	115 (27.5)	90 (23.0)
Stock relief food	163 (38.9)	160 (40.8)
Sale of livestock to buy food	104 (24.8)	46 (11.7)
Saving money for buying food	37 (8.8)	96 (24.5)

### Coping strategies

In order to address hunger, household usually employed various strategies. The general coping strategies employed by households at the time are shown in Table 2.

Project in the community, that carry out cash for work, provide cash as a partial or total payment for work were reported as the main coping strategy in the two districts, by 36.5% HH in Kitui and 39.4% in Mwingi.

**Table 2. Some of the coping strategies during the last drought**

Strategies	DISTRICT			Total
	MWINGI Households N = 272 No.(%)	KITUI Households N = 363 No.(%)	P value	
Cash for work	100 (36.5)	143 (39.4)	0.863	243
Reducing meals	71 (25.9)	64 (17.6)	0.1717	135
Selling livestock	39 (14.2)	7 (1.9)	0.002	46
Cash and food for work	33(12.0)	41(11.3)	0.666	74
Relief food	12 (4.0)	3 (0.8)	0.050	15
Food for work	11 (4.0)	34 (9.4)	0.989	45
Building of terraces	6 (2.2)	65 (17.9)	0.040	71
Migration from low to upperlands	2 (0.72)	6 (1.7)	0.888	8

N/B Numbers in parenthesis are in percentages

Reducing meals which means eating fewer meals per day than is normal for the household, was the next most frequently reported coping strategy, by 25.9% and 17.6% in Mwingi and Kitui Districts, respectively.

In Mwingi District the number of households which reported selling livestock, (14.2%) was significantly higher than in Kitui District (1.9%), (P = 0.002).

Relief food, which is food given as aid in times of disaster by donors, churches, well wishers and individuals was also quoted in both districts as a coping strategy. Mwingi District (4.4%) had significantly more households receiving relief food as a coping strategy than Kitui District (0.8%) at the time of the study (P = 0.0050).

The land scape in the two districts is slightly different, which was indicated by the significantly higher numbers of households reporting building of terraces in Kitui District (17.9%) than Mwingi District (2.2%) (p =0.040). Terrace building is a style of land preparation that aids to conserve water and also prevent soil erosion if the rains fall after a drought. Terracing the land is therefore done before the onset of rain.

The other coping strategies that were mentioned were cash/food for work and food for work (food as partial or total payment for work done). Work and food/food for work was reported by 12.0%, 4.0% and 11.3%, 9.4% of households in Mwingi and Kitui district respectively.

Migration from low lands to highlands was reported by 0.72%, and 1.7% in Mwingi and Kitui Districts respectively. There were no significant differences among the drought coping strategies in the two districts.

### Discussion

#### Preparation for drought and coping strategies

In every community, there are usually established strategies that are carried out as preparation for drought. These include such as, strategies like, selling of livestock, migration to parts of the country that are unaffected by drought and stocking of food. In both districts stocking of relief food and sale of livestock to buy food were the methods most used as means of preparation for drought.

Both methods were, however inadequate, as the food acquired did not last through the drought period [3].

The main coping strategies in both districts were reduction of meals and working for worth programmes like food/ cash for work. Migration of whole household from drought areas to better areas was only necessary in times of extreme distress.

It was also occasionally reported that hunting of wild animal like the dik dik, deer and antelopes, and gathering wild fruits and vegetables was a coping strategy. Unfortunately the hunting was tedious and often not successful. At times hunting was by a group, meaning that, whatever was hunted had to be divided among the many people in the group.

In order to ensure survival during drought some animals were sheltered (around the home stead) limiting their movement hence, requirement for looking for pasture and providing the animals in the shelter (sheltering was necessary to avoid shifters).

Young et al. [4], state that socio-economic data can be used as early warning systems with food security orientation to monitor social economic indicators such as market indicators and coping strategies. The author observed that if coping strategies and their sequence are known it would be possible to assess a decline in food security and predict famine or drought in advance. Sale of livestock, demand for credit,

Migration of family members in search for work, dietary changes are quoted as some of the coping strategies. Coping strategies must be interpreted with care they are specific to particular time, place and group of people. For example, there are two different types of migration as coping strategies for drought: migration of a single household

member for waged work which serves as an early response to food insecurity, and distress migration of the whole household which indicates that the persons have become destitute. In both Kitui and Mwingi Districts both forms of migration were reported, depending on the severity of the drought. Occasionally also, male household heads left their homesteads to go and seek employment/ work. Part of money they earned from such work was sent back to help the family buy food and utilities.

Households with cows removed the cow blood and used as food during drought in Mwingi District, since the milk supply was low and there was none. However, no analysis was done to establish whether this practice helped in sustaining good nutritional status.

Coping strategies are easier to monitor among those communities which experience occasional calamities only. They are less meaningful among communities who face yearly food gaps. As food insecurity worsens the actual strategies used may remain the same, but the reason for using them and the timing of their use may change. The continued use of the same coping strategies may disguise a fundamental change in the local environment, or even mask a collapse of livelihood systems [4].

In conclusion, methods of preparation for drought and strategies for coping with drought were inadequate. The main methods of preparation for drought were prior stocking of relief food and sale of live-stock to buy food. The main coping strategies were participation in cash for worth programmes and reduction of meals.

Community sensitization and creation of forums that the community would come together and discuss better ways of dealing with drought problems may help the communities cope better.

## Acknowledgements

We are grateful to the Applied Nutrition programme (ANP) for the support we received, without which this study could not have been undertaken.

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# Watershed Management For Water and Food Security in kati water catchment of makueni district

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

A. Nderitu, W. Kaluli, M. Gathenya

## ABSTRACT

**Background:** Prudent watercatchment management is a solution to the problems of food insecurity and poverty in ASAL. Land cover/use classification and study of surface topography using GIS are important in the study of catchment management options.

**Objectives:** To demonstrate the use of GIS tools in image processing and generation of digital elevation models (DEM) for catchment management analysis to enhance food security and document the state of existing water resources in Kaiti watershed

**Method:** Features in Landsat images of 21st February 2000 from which land cover map was created were interpreted using ILWIS. Contour lines were manually digitized from topographic maps at scale of 1:50000 in Arc/Info then imported to ILWIS from where DEM was generated. Map of population density was created in Arc/View using data obtained from Ministry of Finance and Planning. Digitizing contour maps at scale of 1:50000 created a drainage map. The study of water situation was carried out through field visits and questionnaires to residents.

**Results:** More than 80% of the water catchment is under cultivation. All rivers are seasonal, with only few streams in the upper parts experiencing some flow through out the year. The area has very complex terrain, with average slope of 30%. Population is mainly concentrated in the upper areas. The main sources of water are rivers, ponds, springs and roof catchment. The few earth dams, which exist, have not been maintained for a long time. Most of these dams were built before independence and many of them are not operational due to siltation, destruction by floods and excessive loss of water through seepage.

**Conclusion:** GIS plays an important role in the study of catchment hydrology to enhance food security. Poor watershed management is held responsible for water insecurity in the Makueni District. To guarantee food security and environmental health, use of sustainable agricultural practices is the key. Drought resistant crops need to be popularized. For environmental protection and income enhancement, tree crops should be considered. Enhancing land cover in the upper parts of the watershed could help to increase low flows in Kaiti basin. Interventions are necessary to protect the watershed and enhance water availability and quality.

Key words: GIS, Digital Elevation Models, ILWIS, Kaiti, ASAL

## 1.0 Introduction

### 1.1 GIS in research

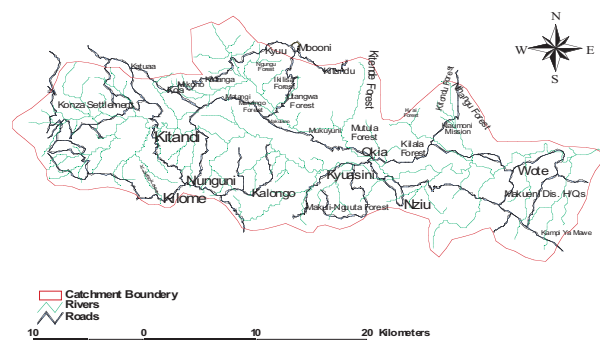
Geographical Information Systems (GIS) and satellite data are effective tools for analyzing and prioritizing natural resources management alternatives. Environmental models are increasingly being used in combination with GIS for numerous agricultural and environmental research and planning purposes. Land cover/use classification and study of surface topography using GIS is of major importance to

any discipline concerned with process modeling like hydrology, climatology, geomorphology and ecology. Several GIS based softwares are available for this purpose.

## 1.2 Description of project site

Kaiti watershed is a sub-catchment of Athi River Basin. It is situated in the upper parts of Makueni District of Eastern Province of Kenya (Figure 1). It is approximately 8000 ha in size. Rainfall is generally scarce and varies with altitude [1]. Surface and groundwater resources in these areas are unevenly distributed, both in space and time [2]. Average annual rainfall is between 500 to 800 mm [2]. The provision of relief food is a common phenomenon in the area and male out-migration to seek employment is high. Food insecurity, low income, malnutrition and illiteracy are persistent in this area [3].

Figure 1: location of Kaiti Watershed in Makueni District



Population growth in the Makueni district has been steadily rising mainly in the upper catchment areas. This has resulted in increase in human activities in these areas. An increase in human activities increases the demand for water, and may result in environmental degradation [2]. Various studies in Machakos District have demonstrated that it is possible to break the cycle of population growth and environmental degradation through correct policies and strategic investments [4]. These findings can be applied to reverse the trend of poverty and food shortage in Kaiti Watershed. In Makueni District, irrigation development is seen as a vehicle for increased levels of employment, income, food production and health standards [2]. Irrigation is required to sustain a high population density in semi-arid and arid areas [5]. However, irrigation has its negative effects on the environment but careful planning can take care of these.

### 1.3 Study objectives

The objectives of this study were to (a) demonstrate the use of GIS tools in image processing using satellite data for land cover/use mapping; (b) demonstrate how digital elevation models (DEM) are generated from contour coverages; (c) document the state of existing water resources in Kaiti watershed and (d) highlight necessary land management changes for food security in Makueni District.

## 2.0 Materials and Method

This exercise employed the Integrated Land and Water Information System (ILWIS) software to process satellite images and produce land cover map and generate DEM. This GIS software has image processing capabilities [6]. The International Institute of Aerospace Survey and Earth Sciences (ITC), Enschede, the Netherlands developed it in 1985, but it has since undergone major modifications. ILWIS has capability to analyse, manage and present geographical data. This study used Land-sat TM bands 2, 3 and 4 images.

### 2.1 Land cover mapping

#### 2.1.1 Image Processing - Viewing Single band images

ILWIS for Windows contains a set of image processing tools for enhancement and analysis of data from space borne or airborne platforms. Remotely sensed data, such as satellite images, are measurements of reflected solar radiation, energy emitted by the earth itself or energy reflected by radar systems that is reflected by the earth. An image consists of an array of pixels (picture elements) or grid cells, which are ordered in rows and column [6]. Each pixel has a digital number (DN) that reflects the intensity of received signal reflected or emitted by a given area of the earth's surface. The size of the area belonging to the pixel is called the spatial resolution. The DN is produced in a sensor dependent range, the radiometric values [6]. An image may consist of many layers or bands. A sensor that collects energy in specific wavelengths of the electromagnetic spectrum creates a band [7]. Through image enhancement procedures makes raw images for specific applications easier to interpret. Image enhancement techniques can be classified in many ways. Contrast enhancement, also called global enhancement, transforms the raw data using statistics computed over the whole data set. Examples include linear contrast stretch and histogram equalized stretch and piecewise contrast stretch. Contrary to this, spatial or local enhancement takes consideration of local conditions only and these can vary considerably over an image [6]. The three bands were processed and viewed separately to get digital numbers (DN) for various areas.

#### 2.1.2 Viewing multiband images

The spectral information stored in separate bands can be integrated by combining them into a colour composite [6]. Many combinations of bands are possible. The spectral information is combined by displaying each individual band in one of three primary colours; red, blue and green. A specific combination of bands used to create a colour composite image is the so-called false colour composite (FCC) [6]. In a FCC, red colour is assigned to the near infrared band, the green colour to the red visible band and the blue colour to the green visible band. The green vegetation will appear reddish, water bluish and the (bare) soil in shades of brown and grey. Some combinations

give colour outputs that resemble natural colours. This combination leads to the so-called pseudo Natural Colour Composites [6]. In this exercise, combining TM bands 2, 3 and 4 created a FCC. Band 4 was assigned red colour, band 3 blue colour and band 2 red colour. It is from this FCC that the land cover features were interpreted.

### 2.1.3 Geo-Referencing

Remotely sensed images in raw format contain no reference to the location of the data. In order to integrate these data with other data in GIS, it is necessary to correct and adapt them geometrically so that they have comparable resolutions and projections as the other data set. This is called georeferencing. Two approaches can be followed; Georeference corners and georeference tiepoints. The later technique, tiepoints, was the method used in this exercise. Geo-referencing was carried out using Africover data, administrative and drainage map of Kenya. Reference points were collected along river meanders and confluences and road junctions.

### 2.1.4 Creating Land cover Maps

A polygon map can be created by digitizing the boundaries of the polygons as segments in the segment editor, then checking the segments in the segment editor and polygonizing the segments using the point map as labels in the segment editor. Interpreting features in the raster maps processed from the images created the land cover polygon map in this exercise. A segment map was first digitized. Checks were carried out to find whether snapping was done correctly. The most important errors that occur during digitizing include dead end, intersection without node, segment digitized twice and self-overlap. The general land classification (LCC) system used in Kenya (FAO system) was used in this exercise. Since ILWIS lacks the capability to clip a polygon, the maps were exported to Arcview and clipped using the geo-processing wizard using Kaiti catchment boundary. This is where the final map was viewed.

## 2.2 Mapping population Density in Kaiti Watershed

Population is an important factor in catchment management geared at sustainable development for food security in arid and semi-arid watersheds. The population of Makueni District has been steadily rising in recent years, mostly in the highland areas. The 1999 census data show that the district had a population density of 97 persons per square kilometre. In 2002, this density had risen to 105 persons per square kilometre. [8]. This population is still rising at an alarming rate and is likely to impact very negatively on Kaiti watershed. This population is mostly concentrated in the highland areas. Mapping of population density was undertaken using Arcview. The data obtained from Ministry of Finance and Planning [8] was used to create unique identity polygons.

## 2.3 Production of the Digital Elevation Models (DEM)

### 2.3.1 Introduction to DEM

Topography plays an important role in the distribution and flux of water and energy within the natural landscape. The term digital elevation model or DEM is frequently used to refer to any digital representation of a topographic surface [9]. These DEM can be visualised by

means of a Geographical Information System (GIS) and evaluated with specialized algorithms. The DEM is most often used to refer specifically to a raster or regular grid of spot heights [10]. Digital terrain model (DTM) may actually be a more generic term for any digital representation of a topographic surface, but it is not so widely used. The DEM is the simplest form of digital representation of topography and the most common [11]. The resolution, or the distance between adjacent grid points, is a critical parameter. The best resolution commonly available is 30 m, with a vertical resolution of 1 m. DEM have a very wide range of applications. They form one of the most frequently used spatial data sources in GIS. They bear also the basis for a large number of derivative information. DEM are used for science, commercial, industrial, military and operational applications where they play a significant role in the improvement of analysis results, product development and decision-making.

There are three main techniques used in DEM generation. These are;

Photogrammetric techniques – use stereoscopic aerial photographs to sample a large number of points with x, y and z values by means of advanced photogrammetrical equipment. The points are then interpolated into a regular grid (raster). It is time consuming and requires photogrammetrical experts and a set of detailed control points.

Point Interpolation technique – used when point data is available for an area. For complex terrain, the interpolation technique is also rather complex.

Interpolation of contour lines digitised from existing maps – This is the simplest technique. It is used when neither existing DEM derived from photogrammetric techniques nor point data is available. Contour lines are digitised and interpolated.

DEM can be stored in raster or vector format. DEM in vector format are often in form of Irregular Triangular Networks (TIN). In ILWIS, DEM are always in form of raster maps with a value domain. Each pixel in the raster maps contains the altitude of the center of the pixel. Using a large pixel size will therefore result in more general DEM. When the pixel size is chosen too large, ridges and small streams may be missed. Accuracy of the DEM depends very much on the detail of the contour maps used for interpolation, and the scale of the original topographic map from which contour lines were digitized. The larger the scale of the map and the smaller the contour interval, the more accurate the DEM will be.

### 2.3.2 Interpolation of Contour lines

The most common method of entering spatial data is digitizing. Features on a map can be digitized. This is done using a device called a digitizing tablet, or digitizing table, or simply a digitizer. A digitizer contains a pointing device (digitizer cursor) to trace spatial features. In this study, four contour maps (Machakos – sheet 162/2, Kisau – sheet 163/1, Kilungu sheet 162/4 and Makueni – sheet 163/3) at a scale of 1:50000 (the most detailed in Kenya) acquired from Survey of Kenya on which Kaiti Catchment falls were used. The contour lines from each map were digitized in arc/info. After digitizing the lines were built, cleaned and transformed to UTM and then transferred to arc/view. In arc/view, the contour maps were transformed into arc/view shape files then joined together using the geo-processing wizard. This formed a single map, which was imported to ILWIS. In ILWIS, a contour heights column was added to the table. An attribute map was then created with the contour heights as the attribute. This attribute map was then interpolated using a value domain and pixel size of 30 m. The resulting DEM was then exported to Arcview in Arc/info ASCII format. In

Arcview, clipping was done using grid pig extension.

## 2.4 Drainage Map and Water Situation in Kaiti Watershed

Digitizing stream networks from the contour maps in the same way as generation of DEM created the drainage map. Node errors were corrected in Arc/Info then the completed maps were transferred to arcview where they were joined using geoprocessing wizard. The study of water situation in Kaiti watershed was carried out through field surveys and questionnaires. The aim was to find out the existence and condition of dams and any other water storage structures in the watershed.

## 3.0 Results And Discussion

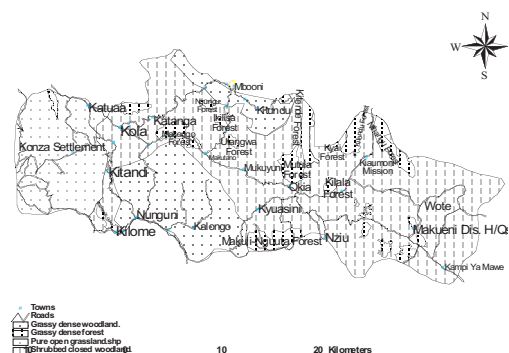
### 3.1 Land-use and land cover

The land cover map of Kaiti watershed is shown in Figure 2. It should be noted that what is shown in the map is not a complete representation of the present reality. Small-scale farms are scattered everywhere in the watershed, making them difficult to map accurately. Areas designated as grassy dense woodland are cultivated highland areas with maize, beans, bananas and other horticultural crops. The area designated shrubbed closed woodland is farmland in marginal areas usually cropped with cereal crops, though maize and beans also predominate. The area designated as pure open grassland is about 20-40% cultivated.

Kaiti watershed constitutes some of the original settlement areas in Makueni District. Since early 1960's people have migrated from the highlands to lower parts of Makueni where soil fertility was still intact. An increased population density in lower Makueni is likely to result in unsustainable human settlement when tree felling, charcoal burning for fuel production take place. Newly settled areas have experienced bush clearing and burning of topsoil and vegetation, as well as over-grazing. The result has been increased soil erosion and fast siltation of water reservoirs in the area.

The absence of adequate land use planning in Kaiti watershed has permitted poor agricultural practices such as irrigated farming along riverbanks. Proper land use planning geared towards food security in the watershed must show which areas are suitable for cultivation in this watershed. It is necessary to identify land use options that could increase agricultural productivity without catchment degradation. Catchment protection in the higher rainfall areas of Kilungu and Mbooni could enhance low flows in Kaiti. This will be the subject of further studies in the watershed.

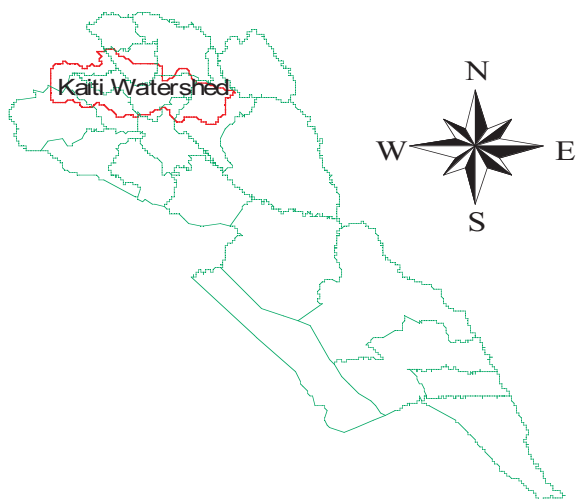
Figure 2: land cover map of Kaiti watershed



### 3.2 Drainage and water situation

Drainage network of Kaiti watershed is a complex of many small rivers arranged in a dendritic system (Figure 3). Almost all the rivers in the watershed are seasonal, with only the streams in the upper most part such as Kilungu (e.g. Kyekolo River) and Mbooni having some flow throughout the year. The main river, Kaiti River, has flow only immediately after a storm. The rest of the year it is dry.

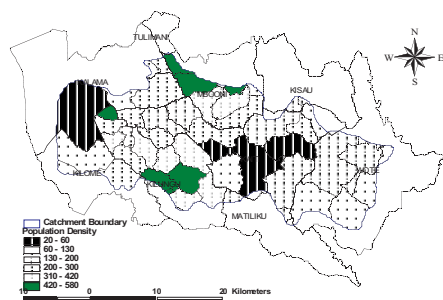
Figure 3: Drainage Map of Kaiti watershed



The main sources of water for domestic and livestock are rain water tanks (roof water harvesting), rivers, ponds and springs. Rivers are seasonal, and dry up soon after a storm. During long dry periods, residents obtain water by burrowing the riverbeds. The few earth dams, which exist, have not been maintained for a long time. Over 90% of these dams were built before independence and more than 50% of the dams are not operational due to siltation, destruction by floods and excessive loss of water through seepage. Consequently water quality is low, and waterborne diseases are common in this area. Under such a situation where the search for this vital commodity is a full time occupation, food security is elusive.

### 3.3 Population

Figure 4: Population Density Map of Kaiti Watershed



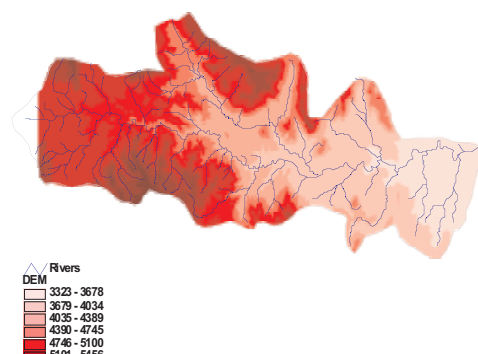
Highland areas of Kaiti Watershed are the most densely populated (Figure 4). For instance, the central area of Kilungu division has a population density of 413 persons per square kilometre compared to the average population density of 105 persons per square kilometre for the

whole district. Mbooni division has 430 persons per square kilometre. This dense population on very steep slopes can exert considerable pressure on the land resources, increasing human activities at a level the land cannot cope with and thereby causing unsustainable land use, with severe repercussions on food security in the watershed.

### 3.4 DEM Generation

Figure 5 shows the DEM of Kaiti Watershed generated from this study. The figure shows that the watershed has a very complex terrain, with very steep slopes. The highest point is 6253 feet (2000m) ASL and the lowest is only 3323 feet (700m) ASL. This gives an average slope of 30%, which is very high by any standard. Such a catchment requires very careful management practices to avert the danger of soil degradation. This is very high quality DEM, created after a lot of work with the most detailed maps available in Kenya. It has a pixel size of 30 m and a vertical resolution of 1 m. Such a DEM is difficult to obtain anywhere and also very difficult to create manually. This DEM can be used for further analysis, particularly for a hydrological modelling in Kaiti watershed to find the best watershed management practices for food security in the watershed.

Figure 5: Kaiti Digital elevation Model (Height in feet)



### 4.0 Conclusions And Recommendations

The following conclusions are drawn from this study;

Land use/cover of Kaiti watershed is a combination of grassy forests in the upper areas, woodlands in the middle areas and open grasslands in the lower areas with scattered communal farms all over the watershed.

Lack of proper land use plans for the watershed has permitted agricultural activities in fragile environment including riverbanks and steep slopes.

Crops with a high water demand such as maize and beans are grown in Makueni where the rainfall is low and excessively drained soils are prone to degradation.

The present practices of growing high water demand crops with a high rate of crop failure has contributed to poverty and frequent famine occurrence in the area.

There is evidence of environmentally unfriendly phenomena such as bush clearing, charcoal burning, and soil erosion in the catchment.

The terrain is very complex and steep, which calls for more careful management practices to avoid soil degradation.

Over 90% of water dams are out of use, and water situation in Kaiti watershed and the whole of Makueni district is very grave indeed.

This study makes the following recommendations:

To guarantee food security and environmental health in Kaiti water catchment, sustainable agricultural practices should be encouraged in the watershed.

To protect the environment and to increase low flows in Kaiti basin, land cover in the upper parts of the watershed should be enhanced. However, only water conserving vegetation should be encouraged. This will require further studies to identify best management practices for this watershed, and identify suitable sites for water reservoir construction.

Ways should be found to restore water storage dams, which have silted up, and to reduce siltation of these dams in future.

## Acknowledgements

This study is part of a larger project designed to investigate water resources development issues in Makueni District. Many people have contributed in various ways. The Department of Resource Surveys and Remote Sensing (DRSRS) provided facilities, maps and Africover data, which we used in the study. DRSRS staff in particular Edward Ojema, Lucy Njino and Gordon Ojwang' of the data management section provided valuable help. We are grateful to AICAD whose funding made this study possible. Dr. P.G. Home, the Chairman of the Department of Biomechanical and Environmental Engineering, JKUAT, provided valuable encouragement during this study. Two students, Joseph Mwaura and Patrick Munyao helped to collect some of the data used in this study. We thank them.

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# Intergrating Human Rights into Nutrition Programmes in Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

R.O. Opiyo.

## Abstract

The nutritional situation in Kenya has been deteriorating over the years. Current rates of chronic malnutrition and underweight are 35% and 23%, respectively, compared to 1998 when the proportion of stunted children was 33% and that of underweight children was 22%. Kenya is party to most of the International Conventions and Treaties in which the right to food and nutrition are articulated. These include the Universal Declaration of Human Rights, International Covenant on Economic, Social and Cultural Rights, Convention on the Rights of the Child and Convention on the Elimination of All Forms of Discrimination against Women among others. However, there is no concrete law that holds the government legally accountable for the observed high rates of malnutrition in the country. This does not mean that the government is not obliged to the rights stipulated in these documents since she is a signatory. Efforts are being made by various government ministries and NGOs to improve nutritional security through policies and interventions. Integrating right-based approach into these national policies and interventions in Kenya has the added advantage of improving effectiveness of nutrition interventions through reinforcement of national laws on food and nutrition, increased participation of both the right holders and duty bearers and empowering women and children to facilitate the realization of their rights to food and nutrition. Various windows of opportunity already exist at both legislative/policy, and strategy levels which the government, agencies, communities and individuals can explore to ensure that everyone in Kenya enjoys the right to food and nutrition. The available windows of opportunity range from Legislation level through to Policy and strategy levels. At the strategy level various windows of opportunity do exist both at institutional and community levels. However, to achieve any meaningful success in the realization of human rights to food and nutrition from strategies of ongoing or proposed maternal and child nutrition programs in Kenya, issues of legislation, strengthening of policies and budgetary allocation for nutrition activities need first to be strengthened.

Key Words: Rights, Laws, Food, Nutrition, Program.

## Government Commitment to Food and Nutrition

### Rights in Kenya

### Right to Food and Nutrition in International Laws:

### Kenya's Position.

Kenya is a state party to most of the International Conventions and Treaties in which the right to food and nutrition are articulated. The Universal Declaration of Human Rights (1948), article 25(1), clearly asserts that "everyone has the right to a standard of living adequate for the health and well-being of himself and his family including food..." Furthermore, state parties have a core obligation to take the necessary action to mitigate and alleviate hunger, and "The right to adequate food is realized when every man, woman and child, alone or

in community with others, has physical and economic access at all times to adequate food or means for its procurement" [1]. Although the Kenya government signed the document on International Covenant on Economic, Social and Cultural Rights on 20th May 1994, she has never submitted any report on the implementation or progress made so far to the Committee as required despite several request and reminders by the committee to do so [2]. The Kenya government has not also taken explicit measures to incorporate these rights in her legislation..

In the Convention on the Rights of the Child (1990), two articles address the issue of nutrition. Article 24 says that "States Parties recognize the right of the child to the enjoyment of the highest attainable standard of health . . . [3] and shall take appropriate measures "to combat disease and malnutrition . . . through the provision of adequate nutritious foods, clean drinking water, and health care [4]". Article 24 also says that States Parties shall take appropriate measures . . . "To ensure that all segments of society, in particular parents and children, are informed, have access to education and are supported in the use of basic knowledge of child health and nutrition [and] the advantages of breastfeeding . . ." In article 27, paragraph 3 [5], States Parties "shall in case of need provide material assistance and support programs, particularly with regard to nutrition, clothing, and housing." The right of the child to adequate food was earlier emphasized in the International Code of Marketing of Breastmilk Substitute adopted by World Health Assembly (WHA) in 1981. This was further supported by the Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding which was adopted in 1990 in Florence, Italy, where various specific global goals, including the goal that "all women should be enabled to practice exclusive breastfeeding and all infants should be fed exclusively on breast-milk from birth to 4-6 months of age" were stated [6].

By ratifying these conventions, Kenya committed herself to ensuring that every child has the inherent right to life [7] and to be free from disease and malnutrition through provision of adequate nutritious food [8]. Kenya has also committed herself to ensuring that the right of every woman to adequate nutrition during pregnancy and lactation is realized [9]. Kenya has implemented the International Code of Marketing of Breastmilk Substitute and is also a signatory to the Innocenti Declaration on the Protection, Promotion and Support of Breastfeeding.

### Right to Food and Nutrition in Kenyan Laws

There has been no provision for the Social, Economic and Cultural Rights in the constitution [10]. This silence renders the government legally unaccountable for its failure to ensure that the rights to adequate food and nutrition are enjoyed in Kenya. The primary responsibility of respecting, protecting and fulfilling rights to food and nutrition however still lies with the Kenya government since she is a signatory to covenants that bind her to guarantee food and nutrition security to the citizens. None of these covenants/treaties have been translated into national laws in Kenya as required. There are Agricultural laws that give ownership of land to persons and which have a bearing on food



security in the country. These are the Government Land Act (Cap 280), the Registered Land Act (Cap 300), the Trust Land Act (Cap 302) and the Wildlife (Conservation and Management Act Cap 376), [11] These statutes if appropriately amended, and even consolidated can influence national food security. It would however be necessary to institute further laws that enhance equity in access to food.

### National Legislation and Policies in Kenya

Kenya has a National Food Policy, [12] which emphasizes on the achievement of national food security through self-sufficiency in production of basic food commodities and generation of foreign exchange for importation of other foods and occasional importation of basic food. Planning however tends to focus more on maize, rice and wheat while the traditional crops like sorghum, millet and cassava receive less attention. Most people therefore still do not have access to adequate nutritious food for healthy and productive life. The other two factors that contribute to nutrition security – adequate care and health, are further threatened by the rapidly collapsing physical, economic and social services in Kenya due to widespread poverty [11].

Following the International Conference on Nutrition (ICN) held in Rome in 1992, Kenya came up with the National Plan of Action on Nutrition in 1994 [13]. National Food and Nutrition Secretariat was also formed within the Ministry of Planning and National Development to oversee the implementation of the National Plan of Action on Nutrition. In addition, there has been an Inter-Ministerial Coordination Committee on Food and Nutrition to coordinate nutrition activities in the country. The government has however realized that it has been difficult to implement the Plan of Action on Nutrition due to lack of a national nutrition policy. A sub-committee has therefore been formed to try and draft a nutrition policy for Kenya. Members of this committee are drawn from Ministry of Health, Ministry of Agriculture, Education, Nairobi City Council, UNICEF, AMREF, WHO, HELPAGE- Kenya, University of Nairobi (Department of Community Health), Nestle Food Industry and Ministry of Planning as the coordinating and convening office. It is upon the development of this policy, which is expected to be ready before the end of this year, that, the National Plan of Action on Nutrition will be revised.

### National Measures to address malnutrition in Kenya

Most national food and nutrition intervention programs are within the government ministries of Health, Agriculture and Culture and Social Services. Interventions within the ministry of Agriculture focus on food production aspect while in the ministry of health the focus is on maternal and child nutrition through promotion of breast feeding, child feeding practices, micro-nutrient supplementation, growth monitoring and promotion. The Office of the Vice President, Ministry of Home Affairs, Heritage and Sports, mainly focus on improvement of nutrition security through enhancing community participation, including children, in the planning and implementation of sustainable social development activities.

As a member of the World Alliance for Breastfeeding (WABA) group, Kenya has implemented the International Code of Marketing of Breastmilk Substitutes to ensure that infants and children are exclusively and optimally breastfed.

Kenya has also implemented the Baby Friendly Hospital Initiative (BFHI) with 232 out of 350 hospital/maternalities officially designated by UNICEF as “Baby Friendly” hospitals. As a response to maternal nutri-

tion, Kenya has implemented the national policy on micronutrient deficiency control in form of supplementation of Vitamin A, Iron and folate for pregnant mothers.

### Budgetary allocation on nutrition activities in Kenya

National initiatives to improve nutrition situation of women and children in Kenya are faced with problems of inadequate resources. National budgetary allocation has been relatively low, hence frustrating the efforts to implementation of planned activities for government sectors dealing with food and nutrition. Table 1 shows a sample trend in budget allocation for nutrition in the Ministry of Health in the past years.

**Table 1: Budgetary allocation for Nutrition within Ministry of Health**

Year	Total Ministry Budget (K Pounds)	Budget Allocation for Nutrition (K Pounds)	% of Allocation
1991/92	154,642,265	1,008,760	
1992/93	169,489,868	1,103,539	
1993/94	203,489,890	193,976	
1994/95	164,821,608	352,516	
1995/96	381,837,290	286,613	
1996/97	400,823,130	220,930	

### 2.0 Added-value of a Right-based Approach in Nutrition Programs in Kenya

First, right-based programming will reinforce some legal force in the legislation of the right to food and nutrition in the country. Currently, there is no provision for the right to food and nutrition in the Kenyan laws. This silence renders the government legally unaccountable for its failure to ensure that all Kenyans enjoy the rights to adequate food and nutrition. Through legislation of the right to food and nutrition in the national constitution, there will be legal laws in place, binding the government, the community, development agencies and all those concerned in the realization of this right. The government will also be able to “...develop and maintain a mechanism to monitor progress towards realization of the right to adequate food” [1]. The national budgetary allocation for nutrition activities will also be improved since all sectors will receive their allocation of funds according to the national identified needs. This will therefore further improve on the quality of nutrition programs in the country.

Secondly, right-based programming of nutrition activities will improve the participation of the right holders and the duty bearers. The right holders (women and children), will be actively engaged “...with high levels of participation, community ownership, sustainability and empowerment” [14]. This will be achieved through educating the women and children that they are also accountable for the realization of their own rights, hence they have to take actions where necessary. In the national Community Based Nutrition Program (CBNP) in Kenya, communities are actively involved in the identification, planning, implementation and monitoring of their own projects. Children too are not left out since they are also involved through Child-to-Child activities. During the World Summit for Children in 1990, leaders appealed to children to participate in the efforts to improve their lives: “Among the partners we seek, we turn especially to children themselves. We appeal to them to participate in these efforts” [15]. The programme personnel, as the duty bearers, will be able to take full responsibility for the impact of their work if they know that they have the obligations

to respect, protect and fulfill the food and nutrition rights of the mothers and children that they get in contact with. Furthermore, integration of this right-based approach will enable most personnel in nutrition programs to treat women and children they are dealing with more dignity.

Thirdly, through right-based approach, children and women will be empowered to know their rights to adequate food and nutrition and what to do or where to go to if their rights are not met. They will also be aware that the realization of their rights cannot be left to the government or NGOs alone. They too have a role to play. For example, through Child-to-Child activities in Kenya, children are able to link the nutritional knowledge they learn in school with their own nutritional situation and that of their families back at home hence their obligation to facilitate the realization of their own rights. If rural and low-income urban women are empowered economically through income generation activities and availability of job opportunities, they will access adequate food for their families to meet their nutritional needs.

## **Windows of Opportunity for Right-Based Programming of Nutrition Activities in Kenya**

Successful integration of right-based approach to nutrition programming in Kenya need to be considered at two main levels: first at the legislation and policy level to ensure that there are laws to protect individual's entitlements to food and nutrition, and secondly at the strategy level while implementing various interventions.

### **Legislation and Policy Level**

The principal obligation to the realization of the right to food and nutrition as set out in General Comment 12 is for state parties to take steps to achieve progressively the full realization of this right. Since Kenya has already ratified the binding international documents on the right to food, the next important step to be strengthened is the legalization of national laws. The National Food Policy [12] which aims at ensuring that everybody has access to adequate food, also needs to be revised and strengthened since there are many parts of the country where accessibility to adequate food has not yet been achieved. Planning should also focus on production of traditional crops like sorghum, millet and cassava instead of concentrating on maize, wheat and rice as the main food crops [16]. Plans are already underway by the relevant government ministries and agencies to update and strengthen this policy and to develop a national Nutrition Policy, which has never been there [17]. It would be important to incorporate a right-based approach to nutrition programming in these policies. It is hoped that in the final Kenyan Constitution, there will be more provision for Social, Economic and Cultural Rights, including the right to adequate food and nutrition to assist in the realization of the right to food and nutrition. It is important that the Ministry of Finance should consider allocating more funds for food and nutrition activities as per the national identified needs.

### **Strategy Level**

#### **Education and Training Level**

Enlightenment and advocacy on the understanding of the concept and importance of human right to food and nutrition is important in the realization of this right through maternal and child nutrition programs in Kenya. The concerned Kenya government ministries, together with

NGOs and donors should provide on a regular basis opportunities for staff training to improve the knowledge and skills required for the realization of the right to food and nutrition. The government ministries and NGOs implementing nutrition activities and donor communities have the obligation to protect and facilitate the rights of women and children in Kenya through capacity building. Training should be based on the human right to adequate food and nutrition established in the Universal Declaration of Human Rights (1948), the International Covenant on Economic, Social and Cultural Rights (1984) and Convention on the Rights of the Child (1990).

### **Health Facility Level**

In addition to capacity building of the health based staff on the right to adequate food and nutrition, the Information, Education and Communication (IEC) materials often used for educating and advising mothers on nutrition need regular updating. This will however require extra funding either from the government or donors. Furthermore, growth monitoring for children should be made compulsory upto 2 years of age. This can be strengthened if the Ministries of Health and Education made it mandatory for all children entering pre-primary or primary school present their growth charts before enrolment into school. That way mothers will be serious with taking their children for growth monitoring. Promotion of breastfeeding should also be strengthened further. Despite the implementation of the National Infant Feeding Policy and Baby Friendly Hospital Initiative in Kenya, only about 17% of the children are exclusively breastfed upto 4 months [18]. A larger percent of children are exclusively breastfed for only upto 2.5 months [19]. This implies that there is need to improve on educating mothers on breastfeeding as a right for both the child and mother.

### **Community Based Level**

There is need to further strengthen community based nutrition activities, such as the ones within the Community Based Nutrition Program in the Office of the Vice President, Ministry of Home Affairs, Heritage and Sports. This is a national program based on a participatory process known as Participatory Approach to Nutrition Security (PANS). The program involves not only adults from the community and various government sectors that have a role to play in the improvement of nutrition, but also children. The NGOs working in the community are also involved in the PANS process. Community based nutrition activities may also be strengthened through advocacy on women's rights, promotion of growth monitoring and income generation activities to empower women economically.

**Table 2: Summary of key issues in the window of opportunity for integrating Human Rights in Nutrition Programs in Kenya**

Activity	Duty Bearer	Nature of Obligation	Mechanisms of Accountability/Remedies
<b>LEGISLATION LEVEL</b> <ul style="list-style-type: none"> <li>Laws protecting person's rights to food and nutrition to be instituted and included in the National Constitution</li> <li>Revision of National Nutrition Plan of Action to include "minimum standards" for nutrition activities.</li> </ul>	<ul style="list-style-type: none"> <li>Office of the Vice president, Ministry of Health, Ministry of Agriculture, NGOs and Ministry of Planning and National Development.</li> </ul>	<ul style="list-style-type: none"> <li>Respect, protect and fulfill</li> <li>Respect, protect and fulfill</li> </ul>	<ul style="list-style-type: none"> <li>Constitutional Review Committee/ Human Rights committee , Parliament /NGOs Civil society</li> </ul>
<b>POLICY LEVEL</b> <ul style="list-style-type: none"> <li>Development of National nutrition policy</li> <li>Revision of National food policy</li> <li>Strengthen the National Nutrition Surveillance activities</li> <li>Improve national budgetary allocation for nutrition</li> </ul>	<ul style="list-style-type: none"> <li>Office of the Vice president/ Ministry of Health, Ministry of Agriculture/ NGOs and Ministry of Planning &amp; National Development/International.</li> </ul> <p>Community/NGOs/Donors</p>	<ul style="list-style-type: none"> <li>Respect, protect and fulfill</li> <li>Protect and facilitate</li> <li>Facilitation and protection</li> <li>Facilitation</li> </ul>	<ul style="list-style-type: none"> <li>Parliament /Media/NGOs</li> </ul>
<b>EDUCATION/TRAINING LEVEL</b> <ul style="list-style-type: none"> <li>Regular training for DHMT, NGOs, CHWs and nutritionists.</li> <li>Strengthen participation of children in advocating and implementing activities to improve their rights to food and nutrition through Child-to-Child activities.</li> <li>Incorporate right to food and nutrition topics in training curriculum for health workers and nutritionists at all levels.</li> </ul>	<ul style="list-style-type: none"> <li>Office of Vice president and Ministry of Health plus NGOs and Donors</li> </ul>	<ul style="list-style-type: none"> <li>Protect/ facilitate</li> </ul>	<ul style="list-style-type: none"> <li>Parliament/ Administration</li> <li>Parliament/Media</li> <li>Media/Community Community Baraza</li> <li>Parliament/Media/Admi nistration</li> </ul>
<b>ACTIVITIES AT HEALTH FACILITY-BASED LEVEL</b> <ul style="list-style-type: none"> <li>Compulsory growth monitoring up to 2 years of age – "no growth chart, no school admission "</li> <li>Regular update on Nutrition Education IEC materials</li> <li>Standardization of nutrition IEC materials to be inline with international laws on the right to adequate food and nutrition</li> <li>Promotion of BFHI facilities to promote breastfeeding</li> </ul>	<ul style="list-style-type: none"> <li>Ministry of Health/Education and Parents</li> <li>Ministry of Health /International Community, Health Workers/Doctors</li> </ul>	<ul style="list-style-type: none"> <li>Protection and facilitation</li> <li>Protection and facilitation</li> <li>Protection and facilitation</li> <li>Protection and facilitation</li> </ul>	<ul style="list-style-type: none"> <li>Administration</li> <li>Administration</li> <li>Administration/NGOs/Media</li> <li>Parliament/Media/NGOs</li> </ul>
<b>COMMUNITY BASED LEVEL</b> <ul style="list-style-type: none"> <li>Strengthen right-based approach to nutrition programming in existing CBNPs through training of staff on the right to food and nutrition.</li> <li>Strengthen Community based Growth Monitoring through community participation and training of CHWs.</li> <li>Training of Community Health Workers (CHWs) on the right to adequate food and nutrition.</li> <li>Identification and reporting of cases of growth faltering to nearest health facilities.</li> <li>Advocacy on women's right to control of resources.</li> <li>Promotion of community based income generation activities to empower women economically.</li> </ul>	<ul style="list-style-type: none"> <li>Office of the Vice president, /Donors/ NGOs/Community</li> <li>CHWs/Community/Ct C children</li> <li>NGOs/Donors/Wome n leaders/Community</li> </ul>	<ul style="list-style-type: none"> <li>To facilitate community participation in realization of rights</li> <li>Facilitation and protection</li> <li>Facilitation</li> <li>Protection and facilitation</li> </ul>	<ul style="list-style-type: none"> <li>Administration/Community</li> <li>Community</li> <li>Community Baraza/Media</li> <li>Community Barazaa/Media</li> </ul>

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# The Role of The Home Economic Extension Programme in Improving Household Food and Nutrition Security

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Introduction

## Historical Background

The Home Economics Extension Programme (HEEP) was started in 1963 under the Extension services division in the Department of Agriculture with the main goal of ensuring better living standards of the farm families. The main objective is to improve the food and nutrition security of farm families in the country.

## Specific Objectives

The specific objectives of the programme are:-

- To promote dietary diversification and better eating habits.
- To promote gender friendly, time saving and energy efficient technologies and practices.
- To improve household incomes through promotion of income generating activities.
- To educate farm families on the need to plan their families in relation to available household resources.
- To address emerging livelihood issues that affect farm families e.g. HIV/AIDS.

## Structure and Staffing

The programme is organised in 3 sections:-

- Food and nutrition unit.
- Appropriate Technology and Entrepreneurship Development unit.
- Population Education Unit.

Currently the programme has a staffing strength of 519 officers from the Headquarters to the front-line level ranging from certificate holders to masters degree holders.

## Strategies

The three sections of the programme has various activities which are conducted through the following strategies: -

Dietary diversification through: promotion of kitchen gardens, nutrition education, food utilisation, food preparation and preservation, food processing and storage and promotion of production and consumption of traditional and under utilized foods.

Developing and disseminating appropriate technologies that improve health, reduce women workload, improve family incomes, and those that improve women's efficiency in production.

Population education and emerging livelihood issues is done by educating families on the need to plan families in consideration of available resources and developing strategies for combating HIV/AIDS through proper nutrition aspects.

The program uses a group approach to reach as many households as possible. Currently we are working with 14,765 extension groups with an average membership of 21 per group. We work with any active group in an area, our experience has shown that women groups are the most stable, and actually most of our groups are women.

The advantages of group approach include: -

- There is 'peer' pressure to learn
- The adoption rate is higher
- There is wide coverage
- Requires fewer staff compared to the individual household approach.
- Requires less funds
- Encourages cost sharing among group members for demonstration materials.
- Ability to mobilize savings and solicit funds for group projects

## HIV/AIDS and Nutrition

The Government of Kenya recognised HIV/AIDS as a national disaster as was declared in 1999. The Ministry of Agriculture set up an Aids Control Unit (ACU) in February 2001. Since the inception of the ACU, the Home Economics Programme has been represented at the Unit especially because of the importance of nutrition in the management of HIV/AIDS. The ACU has HIV/AIDS focal persons in each province, district, training institutions and farmers training centres. Majority of these officers are Home Economics and even where they are not, the Sub-ACU in the field stations incorporate them. All the focal persons have been trained on HIV/AIDS issues which they subsequently pass to the farming communities.

So far one workshop specifically on integration of HIV/AIDS into nutritional programmes has been held. The ACU in collaboration with HEEP is in the process of documenting the extension messages on nutrition and HIV/AIDS. HEEP is represented in the taskforce which is developing National Nutritional guidelines for PLWHA. Currently, however, we have adopted a guideline from FAO on nutritional management of HIV/AIDS which we are using in training the staff and farmers.

## Successful Projects

- Dissemination of maendeleo stove and fireless cookers.
- The improvement of household food and nutrition security through

the Nutrition component of the Nyeri Dry Area Smallholder and Community Services Project .

### Case Study 1: Dissemination of Maendeleo Stove And Fireless Cookers

The Home Economics Extension Programme (HEEP) right from inception (1963) has laid much emphasis on developing and disseminating appropriate technologies that ease women workload. This is in anticipation that the savings made in terms of time, energy and money would directly or indirectly improve the nutritional status of the farm families as a result of women having more time for childcare and productive economic activities. Increased households income would result in higher allocation of money spent on food thus leading to improved diets and subsequently improved nutrition. It has been shown that when women’s income increases more is spent on food than the other family needs [1]. Availability and use of energy saving appropriate technologies by farm households has all along been a concern of Home Economics extension. At first the Ministry promoted raised fireplaces. Apart from saving the cook, the strain of bending, the stoves were smokeless and had more than one cooking point and could also cook more than one pot at the same time thus saving time. Thereafter in the mid 1980’s the HEEP embarked on promotion and dissemination of the “maendeleo stove” [2].

The maendeleo stove was developed from the idea of ceramic stoves liner inserts of Sri Lanka by the Ministry of Energy (through Women and Energy Project) through research oriented activities for three years (1983 - 1986) [2]. The Maendeleo stove is built in ceramic liner that is inverted-bell shaped with an opening for feeding fuel-wood and V-shaped pot rests. The maendeleo liner is built to minimise heat loses and has been found to reduce fuel wood requirements by 50% [3]. There are two sizes of liners in the market, 32 cm and 35 cm width with a thickness of 3.5 cm [2].

Dissemination of maendeleo stoves by MOA was scaled up in collaboration with the women and energy project (WEP) and GTZ. In the beginning, the HEEP attached an officer to the WEP whose responsibility was to disseminate the maendeleo stove [2]. Later an integrated approach was identified and implemented as pilot project in three districts; Meru, South Nyanza and Kisii. This approach was found to have less logistics problems and had a better basis for sustainability of stove dissemination. [2]. The approach was adopted for all districts in Kenya and it greatly improved maendeleo stove dissemination. Under the arrangement, the District Home Economics Officers (DHEO) acted as the project co-ordinators in the district and were initially facilitated to spear head dissemination activities by the GTZ, Special Energy Project (SEP). With involvement of the DHEOs the number of Maendeleo stoves disseminated shot up from about 9000 in 1989 and over 22,000 in the subsequent project years as shown in Table 1.

**Table 1: Number of Maendeleo stoves disseminated**

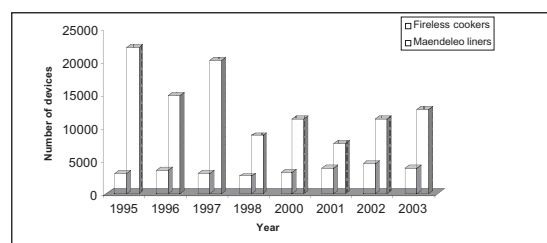
1986-88	1989	1990	1991	1992	1995
26,000	9,000	11,194	25,423	27,372	22,189

Energy awareness seminars conducted for the home economics officers integrated relevant messages as highlighted below. Women groups interested in liner production were trained in the production of quality liners. Keyo women group from Nyanza is one such group that has graduated into a training centre for other groups.

After the project ended in 1994, number of liners disseminated dropped to less than half due to inadequate facilitation. HEEP has continued to disseminate the maendeleo stove and other energy saving devices like the fireless cookers as the main programme activities. The number of energy saving devices has been increasing upwards as shown in Figure.1.

The other energy saving device that HEEP promotes is the fireless cooker. A fireless cooker is an insulated (with wood shavings, cotton waste, grass, wool, dry banana leaves, shredded paper, blanket waste etc) container (box, basket) with a nest for a pot (sufuria), insulation is held together with a cotton cloth. Container is covered with a pillow (or lid) also filled with insulation. It is recommended for foods that do not require constant stirring. Initially the food is partially cooked on fire and thereafter transferred into the fireless cooker which conserves the heat already attained by the food. This is the heat that is used to complete the cooking in the fireless cooker.

NB Figures for 2001 do not include data from Coast Province.



In order to achieve such success the programme developed messages which related the stove to

Figure 1: Dissemination of Maendeleo stoves and fireless cookers  
NB figure for 2001 do not include data from Coast Province.

In order to achieve such success the programme developed messages which related the stove to other agricultural extension messages. Some of the thematic areas are shown below:

Maendeleo stove and fuel wood supply (led to establishment of kitchen wood lots)

The stoves efficiency: The stove has up to 50% fuel saving capacity which translates to saving time, money, labour and trees which are used for other activities.

The stove and food production: This impact message linked to importance of food production for consumption and enhanced kitchen garden establishment.

Stove maintenance and kitchen management: The need to keep the stove under good repair for more benefits was integrated into messages on kitchen hygiene and kitchen arrangement.

The stove and meal planning: The stove can be used in preparing nutritious meals for the family members. Demonstration would be done for preparing meals to meet needs for all family members including those with special needs e.g. children, pregnant and lactating mothers.

Below are examples of sample messages on energy saving tips and maintenance of maendeleo stove.

### Ways of Improving the Efficiency of Cooking Energy

#### **Sample Message 1:** Energy saving tips

1. Use of wood and not charcoal whenever possible.
2. Cut and split wood in small pieces before use.
3. Cook away from the wind.
4. Build the smallest fire possible to do the cooking
5. When food has come to boil, reduce heat to a minimum  
Boiling slowly (simmering) cooks food  
as quickly as boiling fast and uses less firewood.
6. Plan your cooking well, so that excess heat can be used to start slow cooking food for  
the next meal.
7. Use improved cooking appliances, eg. Ceramic charcoal stoves (KCJ), improved wood fuel jikos eg. the Maendeleo jiko.
8. Carry out routine cleaning and proper maintenance of the improved stove.

#### **Sample Message 2:** Maintenance of the stove

- Be gentle with your stove.
- Do not sprinkle kerosene or water on the clay part of the stove.
- For charcoal stoves, close the door after it lights.
- Do not leave any stove on while not in use.
- Cover hot embers with ash to retain the fire for the next cooking

## **Case Study 2: Improving Nutrition and Household Food Security in Kenya**

A Case Study of Nutrition Component of Nyeri Dry Area Smallholder and Community Services Development Project (NDAP) 1991 - 1998

### **Background**

The Nyeri Dry Area Smallholder and Community Services Development Project (NDAP) was a seven-year (1991 – 1998, but extended to 2001) multisectoral project funded by the government of Kenya and the International Fund for Agriculture Development (IFAD). NDAP was located in Kieni East and Kieni West divisions of Nyeri district and lies between Mount Kenya to the east and the Aberdares range on the west (2130 – 2400 metres above sea level). Rainfall varies with altitude and generally ranges between 500-1200 mm rising to over 2000 mm in the upper areas. However, the rainfall pattern is erratic and is characterised by heavy showers and storms that sometimes cause severe erosion and considerable crop damage. The area has hill soils that are of moderate to high fertility, but aridity hinders full exploitation of its innate agricultural potential.

### **Main objective of the Project**

The primary objective of the project was to introduce measures that would reduce mortality, morbidity and improve the well-being of 12,000 poor, smallholder farm families in the project area.

### **Specific Project Objectives**

To raise food production, the income and well being of the target population through increase in agricultural production;

To improve the health of the population through cost-effective primary health care, the provision of safe drinking water and the promotion of an improved diet; and

To promote agricultural techniques that would protect the environment.

### **Implementing Institutions**

The project was multisectoral and multidisciplinary and implemented by five ministries: Planning and National Development; Agriculture; Water Resources; Health; and Culture and Social Services.

### **Nutrition Component**

The nutrition component of the project was implemented jointly and singly by the Home Economics Branch (HEB) of the Ministry of Agriculture and Nutrition unit of the Ministry of Health. This paper only addresses implementation by HEB, which was aimed at improving the nutrition and household food security of the target households. The implementation of the home economics activities of the NDAP heavily borrowed from the following strategies applied by the Home Economics Extension Programme (HEEP) in general

Diversification of food production and consumption through promotion of kitchen gardens and rearing of small livestock such as rabbits and poultry.

Promotion of increased production and consumption of indigenous, drought tolerant and under-utilized foods such as sorghum, millet, sweet potatoes, and cassava.

Food preservation, in particular vegetables and fruits.

Nutrition education on appropriate food production and consumption habits.

Improved food preparation methods of the locally available food-stuffs.

Promotion of women friendly, time saving, and energy efficient technologies and practices.

Population education emphasising the need to plan families in relation to resources available to households.

Promotion of rural income generating activities.

### **Project Coverage and Implementation arrangements.**

A total of 328 women groups with a membership of 9,149 women benefited from home economics extension. About 41 front-line extension staff (FES) at a ratio of 1 staff to 8 groups disseminated various



messages to these groups during group and farm visits, field days and demonstrations. At the division level, the Home Economics officer coordinated the various activities including organizing women groups and FES trainings. The District Home Economics Officer (DHEO) guided and supervised the overall implementation of the component, compiled the annual work plan and budgets and periodical reports.

## Main Achievements

At the end of the project, it was evident that the project investment in nutrition activities through Home Economics and Primary Health Care component had improved nutrition and household food security. Below are highlights of the major achievements realized by the component:

Built the capacity of women in the implementation of food and nutrition activities. The groups were trained on the aforementioned strategies. Extension approaches used include field days, study tours, group visits, demonstrations and lectures.

Created awareness on the role of kitchen gardens in improving nutrition and household food security. At the end of the project about three quarters of targeted members (5,178 out of 6,885) had established kitchen gardens. A total of 40 model kitchen gardens were established for teaching purposes.

Environmental conservation through use of fuel-efficient devices such as the fuel economy stove and fireless cooker. A total of 759 economy stoves, 639 fireless cookers and 367 tea cozy were installed/constructed. Slightly over half (52%) of households adopted one or more of the energy efficient technologies.

Empowered women in resource mobilization and proposal writing. As a result groups were able to mobilize funds (each beneficiary was required to contribute about 30 percent of the total cost), which were used to construct a total of 89 water tanks by end of the project. Two groups had their proposals funded by the Embassy of Belgium where one received a posho mill and the other 18 water tanks for each of its members.

## Impacts of Home Economics Activities

1. Improved nutritional status and general health of the community. Data from the local health facilities indicated a reduction of malnutrition cases. It was reported that the prevalence of underweight, which is an indicator of chronic malnutrition, decreased from 19.3 percent in 1991 to 5.3 percent in 2001 as a result of improved diet.

Improved feeding habits as a result of appreciation of the importance of balanced diet. About 80 percent of the households have knowledge on nutrition.

Establishment of kitchen gardens resulted in improved household food availability and diversity as well as an annual income savings of approximately Ksh. 7000 per household.

Kitchen gardens also generated income for some households that more often were spent on kitchen expenses.

Women also reported that kitchen gardens had a time saving effect as they rarely went to the market to buy fresh produce such as vegetables.

Introduction of kitchen gardens, food diversification, proper storage and preservation and increased cash income, especially when generated by women were found to have a positive effect on household food security.

Improved water harvesting techniques; two out of five households

had constructed water tanks to harness rainwater from roof catchment.

Women empowerment resulting from income-generating activities carried out by groups. A total of 100 groups were involved in on and off-farm income generating activities, while 271 groups were carrying out savings mobilization activities commonly known as merry-go-round.

Energy conservation. Households using the fuel economy stove reported saving up to two thirds of woodfuel and half of the time spent in gathering firewood. Consequently fewer trees were felled down for the purpose of wood fuel. Women also reported that fireless cookers made it possible for them to be away from home for longer periods enabling them to engage in economically productive work. The dissemination of the fuel economy stoves were also found to be sustainable.

The successful implementation and positive impact of nutrition component of NDAP brought nutrition issues into development arena of IFAD-funded projects.

The success of the NDAP also led to initiation of a bigger project covering the dry areas of Central Province (2001 – 2008).

## Main Constraints

The main constraints that hampered implementation of Home Economics activities were: inadequate budgetary supplies; poor financial flow to the district; mismatch between annual work plans and budgets, printed estimates and actual allocations to the project; severe liquidity problem at the district treasury; group disintegration as result of misunderstanding of project activities and also occasioned by the need for members to eke a living through seasonal employment; and inadequate water to sustain kitchen gardens during dry seasons.

## Lessons Learnt

Appropriate technology is in most cases successfully adopted as it saves energy, money and time.

Kitchen gardens contribute significantly to nutrition and household food security.

More often than not groups are cohesive and sustainable when income generating is a core element in most of their activities.

## Challenges Faced by HEEP

In the course of educating farming communities on the various activities, the programme has faced the following challenges:-

The groups may be willing to adopt a technology but are hindered by lack of resources, and inability to get or qualify for credit from microfinance institutions.

In adequate funding of the programme activities.

Lean staffing. The Government has not employed staff over a long period of time.

Women have limited control over available family resources to be able to exploit them fully.

Lack of recognition of nutrition issues in the development arena.

## Lessons Learnt

Capacity building of both staff and farming communities ensures sustainability of a programme.

Where programmes are engendered, the women get more support from the men folk and a greater success is registered.

The groups are very receptive to Home Economics messages.

Ability of women to access savings through merry-go-round has contributed to adoption of technologies.

Simple household/cottage technologies play a significant role in income generation.

Nyeri Dry Area Smallholder and Community Services Development Project Supervision Report. April 2001.

Nyeri Dry Area Smallholder and Community Services Development Project Qualitative Impact Assessment Report. Vol. II & I. June 2003.

## Conclusion and way forward

The Home Economics Programme is carrying out several activities to address the challenges and lessons learnt. Some of these activities are:-

Acquiring and distributing technical reference materials.

Efficient and effective backstopping and supervision of field activities

At the headquarters HEEP has introduced professional talks to educate the other members of staff the programme activities.

We have revised the programme reporting format to be able to capture the details of all the activities in the fields so as to make appropriate decisions and understand the actual situation on the 'ground'. This will assist in designing appropriate strategies and interventions.

We now have annual home economics technical updates which act both as communication channel with the field staff as well as reference materials.

Empowering staff technically through exposure to current activities.

Enhancing and strengthening collaboration with other stakeholders.

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# Christian Children's Fund - Kenya Program Brief

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

## 1.0 Introduction

The Christian Children's Fund (CCF) is an international child development organization, working in more than 30 countries, assisting over 4.6 million children regardless of their race, religion or gender. CCF works for the well being of children by supporting locally led initiatives that strengthen families and communities in order to contribute towards poverty eradication and protect the rights of children.

## 1.1 MISSION

CCF-Kenya mission is to promote growth and the well being of children by empowering families and communities to utilize the available resources and opportunities for sustained benefits for children.

## 1.2 COVERAGE

CCF-Kenya supports over 44,000 enrolled children and impacts on an additional 200,000 in the communities it serves. It has 48 community based organizations clustered into 11 project areas (geographical regions) that are located in 31 districts in the country. The clustering enables strategic use of resources, to optimize program impact. The clustering also enables technical support, resource sharing and easy coordination.

## STRATEGIES

### CCF-Kenya's strategies used in the implementation of its programs include:

- Community Participation and empowerment
- Capacity building of communities and staff
- Partnership with key agencies and government ministries
- Advocacy and networking with stakeholders, GOK at all levels, NGOs, networks, CBOs, FBOs and the community.
- Operational research and documentation of best practices

## 2 An overview of CCF'S Programme:

### APPROACH AT PROJECT LEVEL

CCF- Kenya's goal implement initiatives that support the development of communities and families to ensure social capital and human capacity, commitment and practical resources required to sustainably protect and ensure the well-being of their children. The approach to achieving this goal is centred on the implementation of three pillars:

**Well-being:** Promoting effective and sustained improvements in the child and family through holistic and age appropriate programming.

**Empowerment:** Empowering parents and communities to lead the development process.

**Civil Society:** Broadening development initiatives through partnership and strengthening civil societies.

In order to contribute to the well being of children holistically, CCF implements comprehensive programs that address issues on health, nutrition, water and sanitation, education, early childhood development and livelihood.

## 3.The Health and Nutrition Programmes

### 3.1The Nutrition component

The major objective of the nutrition program is to improve and maintain nutritional status of children and their families. CCF's reorganizes that malnutrition is still a major cause of childhood morbidity and mortality in spite of the global efforts to reduce the problem. In response to the high levels of malnutrition in the country, CCF implements both long term and short term nutrition interventions that target mainly, children 0-5 years, pregnant and lactating women, HIV/AIDS infected and affected persons.

The interventions/activities to promote good nutrition focus on:

Community monthly growth monitoring and promotion of the children under five years old to determine rates of stunting, wasting and underweight using the three indices: Weight for height, height for age and Weight for age.

Supplementing diet with Vit.A and Iron is done for those cases medically assessed and are malnourished (-2 standard deviation). The caregivers are trained on the growth and utilization of locally available nutritious foods and health care.

Nutrition education/training in relation to maternal child health, HIV/AIDS, reproductive health, disease control, prevention, management and environmental health.

Nutrition studies to identify the nutrition and health needs of the communities.

Promotion of school and home kitchen gardening to enhance household food security.

Development of IEC materials containing simple educative messages as well as acquiring other relevant materials from partners.

Collaboration with the government ministries, especially with health in deworming, immunization campaigns and malaria control.

### 3.2 Nutrition in HIV/AIDS

HIV/AIDS has a drastic and obvious effect on the nutritional and health status of the vulnerable groups. Malnutrition weakens the immune system thus making the infected person susceptible to illnesses.

The major HIV/AIDS interventions are:

Training of counsellors and caregivers on integration of nutrition in Home Based Care

Nutrition care and support for OVC and PLWAS

Behaviour change communication on consumption of indigenous nutritious diets

Nutrition education and community sensitization

A lot of emphasis has been put on integration of nutrition in the home based care systems with tremendous success in one of the II projects (Rangala) in Siaya, Western Kenya where 35 chronically ill are benefiting from HBC services. Adequate nutrition and care in Busibi in Busia, Western Kenya through the promotion and consumption of traditional foods of high nutritive value (soya beans, Yellow fleshed potatoes, vegetables). The HBC has made it easy to identify OVCs during home visits, encouraged formation of support groups for PLWAS and also enhanced partnership with other stakeholders (government ministries, NGOs, CBOs, FBOs and community).

#### 3.2.2 Malaria

Malaria is the leading cause of morbidity and mortality in Kenya, about 20 million (70%) Kenyans are exposed to the disease. The health and nutritional status of any individual is worsened by malaria that destroys the red blood cells, resulting to anaemia especially among pregnant mothers. A placenta infected with malaria contributes to low birth weight (LBW) babies.

CCF-Kenya is involved in an integrated malaria program in its effort to contribute to the well-being of children and the malaria interventions focuses on:

Expansion of Insecticide Treated Nets (ITNs) and Long Lasting Insecticide Nets (LLIN)

Training on ITNs and its usage

Re-treatment of Nets

Vector Control

Capacity Building on:

Case Management

Malaria in Pregnancy

Intermittent Preventive Treatment

Malaria Emergency Response

## 4. NUTRITION INTERGRATION INTO OTHER PROGRAMS

### Water and sanitation

Food hygiene and sanitation significantly affects nutritional status of individuals. CCF ensures safe water and sanitation not only to the enrolled families but also to the wider communities that are largely rural. Some of the activities undertaken include:

Water purification using the most cost effective way (boiling, sieving, chlorine) and storage.

Hygienic disposal of faeces and other domestic waste by ensuring

that families have compost pit, dish drying racks, leaky tins and pit latrines.

Food Hygiene to avoid contamination, washing the foods and hands before handling, storing cooked and raw foods appropriately.

Household hygiene

Besides the encouraging communities to exploit all available methods of water access CCF-Kenya has a drilling rig that was donated by a USA sponsor in 2001. The rig has since sunk over 165 boreholes going to an average depth of 350 metres with a total water yield capacity of over 920 cubic metres. Communities are trained on water management, health and nutrition and encouraged to form water associations to manage their water sources and ensure sustainability.

### 4.2 Early childhood care and development program

The objectives of CCF's early childhood care and development (ECCD) program are to increase participation of children 0-8 years in formal education and provide caregivers with knowledge and skills on early stimulation for children's physical growth, cognitive, social and language development. This is done through building on existing positive traditional child-rearing practices. The main components of the ECCD program are:

#### Home based care and institutional care for children (0 – 3/ 4 – 6) years

The main activities are Infant stimulation, childcare and growth monitoring, Nursery/Pre-schools education focus on, supplementary feeding, establishment of child friendly environment, child stimulation that is known to improve the prognosis to recovery of especially malnourished children. Activities at the ECCD include

Food and vit.A supplementation – Mothers assist with preparation of the meals.

Growth monitoring to ensure proper growth of children and take appropriate measures whenever problems are detected.

Deworming at the ECCD centres on quarterly basis in collaboration with the Ministry of Health.

Nutrition education for the caregivers.

Observing high hygiene both personal and environmental within the centres and that is expected to be replicated at homes.

Income generating activities that contribute to household income and food security.

### 4.3 Nutrition and Education program

The main program objective is to increase participation of children 6-15 years in formal and non-formal education and to improve its quality. CCF understands the importance of promoting good nutrition in schools given that nutrient deficiency such as iodine, iron and Vit. A have a direct impact on individual's intelligence. Nutrition activities include:

School feeding programme in collaboration with WFP

Vitamin A supplementation

Deworming in collaboration the Kenyan Government

Nutrition and health awareness talks and formation of such clubs in schools

Promotion of school gardens that provide foods with valuable extra nutrients

## 5 Benefits accrued from integration of Nutrition in CCF's programmes

### 5.1 Nutritional status

There has been improvement of maternal and child nutritional status. CCF focuses largely on enrolled families whose data is collected on monthly basis. This facilitates one to one contact and scrutinizes the nutritional status of these families and acts promptly. Malnourished children are identified and supplementation provided and referrals in cases of chronic malnutrition. The GMP health cards are checked to ensure that children born complete full immunization and go for growth monitoring. The pregnant mothers receive prenatal vitamins, iron folate, tetanus immunization and malaria prophylaxis.

### 5.2 Health status

The health program has realised significant improvement, in terms of nutrition status, safe water access of the community and particularly the U5,

**Table 1: The impact of various components on health and nutritional status**

Health components/Year	2000	2001	2002	2003
Safe water access	48%	49%	51%	53%
Infant mortality	36	42	36	28
Under five mortality	89	88	75	57

Source: CCF AIMES 2003.

### 5.3 FOOD SECURITY

CCF's key focus areas in food and nutrition security focus is capacity building of communities to take charge of their own development. Other areas include:

Supporting culturally appropriate/sensitive technologies.

Indigenous food crop production, consumption, preservation and storage

Promotion of kitchen gardening that is a source of household food security/income

Apiculture (bee keeping) in the drier areas.

Cereal/ seed banking and bulking

Environmental conservation and livestock restocking as well sourcing for marketing for the products.

Promotion of income generating activities as an alternative way of increasing family income.

## 6 Monitoring and evaluation

### 6.1 Information system

CCF-Kenya provides an effective information system known as, Annual Impact monitoring and evaluation system (AIMES) measuring program impact and a tool that assists grass root communities to analyze their needs and implement successful strategy. The indicators have been selected to reflect both CCF's commitment to children and to contribute towards poverty alleviation (MDGs/PRSP). The information is entered on family cards (parent's knowledge, primary health care indicators and year of enrolment), it is then fed on the Standard Impact Tool for Evaluation (SITE) and finally fed on to the national system. Red flags are raised where SITE data indicates problems and action taken.

## 7 Milestones

Since its inception, CCF's health and nutrition programme has made great milestones in improving the nutrition and wellbeing of the Kenyan child. Some of the success stories include:

The use of Child to child approaches in schools has led to behaviour change of parents/ guardians and communities in contributing towards environmental and personal hygiene.

Capacity building of communities that has led to active participation in their own development through problem identification, prioritisation, planning, implementation and monitoring and evaluation of their nutrition projects.

CCF has assisted communities to access safe water within its communities by drilling over 165 boreholes going to an average depth of 350 metres with a total water yield capacity of over 920, besides other water sources.

Communities are now appreciating the relevance of ECCD. A good example the traditional ECCD loipi in nomadic communities where an integrated approach to children's growth is used and the enclosures fully managed by the community.

## 8 Challenges

The implementation of CCF's Health and nutrition programme has not been without challenges, some of these challenges include:

Operating against the backdrop of limited resources against raising diverse community needs.

Inhibitive cultural practices e.g. FGM early marriages, wife inheritance, and food taboos.

High illiteracy levels among the communities especially women.

Harsh environment within which the programme operates.

High levels of poverty among communities, which are largely rural.

High HIV/AIDS prevalence that tends to erode the little gains made in nutrition.

## Conclusions

CCF AREAS OF COVERAGE MAP

# Food Consumption Patterns and Nutrient Intake By Women And Under Five Year Old Children In Wetlands Of Lake Victoria Basin.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Objective:** To determine the food consumption patterns for women and children under five years in wetlands of Lake Victoria region.

**Design:** A cross-sectional study was carried out in purposively selected sites located near major towns in each of the three countries of East Africa.

**Settings:** Three sites representing each of the three East African countries

**Subjects:** One thousand two hundred and twenty four women and children.

**Main outcome measure:** The nutrient intake was determined by comparing the actual intake with that of the FAO/WHO 1989, RDA. Although the mean intake of nutrient in the selected sites were below RDA for all the nutrients, there were a good number of respondents who had above RDA in calories, and protein. Iron and retinol intake were the least consumed nutrients.

**Results:** Most women in the in the wetlands did not meet their RDA with much lower means being recorded for Kenya relative to the other countries. The means for Uganda were high in most nutrients. Consumption patterns of foods indicated a change in taste of women and children in the wetlands from the traditional foods to the exotic foods. This was more pronounced in vegetables and cereals.

**Conclusion:** Consumption patterns indicate a change in taste from traditional foods to exotic foods and an accompanying low consumption patterns of essential nutrients especially retinol for women and children. Promotion of consumption of local foods rich in essential minerals is recommended.

## 1.0 Introduction

The Lake Victoria Basin is facing environmental and socio-economic problems that have led to escalating poverty levels. Wetlands are known to be an important basis of community economic activities for a substantial number of people [3,7,11,13] whereby they provide families with means of making a living. However, the socio-economic and environmental changes taking place in the lake basin have caused considerable adjustments in the lifestyles of these populations. For example, native plants and animal foods formed a large part of the diet in the past, but with environmental degradation such as deforestation and intensification of economic activities such as commercialized fishing, such plants and animal foods are no longer readily available. Consequently, many families are now increasingly becoming vulnerable to malnutrition because most sources of their livelihood such as fishing have become highly commercialized causing among others isolation of many poor families.

In order to adapt to the emerging food shortage communities living in the Lake Victoria Basin had to change their tastes and preferences. In the East African countries (Kenya, Tanzania and Uganda) maize became a leading staple food replacing other foods such as millet and cassava. In Kenya maize is consumed by 89.9% of the population [14] and cassava has become a famine food consumed in large quantities during food shortages. Vegetables and particularly exotic ones such as kales and cabbages are the main relish often consumed alone and only occasionally in a mixture with different foods such as meat and fish [7]. Consequently, many poor households suffer from intermittent food shortages that grossly lead to severe hunger and malnutrition which peaks during rainy season and shortly before harvesting [9]. In spite of its productivity the wetlands are not immune to these trends. There are reports by UNICEF [14] of low consumption of foodstuffs for energy, protein, micronutrients and fat and low consumption of animal foods (22.8%) and fruits (26.8%) among children in Kenya. This therefore means that children may miss to take the recommended daily allowances (RDA) for some essential nutrients.

In addition, according to [1] the percentage of mothers who breastfeed their children exclusively by 4 months in Kenya, Tanzania and Uganda was 17%, 32.5% and 70.4% respectively. It has also been shown that complementary foods are introduced to children at between 6-9 months [1]. Nonetheless, information regarding food consumption patterns and nutritional status of children and women in East Africa especially of wetlands is scarce and scanty. The purpose of this study therefore was to assess the food consumption patterns and nutrient intake of women and under five year old children in the wetlands of East Africa region. The specific objectives of the study were to determine the food consumption patterns and nutrient intake of women, and children and their variations in relation to selected socio-demographic characteristics.

## Materials and Methods

The study was carried out in selected sites of the Lake Victoria wetland of East African in the neighborhood of three leading urban centers. These sites were Kisumu (Kenya) Mwanza (Tanzania) and Jinja (Uganda) where the main economic activity of the bulk of the population is fishing and small-scale agriculture. A cross sectional design was used for this study and data collection conducted between February and May 2004. In Kenya cluster sampling was carried out using the Kenya Bureau of statistics enumeration areas while in Jinja and Mwanza the Health statistics sampling guides for the respective countries were used. Six hundred and twelve households were sampled for the study providing information on 612 women and a similar number of under five year old children. This brings the total number of sample to 1,224, which is above the minimum of 768 recommended by use of [21] guidelines.



**Table 1: Distribution of Sample by Country**

Country	Households	No. of women	No. of Children	Total
Kenya	206	206	206	412
Uganda	205	205	205	410
Tanzania	201	201	201	402
Total	612	612	612	1,224

A research permit was obtained in each of the three sites before fieldwork. The identified households were briefed about the purpose of the study and a verbal consent given by respondents. The local administrator and local village elders assisted the research team in identifying the sampled households during the data collection period. The sampled households were visited and interviews conducted using a semi-structured interview schedule.

The 24 hour recall method where mothers were required to give information on what they had consumed and what they fed their index children in the 24 hours preceding the interview time was employed. A calibrated list helped in estimating the quantity of food consumed by both the child and the mother. Volumes of solid food items were estimated by asking the respondents to depict the actual amount of food consumed. These amounts were then converted to volumes using water and measuring cylinders. A food frequency method was used to determine the consumption of different food items over a seven-day period to establish the types of foods commonly consumed. The obtained information was filled into a questionnaire together with the other required socio-demographic information and later entered into a computer spreadsheet and analyzed using Statistical Package for Social Sciences (SPSS). Information on food intakes were first analyzed using the Food Meter UK 07 to establish the quantity of nutrients consumed then transferred into the SPSS main sheet. Data were analyzed quantitatively by computers using the statistical packages for social sciences (SPSS). Descriptive statistics such as frequencies, proportions, means and standard deviations were used to describe the demographic profiles of target groups. In addition, descriptive summary statistics were used to establish the commonly consumed foods, the frequency of consumption and the nutrient intakes of foods. The percentage distribution of children and women who consumed foods in the last seven days were established for each sampled area. Chi-square tests, ANOVA and Post Hoc tests were carried out to determine the differences between variables.

The information was then used to compare with the FAO/WHO Recommended Daily Allowances for the various population groups. Specifically the nutrients of interest in the study included zinc, iron, protein, vitamin A and calories. In the combined spreadsheet the food consumption and nutrient intake patterns for both the mother and the index child were then computed. Analysis of Variance (ANOVA) and the Chi-Square were used to determine the significance of the relations between the food consumption and nutrient intake patterns of the different sample groups. ANOVA was used in cases where the dependent variable was measured at the scale level while Chi-Square was used for data measured at nominal levels.

## Results

Results presented in Table 2 indicate that consumption of foods rich in carbohydrates such as maize, rice, wheat products, cassava,

sweet potatoes and plantain were fairly high. However, it is maize that was consumed by many (45.6%) households on a daily basis followed by wheat products (17.3%). In the 2-4 times a week, rice was consumed by many (56.9%) followed by sweet potatoes (54.4%). The most consumed plant protein on a daily basis was groundnuts (9.0%) and beans (7.7%) in that order. The reverse order was observed for groundnuts (32.0%) and beans (60.3%) in the 2-4 times a week consumption category.

As Table 2 indicates, the most consumed animal protein on a daily basis was milk (39.9%) followed by fish (25.3%). Most (52.35%) women indicated having consumed beef 2-4 times a week while fish was consumed by 45.9 percent the same number of times.

Chicken was the least consumed form of animal protein in all the categories. The results in Table 2 also indicate that most respondents (63.7%) indicated that there was adequate supply of fish followed by 41.8% who felt milk was in adequate supply. The supply of chicken and eggs was indicated as being too low in the wetlands hence the low consumption patterns for these foods.

Table 3 indicates that tomato (33.7%) and Kales (18.1%) were the most consumed vegetables on a daily basis by women. Consumption of cabbages on a daily basis (3.6%) was comparatively low. However its consumption of 4-6 times (34.8%) per week was the highest followed by pumpkin leaves (26.3%). It is important to note that there were generally low consumption patterns for traditional vegetables such as kunde (5.4%), osuga (3.4%), dek akeyo (5.4%), mito (2.8%) on a daily basis with the proportion of consumption at 25.8 percent, 19.6 percent, 26.6 percent, 18.3 percent respectively in the 2-4 times a week category. Thus the traditional vegetables have become rare foods. Daily consumption of fruits was generally low with high consumption patterns being reported for pawpaw (10.3%), followed by mangoes (9.0%), oranges (2.0%), and pineapples (0.5%). However, consumption of these fruits in the two to four times category was relatively at 31.5 percent, 14.1 percent, 18.3 percent, and 23.0 percent respectively. Oils (61.9%) were consumed more than fats (20.6%). Consumption patterns for sugar (86.1%) on a daily basis was relatively high. Similar trends in consumption of sugar in Kenya were reported by [14].

A majority of the foods were consumed 2-4 times a week as illustrated in table 7. Maize flour was the main food consumed on a daily basis by 45.6% of the respondents. Among the food stuffs consumed 2-4 times a week was rice by 56.9% of the respondents. This finding supports findings by Kinabo et al (1997) which reported the similar findings in Tanzania. In the three East African countries there existed food insecurity during the period of data collection. According to table 7 the food which registered a high level of adequacy was fish at 63.7%.

Table 4 shows that the cereal most consumed on a daily basis by children in wetlands was sorghum (55.0%), followed by maize

(51.0%), millet (38.9%), wheat products (30.1%), cassava (27.5%), and groundnuts (20.7%). The Table also indicates that milk (60.3%) is the most consumed animal product on a daily basis followed by fish (23.2%), chicken (14.0%), eggs (7.4%) and beef (3.6%). Consumption of beef was less common since it had the highest frequency (87.2%) in the 2 to 4 times category followed by chicken (80.0%), eggs (65.4%), fish 23.2 and milk (33.0%).

Table 5 shows that tomato (89.8%) and Kales (40.7%) are the most consumed vegetables among children under five years. Consumption of cabbages (9.2%) on a daily basis was relatively low with very high consumption frequencies in the 2-4 times category. Surprisingly, the consumption patterns on a daily basis for traditional vegetables (kunde 21.3%, osuga 24.1% dek akeyo 22.9%, mto 6.7%)

among children under five years was relatively higher than those of their mothers. However the traditional vegetables remain the least

consumed foods by children. These results do agree with [7,11, 14] which showed that among children 0-36 months sugar was the most consumed item by 77.3% of the children and according to the frequency of consumption data it was consumed 6.2 times per week by children. Consumption of oils (78.5%) like in the case of women were higher than those of fats (67.3%). Similarly consumption of sugar (86.5%) was equally high among children as was among women.

Consumption patterns for fruits among children were highest for mangoes (39.8%), pawpaw (29.1%), and wild fruits (22.5%). Occasional consumption of 2 to 4 times a week were recorded for almost all fruits with the high frequencies for pineapples (88.0%), oranges (79.8%) and wild fruits (75.0%). These patterns could be attributed to the financial implications for pineapples and the seasonal peak supplies of oranges and wild fruits. Data from this study shows that most of these foods were adequate for children's consumption.

The most inaccessible foods for children were fruits mainly oranges and pineapples at 46.7% and 43.4% respectively.

Table 6 indicates that the mean nutrient intake in the three countries were generally low. It is shown that the consumption patterns for all the nutrients significantly differed in the three East African countries

save for iron and zinc. Kenya had higher mean intakes in retinol and iron. Uganda had higher mean consumption in calories, and Zinc while Tanzania had higher mean consumption in protein.

The results presented in the table above indicates that there were

significant differences between the nutrient intake in the three East African countries at the probability of error=0.05. Uganda had relatively higher intakes in all the nutrients save for protein (57.29) where it rated second after Tanzania (73.70). Kenya had the lowest mean intakes for all the nutrients except retinol (44.08) where it had second best mean after Uganda (65.36). Tanzania had the highest mean in protein and the least mean in retinol (22.38) while in the other nutrients it rated second highest mean. The mean nutrient intake for the three countries was however below the RDA for the respective nutrients.

## Conclusion

Based on the findings of this study the following conclusions have been generated. A majority of women consumed maize meal and sugar on a daily basis in all the three countries. Rice and sweet potatoes were consumed at 56.9% and 54.4% respectively by women. Caloric intake was average for women. The findings of this study showed that consumption of foods rich in carbohydrates such as maize, rice, wheat, cassava, sweet potatoes and plantains were fairly high. The most consumed plant proteins were groundnuts and beans.

The most consumed animal protein by women were milk and fish. The least consumed foods by women were fruits and vegetables and this explains the low micronutrient status by women reported in another study, which is part of the VicRes project. Regarding nutrient intakes a majority of the women were not able to meet the recommended daily allowances for calories as over half of the women surveyed were

**Table 2 Weekly consumption patterns of cereals and animal products by women**

Food Item	Frequency of consumption for week			Adequacy	
	Daily %	2-4 Times %	4-6 Times %	Yes %	No %
Maize flour	45.6	32.0	11.8	61.3	25.8
Millet flour	4.4	14.4	2.9	13.9	6.0
Sorghum flour	3.8	7.8	.7	9.8	3.8
Rice	9.0	56.9	7.4	40.5	26.6
Wheat products	17.3	30.4	10.1	31.9	21.6
Plantain/Matoke	7.7	39.4	7.7	33.8	19.8
Cassava	16.3	30.6	3.9	35.8	11.4
Sweet potatoes	11.9	54.4	11.1	55.7	17.3
Irish potato	2.0	25.2	.7	19.4	8.5
Arrow root	1.6	12.6	2.1	19.8	6.5
Beans	7.7	60.3	16.7	55.1	23.0
Peas	1.6	5.1	6.7	2.9	2.1
Groundnuts	9.0	32.0	12.4	35.9	15.7
Fish	25.3	45.9	19.3	63.7	21.1
Beef	1.5	52.3	3.8	33.0	20.8
Chicken	4.1	10.3	.5	10.6	2.9
Milk	39.9	24.3	4.1	41.8	25.8
Eggs	2.1	22.2	3.3	22.9	10.9

**Table 3: Weekly consumption patterns of vegetables, fruits, fats, oils and sugar**

Food	Frequency of Consumption Per Week			Adequacy	
	Daily %	2-4 times %	4-6 times %	Yes %	No %
Sukumawiki (Kales)	18.1	23.5	7.2	33.0	12.9
Cabbage	3.6	15.4	34.8	34.8	15.0
Kunde (Cowpeas Leaves)	5.4	25.8	5.1	27.3	6.7
Osuga	3.4	19.6	.3	16.8	4.7
Dek/Akeyo	5.4	26.6	4.1	29.2	3.8
Mito	2.8	18.3	1.1	16.5	4.2
Pumpkin Leaves	1.8	24.5	26.3	19.4	4.4
Carrots	1.1	9.3	.2	7.0	2.8
Tomatoes	33.7	7.5	2.1	67.0	20.6
Pawpaw	10.3	31.5	.8	35.0	5.9
Mangoes	9.0	14.1	1.0	18.6	3.6
Oranges	2.0	18.3	.7	11.3	10.3
Pineapples	.5	23.0	1.6	12.6	9.6
Wild Fruits	3.6	9.5	1.0	9.6	2.0
Oils	61.9	11.8	4.4	50.0	23.7
Fats	20.6	7.7	2.8	21.2	8.7
Sugar	86.1	9.0	1.6	58.8	33.0

falling below the 60-79% of the RDA. Uganda registered the highest number of women meeting the RDA for calories followed by Kenya and Tanzania at 19%, 15.9% and 2.5% respectively. The protein intake for women in the three countries was fairly good. Tanzania registered the highest intakes for protein followed by Uganda and Kenya at 89.1%, 53.7% and 43.9% respectively. The nutrient intake for iron, Vitamin A and zinc were well below the recommended dietary intake for women. For all nutrient intakes Uganda registered the highest intake of the five nutrients (protein, retinol, iron, zinc and iron in comparison to Kenya and Tanzania).

Breastfeeding of the children was universal up to two months of age. Complementary feeding began early way below the recommended period of four to six months. The most common items used as complementary foods were juices, other milks, porridges, bananas, sweet potatoes and ugali. The most consumed foods by children on a daily basis were milk followed by maize and millet at 60.3%, 51.0% and 38.9% respectively. Sugar and oils were also highly consumed on a daily basis by children at 86.5% and 78.5% respectively. The consumption of vegetables and fruits were low resulting in low micro nutrient intakes by children. In particular traditional vegetables were the least consumed foods by children.

Regarding nutrient intakes 70.2% of the children met the RDA for protein but the nutrient intakes for retinol, iron and zinc were dismal. In general nutrient intakes for protein and calories were favourable. Among the nutrient surveyed Ugandan children registered better nutrient intakes followed by Kenya and Tanzania.

## Recommendations

The study makes the following recommendations based on the findings of this study.

There is need to promote the micronutrient intakes in the study areas since women and children's nutrient intake was way below the recommended intakes. Women had the knowledge regarding the introduction of complementary feeding and yet they did not practice this and therefore there is need to enforce these practices through follow-ups by the community health workers especially for the vulnerable groups. Consumption of fruits and vegetables were low and therefore there is need to educate mothers on the nutritional benefits of these foods. Educating mothers of the nutritive values of traditional vegetables will go a long way in improving the health status of

**Table 4: Children's Weekly Consumption for Cereals and Animal Products**

Food item	Daily	2-4 times	4-6 times	adequacy	
				Yes %	No %
Maize flour	51.0	35.2	13.8	70.4	29.6
Millet flour	38.9	53.2	7.9	69.7	30.3
Sorghum flour	55.0	41.7	3.3	71.6	28.4
Rice	15.9	78.2	5.9	60.3	39.7
Wheat products	30.1	57.0	13.0	57.7	39.3
Plantain/matoke	13.9	74.6	11.6	63.1	36.9
Cassava	27.5	62.5	10.0	75.3	24.1
Sweet potato	16.7	63.4	19.4	76.3	23.7
Irish potato	14.7	81.1	4.2	69.6	30.4
Arrowroot	11.1	74.4	14.4	60.0	40.0
Beans	7.9	69.9	22.2	70.5	29.5
Groundnuts	20.7	53.0	26.3	69.6	30.4
Fish	23.2	57.7	19.1	75.1	24.9
Beef	3.6	87.2	9.2	61.4	38.6
Chicken	14.0	80.0	6.0	78.3	21.7
Milk	60.3	33.0	6.7	62.1	37.9
Eggs	7.4	65.4	26.6	67.6	32.4

women and children. Effective monitoring and evaluation efforts need to put in place by health workers to ensure compliance of health and nutrition initiatives. The study showed that consumption of carbohydrate foods such as maize, millet, rice, wheat, sugar and oils was high. The governments in the three countries need to look into the possibilities of fortifying cereals in order to enhance micronutrient levels. This study focussed on women and children under five due to their nutritional vulnerability but there is need to carry out another similar study focussing on the food consumption patterns and nutrient intakes of men and elderly persons in the wetlands.

### Acknowledgements

To VicRes Grant of the Inter University Council of East Africa for sponsoring this research.

To the universities in the three East African countries namely Kenyatta University, Egerton, Makerere and Sokoine University of Agriculture for enabling the four researchers to

undertake this study.

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**Table 5: Children's Weekly Consumption patterns of vegetables, fruits, fats, oils and sugar.**

FOOD	Frequency Of Consumption Per Week			Adequacy	
	Daily %	2-4 Times %	4-6 Times %	Yes %	No %
<i>Sukuma wiki(Kales)</i>	40.7	41.7	17.6	71.9	28.1
Cabbage	9.2	75.8	15.0	67.6	29.2
<i>Kunde</i> (cow peas)	21.3	68.4	10.3	80.3	19.7
<i>Osuga</i>	24.1	75.9	.0	78.0	22.0
<i>Dek/Akeyo</i>	22.9	60.7	16.4	88.6	11.4
<i>Mto</i>	6.7	85.4	7.9	79.5	20.5
Pumpkin leaves	7.1	92.9	0	81.5	18.5
Carrots	4.7	93.0	2.3	74.1	28.9
Tomatoes	89.8	7.9	2.9	76.5	23.5
Pawpaw	29.1	69.6	1.3	85.6	14.4
Mangoes	39.8	58.3	4.9	83.8	16.2
Oranges	7.3	79.8	12.9	53.3	46.7
Pineapples	4.0	88.0	8.0	56.6	43.4
Wild fruits	22.5	75.0	2.5	83.1	16.9
Oils	78.5	15.8	5.7	67.8	32.2
Fats	67.3	22.4	10.3	71.0	29.0
Sugar	86.5	11.6	2.0	64.1	38.9

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**Table 6 Nutrient intake of children under five years**

<b>Maternal characteristics</b>	<b>% Stunted children</b>	<b>% Wasted children</b>	<b>% Underweight children</b>
<b>Mothers' education</b>			
No formal education	41.3	40.0	42.3
Primary education	36.3	28.9	35.9
Secondary education	8.8	24.4	7.7
Tertiary education	13.6	6.7	14.1
Total	100.0	100.0	100.0
<b>Mothers' occupation</b>			
Trader	66.2	50.0	60.8
Artisan	18.8	19.6	20.2
Professional/Civil Servant	10.0	21.7	11.4
Housewife	5.0	8.7	7.6
Total	100.0	100.0	100.0

**Table 7: Mean nutrient intake of women by country**

<b>Nutrient</b>	<b>Kenya</b>	<b>Uganda</b>	<b>Tanzania</b>	<b>Total</b>	<b>F</b>	<b>p</b>
	<b>Mean ± SD</b>	<b>Mean ± SD</b>	<b>Mean ± SD</b>	<b>Mean ± SD</b>		
Calories	1505.56±533.42	1723.53±456.48	1710.48±300.61	1646.11±452.21	15.67	0.000
Protein	52.12±56.43	57.29±25.81	73.70±19.08	60.96±38.62	18.21	0.000
Retinol	44.08±65.38	65.36±51.63	22.38±24.48	44.52±55.46	21.02	0.000
Zinc	2.51±2.03	5.37±2.26	2.95±2.23	3.61±2.51	102.78	0.000
Iron	3.81±2.00	6.83±2.17	4.72±2.05	5.12±2.43	113.72	0.000



# Maternal Characteristics and Child Undernutrition in Three Different Socio-Economic Groups in Ibadan, Nigeria.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

### Background objectives

Undernutrition in children is closely related to the education and economic status of mothers. This study investigated the relationship between maternal characteristics (education and occupation) and under nutrition in children from three communities of different socio-economic classification in the city of Ibadan, Nigeria.

### Methods

The communities were chosen using stratified random sampling while the children were selected within the communities with a systematic sampling procedure. Anthropometric assessments (height and weight) were conducted on 285 children under the age of five years. Their mothers were interviewed using a structured questionnaire. Undernutrition indices of weight-for-height (wasting), height-for-age (stunting) and weight-for-age (underweight) were diagnosed using a Z-score of less than minus 2 standard deviations of the National Center for Health Statistics/World Health Organization international growth reference. Epi Info 6.0 statistical software was used to analyze the data.

### Results

More than a third (34.7%) of the children fell between the ages of 13-24 months. There were more males (51.2%) than females. Children from the low socioeconomic community had the highest prevalence of wasting (19.7%), stunting (44.1%) and underweight (42.0%), while the middle socioeconomic community had the lowest: wasting (10.3%), stunting (17.1%) and underweight (16.9%). Figures for the high socioeconomic community are 16%, 17.6% and 21.6% for wasting, stunting and underweight respectively. The least educated mothers were from the low socioeconomic community. Although the middle socioeconomic mothers were less educated than high socioeconomic mothers, it appears their occupation types afforded them more opportunity to personally provide more care for their children.

### Conclusions

Women in urban areas may be relatively more educated, find employment outside the home, and earn a higher percentage of the family income. However, the results of this study imply that the gains of more maternal education and higher income are possibly underplayed in the absence of corresponding care when mothers have to devote more time to their occupation. This has significant implications particularly in the light of recently observed increasing urbanization of child undernutrition in Nigeria.

## Keywords

Undernutrition, children, maternal, urban, socioeconomic

## Introduction

Various maternal characteristics have been associated with child undernutrition. Studies have shown some degree of association between mothers' education and the nutritional status of children [1,2]. Data shows that in Nigeria, children of less educated mothers are disadvantaged in terms of nutritional status. Percentage of stunted children under the age of five was 50% for uneducated mothers, 37% for mothers with primary education, 22% for those with secondary education and only 7% for those with tertiary education [3]. Several mechanisms have been postulated in literature to explain this relationship. One of them is that education provides women with knowledge and skills, which enable them to earn higher incomes. Women's income generation leads to greater control over income which in turn leads to expenditure patterns favouring nutrition [4]. In addition, education improves the quality of day-to-day care women give to their children [5]. On the other hand, women's income-generating occupation diverts time from child care to the occupation [4].

This paper reports findings from an urban survey which investigated the relationship between mother's education and occupation and child nutrition status.

## Methodology

The study was carried out in Ibadan Southwest Local Government Area (LGA) of Oyo State, Nigeria. The LGA was stratified into low, middle and high socio-economic communities. One community was chosen by random selection from each stratum, and in each community, systematic sampling (every tenth house in each community) was used to select children under the age of five years for the study. A total of two hundred and eighty five (285) children were thus selected.

Anthropometric assessments (height and weight) were conducted on the children, and their mothers were interviewed using a structured questionnaire. Child undernutrition was evaluated using stunting, wasting and underweight, in comparison with the standard reference population of the National Centre for Health Statistics/World Health Organization (NCHS/WHO) [6].

Undernutrition indices of stunting (height-for-age), wasting (weight-for height) and underweight (weight-for-age) was diagnosed using a Z-score of less than -2SD of the median value of the reference population. Data was analyzed using Epi info 6.0 statistical software. Prevalence for stunting, wasting and underweight were calculated, and the data was further analyzed using frequencies, cross tabulations and analysis of variance.



## Results

### Personal Characteristics of Children

Majority of the children (34.7%) fell into the 13 -24 month age-group. The oldest agegroup (49 -60 months) was the least (3.9%). There were more males than females (51.2%) as shown in Table 1 below:

**Table 1: Personal characteristics of children**

Personal characteristics	Frequency	Percentage
Agegroup (months)		
0 -12	48	16.8
13 -24	99	34.7
25 -36	74	26.0
37 – 48	53	18.6
49 -60	11	3.9
Total	285	100.0
Sex		
Male	146	51.2
Female	139	48.8
Total	285	100.0

### Maternal characteristics by community

Mothers' education as measured by the highest level of education attained is displayed in Table 2. As expected, the most educated mothers were from the high socio-economic community, followed by the medium class mothers. About half of the low socioeconomic community mothers had only primary education.

An investigation of their occupation showed that most of the low socio-economic mothers were traders. Middle income mothers were mostly artisans (e.g. hairdressers, tailors, laundry women, cooks, etc), while high income mothers were mostly engaged in professional occupations (e.g. doctors, bankers, lecturers) and civil servants.

**Table 2: Maternal characteristics**

Maternal characteristics	Low socio-economic	Middle socio-economic	High socio-economic
Mothers' education	%		
No education	8.9	1.4	1.5
Primary education	48.4	10.8	9.9
Secondary education	38.7	50.0	32.4
Tertiary education	4.0	37.8	56.3
Total	100	100	100
Mothers' occupation			
Trader	68.5	17.3	40.8
Artisan	21.0	52.0	8.5
Professional/Civil Servant	5.6	29.3	9.4
Housewife	4.8	1.3	11.3
Total	100	100	100

### Children's Nutritional Status

Data in Table 3 shows that the low socio-economic community had the highest prevalence of wasting, stunting and underweight, followed by the high socio-economic community. The children with the best nutritional status were those of the middle socio-economic group. Analysis of Variance (ANOVA) showed significant difference in the prevalence of stunting and underweight ( $p=0.000$ ) but not wasting ( $p=0.309$ ) among the three communities.

**Table 3: Nutritional status of Children**

Community	Stunted	Wasted	Wasted
	%		
Low socio-economic (n=132)	44.1	19.7	42.0
Middle socio-economic (n=78)	17.1	10.3	16.9
High socio-economic (n=75)	17.6	16.0	21.6

**Table 4: Child under nutrition and Mothers' characteristics**

Maternal characteristics	% Stunted children	% Wasted children	% Underweight children
Mothers' education			
No formal education	41.3	40.0	42.3
Primary education	36.3	28.9	35.9
Secondary education	8.8	24.4	7.7
Tertiary education	13.6	6.7	14.1
Total	100.0	100.0	100.0
Mothers' occupation			
Trader	66.2	50.0	60.8
Artisan	18.8	19.6	20.2
Professional/Civil Servant	10.0	21.7	11.4
Housewife	5.0	8.7	7.6
Total	100.0	100.0	100.0

There were significant differences ( $p < .05$ ) in children's nutritional status by mothers' education and occupation. Table 4 shows that children whose mothers were educated were less likely to be undernourished. However this effect seems to wane after secondary education.

For occupation, housewives and artisans contributed the least proportion of children with undernutrition. On the other hand, children of traders and professionals were more likely to suffer from undernutrition.

## Discussion

This study has observed significant differences in childhood nutritional status within an urban local government area. This supports previous assertions that the urban society as well as its nutritional problems is too heterogeneous to allow generalizations [7]. Prevalence of undernutrition was highest among the low socio-economic community, with levels of stunting and underweight in particular being at least twice higher than that found in the middle socio-economic community, where undernutrition was lowest.

Surprisingly, the high socio-economic children did not have the best nutritional status, as the

differences in children's nutritional status ought to be a reflection of differences in the socioeconomic status of the communities, as explained in the literature [1,8].

A possible explanation for this observation is from the position of mother's occupation. The high socio-economic mothers were mostly employed in professional jobs outside the home (being the most educated among the mothers) most likely, for long hours. This leaves them with no option than to leave their children with alternative caregivers like relatives (such as older siblings, aunts, uncles or grandmothers), employed housekeepers, daycare owners or neighbours. On the other hand, the medium density urban mothers were on the average, less educated but were more of artisans, vocations that gave them the opportunity to take their children to work, and probably provide better care. Popkin [9] observed that the absence of the mother from their home influences the nutritional status of the child. Although time spent in generating income is an important (positive) determinant of household nutritional status, this effect may be less than expected, because mothers may allocate more time to earning money and less to child care [10,11]. When care is compromised, even a good diet has less an effect than it should. This reduces nutritional status and thus, in the process, weakening any advantage of income on nutrition [8]. This is in line with the concept of "care", one of the underlying determinants of child undernutrition [12]. According to Engle et al [13], care refers to the behaviours and practices of caregivers (mothers, siblings, fathers, and child-care providers) to provide the food, health care, stimulation, and emotional support necessary for children's healthy growth and development. These practices translate food security and health-care resources into a child's well being. Not only the practices themselves, but also the ways they are performed - with affection and with responsiveness to children - are critical to children's growth and development.

## Conclusion

There have been arguments over the conflicting economic, biological and cultural roles that women have to play [4]. Women are expected to bear and rear children, and at the same time, play a key role in family economic life. Where economic roles conflict with nurturing roles, the consequences are costly on the nutritional well-being and health of children as a whole. This issue becomes more important in the light of urbanization, an important demographic feature which is associated with the increasing proportion of women engaging in formal and informal income-generating activities.

Meanwhile, there is evidence of increasing urbanization of malnutrition, as both the percentage and absolute numbers of urban underweight children is increasing in several developing countries, Nigeria being one of them [13]. More research is needed in Nigeria to understand the links between mothers' education, occupation and the nutritional status of children especially in urban areas.

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# The Elderly And Health: A Case of Study from Sharperville, South africa, Oldewage-Therone

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

## Abstract

**Background:** Population ageing and the growing number of elderly people are two of the most important demographic changes that have emerged during the last decades of the 20th century. Given the diversity of environments, nature of social changes and the genetic and evolutionary experience across regions, it is difficult to generalise about the health of the growing elderly population. The increasing number of elderly people in developing countries will, however, be vulnerable to the health problems associated with low-income, infections and accidents, and their diet and nutritional status will interact with these conditions. This project will focus on the extent that micro-mechanisms influence food, nutrition and health of the elderly in Sharpeville.

**Objectives:** Determining the socio-demographic and health profile, as well as dietary intake of the sample as part of a situation analysis.

**Methodology:** A pre-tested, structured demographic and health questionnaire was administered to 170 (57%) randomly selected elderly people attending a care centre in Sharpeville (n=300). A 24-hour recall was administered by trained enumerators on two occasions for dietary intake and food consumption patterns. Anthropometric measurements included height, weight and mid-upper arm circumference (MUAC). Data were statistically analysed for means and standard deviations.

**Results:** The mean age was 71.7 years and 6.5% of the subjects were single, 19.4% married, 70% widowed and 4.1% divorced. The average household size was 4.9 people living in brick houses (98.8%) with £ 2 rooms (29.4%), 3-4 rooms (40.6%) or ≥ 4 rooms (30%). The majority of households (65.8%) had an income of R 500-1000 (83-167 USD) per month. Major health problems reported were ear, nose and throat (ENT) problems (72.4%), painful joints (70.6%) and chronic headaches (48.2%). Twenty-nine percent of the subjects indicated weight loss during the past month and 30% experienced a recent change in appetite, whilst 31.2% experienced difficulty chewing. The top five most consumed food items (average portion size±SD) were: tea (299±126.6 g brewed weight), maize meal porridge (273±101.6 g), brown bread (93±41 g), full cream milk (67±111.8 g) and chicken (103±111.8 g) respectively. Daily intakes (mean±SD) were: 5041.2±2299.6 kJ energy, 50.4±28.2 g protein, 38.9±28.2 g fat and 149.1±76.6 g carbohydrates. The nutritional status indicators showed that 16.4 % of the subjects were normal weight (BMI 18-24), 29.5% overweight (BMI 25-30), 27.9% obese (BMI 31-35) and 26.2% very obese (BMI 36+). The mean MUAC was 33.4±0.7cm and 50% of the subjects had more than 40% body fat. Sixty-eight percent of the subjects suffered from hypertension.

**Conclusions:** The results indicate that this is a low-income community with household food insecurity and compromised nutrition, mainly overnutrition due to a mainly carbohydrate-based diet. The study demonstrated that overweight exists among the food insecure. The results of this survey will facilitate planning and implementation of sustainable community-based interventions to promote healthier

lifestyles.

## Introduction

Population ageing and the growing number of elderly people are two of the most important demographic changes that have emerged in the last decades of the twentieth century. The World Health Organisation (WHO) defines "elderly" as all persons over the age of 60. In 1980, 8.5% of the world population was elderly, increasing to 9.4% in 1990 and 11% in 2000. By 2020, it is projected that of the total global population of 7.5 billion people, 13.5% will be elderly [1]. In South Africa (SA) it is estimated that 2.9 million people are 60 years and older. This constitutes 6.2% of the total population [2].

Given the diversity of environments, nature of social changes, involvement in globalisation and the genetic and evolutionary experience across regions, it is difficult to generalise about the health of the growing elderly population. It is, however, certain that the increasing number of elderly people in developing countries will be vulnerable to the health problems that are associated with low-income societies, including infections and accidents, and that their diet and nutritional status will interact with these conditions. Ageing individuals may be intrinsically vulnerable to undernutrition and its associated infectious diseases, as well as to overnutrition and the risks associated with chronic diseases of lifestyle, thus a double burden of disease [1]. Poverty is a root cause of poor diets and may also contribute to chronic diseases. People who live at subsistence levels often have no choice but to consume monotonous diets that are poor in nutrients. Impoverished people in cities often consume fatty and sugary foods that are more affordable [3].

The prevalence of the malnutrition problem in SA is not clearly defined due to the previous absence of a national nutrition surveillance programme. The only data available still consists of single fragmented surveys that have been undertaken amongst isolated groups, as well as the 1999 National Food Consumption Survey (NFCS) amongst children aged one to nine years old. There is thus an urgent need in SA for research on the underlying causes of malnutrition and food insecurity as limited empirical data are available for other groups such as females, males, and the elderly [4]. Ruel et al. [5] further identified information needs in three categories, namely:

Descriptive data to document who the poor are, where they are, their main sources of income, what they eat, their coping strategies and resources available to them.

Data about the determinants of the conditions of the poor for example reasons for poverty, constraints relative to care giving, food security, health and nutrition.

Data about programmes, policies, interventions and safety nets in the areas.

Ruel et al. [5] suggested that a better understanding of these issues would provide information to programme administrators and policy makers to formulate appropriate responses to food security, Solomons [1] furthermore states that because no empirical evidence

exists between the links of under- and overnutrition in the elderly, the major challenge will be to establish gerontology and gerontological nutrition presence and to acquire the evidence necessary to address the issues represented by the increasing elderly population.

It has been recognised that proper nutrition and physical activity can extend people's lives and that proven nutrition intervention can assist in the promotion of healthier ageing, both in the prevention and management of chronic diseases and their consequences. It is important to provide programmes that provide nutritional services to the elderly, especially in the communities in which they reside, work and congregate as the health care costs for those older than 65 years are three to five times higher than for those under 65 years of age and this can create pressure on health care and long-term care spending. Nutrition is the key to maintain functional independence, health and quality of life [6].

In view of these facts and the present situation, it is strongly argued that our proposed project is relevant and will thus focus on malnutrition, including over- and undernutrition amongst the elderly in Sharpeville, with nutrition education included in all the phases of the project. Sharpeville is situated in the Vaal Triangle, South Africa. The Vaal Triangle is an industrial, polluted area situated approximately 70 km south of Johannesburg and has a population of 794 599 people of which 47.9% are unemployed and 46.1% of households live in poverty [7]. The major research question remains to what extent the micro-mechanisms influence food, nutrition and health of the elderly and will be tested empirically against the United Nations Children's Fund (UNICEF) framework of the immediate, underlying and basic causes of malnutrition [8]. The focus of this article is the socio-demographic and health profile of the elderly attending a care centre two days a week in Sharpeville. The results of this project will ultimately assist in the fight against diseases and malnutrition and thus contribute to the national health plan aiming at improving the health care system for all South Africans.

## Methods Planning

This is an integrated nutrition research project whereby a number of variables were investigated. Before launching the project, a multi-methodological research process was followed to facilitate planning of the project. The planning process consisted of three steps, namely: analysing the available scientific literature, writing the research proposal and holding a strategic roundtable participatory planning workshop with all stakeholders. The methodology for the baseline survey will be described in this article.

Before the baseline survey, introductory visits were made to the Sharpeville Care of the Aged for observation purposes and to introduce the researchers, explain the objectives of the project and to acquire consent for the project from the elderly attending the Sharpeville Care of the Aged daily from Mondays to Fridays (n=300).

## Ethical considerations

The ethics committee of the University of the Witwatersrand approved the study (R14/49). The protocol was submitted in accordance with the Medical Research Council guidelines for medical research.

## Sampling strategy

One hundred and seventy male and female subjects, attending the Sharpeville Care of the Aged, were randomly selected for the baseline survey. A total of 150 questionnaires had to be completed by the subjects for a 50% representation of the 300 elderly attending the care centre. The extra 20 subjects were selected to make provision for possible dropout throughout the duration of the project.

## Data enumerators

Eight data enumerators were recruited as field workers. A training manual was developed and an intensive training workshop conducted for training of the field workers to ensure a high standard of research. Various participatory facilitating methods were used in the training including case studies, role-plays and communication skills.

## Measurements

The variables investigated in the baseline survey included the following and various questionnaires were used:

Demographic data such as age, gender of the subjects in the household, home language and education levels. Physical and infrastructure data such as the residence setting, number of household members, number of rooms, number of rooms used for sleeping, water storage, fuel usage, household pests and perceptions related to environmental sanitation services.

Socio-economic data such as health, food, food procurement, processing and preparation behaviour, employment status, household assets, environmental sanitation and caring practices.

Dietary intake and food consumption patterns.

Anthropometric measurements such as weight, height and mid-upper arm circumference (MUAC) and body fat percentage.

Blood pressure and body temperature.

A socio-demographic and health questionnaire were compiled in English and tested for reliability. A structured 24-hour recall questionnaire was drawn up and tested for reliability. The elderly attended the care centre twice a week. Because lunch was served on these days, it was decided to complete the 24-hour recall on two occasions for days when the elderly did not attend the care centre to obtain quantitative, descriptive information about usual food consumption patterns and dietary intake. All the subjects in the sample completed the 24-hour recalls in individual interviews with the assistance of field workers. Food models were simultaneously used to determine portion sizes and to explain food items to the subjects.

Height was measured with the subject standing barefoot with heels together, arms at the side, legs straight, shoulders relaxed, and head in the Frankfort horizontal plane, with heels, buttocks and back of the head against a wall. These measurements were taken to the nearest 0.5 cm by using a stadiometer. Weight was determined to the nearest kg on a good quality, standardised bathroom scale with each subject dressed in light clothing with no shoes. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m<sup>2</sup>). MUAC was measured midway between the lateral projection of the acromion process of the scapula and the inferior margin of the olecranon process of the ulna. This middle point was marked with the elbow flexed at 90 degrees. The measurement was made with a flexible steel tape to the nearest 0.1 cm with the arm hanging loosely at the side of the body. A bio-impedance scale was used to measure body fat per-

centage. Blood pressure and body temperature were measured by trained nursing sisters.

### Statistical analyses

Socio-demographic, health and anthropometric data were captured onto an Excel © spreadsheet. A well-trained and committed data capturer was assigned for this and a bio-statistician consulted for analyses and interpretation of data output. Data analysis of the questionnaires was done using the Statistical Package for Social Sciences (SPSS) for Windows version 10.0 program. Descriptive statistics (frequencies, means, standard deviations and confidence intervals) were determined.

The dietary intake and food consumption data were analysed by the Food Finder © version 3 program by a registered dietitian. Means and standard deviations were calculated for food and nutrient intake.

## Results

### Characteristics of the respondents

(Table 1)

The results in Table 1 indicated that the majority of the respondents were female (87.1%) and the mean age was 71.7 years. The majority of the respondents were Sotho-speaking (84.7%) with a low education level as only 23% attended high school or college. The majority of the subjects were widowed (70%) and only 19.4% married. However, a small percentage (4.7%) lived alone, whilst the majority shared the house with other family members.

### Living conditions

The results (Table 1) showed that 99% of the respondents lived in brick houses with £ 2 rooms (29.4%), 3-4 rooms (40.6%) or > 4 rooms (30%). The average household size was 4.9 persons. The majority of the respondents had resided in Sharpeville permanently for more than five years (96.5%).

### Water and environment

(Table 2)

The socio-economic indicators of the sample are depicted in Table 2. The majority of the households had access to clean, safe water (93.7%), electricity (100%), toilet facilities (94.7%) and waste removal services (96.5%). Most of the households had a gravel road in front of the house (80.6%) and the presence of household pests was reported by all (100%). These included rats, mice, ants and cockroaches.

## Health

The major health problems experienced by the subjects, as reported in Table 3, were ear, nose and throat (ENT) infections (72.4%), painful joints (70.6%) and chronic headaches (48.2%). The majority of subjects used chronic medication (55.9%) of which 40.6% was for the treatment of high blood pressure. Blood pressure measurements indicated that 68% of the subjects suffered from hypertension (? 140/90 mm Hg). The mean systolic blood pressure was 168.6 mm Hg and the diastolic blood pressure 101.0 mm Hg.

The subjects were not very active as 9.4% reported heavy exercise/activity levels and 43.5%, 27.6% and 19.5% reported moderate, light or no exercise/activity levels respectively.

(Table 4)

The results in Table 4 indicate that 88.3% of the respondents never smoked and 88% did not take alcohol, however, a relatively

**Table 1: Demographic data of the sample**

Variable	N	%
Age of respondents	170	
Mean age	71.70 years	
Age range	60-110	
Gender	170	100
Male	22	12.9
Female	148	87.1
Role in the family	170	100
Grandmother	114	67.2
Mother	28	16.4
Grandfather	20	11.5
Father	5	3.3
Other	3	1.6
Marital status	170	100
Widowed	119	70
Married	33	19.4
Single	11	6.5
Divorced	7	4
Education level of respondents	170	100
None	32	18.8
Primary school	99	58.2
Secondary school	9	17.1
Post-School	10	5.9
Home language	170	100
Sotho	144	84.7
Zulu	15	8.8
Xhosa	6	3.5
Other	5	3
Number of people in household	170	100
1	8	4.7
2	24	14.1
3	22	13
4	33	19.5
5	25	14.8
6	21	12.3
7	14	8.2
8	4	2.3
9	4	2.3
10	15	8.8
Mean number of people in household	4.9 people	
Type of house	170	100
Brick	168	99
Zinc shack	2	1
Number of rooms	170	100
£ 2 rooms	50	29.4
3-4 rooms	69	40.5
> 4 rooms	51	30.1
Time of residency in present house	170	100
< 1 year	6	3.5
> 5 years	164	96.5

large percentage of the sample used snuff (32.5%) or had a history of snuff usage (4.6%).

The results in Table 3 indicate that the majority of respondents visited the local clinic on foot (66.2 %) when ill.

The anthropometric indices of the female subjects are reported here as they were the majority of the sample and indicated that the mean ( $\pm$ SD) weight, height and BMI were  $77.1\pm 17.3$  kg,  $1.56\pm 0.76$  m and  $31.1\pm 6.4$  respectively. The BMI indicated 16.4% normal weight (BMI 18-24), 29.5% overweight (BMI 25-30), 27.9% obese (BMI 31-35) and 26.2% very obese (BMI 36+). The body fat composition indicated that 50% of the subjects had fat levels higher than 40%, corresponding with the levels of obesity. The mean ( $\pm$ SD) MUAC was  $33.4\pm 0.7$  cm, falling between the 75th and 90th percentile of the United States Health and Nutrition Examination Survey (NHANES 1) for the elderly between 65 and 74.5 years old (Mahan & Escott-Stump, 9). This is further proof of the obesity in this sample.

**Table 2: Socio-economic indicators of the sample**

Variable	N	%
Clean, safe water availability at home	170	100
Tap inside the house	36	21.1
Tap outside the house	75	44.1
Tap in- and outside house	45	26.5
Fetch water from elsewhere	14	8.3
Toilet facilities	170	100
Flush/sewage	161	94.7
Other	9	5.3
Access to electricity	170	100
Waste removal facilities	164	96.5
Gravel road in front of house	137	80.6
Tarred road in front of house	19	11.2
Pests	170	100
Mice/rats	40	23.5
Cockroaches	23	13.7
Mice/rats & cockroaches	42	24.7
Mice/rats, cockroaches & ants	30	17.6
Mice/rats & ants	10	5.8
Other	25	14.7
Respondents on pension	170	100
Period of pension	170	100
6-12 months	4	2.3
1-3 years	13	7.6
> 3 years	153	90.1
Partner employed	7	4.2
Total household income per month	161	100
< R500 (76 US\$)	1	0.6
R501-R1000 (78-154 US\$)	106	65.8
R1001-R1500 (155-231 US\$)	34	21.2
R1501-R2000 (232-308 US\$)	12	7.5
R2001-R2500 (309 – 385 US\$)	2	1.2
> R2500 (386 US\$)	6	3.7
Number of people contributing to household income	161	100
1	116	72
2	37	23
2	8	5
Household member responsible for household money expenditure	170	100
Father	12	7.1
Mother	53	31.2
Grandfather	93	54.7
Grandmother	4	2.3
Other	8	4.7

## Dietary intake and food consumption patterns

(Table 5)

Although the majority of households indicated that they ate three (58.8%) or two (28.8%) meals per day, the nutrient analysis of both the 24-hour recalls of the female subjects indicated deficient intakes for a number of nutrients when compared with the estimated average requirements (EAR) [10]. These included: total energy and dietary fibre intake as well as calcium, magnesium, zinc, selenium, iodine, vitamins B1, B2, B6, C, D, E, folate, biotin and pantothenic acid. Furthermore, the main source of nutrition was carbohydrates. Table 6 shows that the top 10 most frequently consumed items according to the 24-hour analysis were: tea (299 g), stiff maize meal porridge (273 g), brown bread (93 g), full cream, fresh milk (67 g), chicken, cooked (103 g), beef, cooked (125 g), fermented maize drink (mageu) (212 g), eggs (123 g), apple (160 g) and orange (189 g). The average daily intake is indicated in brackets.

## Income levels and procurement patterns

(Table 7)

All the subjects in the sample received a state pension and the majority (90.1%) had been receiving this for longer than three years. In 4.2% of the cases, the partner was employed. The majority of households (65.8%) had a monthly income of R 501-1000 (78-154 US\$) and in the majority of households (72.0%) the pensioner was the only contributor to household income.

The results in Table 7 indicate that monthly food shopping was done by the majority of households (81.8%) and mostly at supermarkets (68.2%). The majority of subjects (63.1%) spent less than R200 (30 US\$) per week on food for the household. The results further indicated that in these households the mother or grandmother was responsible for household expenditure (31.2% and 54.7% respectively). In a relatively large percentage of households the grandmother was responsible for food preparation (40.6%), food procurement decisions (47%) and feeding the children (43.5%).

## Household assets

It was found in the study that 84.1% and 77.6% of the households owned a radio and television set respectively. Cooking facilities included an electrical stove (73.5%), a gas stove (24.7%) and a paraffin or coal stove (10.6%). Cold chain facilities were encouraging as 81.8% owned a refrigerator and 15.9% a freezer. However, this study did not explore other household assets.

## Discussion

The purpose of this study was to determine the demographic and health profile, as well as dietary intake and food consumption patterns of the elderly attending a care centre in Sharpeville, SA in order to develop an appropriate nutrition intervention programme to meet their needs and tastes for maximum compliance. To achieve this, quantitative and qualitative questionnaires were given to the respondents in the randomly selected sample to complete. The questionnaires were then statistically analysed.

The socio-economic status of these people was poor and tended

towards poverty. Although 100% of the subjects received a monthly pension, the elderly person was the only contributor of household income in 72% of the households and the majority of households had a monthly income of R 501-1000 (78-154 US\$). Although the average household size was 4.9 people, the houses were small and only 30% of all the households had four or more rooms and all experienced problems like rodent and insect infestation.

Household food security was also a problem in this community. Most of the respondents indicated that they bought food only once a month (81.8%) and food was procured mostly from supermarkets (68.2%). Most of the households (63.1%) spent less than R200 (30 US\$) on food per week. Taking into consideration that the average household size was 4.9 people, it was calculated to be less than R5.80

**Table 3: Health indicators**

Variable		
History of chronic diseases in family	170	%
Skeleton disease (painful joints)	120	70.6
Ear, nose and throat (ENT) infections	123	72.4
Heart disease	59	34.7
Respiratory & chest disease	55	32.4
GI abnormalities	37	21.8
Genital abnormalities	28	16.5
Mental disorders	23	13.5
Headaches, chronic	82	48.2
High blood pressure medication	69	40.6
Activity levels	170	100
Heavy/rigorous	16	9.4
Moderate	74	43.5
Light	47	27.6
None	33	19.5
Experience of weight loss during the past month	49	28.8
Experience of a recent change in appetite	51	30
Experience chewing problems	53	31.2
Experience problems with swallowing	24	14.1
Often experience of nausea	32	18.8
Often experience of diarrhoea	26	15.3
Often experience vomiting	15	8.8
Often constipated	33	19.4
Experience of fatigue	170	100
Always	30	17.7
Sometimes	103	60.7
Never	37	21.6
Hearing/speech/sight defects	110	64.7
Use of chronic medication	95	55.9
Type of health facility visited	140	100
Traditional healer	6	4.3
Private doctor	28	20
Clinic	94	67.1
Hospital	12	8.6
Access to health facilities	151	100
On foot	100	66.2
Taxi	51	33.8



(0.9 US\$) per person per day. This was equivalent to a loaf of bread or litre of milk. This was also proved by the type of foods consumed. The Top 20 food consumption list indicated that the majority of food items consumed were carbohydrate-based, and although chicken, beef and eggs appeared as protein sources; these were consumed by a minority of subjects (38, 21 and 24 subjects respectively). Milk, however, was consumed by 73 subjects (43 %), but the mean daily intake was small (67 g). Although fruit and vegetables also appear on the Top 20 food consumption list, the same consumption pattern applied.

More than 80% of the subjects reported occasional money shortage for basic household needs, which confirmed the presence of food

**Table 4: Smoking and drinking patterns**

Variable	N	%
Respondent smoking history	162	100
Yes	6	3.7
No, never smoked	143	88.3
No, stopped smoking	13	8
Partner smoking history	32	100
Yes	7	21.9
No	25	78.1
Respondent snuff usage history	151	100
Yes	49	32.5
No, never used	95	62.9
No, stopped using	7	4.6
Respondent alcohol consumption	125	100
Yes	15	12
No	110	88
Frequency of alcohol consumption	15	100
Every day	1	6.6
Once a week	4	26.7
Occasionally	10	66.7
Type of alcohol consumption	23	100
Commercial beer/cider	8	34.7
Home brewed beer	10	43.7
Strong liquor	4	17.3
Wine	1	4.3

insecurity. Townsend et al. [11] demonstrated that the prevalence of overweight among women (n=4509) increased as food insecurity increased. Among the severely food-insecure women, food intake may be involuntarily restricted due to insufficient resources to access food. However, overweight occurred among women of mild and moderate levels of food insecurity, suggesting that overweight is related to involuntary, temporary food restriction. A possible explanation involves a food acquisition cycle. Abundant food supplies may be available the first 3 wk of the month, followed by 1 wk without money when food selection is limited. Then, when money is restored at the first of the month, food-insecure families may overeat highly palatable and rich foods. This behaviour could be reminiscent of binge eating, which can result in weight gain [11]. Thus, overeating by food-insecure families when palatable food is plentiful, i.e., when money for food is available, followed by a short period of involuntary food restriction, followed by overeating, could be a pattern that results in gradual weight gain over time.

Dietary intake was also compromised as these households consumed mainly a carbohydrate-based diet and although the daily protein intake was sufficient, the intake was deficient for total energy and

dietary fibre, as well as a number of micronutrients including calcium, magnesium, zinc, selenium, iodine, thiamine, riboflavin, vitamins B6, C, D, E, biotin, pantothenate and folate. These findings indicated under-nutrition. However, when the anthropometric indices were compared, the majority of the female subjects were overweight and obese, indicating overnutrition, thus the double burden of disease is prevalent in this sample of elderly people.

The health status of the respondents was compromised as well. Although smoking (3.7%) and alcohol consumption (12%) was not very high amongst the respondents, environmentally, this area suffers very

**Table 5: Analysis of 24-hour recall: daily mean intakes of a sample of the female elderly subjects (n=88)**

Nutrient and unit of measure	24-hour recall (mean ± SD)	EAR*
Energy (kJ)	5041.2 ± 2299.6	12881
Total protein (g)	50.4 ± 28.2	50.4 ± 28.2
Total fat (g)	38.9 ± 28.2	
Cholesterol (mg)	268.7 ± 535.9	
Carbohydrates (g)	149.0 ± 76.6	100
Total dietary fibre (g)	12.3 ± 8.7	21
Calcium (mg)	220.8 ± 209.8	1200 #
Iron (mg)	5.9 ± 3.7	5
Magnesium (mg)	195.1 ± 99.2	265
Potassium (mg)	1337.6 ± 809.1	
Zinc (mg)	6.4 ± 3.7	6.8
Copper (mg)	0.74 ± 0.82	
Chromium (mcg)	33.8 ± 41.6	20 #
Selenium (mcg)	30.2 ± 42.6	45
Iodine (mcg)	33.3 ± 66.9	95
Vitamin A (RE) (mcg)	649.2 ± 2007.9	500
Thiamin (mg)	0.7 ± 0.4	0.9
Riboflavin (mg)	0.75 ± 0.79	0.9
Niacin (mg)	12.17 ± 8.42	11
Vitamin B6 (mg)	0.7 ± 0.45	1.3
Folate (mcg)	157.0 ± 159.4	320
Vitamin B12 (mcg)	4.67 ± 18.2	2
Pantothenate (mg)	4.64 ± 4.50	5 #
Biotin (mcg)	23.78 ± 38.96	30 #
Vitamin C (mg)	38.4 ± 90.5	60
Vitamin D (mcg)	3.65 ± 10.2	10-15
Vitamin E (mg)	4.0 ± 5.2	12

high pollution rates and the area is very dusty as the majority had gravel roads (80.6%). A large number of subjects were taking chronic medication (55.9%) and suffered from a number of disorders including painful joints (70.6%), ENT infections (72.4%) and chronic headaches (48.2%). Although 40.6% of the subjects received chronic blood pressure medication, only 10% of the subjects had a normal blood pressure when measured. The high prevalence of hypertension in this study corresponds with the Transition and Health during Urbanisation in Southern Africa (THUSA) study conducted amongst the black community in the North West Province [12]. A study conducted in Natal, SA also found the black population had a high prevalence of hypertension

(25 %), and found it to be higher than in any of the other population groups in SA [13].

## Conclusion and recommendations

Although older adults are known to be at an increased risk for impaired nutritional status with increasing age [14] in Africa, the elderly are not considered as a priority when planning nutrition interventions and as a result, the impact and effectiveness of such studies have thus not been described for this population [15]. Malnutrition remains a major risk for morbidity and mortality. The numerous effects of malnutrition in the elderly are, however, well documented. Poor dietary intake may result in impaired immunity which will lead to an increased risk of infectious disease. While these adverse effects are applicable to all age groups, the elderly are especially at risk and the many side effects of malnutrition may exacerbate each other, particularly in frail elderly people [16]. Early detection of impaired nutritional status is essential for the implementation of secondary prevention or remedial therapeutic interventions to delay further health impairment

[14].

The findings of this study confirmed that poverty, malnutrition, both under- and overnutrition, as well as household food insecurity and poor health were the major problems observed in this elderly community. These findings correspond to other studies, however limited, conducted amongst the elderly in SA [17].

In this study the grandmother was found to play an integral role in the household in terms of providing income, as well as food procurement and preparation, as well as feeding the children. The female elderly will thus be the target of future intervention studies. The results of this study will form the basis for planning and implementing sustainable community-based intervention projects to promote public health nutrition amongst the elderly in the Vaal Triangle. The focus of these intervention studies should be to reduce malnutrition and household food insecurity to improve health. This will impact on cost savings related to medical care and utilisation of the already limited health care resources in SA as promoted by Charlton and Rose [15].

**Table 6: Food procurement and preparation patterns of the sample**

Variable	N	%
Frequency of food shopping	170	100
Every day	8	4.7
Once a week	12	7
Once a month	139	81.8
When money available	11	6.5
Place where food is bought most of the time	170	100
Spaza shop	9	5.3
Street vendor	4	2.4
Supermarket	116	68.2
Spaza shop & street vendor	3	1.8
Spaza shop & supermarket	7	4.1
Street vendor & supermarket	18	10.6
Other	13	7.6
Weekly food expenditure	160	100
R0 -R50 (0-8 US\$)	30	18.8
R51-R100 (9-15 US\$)	34	21.2
R101-R 150 (16-23 US\$)	18	11.2
R151-R200 (24-30 US\$)	R151-R200 (24-30 US\$)	11.9
> R 200 (30 US\$)	32	20
Do not know	27	16.9
Household member responsible for food preparation	170	100
Mother	74	43.5
Grandmother	69	40.6
Other	27	15.9
Household member responsible for food procurement decisions	170	100
Mother	44	25.9
Grandmother	80	47
Other	46	27.1
Household member responsible for feeding the children	170	100
Mother	63	37.1
Grandmother	74	43.5
Other	33	19.4
Reported head of the household	170	100
Mother	53	31.2
Grandmother	93	54.7
Number of meals served per household per day	170	100
1	10	5.9
2	49	28.8
3	100	58.8
> 3	11	6.5
Place where most of the food is consumed	170	100
Home	170	100
Frequency of money shortage for basic needs in household	163	100
Always	12	7.4
Often	78	47.9
Sometimes	41	25.1
Seldom	17	10.4
Never	15	9.2

## Acknowledgements

We hereby acknowledge the following for their co-operation in the project so far: the Department of Health in the Vaal Triangle, the Vaal University of Technology and National Research Foundation for funding this project, as well as the Sharpeville Care of the Aged elderly and management. We want to furthermore acknowledge Tom Ndanu (biostatistician) and Michelle Wakeley (research assistant) for their valuable assistance.

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# Muslim and Christian mothers as frontline right bearers for children aged 6-36 months in kibera slums of Nairobi, Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

The right to nutrition security, as engendered in the right to adequate food, is a complex concept. Nevertheless, the nutrition fraternity is currently involved in identifying effective ways of interpreting and promoting adequate food as a human right, a phenomenon that is gaining momentum as key in prevention of malnutrition. Current thinking views integration of human rights into nutrition programming as an essential component in which the involvement of different levels of groups of citizens, as perceived in the hierarchy referred to as “duty bearers” is critical. In this hierarchy, the parents/households comprise the first level, followed by the extended family and then the community of which faith-based organizations are integral. Observations suggest that religious teachings, based on the Holy books, have an influence on the duration of exclusive and total breastfeeding.

Breastfeeding as one of the seven globally recognized essential nutrition actions has for a long time been considered key in mitigating negative outcomes, such as malnutrition and poor health among the younger children. The two phases of breastfeeding, the exclusive and with complementary feeding, cover the first six and seven to 24 months of a child's life, respectively. Yet, according to the 2003 Kenya Demographic and Health Survey, only a small proportions of infants; 9.3% and 2.6%, are breastfed exclusively for the duration of 2-3 and 4-5 months, respectively while by the time they are 23 months, 42.7% are completely off the breast.

Given the scenario described above, a cross-sectional study was conducted among 320 systematic randomly selected Muslim and Christian mother and child dyads in Kibera slums of Nairobi, whose object was to determine the influence of religion on child feeding practices and their impact on children's right to food and nutrition security. The findings would indicate the worth of partnering with faith-based organizations in the promotion of breastfeeding and propagation for appropriate childcare practices in nutrition programming.

**Design:** A comparative cross-sectional survey.

**Setting:** Makina village in Kibera division, Nairobi, Kenya.

**Study population:** A systematic randomly selected sample of 320 children aged 6-36 months and their respective households. A total of 160 Muslim and 160 Christian households were surveyed.

**Results:** A significantly higher proportion of Christian children (56.87%) than Muslim children (43.13%) were introduced to complementary foods in less than four months. ( $X^2=6.05$ ;  $P=0.0139$ ). The first main complementary food given to both Muslim and Christian children was porridge (46.9%), followed by mashed tubers and roots (16.6%). No significant difference was observed between Muslim and Christian children who were weaned on porridge ( $X^2=0.8$ ;  $P=0.37$ ), mashed tubers ( $X^2=0.2$ ;  $P=0.65$ ) or milk ( $X^2=0.65$ ;  $P=0.42$ ).

Almost half of the mothers fed their infants with spoon and cup (50.9%) and one fifth (21.9%) used spoon and bowl. Among the Christians, 53.8% and 17.5% used spoon and cup and spoon and bowl respectively, whereas among their Muslim counterparts 48.1% and 26.3% used spoon and cup and spoon and bowl respectively. There

was a significant difference observed in the method of feeding Muslim and Christian infants ( $X^2= 12.298$ ;  $P=0.015$ ).

**Conclusion:** There was a significant difference in the duration of exclusive breastfeeding in Muslim and Christian children, as was hypothesized, therefore religion played a role in the duration of exclusive breastfeeding. No significant difference was observed in the main types of the first complementary foods given both Muslim and Christian children.

More Muslim than Christian mothers, as duty bearers (of the right to food) have actualised their children's right to adequate nutrition through prolonged exclusive breastfeeding periods.

## Introduction

Nutrition is a key universal factor that affects as much as it defines the health of all people. The effects of nutrition not only on growth and physical development but also on cognitive and social development are well understood. The proper mix of nutrients under clean and safe conditions must be available to all, but how far from this gold standard do we remain? [1]. Breastfeeding and complementary feeding behaviour are important predictors of infant and child nutrition, health, and survival. Breastfeeding is linked to stronger intellectual development and reduced risk of cancer, obesity and chronic diseases. Improving breastfeeding and complementary feeding practices will therefore improve health, nutrition, and survival in the short, as well as in the long term and contribute to the well being of future generations [2].

Breastfeeding practices and introduction of supplementary foods are determinants of nutritional status of children, particularly those under the age of two years. With improved nutritional status, the risk of mortality and morbidity among children under five years can be reduced and their psychomotor development enhanced. Breast milk is uncontaminated and contains all the nutrients needed by children [3].

A recent authoritative paper on child survival ranked nutrition interventions among the most effective preventive actions for reducing under-five mortality. Promotion of exclusive breastfeeding ranked first and was estimated to have the potential to prevent 13% of all deaths. Improved complementary feeding ranked third and was estimated to have the potential to prevent 6% of all deaths [4].

Adequate access to food and nutrition is a fundamental human right. When the right to food is not fulfilled, then other human rights are. The human rights approach is essential for sustainable social and economic development. With this approach, people are not just defined as beneficiaries with certain needs, but recognized as active participants with established rights, claims and obligations. The State is obliged to respect, protect, facilitate, and when necessary, to realize these rights. As for all human rights, the right to adequate food and nutrition must be guaranteed without any form of discrimination as to national or social origin, race, gender, language, religion, and political or other opinions. The human right to adequate food is not only a moral right, it is a clear legal right, firmly established in international human rights laws and ratified by most countries [5].

The right to food and nutrition, and to be free from hunger and malnutrition has been expressed in two types of international human-rights instruments: firstly conventions and covenants, which are legally binding on those accepting them, and secondly declarations which, though non-binding, exercise a measure of moral persuasion on governments. The right to adequate food is realized when every man, woman and child alone or in community with others have physical and economic access at all times to adequate food or means to its procurement. The right to adequate food shall therefore not be interpreted in narrow or restrictive sense, that equates it with a minimum package of calories, proteins and other specific nutrients [6].

Children are valued and respected in Islam as individuals with inherent rights. Often for Muslim women breastfeeding is more than an act of feeding, it is a great religious deed, hence they may be resistant to advice of early weaning, even if medically indicated. The prophet Mohamed has stated “Any woman who breastfeeds her child, for each time she puts the infant on her breast, God will grant her divine reward of freeing a slave and when she has weaned him, the angel Gabriel will alight down and with a hand on her shoulder say ‘live your life anew for God has forgiven your past sins’ [7]. Islam encourages mothers to nurse their babies for prolonged periods of up to two years. Meanwhile, Islamic teachings free the lactating mother from any responsibility for her sustenance, even if she is divorced; she is also exempted from fasting [8].

In Christianity, an intimate connection between a mother and baby resonates throughout the history of God’s chosen people. Breastfeeding and the nursing relationship was a great blessing to God’s people. [10], states that breasts are one of the blessings bestowed on God’s people. The availability of breast milk was considered necessary for a child to survive in Ancient Israel. Conversely, in Hosea [10] dry breasts are a curse. In Ancient Israel, the breastfeeding relationship was an enduring one, usually lasting at least two to three years. In both Christianity and Islam, if the baby’s mother had died or could not nurse or did not wish to nurse her own child, a wet nurse was employed. Until recently in human history, if a baby did not have access to breast milk, the baby died. Several passages in the Bible and Qur’an show the honour accorded women who nursed their infants [9] and [10].

**Materials and Methods**

A descriptive and analytical comparative cross-sectional study was carried out between August and September 2004. Muslim and Christian households with children aged between 6-36 months in Makina village, Kibera Division were compared.

The calculation of the required sample size was based on the 2003 prevalence of malnutrition, stunting in Nairobi, Kenya, which was 18%. Based on this, Fischer’s formula for comparative studies was used to calculate the sample size. [11] Hereinafter, 160 Muslim mother and child dyads and another 160 Christian mother and child dyads were sampled. Purposive sampling was used to select Kibera from various other slum areas (Mathare, Dandora, Korogocho, Mukuru) in Nairobi, because it is the largest slum in Kenya and because both Christians and Muslims live there. Purposive Sampling was also used to select one village, Makina from the other villages. Systematic random sampling was used to select the study households in Makina.

All children between 6 and 36 months of age, without chronic illnesses or disabilities that would disadvantage their nutritional status, ascribing from Muslim and Christian households, living with their mothers in Kibera for the past six months prior to the study period were given equal chance to participate in the study. From the sampling frame, 160 households with children aged 6-36 months, for each

of the study area were systematically selected. In instances where there was more than one child in this category, the elder one was considered to be the index child.

A structured questionnaire was used to collect information on socio-demographic and socio-economic characteristics as well as childcare practices. Observation and Focus Group Discussion guidelines and key informant interview schedules were also used in the data collection.

Analysis of diet was done using Statistical Package for Social Sciences (SPSS) version 11.

**Results**

The total population in the 320 households was 1313 persons with 652 (49.7%) Muslims and 661 (50.3%) Christians. The mean Christian and Muslim family size was 4.1 ± 1.2 and 4.1 ± 1.2 respectively. There was no significant difference between the family size in the Christian and Muslim households (t = -.4; P = .7). (Table 1). The females constituted 682 (51.9%) of the study population, which was slightly more than the male population of 631 (48.1%). There was no significance difference between the two sexes in the Muslims and Christians. (X<sup>2</sup> =1.6; P=0.7). Majority of the households were male headed (88.5) while 11.6% were female headed. The mean age of household heads was 31.4± 8.1, with a range of 18-66 years. The mean age of adults in the study population (18-80 years) was 28.7±8.1. There was no significant difference between the female-headed households in Muslim and Christian households (X<sup>2</sup>= 2.1;P=0.2).

The mean of the index children’s mothers was 25.2±4.9 while that of the fathers was 30.9±6.7.

**Table 1: Persons distributed by age in the study population**

	Muslim	christian	Total
<5	212 (32.5%)	222 (33.6%)	434 (33.1%)
5 to15	101 (15.5%)	119 (18.0%)	220 (6.8%)
16 to 25	145 (22.2%)	145 (21.9%)	290 (22.1%)
26 to 50	177 (27.1%)	170 (25.7%)	347 (26.4%)
>50	17 (2.5%)	5 (0.8%)	22 (1.7%)
Total	652 (100%)	661 (100.0%)	1313 (100%)

There was a high literacy level the study population; only 3.1% of residents in Makina (above five years of age) had no education, 51.79% attended primary education, whereas 29.9% and 10.8 % had attained secondary and post secondary level of education respectively. Only 4.4% of the residents had attended Madrasa. The difference in level of education attained between the Muslims and Christians was statistically significant (X<sup>2</sup>=43.05; P=0.00). However, there difference between the literacy levels between the two religions was not statistically significant (X<sup>2</sup>=3.8; P=0.148).

Slightly less than a quarter and about one fifth (24% and 20.6%) of the study population above five years were employed and student’s respectively. Those who engaged in businesses and casual labourers were 15.5% and 11.3% respectively whereas 28.7% were unemployed. The proportion of males who had occupations was significantly higher compared to their female counterparts (X<sup>2</sup> = 265.2; P=0.00), however this difference was statistically insignificant with respect to

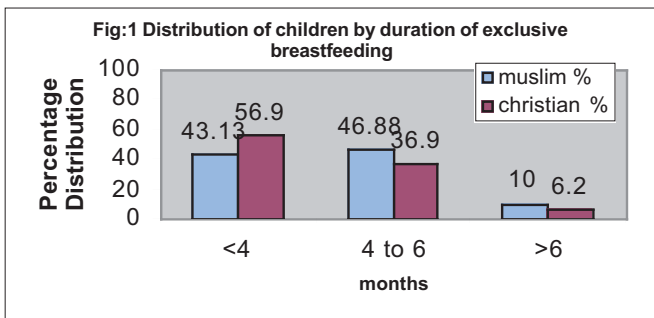
Muslim and Christians ( $X^2 = 5.02; P = 0.286$ ).

The majority of the study population was Nubian, who constituted 37.0%. Luyias, Luos, Kikuyus, Kambas, Somalis and Kisiis constituted 21.6%, 17.0%, 5.3%, 4.9%, 2.5% and 2.5% respectively. There was a statistically significant difference between the ethnic distributions in the two religions ( $X^2 = 1005.8; P = 0.0$ ).

Majority of the index children (95.6%) were breastfed after birth. By the time this study was being carried out exactly half of the mothers were still breastfeeding. The mean frequency of breastfeeding was  $4.7 \pm 2.0$  and mean frequency of putting the child on the breast without actual breastfeeding (to soothe, cuddle or comfort child) was  $2.9 \pm 1.5$ . Mothers acknowledge the need to soothe the child with the breast. There was no significant difference between the frequency of breastfeeding ( $t = -1.1; P = 0.3$ ) and frequency of the times put on breast without breastfeeding ( $t = 0.02; P = 0.9$ ) between the Muslim and Christian children.

The age at which children were exclusively breastfed was varied in the study population. Exactly half of the study children had been breast fed exclusively for less than four months whereas less than half

When the duration of exclusive breastfeeding was grouped, it was observed that there was a significant difference in the duration of exclusive breastfeeding between the Muslims and Christian children. ( $X^2 = 6.3; P = 0.0$ ). A significantly higher proportion of Christian children 56.9% than Muslim children 43.1% were introduced to complementary foods in less than four months. ( $X^2 = 6.1; P = 0.0$ ). (Figure 1)



The mean duration of exclusive breastfeeding in Muslims and Christians was  $3.9 \pm 2.0$  and  $3.2 \pm 2.0$  respectively. There was a significant difference between the exclusive breastfeeding duration in the two groups ( $t = 3.0; P = 0.0$ ). Apart from the mothers who did not breastfeed their children (4.4%), Various reasons were given for cessation of exclusive breastfeeding such as; mothers' milk reduced (22.5%), baby refused breast milk (15.9%), baby was still hungry after breastfeeding (10.6%), resumed work (10%), to reduce dependency on milk alone (7.2%) and others. Some mothers (5.6%) reported that religious teachings had an influence on the duration of breastfeeding; 9.4% were Muslims and 1.9% Christians.

There was no significant difference noted on the reason for introduction complementary foods between the Muslims and Christian mothers ( $X^2 = 15.2; P = 0.1$ ), however a statistically significant difference was found with regard to Muslim and Christian mothers who introduced complementary food as a result of religious influence ( $X^2 = 8.2; P = 0.0$ ).

There was no significant difference in the proportion of the index children breastfeeding in the Muslim (55%) and Christian (45%) households at the time of study. Among those not breast-feeding at 6-12 months, there was a higher but not significantly different proportion of children in the Christian (11.4%) compared to the Muslims (8.45%) children. There was also a higher proportion of Christians (40.9%) than Muslims (39.4%) aged 13-24 months who were not being breastfed at the time of study, though this difference was not statistically different.

However, proportion of Muslims (53.5%) not being breastfed in the age group above two years was higher than for their Christian (47.8%) counterparts, though not statistically significant.

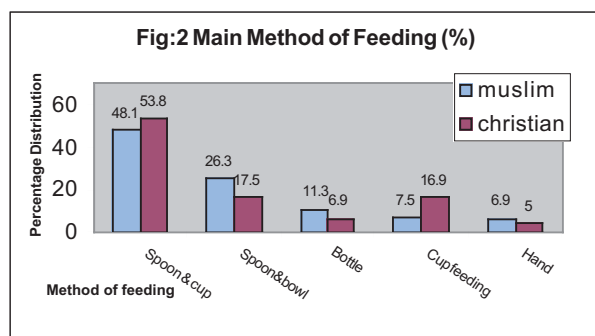
There was no significant difference in the type of initial complementary foods among the Muslim and Christian study groups (Table: 3). Almost half of the index children (47%) and 16.6% were introduced to porridge and tubers respectively. The rest were first introduced to milk and fruit (14%) and vegetables (6.3%). Spoon and cup (50.1%) and spoon and bowl (21.9%) were the most common methods of feeding children in both religions (50.1). There was no significant difference in cup and spoon-feeding, bowl and spoon feeding, bottle feeding and hand feeding between the Muslim and Christian religion however there was a significant difference in cup feeding between the two groups. A higher proportion of Muslims than Christians used bottle feeding and hand feeding.

## Discussion

The households in both religions were of similar demographic characteristics. There was no significant difference between the family size in the Christian and Muslim households.

The mean household size (four) in this study was equal to the one established by Elamass in 1997 [12]. The proportion of females to males in this study was 1:1, in agreement with that documented by Waihenya in 1994 [13].

Preschool students in this research constituted 33.1% of the study population; this figure is less than the one established by



Elamass (38.8%) [12]. There was a high literacy level the study population. Low levels of post primary education may be attributed to high drop out rate especially for girls because of early pregnancies and marriage. The difference in the level of education attained between the Muslims and Christians may be explained by the fact that no Christian attended the Madrasa, but if we consider the literacy levels there is no difference between the two religions. Education is a key determinant of earnings and an important exit strategy from poverty. Low post primary education may explain the poor economic status of the household in both areas, since there were good number of causal labourers and those employed in low-income cadre such as watchmen, cleaners and messengers.

Among the household residence in the study population, Muslims owned 91% and a small number owned by Christians. There was a significant difference in the ownership of houses the in the two religions. This may be attributable to the fact that Nubians, mostly Muslims, from Nuba Mountains were first to settle in Kibera.

There was a reduction in the number of children ever breastfed in Makina (95.6%), in comparison to a previous study carried out by Elamass [12] in Kibera. Study results indicate that children's right to breastfeeding was infringed. The reduction in children breastfed may probably be attributable to the high prevalence of HIV/AIDS in the area.

**Table 2: Distribution of children by age and breastfeeding status at the time of study**

	Muslims N=160		Christians N=160	
	Still breastfeeding	Stopped Breastfeeding	Still breastfeeding	Stopped Breastfeeding
Age in months	(n=88)	(n=71)	(n=72)	(n=88)
6-12	36 (40.9%)	6(8.45%)	30(41.7%)	10(11.4%)
13-24	43(48.9%)	28(39.4%)	36(50%)	36(40.9%)
>24	9(10.2%)	38(53.5%)	6(8.3%)	42(47.8%)

**Table 3: Introduction of first complementary food by religion.**

	RELIGION		Total	P-value
	Muslim	Christian		
	n=160	n=160		
Milk	12.5%	15.6%	14%	0.42
Porridge	44.4%	49.4%	46.9%	0.37
Vegetables	7.5%	5%	6.25%	0.36
Fruit	15.6%	12.5%	14%	0.42
Tubers	17.5%	15.6%	16.6%	0.65
Cerelac	1.25%	0.65%	0.9%	1
Formula	1.25%	1.25%	1.25%	0.62

The mean duration of exclusive breastfeeding was 3.9 and 3.2 months in Muslims and Christians, respectively, slightly less than the figures documented by Elamass 4.8 months [12]. These figures are generally higher than national levels and Nairobi levels. This may be attributable to poor sanitary conditions and thus mothers prefer to delay the introduction of complementary foods, most mothers are housewives, therefore spend practically the whole day with baby and religion may be a factor encouraging mothers to prolong exclusive breastfeeding duration, especially in the Muslim community. Exactly half of the children in Makina were exclusively breastfed for less than four months. Between ages four and six months, 41.2% of the children in Makina were exclusively breastfed. Zewdie found that at the same period, 83% of the children were introduced to complementary feeds [14]. The findings reveal that the children's right to breastfeeding is violated by "duty bearers" (mothers) who do not exclusively breastfeed up to the recommended 6 months.

Comparisons of exclusive breastfeeding duration with other Muslim and Christian countries, revealed that with the exception of Ethiopia, Rwanda and Burundi, all other African countries are far from the goal of exclusive breastfeeding until four to six months of age. Many countries have extremely low breastfeeding rates. Egypt and

Uganda (68%), Eritrea and Morocco (65%) and Algeria (56%) have higher exclusive breastfeeding rates below four months than the findings from Makina. These findings are however much higher than for some countries such as Tanzania and Jordan (32%), Zambia (23%), Namibia (22%) and Zimbabwe (17%) (14). Cereal porridge is the first main complementary food given to African infants, yet starchy cereal porridges have energy and nutrient densities that are lower than those of breast milk (i.e. 30kcal/100ml and 70 kcal/100ml respectively). Thus, since cereal porridges were the main complementary food, the energy and nutrient quality of the children's diet was poor. This can explain high prevalence of malnutrition once complementary foods are introduced and eventually weaning begins [16]. Children in Makina are not adequately nourished, meaning, their right to safe and adequate nutrition, as a means of attaining and maintaining the right to health is not realized. Mothers in Makina have respected and protected children's right to breast milk by acknowledging the importance of breastfeeding their children and not introducing their children to inappropriate breastfeeding substitutes. Often the duty bearers are in a dilemma when the infant refuses breast milk early, or when the claimant (infant) cries, as an expression of infringement of their breastfeeding rights to be breast milk when not breast fed by their mothers.

## Conclusion

The duration of total breastfeeding and exclusive breastfeeding in Muslims is longer than for Christian, indicating that Muslims are better duty bearers compared to their Christian counterparts; though the goal of exclusive breastfeeding for six months has not been accomplished in both religions. Children's right to adequate food and nutrition has been infringed on, as mothers' milk is the best source of nutrients for children below six months. Religion has an influence on the feeding practices of children 6-36 months in Makina especially in the Muslim community. Child-feeding practices in Makina are generally poor irrespective of religious influence. Religion has an influence on the actualization and operationalization of the right to adequate food and nutrition, of children, 6-36 month in Makina. More Muslim mothers, as frontline right to food duty bearers, have fulfilled this right to their children, by having longer exclusive breastfeeding and total breastfeeding durations than their Christian counterparts.

This study therefore concludes that the children's right to food and nutrition is violated by inappropriate breastfeeding and complementary feeding practices, this in turn infringes on other rights such as the right to life, education and health.

## Recommendations

Faith Based Organizations (FBOs) should be incorporated in national policies and programs which aim at improving the nutritional status of communities as a way of operationalization of the right to adequate food and nutrition. This is because child health will improve only through comprehensive and integrated policies and programs, which have a deep and enduring impact on everyday customs and habits. The integration of religion, human rights and nutrition is an excellent investment, which aims at achieving one of the Millennium Development Goals of reducing child mortality. Therefore, all programs of development and nutrition should further the realization of human rights as laid down in international human rights instruments, there is also serious need for education and training in the promotion of the understanding of the right to food and nutrition.

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# The Impact of enrichment of Staple Foods on the Nutrient Intake of Pregnant Women in the Vaal Triangle, Gauteng, South Africa

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Background:** The enrichment of staple foods (white and brown bread, flour and maize meal) with some micronutrients was enforced by the Department of Health in South Africa during October 2003. A study was conducted during 2001 to determine the nutrient intake of pregnant women in the Vaal Triangle (n=315). The study was repeated during 2004 on pregnant women (n=84).

**Objectives:** The main purpose of this study was to determine food consumption patterns and demographic profile of a randomly selected sample population (n=84) in the Vaal Triangle. This was done in order to determine the impact of enrichment of staple foods on the nutrient intake of the sample population and compare it to the results of 2001. **Methodology:** A validated demographic, health and medical questionnaire, and quantitative food frequency questionnaire (QFFQ) was used and statistically analysed. Trained fieldworkers conducted interviews with the help of food models to estimate portion size.

**Results:** The ten items most often consumed by pregnant women were, in descending order: Maize meal-stiff, tea, milk, maize meal-soft, apples, oranges, cold drink, brown bread, rice and coffee. According to the results compared to 2001, the intake of specific micro-nutrients (vitamins, folic acid, iron and zinc) has improved slightly by the pregnant women because of the fortification of staple foods in South Africa to that of 2001.

**Conclusions and recommendations:** Based on the results of this study, it is clear that food insecurity is evident amongst pregnant women in the Vaal Triangle. The enrichment of the staple foods is not sufficient to reach the EAR (Estimated Average Requirement) of the sample population. The development of a food multimix will attempt to examine a cost-effective (R1.10 p/300 g) means for medium and long-term sustainable food based solutions to food and nutrition security of low-income, pregnant women in the Vaal Triangle in order to prevent malnutrition during pregnancy.

**Keywords:** Nutrient intake of South African women.

## Introduction

Iron deficiency is highly prevalent in the developing world as a result of various causes at different levels. Underlying most of these is poverty. Lack of purchasing power to afford foods containing heme iron or to afford the time or transport costs to access antenatal services, all co-exist in poor households where anaemia rates are invariably high. The poor social status of women is another basic cause. Low iron intake, poor bioavailability of dietary iron and infection combine to jeopardise an individual's iron levels, particularly at certain stages of the life cycle [1].

Starvation and severe undernourishment, as during food shortages or famines, will usually result in cessation of menstruation in women of child-bearing age. Women who have ceased to menstruate in this way

are infertile until their nutritional status improves [2].

Numerous pregnancies and lactations, especially at short intervals, are likely to deplete the mother of nutrients unless she has an exceptionally good diet. A woman whose diet is deficient during pregnancy, especially in terms of total food and energy, is likely to give birth to a baby that is smaller than it would have been if she were adequately nourished [3,4].

According to a review by Vorster et al., [5], several studies done previously [6,7,8,9 and 10] have identified insufficient breast feeding and inappropriate weaning practices as being major contributors to under nutrition in South African babies and children. The risks of unhygienic feeding, infections and diarrhea with consequent under nutrition in deprived communities, are well known [5].

In a study done in Phoenix, Durban, 774 Indian women who had participated in a series of absorption studies also had their iron status determined.

Forty percent of the subjects had iron deficiency anaemia (IDA) and all belonged to a low socio-economic level [6]. According to a study done in West Java, Indonesia, in 1992 on the supplementation with vitamin A and iron for nutritional anaemia in pregnant women, all 305 pregnant women were from low socio-economic levels and aged between 17 and 35 years [7].

In a study done on Coloured women in Tygerberg Hospital, Western Cape showed that the social profile of pregnant women with the highest risk for anaemia were identified as being unemployed, single and without their own income or the same claim to household resources as male family members [8].

The risk of preterm delivery, inadequate gestational weight gain and increased perinatal mortality are all directly related to Anaemia [9].

The association between anaemia and both preterm delivery and growth retardation is strongest during the early months of pregnancy. It is suggested that prepregnancy improvement in iron status is warranted. A study done in the U.S.A showed that iron-depleted non-anaemic women were also found with reduced levels of oxygen consumption when they were compared to a matched iron-sufficient group. The reduction associated with iron depletion was related to reduced body storage and was not related to decreased oxygen transport capacity of the blood [10].

Dietary assessment is an aid in the interpretation of anthropometric, clinical, and laboratory findings that provide a foundation for dietary counselling. Dietary assessment is also an important aspect of surveys of nutritional status of population groups. Different methods are used to obtain food consumption patterns at individual level, for example, weighed record, estimated record, 24-Hour recall, food diary (FD), quantitative food frequency questionnaire (QFFQ), and diet history [11].

It is difficult for mothers to cover their very high iron requirements by means of diet alone. This problem is compounded by the high prevalence of insufficient dietary iron intakes among pregnant and lactating women in developing and developed countries, as well as the low absorption of non-heme iron from cereal-based diets. If the iron stores are depleted, then dietary iron requirements during the second half of pregnancy can be double those of a non-pregnant woman [12].

In 1999 the Department of Health in South Africa carried out a sur-

vey in different cities, towns, informal settlements and farms. The objectives of the survey was to find out what types of food people eat, frequency of feeding and how much money they could spend on food each week.

This information allowed them to see if South Africans were eating healthily. The government then realized that they had to do something to help South Africans to become healthier. They decided that the best way would be to fortify the most commonly eaten foods i.e. maize meal and white and brown bread flour (and bread baked with this flour), with vitamins and minerals. Therefore the enrichment of staple foods was enforced by the Department of Health in South Africa since October 2003.

The aim of the study was to determine food consumption patterns and demographic profile of randomly selected sample population (n=84) in the Vaal Triangle.

A study was conducted during 2001 to determine the nutrient intake of pregnant women in the Vaal Triangle (n=315). This study was repeated during 2004 on pregnant women (n=84). This was done in order to determine the impact of enrichment of staple foods on the nutrient intake of the sample population and to compare it to the results of 2001. The Vaal Triangle, which is  $\pm$  80 km South of Johannesburg and is a semi-industrial, low income area consisting of formal and informal settlements. The Vaal Triangle was chosen for research because it is a disadvantaged area, with a high prevalence of malnutrition amongst the low economic households.

## Subjects and methods

During 2001 the study population consisted of 431 females, of which 116 were lactating and 315 were pregnant, from the Vaal Triangle, aged between 16 and 35 years. During 2004 the study population consisted of 84 pregnant women, from the Vaal Triangle, aged between 20 and 35 years. Random sampling was done where a list containing the names of clinics in three towns was drawn up. The list consisted of only the pregnant and lactating women who visited the clinics. The names of the towns were Vereeniging, Meyerton and Vanderbijlpark. A sample of the various clinics in the different towns was drawn at random and all pregnant mothers visiting these clinics were included on a list. Stratified random sampling was then used because it was necessary to have a full list of individuals in each stratum and also to determine the demographic profile such as age groups, geographical areas and social class categories [11].

The inclusion criteria for participation in the project were the following: females, age between 20 and 35 years old, pregnant and/or lactating, monthly income less than R1000 per household (1\$ = R6.40).

All the subjects were eligible to participate in the study if these criteria were met.

The first survey was conducted between November 1999 and April 2000 and the second survey between April to September 2004.

During the first study a sample size of 30 volunteers at 19 clinics was used. This is due to the fact that most pregnant and lactating women are anaemic or iron deficient and if too much blood is drawn this could in fact affect the mother and the baby.

The sample size of blood specimens was therefore chosen according to the availability of pregnant and lactating women who were willing to have their blood drawn [12,16].

A consent form was drawn up for the drawing of blood and was approved by the Ethics Committee from the Vaal Triangle Technikon. The consent form drawn up included information explaining the purpose of the study as well as the procedures to be followed during the study. Written consent was given by all 30 women (n=30) from 19 clinics to participate in the project. The participants were given an option to discontinue participation at any time.

All the clinics were given copies of the form because the clinic sisters

performed the actual drawing of the blood. Thirty blood samples were drawn for the determination of haemoglobin (Hb), HCT, red blood cells (RBC), MCV, iron, ferritin (FER) and transferrin (TRF).

All the fieldworkers chosen were Sotho speaking and were given extensive training and detailed instructions on the administering of the QFFQ's and demographic questionnaires, the use of food models, anthropometric measurements and the 24 hour recall questionnaires.

The demographic questionnaire included questions on age, race group, present employment, breadwinner in the family, geographical area and if lactating, the age of the baby. A validated QFFQ was used as a test measure in this study to obtain qualitative, descriptive information about usual food consumption patterns, specifically those containing iron and dietary intake. The QFFQ's were distributed, completed and collected by field workers. Food models were used simultaneously to determine portion sizes and to explain and describe the food items to the subjects.

Validity of the quantitative food frequency questionnaires (QFFQ) was tested by the 24 hour recall questionnaires. The reliability of the questionnaires was tested twice by 10% of the sample population in this study and the answers were compared to each other.

Laboratory assessment is important as it provides information on the nutritional status of the study participants. The subjects were required to fast overnight (12 hours). Venous blood samples were collected by the nursing sisters using a 21-gauge scalp vein infusion set. All the blood samples were drawn with minimal stasis between 0700 h and 1000 h to avoid effects of diurnal variation.

The following samples were collected from each subject:

v 5 ml EDTA (whole blood) for the full blood count and measurement of haematological markers: Hct, MCV, red blood cell count and Hb;  
v 10 ml serum for the analysis of ferritin and transferrin.

All the samples were collected and analysed by a hematologist under controlled, standardised conditions. The assessment of the iron status of the sample population was important in order to determine whether the sample population was iron deficient or anaemic. The assessment was also important to determine the association between the nutrient intake and iron status of the pregnant and lactating women in the Vaal Triangle.

The Hb levels were determined using venous blood, anticoagulated with EDTA.

At the clinics the fieldworkers recorded the subjects' anthropometric measurements namely weight, height and weight-for-height and compared it against the weight-for-height tables to determine over- and underweight. All the subjects were weighed in light clothes without shoes on a portable electronic scale. Height was measured with an upright stadiometer placed against a perpendicular wall. Two measurements were made and were not to disturb more than 0.5 kg (weight) or 0.5 cm (height).

The dietary intake of the pregnant women was determined by using the QFFQ's and the 24 hour recall questionnaires. The QFFQ's were sent out to determine the food consumption patterns of foods commonly consumed by pregnant and lactating women in the Vaal Triangle.

The iron status was also determined by taking blood samples of the target population. The food diaries were used as a cross-check for items reported in the QFFQ.

The results from the QFFQ and the results from the blood samples were determined from the iron intake from the QFFQ and the blood parameters (Hb, HCT, RBC, MCV, iron, ferritin (FER) and transferrin (TRF)).

The results of the blood analyses were computerised and statistically analysed by a qualified statistician using SPSS®, version 8. The data entry programmes had a number of quality control mechanisms, including validity checks, duplicate detection and verification proce-

dures, written in SPSS.

Differences between the pregnant and lactating group for all variables were compared using Levene's two-tailed test for equality of variances. Differences were considered to be significant if  $p < 0.05$ . Chi-Square and Fisher's exact test (two-tail) correlation coefficients were used to test for associations between iron, BMI and macronutrients. Correlation was considered to be present if  $r \geq 0$  with significance level  $p \leq 0.05$ .

## Results

The results were presented for three trimesters of pregnancy. The results of this study showed that 26.9% lactating- and 73.1 % pregnant women participated in the study.

According to the demographic data, most of the women were between the ages of 21 to 30 years old and 98% of them resided in townships while 79.3% were unemployed. The average monthly income of the majority of the pregnant women was between R501- R1000 (1\$ = R6.05) per month.

The mean intake of all QFFQ's, per subject was to represent the consumption patterns and nutritional intake. Dietary Manager © programme with the South African food composition tables (1991) as part of the calculations was used to determine the food consumed by the sample population. The frequency of consumption of food was examined and the standard deviations were also determined.

The diets of the subjects consisted of very few plant foods and animal foods were scarce except for milk. Most of the items consumed were low in iron.

The iron status was conducted using the original values of iron, Fer, Trf, Hb, Hct, MCV and Rbc. According to the results 50% of the pregnant women and 83.3% of lactating women suffered from IDA.

**\*Table 1: Interpretation of iron status from blood samples**

**Summary table of cut-off points.**

	% Pregnant	% Lactating
Normal	4.17	16.6
Iron	0.00	0.00
Iron deficient	41.6	0.00
Iron deficient anaemia	50.0	83.3
Missing	4.17	0.00
Total	100.0	100.0

The Fisher exact test correlation coefficient was used to test for the association between iron, BMI and macronutrients.

There is a very big association between iron and the macronutrients especially for lactating women. The correlations for pregnant women were not as statistically significant as that of lactating women. The p value in a test is the smallest value for \_ for which the sample results become statistically significant.

Regarding the correlations between the BMI/weight there is no associations, for both pregnant and lactating women.

The following cut-off points were used to determine iron intake [10]

- Pregnancy: first trimester - 13 mg
- Pregnancy: second trimester - 18 mg
- Pregnancy: third trimester - 23 mg
- Lactation - 13 mg

\*Statistically significant

**\*\*Table 2: Summary of the associations using the Fisher Exact Test. P = 0.05**

Variable	Pregnant (Correlation R_)	Lactating (Correlation R_)
Energy vs Iron	0.4715	0.9862*
Protein vs Iron	0.3291	0.9235*
Carbohydrates vs Iron	0.4221	0.9064*
Fat vs Iron	0.2884	0.9027*
BMI vs Iron	0.0007	0.0199
BMI vs Energy	0.008	0.0226
BMI vs Protein	0.0014	0.0611
BMI vs Carbohydrates	0.0211	0.0025
BMI vs Fat	0.0028	0.0408

## Discussion

In African societies, both rural and urban, the number of single mother households is increasing all the time. Rural women, deserted by their husbands are forced to go out and work. Although this is very much part of the African lifestyle, it often puts a greater strain on the poverty wrecked rural families and communities. According to the demographic data of this study most of the subjects were Black, residing in townships and their monthly earnings was between R501- R1000 (1\$ = R6.05).

Their way of living affects their food consumption patterns. According to the results, the food items most often consumed by the subjects contained very little iron. According to Barasi [13], there are many factors influencing iron absorption and they include: other nutrient-certain nutrients enhance iron absorption. These include sugars, citric acid (vitamin C). The addition of a serving of a vitamin C rich food at every meal will significantly enhance the absorption of dietary iron. Factor enhancing absorption are: animal protein, human milk, acid medium, calcium, intrinsic factors and physiological state. The top ten items most often consumed by the subjects contained very little vitamin C and animal protein. During 2001 the top ten items most often consumed by pregnant women were, in descending order: fresh milk, tea,

coffee, cold drink, maize meal, fruit juice, bread rolls, magou, rice and sugar. Daily intakes (mean  $\pm$  SD) for pregnant women were 8425.7  $\pm$  2279 kJ, 73.2  $\pm$  23 g protein, 62.3  $\pm$  23.7 g fat, 292.5  $\pm$  72.2 g carbohydrate, 9.7  $\pm$  3.8 mg iron. During 2004 the top ten items most often consumed were in descending order: Maize meal-stiff, tea, milk, maize meal-soft, apples, oranges, cold drink, brown bread, rice and coffee. According to the results compared to 2001, the intake of specific micro-nutrients (vitamins, folic acid, iron and zinc) had improved slightly by the pregnant women because of the fortification of staple foods in South Africa to that of 2001.

The reason for the low intake maybe from the types of foods consumed since most of the subjects are from low income households and cannot afford the more expensive iron containing foods like meat, poultry, seafood and therefore rely on cereal-based foods as these food items are cheaper and more filling.

There are two major sources of food iron: heme iron and non-heme iron. Heme iron is highly bio-available, since it is absorbed intact within the porphyrin ring and is not influenced by most inhibitory factors in the diet. The non-heme iron in food enters an exchangeable pool which is markedly affected by inhibitory iron-binding ligands. Some forms of non-heme iron, like ferritin and hemosiderin, only partially enter the exchangeable pool and are poorly absorbed. The two forms of iron in the diet are absorbed with different efficiency. Organic (haem) iron must be hydrolysed from any protein to which it is attached and is then absorbed relatively easily, but slowly. The overall absorption of iron from meat may be 20-25 %. The most efficient absorption takes place in the duodenum, and is inversely related to the iron store level [13].

Non-haem iron must first be soluble and hydrolysed before absorption is possible. Hydrochloric acid in the stomach performs this function and also converts any ferric iron in food to its absorbable ferrous state. This reaction is facilitated by ascorbic acid (vitamin C). Other factors enhancing the absorption of inorganic iron includes citric acid, lactic acid, fructose and peptides derived from meat.

All of these form ligands with the ferrous iron, maintaining its solubility and thus facilitating absorption [13].

The three most important factors that determine the amount of iron absorbed from the diet are the amount of iron ingested, its bio-availability and the iron status of the individual. Low dietary intake and the lack of iron supplements was the main reason for iron deficiency in the present study. Low bio-availability of the dietary iron was also a factor due the high intake of plant sources for example, maize meal porridge and bread, together with a low intake of heme iron sources such as meat, fish and chicken.

The availability of iron from non-heme foods could also be decreased by the high intake of tea and coffee with meals. Ascorbic acid is considered the most potent enhancer of non-heme absorption. The effect of ascorbic acid on iron absorption is so pronounced that it has been recommended that each meal should contain at least 25 mg and even up to 50 mg of ascorbic acid. The more inhibitors present in a meal, the more ascorbic acid is necessary to achieve the same absorption increase [8]. In the present study the iron status for pregnant women were as follows: 4.1% normal, 41.7% iron deficient erythropoiesis and 50% IDA and for lactating women: 16.7% normal and 83.3% IDA.

In a study done in Kenya, Mexico and Egypt it was found that women who were heavier and fatter at conception had retained substantially less weight and fat at 2-4 weeks post partum, reflecting the lower weight gain of fatter women during pregnancy.

The prevalence of anaemia in the present study is 50% for pregnant women and 83.3% for lactating women. This compares unfavourably with studies done in other parts of SA. In a study done on Black pregnant women at Baragwanath Hospital (Johannesburg) the prevalence of anaemia (Hb<11g/dl) was found to be 20.5% and a

study done on pregnant women at the a on is an important strate

## Conclusion and Recommendations

Dietary improvement by means of food fortification, food diversity and iron supplementation is essential. Fortification of suitable food vehicles with absorbable forms of iron is a highly desirable approach to controlling iron deficiency. Food fortification with iron is an important strategy for improving iron nutrition on a sustainable basis. In developing countries, most diets are plant based, even though they contain high amounts of iron, the iron is not readily bioavailable because of the presence of inhibitory substances such as phytates and polyphenols. Most developing countries do not practice iron fortification. As industries become established and the processing of foods become centralised, opportunities for fortification can be developed. There have been notable successes in countries such as Chile, Venezuela and the United States, where iron has been added to staple foods. If a fortifiable food exists and is consumed by many people at risk of iron deficiency, fortification is likely to be the most cost-effective strategy. There are many possible strategies for iron fortification. One approach is to fortify staple food that is consumed in significant quantities by most of the population. Fortification of wheat flour with iron is technically relatively simple and this has been successfully implemented in several countries in South America, North America and Great Britain. Another approach is to fortify a widely consumed condiment, which could be afforded by women from low-income households.

Iron supplementation refers to the distribution of iron in medicinal form (tablets, liquid form or parenteral injection) and is often the only way to improve iron status. WHO considers pregnant women as a priority group for iron supplementation [15]. The subjects in the present study did not take any iron supplements since they did not understand the need for it. Blanket supplementation need not be expensive, because preventative rather than therapeutic doses of supplementation can be used. Side effects of iron supplementation which is usually minor (constipation, diarrhea and nausea) will be less with lower iron doses and can be improved by counseling about the diet and supplement use. Motivation of the patient, explaining why and how the tablets should be taken, as well as reduction of side effects is some of the essential recommendations for iron supplementation programmes. It is recommended that all women in low socio-economic communities should be supplemented with iron during the second half of pregnancy, when iron requirements are increased. Part of their daily iron requirement can be supplied as iron fortified food, which will reduce the dose of iron to be taken in tablet form. Information on the importance of iron to the pregnant and lactating women and the unborn child, on how to take the iron supplements and how to handle side effects will improve compliance to and effectively of the supplements [8].

No nutrition education was given at these clinics; therefore an intervention programme is recommended that include iron supplementation with a nutrition education programme. The nutrition education programme should include proper dietary guidelines within a limited budget and ways to increase iron intake during pregnancy and lactation. Further research on iron supplementation and nutrition education programmes in this population of pregnant women is recommended.

The daily meals of most South Africans are deficient in micronutrients essential for good health. Food fortification restores micronutrients to the white and brown bread flour and maize meal that may be lost during the manufacturing process, as well as adding additional vitamins and minerals. It also adds vitamin A which is not naturally present in food.

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# Nutritional Status and Socio-Demographic Profile of Primary School Children as Indicators for the Development of a Breakfast Product in an Informal Settlement in the Vaal Triangle, Gauteng, South Africa

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

### Objectives

The main objective of this study was to determine the nutritional status and demographic profile of primary school children in a school in an informal settlement to gather information for planning and developing a nutritious novel food product as part of an intervention to address the malnutrition problem in the area.

### Study design

The questionnaires were completed in an interview situation with the parents. Anthropometric measurements (n=149) included weight-for-age, BMI-for-age and height-for-age.

A nutritious novel food (maize meal and whole wheat “vetkoek”) was developed to administer to the primary school children according to the nutritional needs of the children.

## Results

The results showed that all of the children stayed in an informal settlement with an average monthly household income of less than R500 (US\$ 62.5) (69%). Seventy three percent of the children ate their meals at home with 5.2% having something to eat at school. Fifty nine percent of households spend less than R100.00 (US\$ 12.5) on food per week. Food most commonly purchased and consumed was maize meal, tea, sugar and oil with animal protein 6th on the top 20 foods purchased list. With regard to anthropometric indices, 17.4 % were underweight (weight-for-age below -2SD from the reference NCHS median), 12.7 % were wasted (BMI-for-age -2SD) and 18 % stunted (height-for-age -2SD). The product contain the following ingredients: maize meal, whole wheat, yeast, spinach, milk powder and pilchard fish.

## Conclusion

Comparing the number of children eating a meal at home and the weekly expenditure on food, it can be seen that very little food is available at home. Comparing income and the number of employed persons to the number of people in the household, little money is available for food. This can possibly be reflected by the prevalence of stunted children in the sample population, indicating a chronic rather than acute malnutrition problem. Food analysis was done through an accredited laboratory to determine the nutritional value of the product. The laboratory found the following: Ash, moisture, fat, protein, folic acid, vitamin A, carbohydrates, vitamin B1, vitamin B 2, vitamin B6, vitamin B12, vitamin C, energy, calcium, magnesium, copper, iron and zinc

Keywords: Malnutrition, school children, school feeding, product development.

## Introduction

Hunger and malnutrition remain amongst the most devastating problems facing the majority of the world's poor and needy, and will continue to dominate the health of the world's poorest nations. Nearly 30% of humanity including infants, children, adolescents, adults and the elderly in the developing world, are currently suffering from one or more of the multiple forms of malnutrition. The tragic consequences of malnutrition include death, disability, stunted mental and physical growth that can result in a retarded national socio-economic development [1].

Bellamy, [2] indicated in a study that the nutritional status of South African children is below the average when compared to the rest of the world. In Africa, a third of all children are underweight, with black and coloured children having the highest prevalence (25% and 17% respectively). Rural black children are the most vulnerable group [3,4].

In SA, under nutrition continues to be the major problem facing children. This form of malnutrition is caused by poor food intake and increased infections in young children [3,5]

South Africa occupies the southernmost part of the African continent. The surface area is 1 219 090 km<sup>2</sup>. Gauteng takes up 17 010 km<sup>2</sup> of the surface area of the country. The rate of urbanisation is 97%. The population for Gauteng is estimated at 7,35 million. This area relies heavily on the Vaal Dam on the Vaal River, from whence water is piped across the province. The Vaal Triangle forms part of the Gauteng province as a strong manufacturing sector, and is situated approximately 70 km south from Johannesburg [6].

The 1999 National Food Consumption Survey (NFCS) furthermore indicated that one out of five children, aged one to nine years old, in SA are stunted at national level. Gauteng showed a prevalence of 20%. Nationally the prevalence of stunting decreased with age from 25,5% in children aged one to three years to 21% in those aged four to six years to 13% in those aged seven to nine years old. A similar pattern emerged for the prevalence of underweight whilst the prevalence of wasting remained constant in all age groups at less than 4% [7].

Many changes occur in a child's life when formal education begins. Lunch eaten at school is different to lunch eaten at home. Getting to school on time and having to walk long distances to school can interfere with breakfast. Children might be unwilling to get up in time to have breakfast and busy parents may not have time to provide their children with breakfast [8].

Several studies have indicated that breakfast plays an important role in the intellectual and physical performance of school children. Children who do not eat breakfast have been shown to have changes in brain function, particularly in the speed of information retrieval in working memory and this is especially true in children who are already malnourished. There are considerable data indicating that iron deficiency is associated with impaired development during infancy, adverse effect on IQ and learning tasks in pre-school children, and poor educational achievement in children of school age [8,9,10]



A summary of school feeding programmes by Kruger, et al. [9]. (Table 1) indicated that 14-19% of school children studied skipped breakfast and that the children from low income households that do eat breakfast take tea and bread only. Children should be encouraged to eat a nutritionally balanced breakfast every morning and could consist of one of the following:

High fibre cereal with skimmed milk

Porridge with skimmed milk and a glass of fruit juice

Whole wheat toast spread thinly with butter or margarine, boiled egg or a slice of cheese and fresh fruit or juice [8].

Richter et al. [11] reported that studies in developing countries experienced many problems in trying to isolate the effects of school feeding from other socio-economic, cultural and educational factors. Food distribution programmes, including school feeding, are not always sufficiently well implemented to show beneficial effects. Problems such as inter alia supply, administration, storage and delivery of food may occur. However, school-feeding programmes can have numerous benefits. Children from poor families or marginal communities are frequently absent from school and this reduces the likelihood of their profiting from educational activities

The advantages of serving breakfast at school are:

Parents are more eager to send their children to school.

Children are more eager to go to school.

Children are better able to concentrate, learn and benefit from school [12].

Richter, [11] concluded that a school breakfast programme had a beneficial effect on the cognitive and behavioral performance of socially disadvantaged, undernourished children in their first two years attending school.

In view of the above mentioned facts and the present situation in this area, it is strongly suggested that this project is relevant and a worth while undertaking. The main focus of this study was to develop a nutritious breakfast product that might affect the nutritional status of primary school children in the Vaal Triangle.

## Methods

The study population consisted of 149 male and female children, aged six to 13 years old in the Vaal Triangle. The multistage randomly selected sample was made up of two Gauteng Education Department primary schools.

The trained fieldworkers obtained dietary data from each child's mother or caregiver by means of a pre-tested quantified food frequency questionnaire (QFFQ) The questionnaire consisted of two components namely a list of the foods and a set of frequency-of-use response categories. An extensive list of simply defined foods was included with the aim of estimating total food intake, and thus dietary diversity.

Socio-demographic information was obtained through a socio-demographic questionnaire (n=259). The socio-demographic questionnaire included questions on age, the residence setting, income level of the family, employed number of people per household and the number and ages of children in the household. Both the questionnaires were completed in an interview situation combined with weighing and measuring of the children (n=149). The measurements included the following; BMI-for-age, weight-for-age and height-for-age.

The weight measurements were done as follows:

The scale was placed on an even uncarpeted area with the spirit level indication in the middle.

The scale was switched on and waited until the zero indication (0.0) appeared as well as the stable indicator (° in the top left-hand corner of the display panel).

The subjects were weighed with clothes, without shoes, after emptying their bladders.

The subjects were placed on the scale. They had to stand upright in the middle of the platform, facing the fieldworker and looking straight ahead. Their feet had to be flat and slightly apart. They had to stand still until the measurement was recorded in the space provided on the station card.

The subject had to step down from the scale and wait for the zero reading to appear on the digital display.

Then the procedure was repeated. The reading had to be within 100 g of each other [13].

The height measurements were done as follows:

The subject had to remove his/her shoes.

The subject was positioned as follows:

facing the fieldworker shoulders relaxed, with shoulder blades, buttocks and heels touching the measuring board arms relaxed at the sides legs straight and knees together feet flat, heels touching

The subject had to look straight ahead before the headpiece was slid down on the head. It just touched the crown of the head.

The fieldworker recorded the reading in mm on the anthropometric measurement space provided on the demographic questionnaire.

The procedure was repeated. The two readings should not vary by more than 5 mm [13].

## Analysis of questionnaires

The data was captured and send to a statistician and analysed. Standardised methods were used. Data were presented in terms of frequencies and percentages for the following categories:

age;

gender;

number of children per household;

household income;

regional dimensions; and

occupation of the breadwinner.

After completing the fieldwork, questionnaires were checked for completeness, accuracy and usability by the researcher. The QFFQ's were analysed by using a dietary software package called Dietary Manager®. The data from the QFFQ's were captured and related in tables and graphs for interpretation. The statistical analysis was done by an independent statistical analyst to determine the adequacy of the nutrient intake and prevalence of deficiencies that could be concluded from the QFFQ's.

## Development of the product

A nutritious novel food (maize meal and whole wheat "vetkoek") was developed to administer to the primary school children according to the nutritional needs of the children. The product contains the following ingredients: maize meal, whole wheat, yeast, spinach, milk powder and pilchard fish. Food analysis was done through an accredited laboratory to determine the nutritional value of the product and the laboratory analysed the following: Ash, moisture, fat, protein, folic acid, vitamin A, carbohydrates, vitamin B1, vitamin B 2, vitamin B6, vitamin

**Table 1. Research studies conducted in school feeding programmes.****South African Studies:**

Study	Study population	Intervention	Results
Richter et al.	55 undernourished rural South African children 7-14 years (test group) 53 well nourished urban children 7-10 years (control).	Test group receive a school breakfast of fortified cereals with milk and banana for 6 months.	The breakfast had a significant beneficial effect on cognitive and behavioral performance.
van Stuijvenberg et al.	115 South African children 6-11 years (test group); 113 children in control group.	Cookies fortified with 60% RDA of beta-carotene, iodine and iron, and a drink with 90mg vitamin C, on school days for a 1 year period (test group); placebo snacks (control).	Improvement in short term memory and attention in test group and fewer illness-related absences from school.
INTERNATIONAL STUDIES:			
Study	Study population	Intervention	Results
Benton & Robberts	90 Welsh school children 12-13 years.	Vitamin/mineral supplement for 8 months (30 children) placebo (30 children) no treatment (30 children).	Increase in non-verbal intelligence in supplemented group.
Powell et al.	407 undernourished 407 well nourished Jamaican school children.	Breakfast, every day for 1 year period (test group); one-quarter orange and same attention (controls).	Breakfast improved nutritional status, and school attendance.
Schoenthaler et al.	740 Chinese school children 6-9	Supplements with 20 mg Zinc,	Micronutrient supplementation with zinc
Sandstead et al.	740 Chinese school children 6-9 years from urban, low-income families.	Supplements with 20 mg Zinc, micronutrients or both, six days per week for 10 weeks.	Micronutrient supplementation with zinc improved neuro- psychological performance and growth significantly.
Jacoby & López de Romaná	500'000 school children of Peruvian Andes 5-10 years.	School Breakfast with 60% RDA of vitamins and minerals, and 100% iron daily for 6 months.	Anemia prevalence fell from 66% to 14%; School attendance improved significantly Improvement in vocabulary test.
Chandler et al.	Jamaican schoolchildren	School Breakfast for Undernourished children.	Undernourished children's performance on verbal fluency improved significantly compared with nourished children without breakfast (no improvement)
Cromer et al.	Well-nourished US children, grade 9	With a low-energy breakfast, high levels of beta-OH-butyrate were found.	No significant differences in cognitive function were found between the two groups.

Table 2. Results of the Test report from ARC :May 2004

Analysis	Unit	Sample
Freeze drying	%	73.60
Ash	%	2.21
Dry Matter	%	70.14
Moisture	%	29.86
*Protein	%	10.32
Fat (ether extraction)	%	17.79
Carotene	mg/100 g	0.11
Folic acid	_g /100 g	540
Vit A	mg/100 g	0.07
Vit B1	mg/100 g	0.41
Vit B2	mg/100 g	0.21
Vit B6	mg/100 g	0.36
Vit B12	_g /100 g	1.49
Vit C	mg/100 g	0.42
Carbohydrates (calculated)	g/100 g	39.82
Energy (calculated)	kJ/100 g	1511
Calcium	mg/100 g	156.03
Magnesium	mg/100 g	72.13
Copper	mg/kg	1.77
Iron	mg/kg	69.40
Zinc	Zinc	36.43

B12, vitamin C, energy, calcium, magnesium, copper, iron and zinc (Table 2). Different methods for chemical analyses of the novel food product were used to determine the nutrient content (Table 3).

For the conversion of nitrogen content to protein content the factor 6.25 was used.

**Table.3 Methods for chemical analyses of the novel food product to determine the nutrient content.**

Nutrient	Method	Basic Principle
Protein	Total Kjeldahl digestion method (Modified Berthelot reaction)	Acid is used to release nitrogen from the sample, which is then measured and used to derive protein value by using a conversion factor.
Fat	Acid - hydrolysis	Hydrochloric acid is used to digest the sample of fat and ether is added to dissolve the fat.
Ash	Direct	Organic matter is removed by heating the sample in a furnace at 550° C.
Moisture	Drying	Water is evaporated by drying the sample in an oven at 105° C.
Carbohydrate	Derived	100 % - (% protein + % fat + % ash + % moisture).
Energy	Derived	(Protein X 16.8 kJ) + (Carbohydrate X 16.8 kJ) + (Fat X 37.8 kJ)
Minerals (Ca & Fe)	Atomic absorbance spectroscopy (AAS)	Sample is digested in acid to release minerals. AAS atomises sample then passes a beam of radiation through it. Absorption is measured at wavelength corresponding to mineral of interest
Minerals (Cu, Mg & Zn)	Inductively coupled plasma mass spectroscopy (ICP-MS)	Sample is digested in acid to release minerals. ICP – MS ionizes sample, then separates ions according to mass and counts the ions
Vitamins (B's, A, C & folate)	High performance liquid chromatography (HPLC)	
Vitamins (other)	Theoretical calculations	SA food composition tables and Food Finder/Dietary Manager®.

### Sensory Analysis

The primary function of sensory testing is to conduct valid and reliable tests, which provide data on which sound decisions can be made. The test subjects must be selected and trained to give a reproducible verdict. A sensory panel that was constituted by random selection of representatives from the various target groups in Setlabetjha School tested the product. The sensory panel received training and guidelines before the sensory evaluation. The following steps were considered when the sensory evaluation was conducted; the project and test objective was determined, the samples were screened and the test was designed and conducted, the data was analysed and the results were interpreted.

A paired preference test was done to determine which of the three products the subjects preferred. Of the subjects 80% preferred sample B, the maize meal and whole wheat “vetkoek”.

The method of consumer sensory evaluation was used. The goal was to study the subject’s responses and emotional reaction to the maize meal and whole wheat “vetkoek”. In the sensory analysis it was determined that the 65% of the consumers liked the product very much and said it was very tasty, 18% liked the product moderately, and 17% found it acceptable. All subjects in the evaluation was part of the target consumer group, aged six to 13 years old. A smiley face scale was used to evaluate the product. This method is suitable to measure children’s response to products.

### Shelf life study.

Shelf life represents the useful storage life of food. At the end of the shelf life, food is developing characteristics- changes in taste, aroma, texture or appearance that are deemed unacceptable or undesirable. The underlying cause for the change may be microbiological, chemical or physical. Microbiological spoilage is exemplified by the above attributes. Examples of chemical and physical deterioration include rancidity and freezer burn. Microorganisms possess specific growth requirements for temperature, moisture, acidity, nutrients and time. For microorganisms to grow, cultural conditions must be within a certain range. If minimum conditions are not satisfied growth will not occur. In general, organisms grow at temperatures between 0° and 55° C, at pH values between 2 and 10, and at water-activity levels greater than 0.6. This limited range is not absolute, and the boundaries around them are not usually sharply defined. Optimal growth generally occurs in the middle region of the various ranges, and slows as the boundaries are approached. Assessing a food item in terms of its microbial growth requirements makes it possible to determine its potential for spoilage (Table 4).

Shelf life studies will be carried out under a range of controlled test conditions. Microbiological tests will be done to evaluate the growth of harmful bacteria and microorganisms after special time periods to determine shelf life. An accredited laboratory (Agricultural Research Council ARC.) will be used for the shelf life tests. Tests will be done to determine the correct storage temperature, and method for

storage. The rancidity, taste, texture, colour and flavour of the maize meal and whole wheat “vetkoek” will be monitored.

The taste, odour and appearance of a food are the ultimate criteria used by consumers to judge food’s acceptability. Organoleptic evaluation of food can be used as a direct method for determining shelf life. The food is prepared and periodically examined for changes in appearance, aroma, texture and taste until it becomes unacceptable. The organoleptic quality of food changes as micro-flora, bacteria, yeast and mould, grow and metabolise available nutrients. The sensory changes at first might be subtle, but they eventually make the food unacceptable. Trained panellists from the ARC laboratory. Were used to conduct organoleptic evaluation for determining shelf life.

High numbers of microorganisms are normal in certain foods, but indicate deterioration in other foods. Therefore, it is desirable to know, even in the absence of objectionable organoleptic changes, the microbiological state of food as it nears the end of shelf life. For the delivery of a product with maximum quality, the shelf life of a product should be determined by onargoleptic and microbiological examination.

**Table 4. Pathogens that may be considered for use in challenge studies for various food products.**

Food type	Type of organism
Salad dressing	Salmonellae, Staphylococcus aureus
Bakery items (fillings, icings, non-fruit pies)	Salmonellae, Staphylococcus aureus
Sauces and salsas stored at ambient temperature	Salmonellae, Staphylococcus aureus
Dairy products	Salmonellae, Staphylococcus aureus, Clostridium botulinum, enterohemorrhagic Eschericia coli, Listeria monocytogenes
Confectionary products	Salmonellae
Formula with new preservatives	Salmonellae, Staphylococcus aureus, Clostridium botulinum, enterohemorrhagic Eschericia coli, Listeria monocytogene

Adapted from (FDA) Food and Drug Administration, Center for Food Safety and Applied Nutrition.

## Results

### Demographic characteristics

Table 5 is a summary of the demographic characteristics of the sample. Income, educational attainment of parents, and family size are significantly associated with the nutritional status of the school child [14]. The basic causes of malnutrition include number in the household, ethnicity, education levels of parents, occupation of parents, family income, housing characteristics, family food expenditure per month, eating away from home, and health services, safe water and sanitation [15].

All of the children that partook in this study were resident in an informal settlement, which is not situated close to a lot of shopping complexes and shops, the availability of the food was a problem, but the availability of resources to acquire the food is a bigger problem. Unemployment and large families could be the cause of unavailability of food. The low income of the families indicates that very little money is available for food. As poverty improves and income increases the families will probably have more money available for food and thus improve their eating habits and improve the nutritional status of the children if the correct foods are brought into the households, by buying the correct foods for optimal nutritional growth.

**Table 5:General information on the household**

Parameter	Number	%
Age distribution of the sample population (N=149)		
6-9 years	79	47.3
9-13 years	78	46.7
13+	10	6
Gender of the respondents		
Female	83	55.7
Male	66	44.3
Number of children per household (N=145)		
One	41	28.3
Two	12	8.4
Three	5	3.4
Four	3	2
Five	2	1.4
Six	2	1.4
All	16	11
Geographic area of the households (N=259)		
Informal settlement	259	100
Employed people per household		
None	235	93.3
One	17	6.7
Frequency of money shortage N=242		
Always	85	35.1
Often	46	19
Sometimes	74	30.6
Seldom	21	8.7
Never	16	6.6
Frequency of shopping N=249		
Everyday	50	20.1
Once a week	135	54.2
Once a month Other	41	16.5
Income into the household N=259		
R0-R500	116	69
R500-R1000	40	23.8
R1000-R1500	6	3.6
R1500+	6	3.6

### Anthropometric measurements

The “road to health” chart (RtHC) of the Department of Health SA were used to make a statistical comparison of the anthropometric indicators. As recommended by the WHO, the nutritional status of the children in the survey was compared with an international reference population defined by the NCHS. Height and weight measurements were classified according to these percentiles, which are generally used as an intentional reference population. For this study age was calculated in years from the date of birth to the actual date that each child participated in the survey.

The anthropometric measurements was sent to a statistician and analysed and scatterplots was drawn on the RtHC. The measurements included the following; BMI-for-age, weight-for-age and height-for-age indicated on the 5th, 50th and 95th percentile of the NCHS median.

### Nutritional status

According to a countrywide study in SA done by Labadarios et al. [16] amongst children of one to nine years of age (at national level, stunting remains by far the most common nutritional disorder affecting nearly one out of five children).

### Underweight (Low weight-for-age)

Acute underweight (Table 6) occurs when an acute shortage of food has been experienced and is indicated where the weight-for-age is lower than -2SD of NCHS median. In the Vaal Triangle 17.4% of the children were severely underweight. It was also indicated that 58.4% of the children fall in the risk area of malnutrition (> -2 < 1). Only 22.8% of the children had a normal weight-for-age. These results indicate that a severe underweight problem exists in the Vaal Triangle.

The results in this study are similar when compared to the National food consumption survey results where it was found that in Gauteng 8% of children one to nine years of age sorted under the < -2SD group resulting in underweight [16].

**Table 6: Weight-for-age**

Nutrient	RDA	Gauteng	SA
Vit E	7IU	4.1	5.1
Vit C	45mg	31	48
Phosphorus	500mg	604	678
Calcium	800mg	282	315
Zinc	10mg	5.1	5.8
Iron	10mg	5.8	6.9

### Stunted (Low height-for-age)

Eighteen percent (18%) of the children was seriously stunted (Table 7) as shown in the height-for-age less than -2SD of the NCHS median. This indicates a chronic shortage of food experienced possibly because of the low-income level and unemployment. The percentage risk cases for stunting is 53.7% and only 23.5% of the children had a normal height. The WHO [1] estimated that 43% of children under five years old in developing countries have a low-height-age.

Labadarios et al. [16] indicated that 20% of children one to nine years of age in Gauteng were stunted. The value of stunting as an indicator of nutritional status was questioned by Schaaf [17] in saying that children adapt to their nutrition environment by restriction their growth for optimal weight in relationship to height [17].

**Table 7: Height-for-age**

Parameter	N=149	%
Standard deviation (SD)		
< -2	26	17.4
>-2 < 1	87	58.4
> 1 < 3	34	22.8
> 2	2	1.4

### Wasted (Low weight-for-height)

In this study 12.8% of the sample population had low weight-for-height (Table 8) that indicated wasting indicated at <-2SD from the NCHS median. Sixty four percent (64%) of the children are however at risk of being wasted. These results are similar to other studies completed in South Africa. Labadarios et al. [16] indicated that 2% of children one to nine years of age were wasted.

In terms of the NCHS standards a large portion of the children were stunted (39%), which is consistent with other studies done in South Africa, indicating chronic malnutrition. Fourteen percent of the children were underweight indicating acutely undernourished children. The availability of foods is as much a problem as the availability of nutrient dense foods, this is obvious when comparing the nutrient intake to the nutritional status of the children.

**Table 8: Weight-for-height**

Parameter	N=149	%
Standard deviation (SD)		
< -2	27	18.1
>-2 < 1	80	53.7
> 1 < 2	35	23.5
> 2	7	4.7

### Product analyses

Food analysis was done through the Agricultural Research Council (ARC.) Department analytical services, an accredited laboratory to determine the nutritional value of the product . The laboratory found the following: Ash, moisture, fat, protein, folic acid, vitamin A, carbohydrates, vitamin B1, vitamin B 2, vitamin B6, vitamin B12, vitamin C, energy, calcium, magnesium, copper, iron and zinc (Table 2) and addresses 23% of the DRI's for energy requirements for children of this age, 62% for zinc, 14% for calcium, 43% for magnesium, 140% for iron and 18% for vitamin A [19].

## Discussion

The objective of this study was to determine the demographic profile and nutritional status of the primary school children to develop a breakfast product, in terms of the NCHS standards a large portion of the children were stunted (18.1%), which is consistent with other studies done in South Africa, indicating chronic malnutrition. Seventeen percent of the children were underweight indicating acutely undernourished children. The availability of foods was as much a problem as the availability of nutrient dense foods. This is obvious when comparing the nutrient intake to the nutritional status of the children.

The National Food Consumption Survey indicated that children 7-9 years old in Gauteng (Table 9) has a lower intake of nutrients than children do in South Africa in general and this is reflected in the baseline results of this study. Eighty two percent of these children take in less than two-thirds of RDA for vitamin A in South Africa, In terms of iron status, 10% of children in South Africa is iron depleted or deficient, one in twenty is severely iron depleted or deficient and one in twenty has iron deficiency anaemia. Anaemia and poor iron status are more prevalent in urban areas [13]. According to Voster et al. [18] multiple micronutrient deficiencies existed in rural black pre-school children in the form of vitamin A, iron, folate, vitamin E and vitamin B6.

Comparing income and the number of employed persons to the number of people in the household, little money is available for food. This can possibly be reflected by the prevalence of stunted children in the sample population, indicating a chronic rather than acute malnutrition problem. The incorrect eating habits probably contributed to the high prevalence of malnutrition, with food items like tea, maize meal, sugar and other starchy products mostly consumed by the people in the households. The families could also see this as the bare essentials for a diet and education of the caregivers and also the children might change the perception of what is needed to sustain basic nutritional health.

All the children that partook in this study were residing in an informal settlement, which showed to be far away from shopping complexes and shops and shopping was mostly done at informal community shops (Spaza shops). Therefore the availability of the good quality food was as much a problem as was the availability of resources to acquire the food. Unemployment and large families could be the cause of unavailability of food. The low income of the families indicated that very little money is available for food. As financial status improved and income increase, the families will probably have more money available for food and thus improve their eating habits and improve the nutritional status of the children if the correct foods are brought into the households, by buying the correct foods for optimal nutritional growth.

Although some of the children that took part in this study attended a school where a school feeding programme is in place, considering the results of this study it can be speculated that the children either do not get enough food to sustain them or that the food is of poor nutritional value. If a school feeding programme is in place it is important that the school should adhere to a diet planned by a professional person to ensure that the children receive enough and the correct food to ensure optimal nutrition for the time spent at this facility and for their activity level.

The specific aim of this project was the development of a nutritious novel food that is based on the following criteria: Balanced nutritional value: Rich in energy, rich in protein and micronutrients, specifically those where deficiencies are present. Practical: the product must be easy to prepare, caregivers must be able to use local raw materials and there must be minimal waste. Acceptable to children.

The vetkoek contain the following ingredients: maize meal, whole wheat, yeast, spinach, milk powder and pilchard fish, all these ingre-

dients form part of the top 20 items mostly consumed in this area, and addresses 23% of the DRI's for children of this age, 62% of the EAR's of Zinc requirements, and 14% of the calcium requirements [19].

This project will initiate the involvement of the local communities and the NGO's in the Vaal Triangle for the upliftment of the community by assisting in gathering information, developing a cost effective, nutritious product easy enough to be prepared by the parents and the school and recommendations for developing a programme to overcome malnutrition in the school.

It is essential to identify the causes of malnutrition in the community to ensure the actions undertaken to address the problem are applicable and relevant to the local setting and needs. The nutritional status of the children is a good indicator of the state of the whole community. This project will concentrate on the effects of a nutritious breakfast given to the school children.

Food is a commodity that has to be purchased and until the purchasing power of the poor increases, endemic malnutrition will remain a problem. There is therefore some urgency in arriving at a national consensus on strategies to combat high unemployment and low wages.

Nutrition intervention in schools as well as nutrition education will have to be planned and implemented.

**Table 9: Mean nutrient intake of children 7-9 years old in Gauteng and SA [16].**

Parameter	N=149	%
SD		
< -2	19	12.8
> -2 < 1	96	64.4
> 1 < 2	32	21.5
> 2	2	1.3

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# Prevalence of Malnutrition Among Children Aged 6-59 months living in Different Sections of a Slum Environment in Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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**Objective-** To assess the nutritional status and describe feeding practices and morbidity of children aged 6-59 months.

**Purpose-** To establish whether there are significant variations in nutritional status and its determinants among children living in different sub locations of the same slum area for enhanced targeting of interventions.

**Design-** Cross-sectional descriptive and analytical study was conducted in the third largest slum (Kangemi) in Nairobi.

**Methodology-** The study applied systematic random sampling to identify 330 children that represented a similar number of households. The study assessed the anthropometry of the children and used a structured questionnaire and focus group discussion to collect data on demographic and socio-economic characteristics while estimation of nutrient intake was done using the 24-hour recall. Morbidity of children aged 6-59 months was also recorded

**Findings-** There was higher level of malnutrition in Kangemi Sub-location than in Gichagi Sub-location. Prevalence of stunting was 27.6% and 25% in Kangemi sub location and Gichagi, respectively, with  $p=.021$  while underweight was 12.5% and 10.8% in Kangemi sublocation and Gichagi, respectively, with  $p=.39$ . Wasting was (6% and 2%) in Kangemi and Gichagi, respectively, with  $p=.38$ . There was no significant difference identified in feeding practices with  $p=.657$  whereas slightly higher proportion of children were ill in Kangemi sub location than in Gichagi with  $p=.196$  in the last seven days before the survey.

**Conclusion-** Having been established that the prevalence of stunting was higher in one section of the slum (Kangemi sub location) than the other (Gichagi) demonstrates existence of differences that may call for diversified intervention strategies.

**Practical application-** The study Contributed to

findings of the current nutritional status of children aged 6-59 months living in Kangemi that can be used as a platform from which interventions for the study population can be formulated for and other communities.

## Introduction

Malnutrition is a serious health problem in developing countries.

Malnutrition may be defined as a state of nutrition where height for age, weight for age and weight for height indices fall outside certain pre-determined cut-off points, i.e., below  $-2$  Z Scores of the NCHS reference. (NCHS)-U.S. National Centre for Health Statistics, is a standard recommended for use by the World Health Organisation (WHO). Malnutrition is a wide spread problem with devastating consequences. It weakens immune systems and worsens illnesses negatively imparts on school performance and work productivity. Good nutrition helps to protect natural immunity, which is particularly important for health, as resistance to drugs increases and new diseases emerge [1].

According to UNICEF [2] the nutritional status of children under five years of age has deteriorated in recent years. Although there are considerable regional disparities, estimates of prevalence of malnutrition indicate that about 34 percent of Kenyan children are stunted and 25 percent are underweight [2].

This paper reports the findings of a study conducted to establish

whether there are significant variations in nutrition security and its determinants among children living in different settings of the same slum area in Kangemi Location, Nairobi. In the context of this study slum refers to an area in a city that is marked by poverty and inferior living conditions without formal infrastructure, inadequate sanitation facilities, temporary housing and overcrowding [3]

The objective of the study was to describe the nutritional status, feeding practices and morbidity of children aged 6-59 months and to identify the determinants.

## Materials and Methods

### Study Area

Nairobi, which is the capital city of Kenya, is situated about 5,500 feet above sea level. It has eight divisions. Kangemi and Gichagi, the study sites are sub locations of Kangemi Location of Westlands Division of Nairobi. The study was conducted in Westlands Division, Kangemi Location.

Kangemi Location where the study was conducted has an estimated population of 59,288 people (GOK, 2001). Kangemi, which is one of the urban slums in Nairobi, is located in western suburbs of Nairobi, about 10 km from Nairobi City Centre and lies on two sides, left and right of Waiyaki Way.

### Sampling technique

Multistage Sampling was used to identify the study households. At stage one Nairobi District was selected using purposive sampling which was followed by selection of Westlands division. At the third stage Kangemi Location was selected using the same method, (purposive sampling). Purposive sampling was used to select two sub locations Kangemi sub location and Gichagi sub location from the three sub locations of Kangemi Location omitting the third sub location, Mountain View, because it is different from the other two. At the fifth stage four villages were selected from seven villages randomly; three villages from Kangemi sub location from the five villages and one village from Gichagi sub location from the two villages were selected. At the sixth stage 330 households were selected following the set selection criteria, which was the presence of children aged 6-59 months that have lived in the area for at least three months.

A systematic cluster sampling procedure was used in selection of the households to participate in the survey as following: The group collecting data including the Principal Investigator went to the centre of the village. After choosing a direction in a random way, that is, by spinning a bottle on the ground and choosing the direction the bottleneck indicated walked in the chosen direction, the data was collected from every third household. If the boundary of the village was reached before the number of children expected from that village was not weighed and measured the group returned to the centre of the village and

The study assessed the anthropometry of the children under five years

old using structured questionnaire and focus group discussions and collected data on demographic and socio-economic characteristics, estimation of nutrient intake and morbidity of children aged 6-59 months.

The study assessed the anthropometric measurements (weight and height) obtained following the measuring techniques described by Cogill [4] and the conversion of the anthropometric values used Epi-Nut in EPI-INFO. Weight: Salter weighing Scale that could weigh up to 25 kilograms with accuracy of 100 grams, together with a plastic pant were used.

The Salter Scale, with the pant hang on it was adjusted to ensure that the needlepoint was at zero before placing the child on, while the Salter Scale was hang on to a pole or tree. Then, the child left with minimal light clothing and without shoes, hanging freely, the weight was recorded to the nearest 0.1 kilogram. The weight was taken twice and the average was recorded. However, if the difference between the two readings was more than 0.5 kg, weighing was repeated.

Length: for children who were less than 24 months of age, length was taken using a wooden length board. The child was laid on the board, which was itself placed on a flat surface. The head was positioned against the fixed head board, with eyes looking vertically. The knees were extended and the feet were flexed at right angle to the lower legs. The up-right sliding foot piece was then moved to obtain firm contact with the bottom of the feet and the length read and recorded to the nearest 0.1 cm.

Height: For children two years and above a vertical measuring board was used. After removing shoes, the child stood on a flat surface with feet parallel and with heels, buttocks, shoulders and the back of the head touching the upright, the head was held straight looking ahead, the arms hung loosely at the sides, then the head – piece was gently lowered, crushing the hair and making contact with the top of the head, and the height was then read and recorded to the nearest 0.1cm. The length/height measurement was taken twice and the average calculated for each child. However, the exercise of height/length measurement was repeated where the difference between the two readings was more than 0.1 cm.

The study also assessed demographic and socio-economic, status and nutrient intake and morbidity of children aged 6-59 months old.

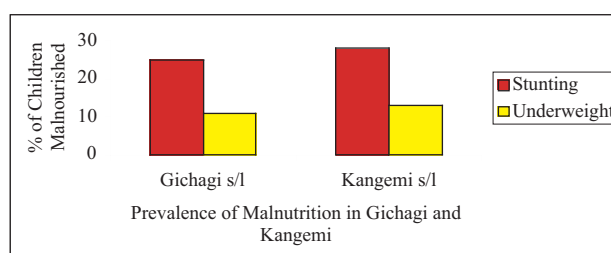
## Results

The identified determinants of malnutrition were income level (below or above poverty line), amount of water used per day per household and the sex of head of household. This study revealed that the prevalence of malnutrition was higher in households headed by males than in households headed by females. Prevalence of stunting was 28% and 15.6% in households headed by male and female, respectively. The prevalence of underweight and wasting was 12.8%, 6.5% and 5.2% and 3.2% in households headed by male and female respectively.

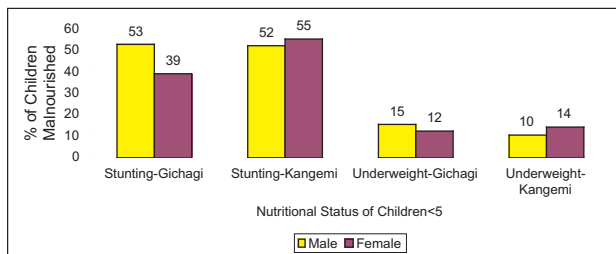
**Table 1 Distribution of households by socio-economic, demographic and sanitation characteristics.**

	Gichagi sub location (N= 65)		Kangemi sub location N= 271	
	58	7	237	34
Gender of household head	Male	Female	Male	Female
In percentage	52.7	5.4	53	6.4
	c <sub>1</sub> =206	p=. 000	c <sub>2</sub> =756	p=. 000
Mean household size	3.6		3.7	
Mean income per month	7025.7		6942	
Proportion of households				
< poverty line	N=34	68%	N=34	68%
			N=144	59.6%
Mean amount of water used	61 in litres		65 in litres	
			t=2.2	
<80 litres	79.4% of households		71% of households	
≥80 litres	20.6% of households		29% of households	
Toilet	Private 4.5%, Communal 95.5%		Private 11.7%, Communal 83.3%	
% of children ill	53%		61.7%	

**Figure 1: Prevalence of malnutrition in Gichagi and Kangemi**



**Figure 2: Comparison of nutritional status by gender and the two sub locations**



NB. One of the sub locations (Gichagi) did not have children who were wasted as a result it was not comparable.

No significant difference was identified in income level in both sub locations  $\chi^2=0.671$ ;  $p=0.413$ . Regular and casual employment was one of the determinants of nutritional status of children 6-59 months old shows no significant difference in both sub locations as the  $p=0.053$  of chi-square test. Out of the 330 households 71% and 79.4% from Kangemi sub location and Gichagi, respectively, used inadequate amount of water daily while 29% and 20.6% of the households used adequate amount of water in Kangemi and Gichagi sub locations, respectively. No significant difference was observed in the use of water in the two sub locations ( $p = .182$ ) There was a significant difference in the sex of head of households as  $p= .000$  of chi-square test. There was no significant difference in feeding practices and morbidity of children aged 6-59 months in both sub locations chi-square test shows  $p= .657$  and  $.196$  respectively.

No association was found between morbidity and nutritional status of the index children in this study.

Correlation of nutritional status of children and income of households show that the nutritional status of children (wasting, underweight and stunting) are inversely related to income level i.e., when income decreases the nutrition status deteriorates or malnutrition level increases and when the income level increases malnutrition of children decreases.

The odd ratio of amount of water used in a household and nutritional status of children indicated that the risk of wasting was 1.3 times more and that of stunting 1.7 times more among children from households that used less than the recommended amount of water (<80 litres) per day. Among the underweight children 11.7% were from households that used the recommended amount of water per day while 13.3% were from households that used less water than the recommended amount of water per day.

## Discussion

The nutritional status of infants and children under five years of age is of particular concern since the early years of life are crucial for future growth and development. Their nutritional well being reflects household, community and national investments in family health thereby contributing both directly and indirectly in overall country development [5].

The established level of stunting (27.6%) is slightly higher than the reported 22% stunting level of Kibera [6] but lower than the stunting level of children in a slum area of Addis Ababa, Ethiopia [7]. The prevalence of stunting in Kangemi location is slightly higher than the national level of stunting (24%) [8].

Proper infant and child feeding practices include exclusive breastfeeding in the first six months of life followed by gradual introduction of

supplementary foods starting with liquids and progressing to solids, as the child grows older. Since supplementary feeding given in the weaning phase gradually replaces breast milk, they should be nutritionally adequate, safe, and free from contamination. These foods must be of a consistency and quality that an infant or young child would be able to consume, enjoy and benefit from [9].

There was no significant difference identified in feeding practices in two sub locations, which was indicated by  $p= .657$  of the chi-square test. In general out of the 330 study children 43% were breastfeeding at the time of the survey that is lower than reported in Kibera (58.2%) [6] and also of Kumasi, Ghana (81.4%) [10] which shows that breastfeeding practices appear to vary from one low-income area to another. Good nutrition, in the early months of life, is more usually determined by feeding practices, whether the right food is given at the right time, in the right way and the right frequency, severity, and duration of disease. Disease depresses appetite and inhibits the absorption of nutrients. Disease like fever makes the body to consume a lot of calories as it tries to fight off infection. It drains away nutrients through vomiting and diarrhoea; and it alters the body's metabolism, in ways that are still not entirely understood, such that the benefits of the available nutrients are lowered [11].

The prevalence of morbidity in this study community 75.4% was slightly more than the recorded (74.2%) in a slum area of Addis Ababa, Ethiopia [7].

## Conclusion

Stunting was significantly different in the two sub locations in nutritional status of children under five years of age but wasting and underweight in the two sub locations were not significantly different. Feeding practices and morbidity pattern was not significant probably because they are in the same setting.

Overall, the findings suggest that reduction of poverty may directly lead to better nutritional status of children. As the result, it is recommended that putting up income generating activities in the study community will enhance the purchasing power of households which will improve nutritional status of children under five years.

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# Nutritional Status of Children Participating and Those not Participating in School Feeding Programme in Korogocho Slums in Nairobi, Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Background:** Studies show that school feeding programmes could have an influence on nutritional status of school children. Other studies have shown no significance difference in nutritional status between children participating and not participating in a school feeding programme.

**Objective:** The main objective of the study was to determine the differences in nutritional status, food consumption and morbidity pattern and school attendance patterns among children participating and those not participating in a school feeding programme.

**Design:** A cross-sectional study was carried out.

**Setting:** The study was carried out in Korogocho slums of the capital city of Kenya, Nairobi.

**Subjects:** School Children aged 6 – 10 years in schools with and without a school feeding programme.

**Methods:** Korogocho slums in Nairobi were purposively selected because they are overpopulated with the urban poor. Systematic sampling was used to select schools with and without a school feeding programme. Stratified sampling was used to select pupils by class and gender. Random sampling was used to select pupils from class 1-5.

**Results:** 24.2% of the children in the study area were stunted while 18.4% and 5% of them were underweight and wasted respectively. Although not significantly different more children participating in a school programme were malnourished compared to those not participating in a school feeding programme. Although not significantly different more boys and girls participating in school feeding were malnourished compared to those not participating in school feeding. Whether participating in a school feeding programme or not more boys (14.1%) girls (10.1%) were stunted. More girls (3.9%) than boys (1.1%) were wasted. Food consumption and morbidity patterns were also not significantly influenced by school feeding. There was a significant difference in the number of pupils missing school and participating in school feeding programme with significantly more of those not participating in a school feeding programme (32.5%) missing school than those participating in a school feeding programme (11%).

**Conclusion:** School feeding did not appear to have an impact on the nutritional status of the pupils. It however had a significant positive impact on school attendance.

**Recommendations:** School feeding programmes can be used to improve school attendance in primary schools and especially the slums and are therefore recommended. Improved school attendance eventually results in improved school performance. Parents are encouraged to contribute towards school feeding programmes. Donors are also encouraged to support schools through food donations to ensure that school children get at least a meal in school.

## Introduction

Slum areas are usually characterized by overpopulation by the

urban poor, low levels of hygiene, poor feeding habits and high incidence of crimes thus threatening schooling and the nutritional status of children [1]. School feeding programmes are one of the nutrition intervention programmes used to improve nutrition status of children living in slum areas [2].

Service providers such as NGOs and churches have initiated school feeding programmes in some schools in Korogocho slums of Nairobi to improve the nutritional status of school children.

While some studies show that school feeding programmes have no impact on the nutritional status of the participating children, others show that there is a significant difference in nutritional status between children participating and those not participating in such programmes.

A study carried out by Sigman et al [3] on the nutritional status of children participating and those not participating in a school feeding programme in Embu indicated that those participating in the programme had significantly better nutritional status than those not participating. This was attributed to the fact that school feeding provides an extra meal to children who usually miss some meals at home.

Other studies show that the meals served in such programmes could be inadequate in quantity and quality, irregular and thus not influencing the nutritional status of the participants [4, 5].

This paper compares nutritional status and dietary patterns between children participating and not participating in a school feeding programme in Korogocho slums in Nairobi.

## Materials and Methods

A cross – sectional study, comparing two groups of school children participating and not participating in a school feeding programme in aspects of nutritional status, dietary patterns and health was carried out from March to May, 2004. A sample size of 240 pupils (120 participating and 120 not participating) was determined on the number of schools in a feeding programme.

Korogocho slums in Nairobi were purposively selected because they are overpopulated with the urban poor. Systematic sampling was used to select 4 schools with and 4 schools without a school feeding programme. Stratified sampling was used to select pupils by age, class and gender. Random sampling was used to select pupils from class 1-5 until the desired sample size was realized.

The inclusion and exclusion criteria those participating in a school programme were school children aged between 6 and 10 years and at least take a meal daily in school and do not carry packed meals to school. The inclusion and exclusion criteria for those not participating was school children aged between 6 and 10 years and do not take any meals in school and do not carry packed meals to school.

A pilot study and pre-testing of the questionnaire and research equipment was carried out in mid February 2000. The researchers and field assistants identified the study boundaries before data was collected using pre-tested structured questionnaire and focus group discussion guides and observations during the months of March to May 2004.

At the analysis stage a child was considered stunted if he/she fell below  $-2$  Z scores of the reference child using the National Centre for

Health Statistics standard. If the child was more than -3 Z scores the child was considered to be severely stunted (height for age). Similarly a child was wasted if he/she fell below -2 Z scores of the reference child and was severely wasted if more than -3 Z scores for the weight for height index. A child was considered underweight if he/she fell below -2 SD of the reference child (National Centre for Health Statistics).

If the child was more than -3 SD the child was considered to be severely underweight (weight for age). Descriptive statistics were performed on all data and reported as percentages and frequencies. Chi-square tests were used to obtain p-values. A p-value of <0.05 was considered as significant.

## Results

### Levels of malnutrition

24.2% of the children in the study area were stunted while 18.4% and 5% of them were underweight and wasted respectively. These figures are lower than the national figures of stunting (35%), underweight (21%) and wasting (6%) respectively. Although not significantly different (p<0.05) more children participating in a school programme were malnourished compared to those not participating in a school feeding programme.

Although not significantly different (p<0.05) more boys and girls participating in school feeding were malnourished compared to those not participating in school feeding. Whether participating in a school feeding programme or not more boys (14.1%) girls (10.1%) were stunted. More girls (3.9%) and boys (1.1%) were wasted. Distribution of levels of malnutrition and sex are shown in Table 2.

Figures in Yes and No columns represent percentages of pupils participating and not

Participating in a school feeding programme

### Food consumption patterns

There were no significant differences (p<0.05) in food consumption.

Table 3 shows the consumption of different types of foods. Table 3: Distribution of children by school feeding programme and food consumption patterns.

There was no significant difference (p<0.05) in consumption of fruits between children participating and those not participating in a school feeding programme.

The fair consumption of fruits was possibly because the fruits were in season at one time or another. Some fruits such as avocados were generally cheap while pineapple and paw paw were generally more expensive.

There was also no significant difference (p<0.05) in consumption of carbohydrates. Ugali was consumed often than any other carbohydrate.

Consumption of proteins did not differ significantly (p<0.05) by children participating and those not participating in a school feeding programme.

However, there was generally low consumption of proteins of high biological value by most children. Children reported that they take milk only in tea. This could be explained by the fact that proteins are expensive and most households could not afford.

Consumption of vegetables also did not differ whether children were participating in a school programme or not. Kales and tomatoes were the most consumed vegetables possibly because they are readily available and cheap.

This trend in food consumption possibly explains why there were no significant differences in nutritional status because the children ate

almost the same kind of foods. Nutritional status seemed not to be significantly (p<0.05) influenced by the type of food eaten in school.

Table 4 shows that malnutrition forms did not significantly differ

**Table 1: Distribution of malnourished children by school feeding participation.**

Malnutrition	Forms of Malnutrition	Overall area N=240 (%)	School feeding Participation		
			Yes (%) N=120	No (%) N=120	X2 tests
Stunting	Moderate	17.5	10	7.5	0.075
	Severe	6.7	3.7	3	0.088
	Total	24.2	13.7	10.5	0.067
Underweight	Moderate	14.2	9	5.2	0.058
	Severe	4.2	2	2.2	0.112
	Total	18.4	11	7.4	0.056
Wasting	Moderate	3.3	1.7	1.6	0.123
	Severe	1.7	1	0.7	0.078
	Total	5	2.7	2.3	0.127

**Table 2: Distribution of malnutrition (total malnutrition) by school feeding programme and sex.**

Variable	School Feeding Participation								
	Stunting			Underweight			Wasting		
	Yes N=120	NO N=120	X2 tests	Yes N=120	NO N= 120	X2 tests	Yes N= 120	NO N=120	X2 tests
Sex									
Boys	7.6	6.5	0.088	7	4	0.051	0.7	0.4	0.089
Girls	6.1	4	0.067	4	3.4	0.901	2	1.9	0.157

Types of foods consumed often	School feeding participation		
	Yes (%) N=120	No (%) N=120	X2 tests
Consumption of Fruits	11.4	9.2	No sign. differences
Oranges	12	12	
Bananas	23	22.9	
Avocado	6	6	
Paw paw	6	6	
Pineapple	27	26.9	
Mangoes			
Consumption of carbohydrates	41	39	No sign. differences
Ugali	12	11	
Rice	7	9	
Chapatti	0.5	0.4	
Yams	4.3	4.5	
G. Bananas	1.6	1	
Arrow Roots	3.2	2.6	
Sweet Potatoes	5.9	7	
Irish Potatoes			
Consumption of proteins			No sign. differences
Fish	2.1	1.9	
Eggs	3.4	3.2	
Milk	24.2	24.1	
Chicken	0.3	0.4	
Beef	7	6.5	
Beans	9	9	
Consumption of vegetables	8.5	10	No sign. differences
Cabbage	10	8.1	
Carrots	10.4	11	
Spinach	34	36	
Kales	35	35.6	
Tomatoes	6	6	
Cowpeas			

( $p < 0.05$ ) depending on what was eaten in school. This is possibly because at the end of the day the children had a variety of foods either from school or home.



**Table 4: Distribution of malnutrition by type of food eaten in school**

		Type of food eaten in school		
		1 Githeri N=66	variety N=54	X2 tests
Stunting	Moderate	6	4	0.057
	Severe	1.7	2	0.155
	Total	7.7	6	0.176
Underweight	Moderate	5	4	0.056
	Severe	1.3	0.7	0.077
	Total	6	5	0.076
Wasting	Moderate	1	0.7	0.059
	Severe	0.6	0.4	0.087
	Total	1.6	1.1	0.097

**School feeding participation and other variables**

Table 5 shows the distribution of children participating and not participating in a school feeding programme and other variables.

**Table 5: School feeding participation and other variables**

Variable	School feeding participation		
	Yes (%) N=120	No (%) N=120	X2 tests
School attendance Absent this term	11	32.5	0.038
No. of meals/day			No difference
One	23	20	
Two	77	81	0.099
Three			0.067
Food prepared by			
Mother	28	44	0.043
Self	20	13	0.051
Other	52	43	0.056
Frequency of diseases (often)			
Coughs and colds	28	26	0.122
Stomachache	24	22	0.093
Diarrhea	8	11	0.077
Vomiting	10	12	0.087
Malaria	20	15	0.056
Skin Problem	10	10	No difference
Occupation of breadwinner			
Employed	33	27	0.055
Small Business	14	21	0.059
Unemployed	53	52	0.074

There was a significant difference ( $p < 0.05$ ) in the number of children missing school and participating in school feeding programme. There were significantly more children (32.5%) not participating in a school feeding programme compared to those missing school and were participating in a school feeding programme (11%).

School feeding seemed to significantly improve school attendance. No child whether participating in a school programme or not reported to take one meal a day. There was no significant difference between school feeding participation and number of meals taken per day. This could be explained by the fact that school feeding provides only one meal and the child could have other meals at home. Significantly ( $p < 0.05$ ) more children (44%) not participating in a school feeding programme had their mothers cook food for them compared to those participating in a school feeding programme (28%).

Although not significantly different more children (20%) participating in a school feeding programme compared to those not participating in a school programme cooked family meals at home.

The responsibility of preparing meals could influence the decision of parents to want their children feed in school. Mothers cooking at home would not mind their children coming home for lunch. Children going home for lunch to cook for themselves would rather eat in school.

There were no significant differences in disease frequencies between children participating and those not participating in a school feeding programme.

There was also no significant difference between bread winners' occupation and school feeding.

This could possibly be explained by the fact that the school meals in some schools were donations and children took them whether their parents were employed or not.

**Discussion**

The findings of this study indicate generally high levels although not as high as the national figures as seen earlier [6]. Findings show no significant difference in pupils' nutritional status and school feeding programme. Pupils participating in school feeding programme had poor nutritional status, although not significant possibly because school meals were inadequate in quantity and quality, that pupils missed breakfast and supper at home or because non-participants went home for lunch or had some cash to buy lunch.

School meals form just a part of what a child ate in a day and therefore one meal in school may not influence the nutritional status of the participants. The findings of this study agree with those of a study carried out by Nelles [4] and in Lesotto and Majorie [8] to assess the effects of school feeding schemes which found out that there was no significant difference between children participating and not participating in a school feeding programme.

This was attributed to the fact that school meal may be a small portion of what a child eats in a day, and about a fourth of what a child eats in a week. Due to school holidays the meals present even a smaller portion of what is consumed in a year. The conclusion was that school feeding did not have an impact on pupils' nutritional status. Other studies contradict this and support the fact that school feeding programmes have an effect on nutritional status.

A study carried out in Tokyo in 1950 revealed that pupils in a school feeding programme had significant gain in weight and height compared to non-participants [8].

Consumption of different foods did not differ whether children were participating in a school programme or not. High consumption of some fruits and vegetable was possibly because they were in season and therefore cheap. Ugali was consumed often than any other carbo-

hydrate possibly because maize meal flour is cheap compared to other starches.

Proteins are generally expensive and this explains their low consumption. It did not matter what the child ate in school since the child would eventually take a variety of foods at the end of the week as shown by food consumption results. These findings also agree with those of a study by Nellel [4].

Boys, whether participating in a school feeding programme or not were at a greater risk of being severely stunted probably because boys tend to go to play far away from home, therefore missing some snack while girls remained in the kitchen with their mothers and ate while cooking and also during meal service. Girls were, however, at a higher risk of wasting possibly because they did not like the type of foods provided in school thus consuming less.

These findings agree with those of a study by Kimani [9] which found out that girls did not like the lunch provided in school and opted to be given money by parents to buy some snack.

The significant difference in school feeding and school attendance could be attributed to the fact that a child is sure of getting a meal at school and thus will not miss school. In school where food was provided by donors children would attend school and get a free lunch which would otherwise be bought in an urban area such as Nairobi where the study was carried out. In times of hunger, lunch may not be available at home and therefore a child will be assured of lunch if he/she attended school. These findings agree with those of a study by Ngome [5] in Kajjado District which found out that children will attend school because they are assured of a meal in school.

Overall morbidity did not differ among school feeding participants and non-participants possibly because the pupils come from one geographic area and are mixed up and the fact that the area is affected by the same factors causing disease. These findings also agree with those of a study carried out in Machakos by Mbithe [10] among coffee and non-coffee growers which found no difference in morbidity patterns among children from both types of households.

## Conclusion

From the findings of this study school feeding programmes do not appear to have an impact on nutritional status of children since the children reported to take at least two or three meals a day whether they participated in a school feeding programme or not.

The food consumption patterns of children participating and not participating in a school feeding programme did not significantly differ and this could also explain why there were no differences in nutritional status of children.

Disease patterns and occupation of the family's bread winner did not affect the number of children participating and not participating in a school feeding programme.

However, school feeding seemed to significantly affect school attendance, possibly because the children participating were assured of a meal in school and lessened work of going home to prepare for a meal themselves.

In this view therefore school feeding programmes would be recommended as they kept children in school.

## Acknowledgements

Concern Worldwide is acknowledged for provision of resources to undertake this research.

Also acknowledged are the field assistants for their commitment to data collection, the pupils and teachers of the study schools in the study area for their willingness to respond to research questions asked.

Also acknowledged is Kenyatta University staff of the Bureau of Educational Research (BER).

Mr. Franz Avisah is acknowledged for his contribution in data analysis and provision of moral support.

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# Opportunities and Challenges Posed by the Functional foods

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Indigenous Kenyan vegetables are widely consumed among Kenyan communities. They make an important nutritional contribution to the diet of these communities. In this context, they mainly supply vitamins and minerals. However, their nutritional value as a source of vitamins is limited by the fact that they have to be boiled for a relatively long time during preparation. This boiling reduces the content of heat sensitive vitamins. The mineral availability from these vegetables may also be constrained by the occurrence of mineral binding anti-nutritional factors such as phytates in these vegetables. These factors bind important dietary minerals, including iron and zinc.

The indigenous vegetables are also extensively used as functional foods in Kenya, with alleged health benefits that cannot directly be attributed to their nutrient content. Studies elsewhere have identified a number of functional factors in vegetables. There is probability that some of the functions may be due to antioxidants, as these have been found to be the source of functional properties in other vegetables. The relatively high fibre content in these vegetables may be another source of functional factors, such as active sterols and phytoestrogens. Some of the vegetables may even possess anti-microbial components, while others could contain immune boosting factors. Some of the vegetables have high catechin content. Catechins were previously regarded as anti-nutrients, but are now considered important functional factors. Elsewhere, technology has been developed to incorporate the functional factors into other popular processed foods. There is therefore the potential that even in Kenya, functional factors in the vegetables could be extracted and incorporated in other processed foods. There is therefore need to identify the functional factors through which these vegetables confer their alleged functional benefits, and develop a strategy of expanding the use of these vegetables as functional foods. As is the case in some other countries, these vegetables could turn out to be more important as functional foods, rather than as nutrient sources.

**Key words:** Functional foods, opportunities, challenges, phytochemicals

## Introduction

There is no universally accepted definition of the term functional foods. Several definitions have been suggested by different organizations. The definition given by the International Food Information Council and the International Life Sciences Institute (ILSI) is that they are foods that provide health benefits beyond basic nutrients<sup>1</sup>. They are also defined as foods that exert health properties beyond the traditional nutrients that they contain<sup>2</sup> by the Food and Drug Administration (FDA).

The different definitions all lay emphasis on the reduction of disease risk through availability of health promoting properties of the food beyond the traditional nutrients in functional foods. This is in contrast

with the traditional emphasis on role of nutrients in treating disease symptoms. The definitions also distinguish functional foods from medicines, which have to demonstrate a dose response relationship in combating disease causing agents such as microbial pathogens or chemical and physical agents<sup>3</sup>.

In plant foods, functional foods can be placed into two broad categories<sup>4</sup>.

Phytochemicals or Nutraceuticals – these are foods that contain biologically active, non-nutrient compounds that provide health benefits.

Designer foods – These are food products specifically formulated to have higher amounts of phytochemicals or nutrients than would naturally occur.

Phytochemicals only occur in plant foods. Many vegetables and fruits are natural sources of phytochemicals. Though not necessary for the maintenance of life in the same way as nutrients, these phytochemicals help promote optimal health by lowering risk for the occurrence of chronic diseases such as cancer and coronary heart diseases (CHD). They are believed to have many other health benefits.

## Phytochemicals - examples

Though there are many phytochemicals, mechanisms of action of only a few of them are understood. These include the following:

Allyl sulphides: These decrease cancer risk by stimulating activity of enzymes that help eliminate toxic compounds<sup>5</sup>. They are found in onions, leeks.

Isothiocyanates: These decrease cancer risk by increasing activity of enzymes that help to detoxify carcinogens<sup>6</sup>. They naturally occur among vegetables of the Cruciferous family such as cabbage and broccoli.

Indoles: These are phytoestrogens – phytochemicals that interfere with oestrogen metabolism<sup>6</sup>. They help reduce oestrogen related cancers such as breast cancer. They also occur in the Cruciferous family.

Lignans – these also act as phytoestrogens, therefore reducing cancer risk<sup>6</sup>.

Flavonoids: These include hundreds of different plant pigments, such as flavonones and anthocyanins. Most are excellent antioxidants, and reduce negative oxidative reactions, lowering cancer risk<sup>7</sup>.

Polyphenols/catechins: These act as anti-oxidants and reduce risk of coronary heart disease. They are naturally found in tea<sup>4</sup>.

Carotenoids: This group also includes a wide group of pigments. Among the important members of the group is  $\beta$ -carotene, the precursor of vitamin A.  $\beta$ -carotene is also a phytochemical linked to reduced risk of lung cancer. It occurs in carrots and many green leafy vegetables. Lycopene, the pigment which naturally occurs in tomatoes, is another important phytochemical within this group. It is linked to reduced risk for prostate cancer. Lutein is another carotenoid which is a phytochemical. It is linked to reduced risk for cancer. It naturally occurs in green leafy vegetables.

## Opportunities for application of functional foods in Kenya

Traditionally, many communities in Kenya and the rest of East Africa used some foods benefits other than as nutrient sources. Indigenous vegetables were particularly favoured for this role, as they were widely applied allegedly to enhance health. For instance, among the coastal people of Kilifi, in Kenya *Launaea, cornuta*, an indigenous vegetable is reported to prevent and cure malaria while *Cucurbita maxima* is said to keep diseases away<sup>8</sup>. The same workers reported that among the Kisii, also in Kenya, *Basella alba* is said to cure skin diseases while *Solanum nigrum* is used for regaining appetite among the Tharaka people. There is therefore a tradition of the application of some indigenous foods as functional foods among the various Kenyan communities.

Indigenous vegetables are otherwise widely used as food in Kenya. They constitute part of the staple diet of many Kenyan communities. Over 250 traditional leafy vegetables are used in the country<sup>8</sup>. Some of the species are cultivated while many are still growing wild.

Analysis of the fresh leaves has revealed that these vegetables are a good source of micronutrients – vitamins and minerals. They specifically contain relatively high amounts of beta-carotene, the precursor of vitamin A, and vitamin C<sup>10</sup>. They also contain modest levels of minerals, such as iron and calcium. On the other hand, they generally contain low levels of macro-nutrients – proteins and lipids. One reason for this is their high content of water, 80 – 90%<sup>9</sup>. Chweya<sup>10</sup> reported a protein level ranging from 0.8 to 5.5 g/100 g fresh leaves of nine species of traditional leafy vegetables commonly eaten in Kenya. The fat content is generally below 0.5%<sup>9</sup>. The vegetables are also low in energy (calories), since they contain very low levels of starch and sugars. Most of their carbohydrates are in the form of dietary fibre, which is not easily metabolized into energy in man<sup>11</sup>.

In terms of provision of nutrients, the indigenous vegetables are therefore important mainly as a source of some vitamins and minerals. It is noted, however, that most of the data available about the content of these nutrients is in the fresh leaves. The actual amount of nutrients available to the human body may be much lower after preparation and cooking of these vegetables. Most of these vegetables have to be cooked for a relatively long period of time before they are consumed. Makokha and Kebenei<sup>12</sup> reported a loss of between 57% and 78% of vitamin C after 30 minutes of cooking. There can be a maximum cooking loss of up to 100% in the case of vitamin C and folic acid<sup>13</sup>. These vegetables are rarely used in salad form, which would conserve such vitamins. For the case of vitamin A, there is a low conversion factor of beta-carotene to retinol equivalent, the form in which vitamin A is utilized in man. This conversion ratio from beta-carotene to retinal equivalent is about 12:1<sup>14</sup>. Additionally fat is required in the diet to enhance absorption and bio-availability of the beta-carotene.

In the case of minerals, plant foods including vegetables generally contain relatively high amounts of compounds which bind them, such as phytates and tannins<sup>15,16</sup>. The bio-availability of mineral nutrients such as iron and zinc from indigenous vegetables may therefore generally be low, even when absolute mineral content is high. The bio-available nutrient is the proportion of that nutrient in a food or diet that is available for intestinal absorption in a form that is physiologically useful to the body<sup>17</sup>. In the case of iron, the available iron from plant foods may be less than 10% of the iron content in the food<sup>18</sup>.

The significance of indigenous vegetables as a source of nutrients (vitamins and minerals) is therefore limited by some of the factors mentioned above. For successful commercial exploitation of these vegetables, alternative uses of these vegetables have therefore to be

explored. Expanded application as functional foods increase the exploitation of such foods on a commercial scale.

## Global Perspective of Functional Foods

In Asia, particularly in countries such as China and Japan, functional foods have been part of their people's culture for centuries<sup>19</sup>. Foods with medicinal effect were documented in China as far back as 1000 BC. To date the Chinese regard food not only as a source of nutrients, but it is also understood to have both preventive and therapeutic effects. A lot of research has been done to validate the health benefits of various foods.

In comparison in Europe and the USA, generally there appears to have been comparatively limited tradition of using functional foods. However, in recent years the use and sale of these foods has increased so rapidly that it may be regarded a revolution. The functional food sector represents a very fast growing segment of the food industry in the USA and in many countries of western Europe<sup>20</sup>. Many companies – food, drug and chemical companies are racing to bring functional foods to the market. For instance, in the USA, the functional food trade and market was almost non-existent in 1990. It is now estimated to be a \$10 billion per year industry, with a growth rate of 8 – 10%.

## Challenges

Though there is a long tradition of using indigenous vegetables for disease prevention or therapeutic purposes among various Kenyan communities, most of the allegations about the health benefits of these vegetables have not been scientifically proved. There has been very little research done to identify and quantify the phytochemicals in the various indigenous vegetables. Equally lacking is the information on the identification of the mechanisms of physiological action of the phytochemicals in these vegetables.

In recent years, there have been a rapid expansion of knowledge of phytochemicals worldwide. Methodologies for identifying and quantifying the phytochemicals have been developed or improved. The challenge is to apply this knowledge in the identification and quantification of the phytochemicals in the various indigenous vegetables and other foods.

Safety is an important issue of concern in the use of phytochemicals. However, unlike food additives or drugs, most of the ingredients in some functional foods, such as vegetables, do not have to undergo tests to see if they cause disease. This is generally due to the fact that many of the vegetables or foods in which these phytochemicals occur have been used as food for a long time. However, for commercial production and marketing of these foods or their extracts as functional foods, it is important to design studies which may be used to determine their toxicity, if any. Such toxicity could arise from the presence of other naturally occurring components in the functional food, other than the phytochemicals<sup>23</sup>. For instance, the vegetables in the cruciferous family are rich in phytochemicals, but also contain goitrogens. The latter inhibit the metabolic activity of iodine in the synthesis of thyroid hormones<sup>16</sup>. Apart from the possibility of long term risks such as cancer or liver toxicity, there is also the concern that some of the functional foods may cause allergy to some people.

In the USA, the Food and Drug Administration (FDA) has to approve a 'health claim' label for commercial functional foods. Products that carry such a claim have been convincingly demonstrated to be beneficial for their intended purposes<sup>3</sup>.

Related with the issue of safety is that of safe levels of intake. This may not be an important issue to address in the case where the phy-

tochemicals are ingested in the form of food, such as the indigenous vegetables. However, it is specifically an important issue in the case of extracted or concentrated phytochemicals. Levels which offer optimal beneficial activity have to be established for the different phytochemicals.

In the application of functional foods, it should be remembered that much as they may be useful, they are only one aspect of diet, and diet is only one aspect of a comprehensive life style that ensures good health. Other important aspects such as regular exercise, tobacco avoidance, maintenance of a healthy body weight and stress reduction have also to be practiced in pursuit of good health.

## Conclusion

In conclusion, functional foods (phytochemicals) have recently gained prominence as they confer alleged health aspects, other than the provision of nutrients. The indigenous Kenyan vegetables have traditionally been used as functional foods by various communities. There is great potential to increase the commercial utilization of the indigenous vegetables as functional foods, as has been done in Asia, USA and Europe. However, research work is required to identify and quantify the phytochemicals in these vegetables, and establish their mechanism of the physiological activity in the human body. There is also the necessity to establish safety aspects of the functional foods.

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# Functional Foods – Relevance to Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Nutrition is coming to the fore as a major modifiable determinant of chronic diseases, with scientific evidence increasingly supporting the view that alterations in diet have strong effects both positive and negative, on health throughout life. Most importantly, dietary adjustments may not only influence present health, but may determine whether or not an individual will develop such diseases as cancer, cardiovascular disease and diabetes much later in life. However, these concepts have not led to change in policies or in practice. In response, the food industry has introduced a class of foods referred to as functional foods. These are foods containing not only nutritional value but also function either to maintain health (e.g., vitamins or minerals) or act as a therapeutic agent (e.g., soluble fibre in non insulin-dependant diabetes). A food can be regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved stage of health and well-being and/or reduction of risk of disease. A functional food must remain food and it must demonstrate its effects in amounts that can normally be expected to be consumed in the diet: it is not a pill or a capsule, but part of the normal food pattern.

The current work was a review of the contemporary available data/information on functional foods. Their relevance to a developing country such as Kenya was assessed with a view to formulating research areas in this field on Kenyan based foods and food culture. It is hoped that such an exercise will enable the country use foods for better health and well-being of its population.

Key words: Functional Foods, Nutrition, Chronic Diseases.

## Introduction

The current work was a review of the contemporary available data/information on functional foods. For example, five categories of foods can be classified as functional foods. These are dietary fibres, vitamins and minerals, bioactive compounds especially phytochemicals, fatty acids, and probiotics and prebiotics. Their relevance to a developing country such as Kenya was assessed with a view to formulating research areas in this field on Kenyan based foods and food culture. It is hoped that such an exercise will enable the country use foods for better health and well being of its population. This work is expected to act as a log-frame for teaching, research and development of functional foods based on currently available “foods and food cultural practices” in Kenya – thus, a greater use of “traditional” nutritious foods and dishes. The traditional foods and dishes will need to be readily available and acceptable to the target populations.

The following areas will be important during the process of integrating “foods and food cultures” of Kenya into the countrys’ food systems.

Use of readily available sources of non-digestible fibre for example, cooking bananas.

Use of traditional fermentation processes both of cereals/tubers (e.g., millet, maize, sorghum and cassava) and milk (e.g., camel and cow milk) products in probiotics.

Use of legumes as low glycemic foods for diabetes and obesity control.

Use of local fruits and vegetables as sources for various vital micronutrients.

It is hoped that the information highlighted here will help improve the health especially of the mother and child, and increase food economic activity in Kenya. Hence, a reduction of the high level of poverty being experienced by large populations in Kenya is anticipated. Using readily available foods and food cultural practices in Kenya to improve health will improve the social-economic status as follows:

Reduced number of children and mothers seeking treatment in health facilities. The time and money saved will be utilized in other economic activities. It is important to note that women perform more than 60% of the labour in Kenya.

More children will spend quality time in school with better performance due to improved health.

Some of the unique foods available in Kenya may finally be commercialized for internal and external trade.

The general health of the Kenyan population will be improved, reducing government expenditure on disease management

## Definitions

A food can be regarded as functional if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way, which is relevant to either the state of well-being and health or the reduction of the risk of disease [1]. Health claims are expected to be authorized for functional foods based either on enhanced function (type A claim) or disease risk reduction (type B claim). Functional foods are thus, different from “Nutraceuticals”. Nutraceuticals are compounds rather than food or food ingredients, and may compete with pharmaceutical products [2]. “Functional Foods” presents items ingested as snacks, with meals, or as drinks. The definition of a functional food is not limited to commercial food products; it applies to those, which have been used to overcome micronutrient deficiency problems globally. Food fortification is considered to be one of the most successful examples of functional foods, in terms of product development and goal achievement [2]. A food can be made functional by increasing the concentration, adding or improving the bioavailability of a particular component [3]



## General Issues

Functional foods are a reality today and are likely to be so in the future. The key drivers behind functional food research and development are the food industry, consumers and governments. The global potential for functional foods is significant and glowing because of increasing health consciousness and self-care trends associated with ageing, knowledgeable and wealthier consumers. Today's consumer expects food to be convenient, safe, healthy, and above all tasty. Functional foods are expected to provide a credible health benefit beyond basic attributes to ensure daily and future health. Health claims are expected to be authorized for functional foods based either on enhanced function (type A claim) or disease risk reduction (type B claim) [4]. The development of functional foods is a unique opportunity to contribute to the improvement of the quality of the food offered to consumer's choice for the benefit of his well-being and health [5]. The functional food science will create many opportunities, but its ultimate success and impact on public will depend on the consumer's appreciation of products based on objective criteria like taste and convenience and subjective criteria like trust and credibility. Functional foods provide an unprecedented opportunity to expand the use of food to improve health, decrease risk of disease, and increase productivity. The functional food science aims to improve dietary guidelines by integrating new knowledge on the interactions between food components and body function and/or pathological processes.

## Marketing issues

For the future, an approach that integrates insights into consumer needs and demands (market pull) and a structured scientific research process (scientific push) will give the largest chance for real innovations. The scientific research process into functional foods will be powered by technology and insights available from other disciplines such as informatics, pharmacology, engineering, proteomics and genomics. The combination of "market pull" and "science push" in functional foods research will result in a research funnel starting from consumer needs and narrowing down to the final functional foods products by following stepwise approach [6]. Three main market sectors will be leading the growth in functional foods. These will be:

Products making claims backed by extensive scientific research for which endorsement is key especially in the area of health and weight management

Products targeting enhancement of physical and mental performance, with sports and energy drinks becoming even more popular

Products such as probiotics and antioxidants with less extensive scientific research on specific product claims.

Three success factors that seem to be paramount are: taste, convenience, and trust. Consumers except a small minority will not be willing to sacrifice taste for health [4]. While functional food science is motivated, to some extent, by its potential for public health benefits, the prevalence of diet-related disease and illness, together with other health-related problems, is skewed towards people in lower socio-economic groups [2]

## Health issues

Scientific discoveries and wide spread interest in the potential health benefits of foods and food components have fostered a variety of health and structure-function claims such as on obesity and diabetes, and gastrointestinal physiology and functions, and immune sys-

tem modulation. Functional foods have proven to be valuable contributors to the improvement of health and the prevention of health and the prevention of diseases in pediatric populations [7]. Obesity arises from an energy imbalance whereby energy intake exceeds energy expenditure. Thus, management requires modification of one or both components of energy balance. This could involve foods products that help management of 'hunger' or increase 'satiety'. One promising avenue to reduce energy intake through increased satiety is use of functional foods. The goal is to provide foods that increase the sense of fullness and encourage the individual to stop eating sooner, thereby reducing energy intake. The main determinant of energy density is the non-caloric content of food; primarily water [8]. Foods with high water content have a low energy density. Fibre also reduces energy density since it contributes substantially more food weight than caloric content. High protein diets are now popular for weight loss and are based, in part, on the idea that high-protein diets promote satiety. High fibre diets may trigger maximal sensory stimulation in the mouth due to increased need for chewing. High-fibre diets also lead to slower gastric emptying and slower rate of nutrient absorption. A high-fibre content reduces the energy density of the overall diet.

## Future of functional foods

An emerging discipline that will have a profound effect on the future of functional food research and efforts is nutrigenomics, which investigates the interaction between diet and development of diseases based on an individual's genetic profile [9]. In February 2001, the complete sequence of the human genome was announced. This technological break-through could eventually make it feasible to tailor a diet for an individual's specific genetic profile [9]. Nutrigenomics will have a profound effect on the future disease prevention efforts including the future of functional foods industry. Another technology that will greatly influence the future of functional foods is biotechnology. Examples of biotechnology-derived crops, which have tremendous potential to improve health of millions world wide, include the golden rice and iron-enriched rice. These grains are genetically engineered to provide enhanced levels of iron and beta-carotene, which could, in turn, help prevent iron deficiency anemia and vitamin A deficiency-related blindness worldwide. In the future, other foods enhanced with nutritive or non-nutritive substances may help to prevent chronic diseases such as heart disease, osteoporosis or cancer. However, consumers must realize functional foods are not a "magic bullet" or a panacea for poor health habits. Diet is only one aspect of a comprehensive lifestyle approach to good health, which should include regular exercise, tobacco avoidance, stress reduction, maintenance of healthy body weight and other positive health practices. Only when all these issues are addressed can functional foods become part of an effective strategy to maximize health and reduce disease risk.

## Relevance to Kenya

The only rational approach to all types of disease is prevention, and most of all the protection and creation of healthy environments, at household, community, municipal, state, national and global levels. This approach must include the protection, development and creation of food systems that are appropriate, sustainable and dynamic, designed to preserve, strengthen and improve the human and also the living and natural world [10]. Thus, food can play an important role at least in reducing the risk, if not totally preventing disease especially chronic diseases. The chronic diseases are non-communicable diseases, either debilitating, disabling, or deadly. They affect all systems

of the body. They include oral disease including dental caries, gut disorders and disease, obesity, diabetes, cardiovascular diseases (including high blood pressure, stroke and coronary heart disease), osteoporosis, and cancer. Different chronic diseases have common causes. Chronic diseases are now major causes of premature disability and death in most countries in the world. The chief causes of diseases are:

- Use of tobacco
- Grossly imbalanced food and nutrition
- Physical inactivity

The global burden of disease (GBD) study estimates that by the year 2020, non-communicable disease deaths (NCDs) in the developing regions will be four times higher than communicable disease deaths [11]. Thus, on a global scale, NCDs are set to become the major health problems. Three main forces will drive the emergence of NCDs as major health problems in sub Saharan Africa as a whole over the next 30 years. These are:

- Increasing elderly populations as infant death rate and fertility fall.
- Increasing urbanization and associated changes in lifestyles.

The promotion of tobacco and “Western” diets by multinational corporations.

In view of this, Kenya needs to develop strategies to reduce the negative effect of NCDs. One strategy will be incorporation of a policy on Functional Foods in the food systems as a means of reducing the risk of chronic diseases.

## Acknowledgements

This work was funded by the German Academic Exchange Service (DAAD) through a study visit grant at University of Giessen, Giessen, Germany

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# Scientific Substantiation of Health Claims on Foods – European Situation

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

There are 2 categories of claims on foods and food components: nutrition claims and health claims. Health claims are associated with functional foods, which can be defined as “foods and beverages with claimed health benefits based on scientific evidence”. Current developments in Europe concern the EU-project PASSCLAIM (Process for the Assessment of Scientific Support for Claims on Foods) and a draft Regulation for nutrition and health claims on foods. Passclaim is about developing criteria for the scientific substantiation of claims on foods; the final set of criteria will be published in 2005. The formal Regulation is expected to be implemented in 2006.

## Foods and Health

In 2004, the World Health Organisation has published their Global Strategy on Diet, Physical Activity and Health [<http://www.who.int/diet-physicalactivity/strategy/eb11344/en/>]. This strategy was endorsed by the World Health Assembly in May 2004. This issue has motivated the food sector to steer towards strategies compatible with public health needs. Also recently, consumers’ interest in healthy eating extended from avoiding negatives (e.g. calories, fat, sodium) towards seeking positives (i.e. beneficial foods and food components). Thus, nutrition is at the forefront of the fight against non-communicable diseases, such as obesity, diabetes, cardiovascular disease, and some forms of cancer.

Functional foods are defined as “foods and beverages with claimed health benefits based on scientific evidence”. The concept of Functional Foods is introducing a new era in nutrition [1]; [2]. It focuses on foods and beverages that deliver substantiated health benefits beyond their normal nutritional value. The key example in the area of functional foods is spreads containing phytosterols that are safe to use and have been proven to lower blood cholesterol levels [3]

In addition, nutrition can significantly improve health status in developing countries where under-nutrition and malnutrition are still prominent. A key example in undernourished/malnourished societies is salt fortified with iodine that combats iodine deficiency disorders; the success of this food is linked with a dedicated business model [3].

## Claims on foods

For a functional food to be identified to the consumer/purchaser a claim is indispensable. A claim means any representation that states, suggests or implies that a food has particular characteristics relating to its origin, nutritional properties, function, nature, production, processing, composition or any other quality [<http://www.codexalimentarius.net/reports.asp>]. There are 2 categories for claims on foods: “nutrition claims” and “health claims”, while “medical claims” and “misleading claims” are universally prohibited for foods. [4]

## Nutrition claims

A nutrition claim means any representation that states, suggests or implies that a food has particular nutritional properties. Nutrition claims relate to what a food product contains; these include the following:

Content claims: indicate what the food product contains.

Comparative claims: compare the nutrient levels and/or energy value of two or more foods (examples: “reduced”, “less than”, “fewer”, “increased”, “more than”).

Claims referring to dietary guidelines: such qualitative claims are focussing on special foods like “vegetarian”, “halal”, “kosher”, or referring to e.g. diets high in fruits and vegetables, or linked to the Mediterranean diet.

## Health claims

A health claim means any representation that states, suggests or implies that a relationship exists between a food or a constituent of that food and health. Health claims relate to what the food or food components of the products do; these include the following:

Nutrient Function Claims: are generally based on well-established and generally accepted scientific knowledge. They describe the role of a nutrient in its broadest understanding in growth, development and normal physiological functions of the body.

Enhanced Function Claims: refer to specific beneficial effects of foods and food components on physiological and psychological, cognitive functions or biological activities, but do not include nutrient function claims.

Reduction of Disease Risk Claims: refer to the fact that the consumption of a food may help to reduce the risk of a disease. The disease or disorder is named and the risk reduction is explicitly stated.

## Recent developments in Europe

The European Union is drafting a regulation for nutrition and health claims. The most recent version [[http://europa.eu.int/comm/food/fs/fl/fl07\\_en.pdf](http://europa.eu.int/comm/food/fs/fl/fl07_en.pdf)] has elements that are highly welcomed (harmonization, notification, prior authorization, requirement for scientific substantiation, meaningful communication). A final draft version is expected to be discussed in the European parliament in spring 2005, and the final Regulation may be in place as of 2006.

As concerns scientific requirements for health claims, the

International Life Sciences Institute Europe currently runs the EU-project "Process for the Assessment of Scientific Support for Claims on Foods" (PASSCLAIM). PASSCLAIM builds on the basis of the EU-project "Functional Food Science in Europe" (FUFOSE), in which it was identified that claims for "enhanced function" and "reduction of risk of disease" are only justifiable when they are based on appropriate studies. PASSCLAIM develops a set of criteria for the scientific substantiation of health claims on foods. The project runs from 2001 - 2005. All papers are published in the European Journal of Nutrition and can be downloaded from: [<http://europe.ilsa.org/passclaim/>]. The final consensus document will be published in spring 2005, and is the result of 4 years of intensive debate in Europe among hundreds of scientists, authorities, industry representatives and other stakeholders.

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# Application of The Food Multix (FMM) Concept As An Adjunct To Community Nutrition Support In Food Insecure Economies

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Food insecurity, chronic hunger, starvation and malnutrition continue to plague millions of people throughout the developing world especially Sub-Saharan Africa (SSA). Various initiatives made to boost economic development by African governments and International Agencies have all failed to provide the much-needed solution to these challenges, especially the most vulnerable members of poor communities.

The use of ad hoc measures as an adjunct to community based rural integrated projects have provided little success and will be unsustainable unless they are linked to harnessing available local resources. This paper therefore, focuses on exploring alternative ways of harnessing the scant agricultural resources by employing the Food Multimix Concept (FMM) as a scientific approach to food related problem-solving.

Established proximate and micronutrient analyses were carried out to determine nutrient levels in food multimixes developed and to meet the required nutritional needs of different target groups in a SSA community. The findings show that the FMM concept can provide at least 40% of the daily nutritional requirements of 100g per child serving or 300g per adult servings of culturally acceptable and easily affordable composite diets of poor and food-insecure communities.

FMM is an innovative track which makes better use of traditional food sources and offers a scientific contribution to meet community nutritional needs and the food insecurity challenges that confront most of the developing world in the twenty-first century.

## Keywords:

Food Multimix Concept (FMM); food insecurity; malnutrition; nutrient enrichment; economic development; Sub-Saharan Africa (SSA).

## Introduction

Poverty, food insecurity and chronic hunger continue to account significantly for growth failure (Marasmus), oedematous malnutrition (Kwashiorkor) and other causes of morbidity and mortality in developing countries, particularly in sub-Saharan Africa (SSA). Despite its rich human and natural resource base, SSA is ridden with economic instability, under-utilization of agricultural resources, poor education, limited access to good nutrition and affordable good quality health care [1,2]. Food security, defined as the situation in which all individuals and communities at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their energy and nutrient requirements for an active and healthy life, remains elusive for many millions of people in developing countries.

Implications of poor food intake for growth and development across the life cycle are enormous. Poor nutritional status adds extra pressures during the key stages of development such as in foetal growth, infantile growth spurt and in altered physiological states such

as pregnancy. In pregnancy, a recognition of these nutritional stresses [3,4] and their immediate and longer term impact has led to the hypothesis of "nutritional programming". The immediate, direct impact of nutrient deficiency on pregnancy outcomes is however very well established in relation to cretinism [5,6] and neural tube defects (NTDs) [7]. Furthermore, evidence is accumulating relating chronic maternal iron deficiency to low birth weight and other neonatal and infant morbidities [8]. Similarly, maternal vitamin A status has been shown to correlate with risk of vertical transmission of infections including the human Immuno-virus (HIV) infection [9,10,11]

The importance of good nutritional support in the clinical management of disease is also increasingly being recognised particularly in industrialized countries [12,13] where efforts are constantly being made to undertake clinical audits to support evidence-based medical practice and interventions. Nutritional status is a recognised prognostic index for diseases like HIV / AIDS whose prevalence is incidentally high in SSA. Sadly, there are currently neither coherent nor structured nutrition policy guidelines for supporting hospitalized patients in general and those suffering from HIV / AIDS in particular in most SSA countries.

The urgent need for appropriate nutritional support is quite clear. This paper demonstrates the processes through which these may be achieved to support short-term clinical needs and how these may further be applied to meeting nutritional needs of special (vulnerable) groups in food-insecure communities, as part of integrated food-related interventions aimed at promoting good health and supporting primary prevention strategies by employing the food multimix concept.

## The 'Food Multimix' (FMM) Concept

FMM is a novel scientific approach to the concept of food and dietary diversification employing scientific methods but traditional food processing technology; while targeting food products to the nutritional and / or clinical needs of target groups within a social and cultural context. This concept (FMM) is a blend of locally available, affordable, culturally appropriate, acceptable and commonly consumed foodstuffs mixed proportionately, drawing on the 'nutrient strengths' of each component of the mix in order to optimise the nutritive value of the end-product without the need for fortification.

## Objectives

The primary objective of this project was to design FMMs to meet nutrient requirements of specific target groups taking into account clinical need, metabolic considerations and factors influencing nutrient bioavailability.

A further objective was to establish the dietetic, clinical and field applications of FMM products within a cultural context through sensory evaluation and acceptability assessments. Finally, the project focused on developing cost-effective dietetic products to meet at least 40% of daily requirements per serving, drawing from energy and nutri-

ent strengths of individual components of local foodstuffs without the need for fortification.

## Study Design

### Materials and methods

Standard food composition tables and nutrition databases [14-18] were used to estimate nutrient content and 'nutrient strengths' of local food ingredients. The food ingredients were purchased in London, UK from a local African stall and were cereals, legumes, pulses / nuts and fruits imported from Ghana. This was followed by formulation of FMMs in relation to physiological and / or clinical needs of target groups for human weanlings aged 6-9 months, and children, 6-36 months at various stages of rehabilitation (half strength and full strength). Formulations were also developed for adults with HIV/AIDS and Wasting syndrome, pregnant women and Institutionalised individuals such as prisoners and patients in secure and psychiatric units.

Proximate analyses of macronutrients were conducted to determine the following: protein content by employing the Kjeldahl method with a modified Berthelot reaction [19,20]; lipid determination by employing Association of Official Agricultural Chemists (AOAC) acid hydrolysis standard Official method 922.06 [21,22]; dietary fibre determination by employing AOAC standard Official method 991.42). Total carbohydrate analysis was by derivation.

Minerals (Ca, Fe, Mg, and Zn) were analysed using atomic absorption spectrometry (AAS) and inductively coupled plasma mass spectrometry (ICP-MS). Vitamin content (B1, B2, B3, B12, Folate, A and C) was estimated from nutrient databases and subsequently correlated with experimental energy and nutrient values. Optimisation of FMMs followed initial experimental analyses in order to enrich their nutritive values for intended targets. FMMs were then processed into porridge, soup, biscuits, cakes and cookies. Sensory evaluation was conducted in Ghana, West Africa to ascertain acceptability of the various products.

### Subjects

One thousand (1000) subjects aged 11 – 16 years (school-age group) and 18 – 60 (adults group) males and females consented and were recruited to take part in the sensory evaluation of FMM products. Subjects were selected using a two-stage cluster sampling followed by stratified sampling procedure. School age children were recruited from a cluster of Junior Secondary Schools (JSS) in Accra and adult groups from the Korle-Bu teaching hospital in Accra and the Ministry of Education in Accra. Sensory evaluation tests took place between May and September 2003 following ethical approval from the Health Research Unit, Ghana Health Service. The volunteers were asked to indicate the degree of acceptability of products in terms of appearance, colour, smell, flavour and texture. Based on the assessment of these characteristics, an overall acceptability of the products consumed was ranked from 0 to 10 employing a Likert scale.

### Data analysis

Data collected were analysed using Excel version 5.0. Results are presented as means and standard error of means ( $\pm$  SEM) to ascertain the level of variation of nutrient content in FMMs formulated within each target group. Logistic regression analysis was used to predict the relationship between FMM edible product characteristics and their acceptability among the different age groups of consumers involved in

the sensory evaluation test from which the regression coefficient and odds ratios were calculated. Results of significance tests are reported at  $p \leq 0.05$ .

## Results

Energy densities (kcal/g) of optimised FMMs for human weanlings, half strength nutrition rehabilitation, and full strength nutrition rehabilitation were: 3.69( $\pm$ 0.123), 3.50( $\pm$ 0.044), and 3.94 ( $\pm$ 0.076) respectively. HIV/AIDS, Institutionalized individuals and pregnant women had energy densities of: 3.92( $\pm$ 0.034), 4.01( $\pm$ 0.06) and 4.01( $\pm$ 0.08) respectively. Percentage energy contribution from protein, carbohydrate and fat for each target group were in the ratio of 14:49:37 for weanlings, 12.1:58.2:29.8 for half strength nutrition rehabilitation patients, and 15.2:56.6:28.2 for full strength nutrition rehabilitation patients. This gave percentage contribution to daily energy requirements (estimated average requirements – EAR) per serving in each of the above target group categories as 46.7%, 36.4% and 40.9% respectively (Table 2.0). For HIV/AIDS patients, the percentage distribution was 24.6:45:30.3; 15.6:56.9:27.5 for Institutionalized adults and 19.8:47.4:32.8 for pregnant women. The percentage contribution to daily energy requirements (EAR) per serving in each of these target group categories were 52.3%; 53.6% and 56.3% respectively (Table 3.0). The pooled mean contribution of an average of 4 different minerals to daily requirements for all target groups is presented here as well as the relative index of nutritional quality (INQ) as follows: for human weanlings 54.7% of reference nutrient intakes (RNI) were met, with a pooled mean INQ of 1.17. Slightly lower contributions were met in the various stages of nutritional rehabilitation patients (Table 2.0). Similarly, % of RNIs and INQs for FMM products for, HIV/AIDS, Institutionalised individuals and pregnant women were 119.2% of RNI and 2.44 of INQ; 134.03% of RNI and 1.75 of INQ; and 143.5% of RNI and 2.99 of INQ respectively (Table 3.0).

Pooled means of vitamin content of an average of seven vitamins would provide at least 100% of the RNI and a mean INQ exceeding 2.0 for all target groups in this study (Tables 2.0 and 3.0).

## Discussion

The newly formulated FMMs compared favourably with existing commercially available (and fortified) food products including Weanimix and protein-enriched Koko® for children (Table 4.0). FMMs formulated to meet nutrient requirements of adults under different conditions also compared very well with FAO/WHO reported products (Table 3.0) [23]. Through the use of local, traditional, mostly plant-based food ingredients, it is demonstrated in this study how the nutritive values of individual components of the diet can be combined to effectively improve nutritional quality and possibly benefit vulnerable groups without necessarily fortifying the products or supplementation with synthetic products.

Most iron sources were non-haem from plant sources. Absorption of iron is negatively influenced by calcium, phytates and fibre found in cereals and legumes. The presence of copper (Cu) in FMM, however, would enhance the iron absorption and Cu also has antioxidant properties and influences  $\beta$ -cell function [24-26]. The daily inclusion of citrus fruits (and / or fruit juices where affordable) containing ascorbic acids would increase the non-haem absorption by a factor of at least two to three times [27,28].

FMMs did register good iron levels so that in spite of inhibitory factors, FMMs will still provide adequate amounts to meet daily iron requirements when consumed. Risk of iron overload has previously

been reported by other workers in relation to African diets [29,30] but the evidence for this is rather weak and inconsistent. Moreover, except for therapeutic feeding in the acute phase of protein energy malnutrition (PEM) and HIV where we have been deliberately careful to limit the iron content of the product, by and large, these products are targeted at populations who may require iron repletion and it is expected that the risk of iron overload if at all, would be minimal.

There is no doubt that dietary supplements and fortified foods have their place in clinical management but their overall efficacy, costs and the ability of poor communities to sustain fortification and supplementation programmes remains highly debatable. Identification of suitable vehicles for fortification remains a challenge and the assurance that local consumers would use such vehicles is not fully evaluated. There are advantages in utilizing commonly accessible, affordable, identifiable food sources and processing methods which are familiar and culturally appropriate to poor communities. There is also evidence that natural food sources of nutrients are better absorbed than expensive synthetic supplements [31,32]

These results demonstrate that it is possible in one composite mix, to provide a food product to meet minimum nutrient requirement by employing this food-based approach even in poor communities. The findings support the hypothesis that energy and micronutrient needs of individuals and population groups in poor communities can be met through scientific approaches to dietary manipulation employing traditional food ingredients without the need for fortification. This view is much more cost-effective than the single nutrient approach (Table 1.0).

The study demonstrates that the effective combination of local staples, vegetables and fruits using hurdle technology and food processing techniques can yield nutritionally balanced products to meet nutrient needs of vulnerable groups in developing countries and thus have important clinical and dietetic implications.

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**Figure 1.0: Logistic regression of product characteristics and their acceptability rating among tasters**

(1000 subjects aged 11 – 63 years)

		<i>11 – 16 years school children</i>			<i>18 – 63 years adults</i>				
<b>Product characteristic</b>	<b>Options</b>	<b>Regression coefficient</b>	<b>p-value</b>	<b>Odds ratio</b>	<b>Regression coefficient</b>	<b>p-value</b>	<b>Odds ratio</b>	<b>Options</b>	
<b>Appearance</b>	Acceptable appearance	1.675	0.001*	5.339					
	Very acceptable appearance	1.705	0.000*	5.499					
<b>Smell</b>	Acceptable p. smell	1.171	0.043	3.226	2.738	0.009**	2.359	Acceptable fishy smell	
	Unacceptable fishy smell	-1.498	0.043	0.224	1.271	0.023	15.457	Very Acceptable fishy smell	
<b>Texture</b>	Unacceptable hard texture	-1.403	0.029	0.246	1.422	0.035	4.146	Unacceptable hard texture	
<b>Taste</b>	Unacceptable bitter taste	-0.410	0.020	0.663	-0.561	0.003**	0.570	Unacceptable sour taste	
<b>Palatability</b>	Acceptable palatability	0.363	0.000*	1.438	0.700	0.000*	2.014	Acceptable palatability	
	Constant	-0.808	0.646	0.446	-3.946	0.077	0.019	Constant	

**Table 1.0: Table showing what a typical FMM consist of and its cost**

<b>Food item</b>	<b>Weight (g)</b>	<b>*Cost (Cedis) [1\$= 8920 cedis]<sup>ø</sup></b>
<i>Maize</i>	40	88 (@ 2200 cedis / kg)
<i>Black eyed beans</i>	15	60 (@ 4000 cedis / kg)
<i>Peanuts</i>	20	132 (@ 6600 cedis / kg)
<i>Kidney beans</i>	25	100 (@ 4000 cedis / kg)
<b>TOTAL</b>	<b>100</b>	<b>380 (@ 3800 cedis / kg)</b>

æPrices of items obtained from Ghana at current local market sources, April 2004. øDollar Exchange Rate as at 02/02/2005

**Table 2.0: Key Nutrient findings in FMMs for 100g per child servings compared with Ghanaian products**

	Weanmix	Koko <sup>o</sup>	Weanlings	Nutr. Rehab <sup>o</sup>	Nutr. Rehab <sup>o</sup>
<b>Proximate</b>					
Energy Density (kcal/g product)	3.69±0.123		3.50±0.044	3.94±0.076	435
<i>Energy Distribution (%)</i>					
Protein	25.84		13.6±0.39	15.2±0.54	13.79
CHO	66.02		49.5±0.75	56.6±0.29	62.62
Fat	8.14		36.8±0.61	28.2±0.58	23.6
EAR/serving (%)	45.2	46.7	36.4	40.9	
<b>Mean Mineral content-</b>					
RNI (%)	54.8	54.7	28.7	27.7	
INQ	1.21	2.15	1.17	0.79	0.68
<b>Vitamin content-</b>					
RNI (%)	49.1	96.3	51.1	109.7	
INQ	1.09	3.29	2.08	1.41	2.68

-Mean vitamin content from 7 vitamins estimated (B1, B2, B3, B12, Folate, A & C); Weanlings: 6 – 9 months; Nutrition Rehabilitation: 6 – 36 months

-Mean vitamin content from 4 minerals analysed (Ca, Fe, Zn & K) Nutr. Rehab<sup>o</sup> – Half-strength Nutr. Rehab<sup>o</sup> – Full strength; Weanmix: a cereal-legume blend & Koko<sup>o</sup>: (fermented maize dough, fortified with fish meal (Lartey, Manu, Brown, Pearson, and Dewey; 32)

**Table 3.0: Key Nutrient findings in FMMs for 300g per adult servings compared with WHO/FAO products**

	HIV/AIDS	Pregnancy	Institutionalised	WHO (A)	WHO (B)
<b>Proximate</b>					
Energy Density (kcal/g product)	3.92±0.034	4.01±0.06	4.01±0.08	3.33	3.33
<i>Energy Distribution (%)</i>					
Protein	24.6±0.23	19.8±1.12	15.6±1.3	13	13
CHO	45.1±0.44	47.4±1.25	56.9±1.3	59	59
Fat	30.3±0.55	32.8±0.81	27.5±0.09	28	28
EAR/serving (%)	52.3	56.3	53.6	44.5	44.5
<b>Mean Mineral content-</b>					
RNI (%)	119.2	143.5	134.03	46.79	51.61
INQ	2.44	2.99	1.75	1.05	1.16
<b>Vitamin content-</b>					
RNI (%)	121.79	260.37	196.58	118.8	127
INQ	2.33	4.63	3.67	2.06	2.86

-Mean vitamin content from 7 vitamins estimated (B1, B2, B3, B12, Folate, A & C); WHO composite mixes were based on 3 minerals (Ca, Fe & Zn) and 3 vitamins analysed (Fol, A & C) - Mean vitamin content from 4 minerals analysed (Ca, Fe, Mg & Zn); WHO(A): Rice-based composite mix; WHO(B): Potato-based composite mix (FAO/WHO, 23)

**Table 4.0: Limiting nutrients based on INQ calculated from two typical FMM compared with three commercial food composites**

<b>Foods Nutrient</b>	<b>FMM</b>	<b>Weanimix Koko®</b>	<b>Optimised Super5®</b>	<b>Super5®</b>
Protein <b>0.88</b>	1.64	1.64	3.17	1.4
Calcium <b>0.03</b>	<b>0.36</b>	0.14	1.23	0.12
Iron 2.17	3.498	2.60	4.6	2.22
Zinc <b>0.35</b>	0.904	0.96	1.55	0.85
Potassium <b>0.78</b>	1.102	0.94	0.79	1.83
Thiamine 2.55	2.44	3.3	2.48	3.33
Riboflavin <b>0.39</b>	0.637	0.01	0.4	1.04
Niacin 1.02	2.08	1.8	2.12	1.39
Vit. B12 <b>0</b>	0.2	0	15	0
Folate 1.42	2.6	1.85	0.87	5.6
β-Carotene <b>0.198</b>	2.7	0.14	0.19	6.16
Ascorbic Acid <b>0.15</b>	0.9	0.006	0	1.64
Limiting Nutrient <b>8</b>	<b>5</b>	7	5	3

Limiting Nutrient: INQs below 1.0 as highlighted above; Weanimix: a cereal-legume blend & Koko®:(fermented maize dough, fortified with fish meal (Lartey et al., 32)



# Potential of Yellow Oleander(*Thevetia peruviana* Schum), Orange and Yellow Flowering Varieties as Possible Sources of Edible Vegetable Oils and Proteins in Kenya.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Summary

The seeds of *Thevetia peruviana* contains 62% of triglyceride pale yellow oil, about 25% protein cake and 8% of biologically active principles (glycosides). The presence and toxicity of the steroidal (cardioactive) glycosides have hindered direct utilization of the seed oil and proteins for edible purposes in Kenya.

An evaluation of three conventional methods of vegetable oil extraction during this work has shown that solvent extraction using n-hexane extracts the seed oil free from the toxic glycosides. Mechanically (pressed) extracted seed oil when filtered by Whatman filter paper also produces oil free from the toxic cardio active glycosides. Extraction of the defatted seed Kernel with an alcoholic solvent has been used to remove completely the glycosides from the defatted seed kernel.

An analysis of the fatty acid composition showed that the oil contains myristic 8.83%, palmitic 21.96%, stearic 8.11%, oleic 52.10%, and linoleic 17.83% fatty acids. The physico-chemical characteristics of the oil were: saponification values (SV) 171.6, Iodine value (IV), 71.2, Acid value (A.V) 0.98, peroxide value (Pe.V) 20.6, refractive index at 25°C 1.4649 and density of 0.9108. These values meet the recommended international Codex for edible oils [1]. The crude protein content was analyzed by Okalebo et al [2] and was found to be 65.8%, which is quite high. It compares to 60% in sunflower and 70% in Soya beans. The species is locally available and can be used as an alternative source of edible oil and proteins to alleviate food shortage and poverty in Kenya. The oil and protein concentrate can be useful nutritionally to both man and livestock once feeding trials and further toxicological study is conducted on the two products.

## Key words;

*Thevetia peruviana*, seed oil, protein concentrate, glycosides, fatty acids,

## Introduction

*Thevetia peruviana* Schum. (= *Thevetia nerifolia* Juss) belongs to the family Apocynaceae. *T. peruviana* commonly known as Yellow Oleander is native of Latin America (Peru) and the West Indies, however it has had worldwide distribution through introduction and has naturalized in many tropical regions of the world in Africa, Asia and Europe. This species is economically important and adaptable to harsh agro-ecological conditions prevalent in parts of the tropics. It is drought tolerant, resistant to many plant pests / diseases and requires minimum attention during utilization. In Kenya orange and yellow flowering varieties have been found and forms the basis of this study.

## Literature Review

*Thevetia peruviana* (Yellow Oleander) is a potential oil seed (63% oil) and good alternative protein source (37%) for livestock feeds. The plant remains an ornamental plant because of the high level of toxins in the seeds. It is likely that the attention given to toxins has distracted interest from proper research of the oil and protein that would have promoted its industrial and domestic potential. Several feeding trials and thermal studies have shown that the oil has a very good replacement values for orthodox domestic vegetable oils [3,4,5]

*T. peruviana* grown as a hedge produces 400-800 fruit per annum depending on the rainfall and age of the plant. Pot experiments showed that the plant responds well to nitrogenous fertilizer, and its response to calcium and phosphorus follows the normal pattern for most plants [6].

Oil from *T. peruviana* can compete effectively with orthodox oils if its plantations are developed [5]. The oil is recommended as a suitable substitute for *Arachis hypogea* (peanuts) and *Prunus dulcis* (almond) oil [7]. Seasonal variation in the fatty acid composition of the oil has also been studied and reported [8].

Eighteen amino acids including essential and non-essential amino acids have been reported to be present in the leaves of *T. peruviana*. These include glutamic, leucine, glycine, isoleucine that were predominant over arginine, valine, alanine, proline, phenylalanine, aspartic acid, cystine, lysine, serine, tyrosine, histidine, threonine, methionine, and tryptophan. The sulphur containing cystine is present in significant quantities. The leaves could be used as sources of the amino acids in nutrition after removal of the toxic glycosides, [9].

The natural glycosides of *Thevetia* appears to be triosides and contain aglycone unit combined with three units of sugar. The aglycone of these glycosides is digitoxigenin, one of the aglycones of the glycosides of *Digitallis purpurea*. The sugars are D-glucose and L-thevetose with an enzyme responsible for their degradation designated as thevetinase. The following steroidal (cardiac) glycosides have been isolated from the defatted, fermented seed kernels of *T. peruviana*: Thevetin A, melting point 1900C-1920C, thevetin B melting point 190-1950C peruvoside melting point 1450C-1470C and nerifolin melting point 2030C-2070C. Of all the *Thevetia* glycosides peruvoside is of most cardiotoxic effect and had been recommended for therapeutic use in patients with cardiac insufficiency and cor pulmonale chronicum [10].

*Thevetia peruviana* seeds oil compares favorably with respect to yield, composition and properties to commonly used pharmaceutical oils. Purification to remove the toxic glycosides will afford a suitable substitute for unsaturated fixed oils [11].

## Materials and Methods

The seeds (mature) were collected from Bondo district from adult plants of yellow flowering variety growing there. The seeds were shelled manually, sun dried and packed in transparent polythene bags

to Jomo Kenyatta University of Agriculture and Technology (JKUAT) for extraction and analysis.

Three conventional oil extraction methods were evaluated. Solvent system using a hexane in a soxhlet apparatus, mechanical (cold pressing) using ram press (Approtech designs) and wet rendering by autoclaving at 1210C for 45 minutes in 0.25 % acetic solution. 252 g and 200 g of the shelled seeds were extracted with n-hexane using the solvent system 587 g and 300 g of the shelled seeds extracted by mechanical method and 100 g and 186 g of the shelled seeds were extracted by wet-rendering method.

Fatty acid composition analysis by gas chromatography (GC) was done by injecting about 1 microliter of derivatised (methyl esters of yellow oleander oil) into Shimadzu 9A GC equipped with flame ionization detector (FID) maintained at 2200C with a glass column (1m x 5mm) packed with diethylene glucosuccinate (DEGs) coated with Uniport B maintained at 1700C. Nitrogen was the carrier gas with a flow rate of 50 ml per minute. The methyl esters of standard fatty acids were injected at the same conditions and sample methyl esters identified by comparison of the peaks and retention times of the standards with the sample peaks. The methyl esters were derivatised and purified by weighing 10 ml of the oil sample into 250 ml conical flask, hydrolyzed by adding 2 ml of 1% hydrochloric acid in methanol refluxing for 1 hr in a fume hood. After cooling, 2 ml of n-hexane was added to extract the methyl esters thrice. The n-hexane layer was further purified by addition of brine and sodium hydrogen carbonate. Anhydrous sodium sulphate was added in excess to remove water molecules.

The dehydrated samples were further eluted with n-hexane through a glass column packed with silica gel to remove further other polar impurities.

Physical and chemical parameters were determined using standard analytical methods as outlined by [1,2]. Using these methods crude protein, saponification, iodine, acid, peroxide, density and refractive index values of the oil were determined respectively.

Tests for the presence of the glycosides was done by acid hydrolysis using 0.1M hydrochloric acid and developing (spotting, co spotting, eluting in acetate-pyridine-water at 5:1:4, and spraying with locating reagents containing 1 ml concentrated sulphuric acid, 20 ml acetic anhydride, and 50 ml of chloroform in fume chamber) the samples in commercial Thin Layer Chromatographic plates coated with silica gel.

Crude protein content was determined by Micro Kjeldahl standard method as outlined by [2]. In this method, 0.3 g of the defatted and deglycosidised seed kernel was digested, distilled and titrated with 0.2M hydrochloric acid.

The defatted seed kernels were deglycosidized by exhaustive extraction with ethanol and subsequent oven drying at 100 °C to remove traces of the ethanol.

## Results and Discussion

The oil yield for wet rendering, mechanical and solvent extraction methods are presented in Table 1.

**Table 1: Percentage oil yield from conventional extraction methods;**

Methods of oil extraction	Percentage (%) oil yield efficiency
Solvent	62
Mechanical	21
Wet rendering	20

Solvent extraction method gave the highest oil yield of 62%. The method also did separation of the oil from the glycosides since n-hexane is non-polar and did not dissolve the polar steroidal (toxic) glycosides.

Mechanical extraction was less efficient owing to high oil content versus low fiber content of the oil seeds. Much of the oil was retained in the cake. The ram press was found to be less efficient for extraction of the oil seeds due to the low fiber content of the seeds. Wet rendering process was the least efficient since the process required a lot of time, energy, and manual decantation.

Fatty acid analysis by GC showed the presence of the following fatty acids.

**Table 2: Fatty acid composition of the oil.**

Fatty acid composition	Percentage (%) composition of the oil
Myristic	8.83
Palmitic	21.96
Stearic	8.11
Oleic (18.1)	52.10
Liholeic	17.83

The oil is rich in the mono unsaturated oleic acid (18.1), which comprises 52.1%, and the essential amino acid linoleic (18.2), which constituted 17.8% of the fatty acids. The oil is suitable for nutritional purposes based on the essential (18:2) and mono unsaturated (18:1) fatty acids composition which are essential for dietary intake.

The physico-chemical parameters of the oil and the crude protein content of the defatted, and de glucosidated seed kernel were determined and the results are shown in Table 3.

The physico-chemical parameter falls within the range recommended by international codex for edible oils such as sunflower, sesame, peanuts and palm oil. The high saponification value makes it further suitable for soap making. The iodine value shows that the oil is highly constituted with unsaturated fatty acids, which is recommended for dietary purposes. The low acid value falls within the recommended standards however the high peroxide value shows that the oil is prone to oxidation and should be treated with an antioxidant to restore its shelf life. The crude protein content was very high second to Soya, which is 70 and has a high potential for provision of nutritional. Soya protein is commercially used as an ingredient to human food and livestock feeds.

Both acid hydrolysis and T.L.C. showed the absence of the glycosides in the n-hexane extracted seed oil as shown in the plate 2 below. This showed that n-hexane can be used for extraction of the glycoside free seed oil suitable for edible use and alcoholic solvents such as ethanol can be used to remove the glycosides from the defatted seed kernel hence making the safe for consumption.

### Conclusion and Recommendation

The elimination of the steroidal / cardiac glycosides by solvent

**Table 1 3: Physical and chemical parameters of the sees oil and crude protein value of T. peruviana**

Physical and chemical parameters of the sees oil and crude protein value of T. peruviana	
Saponitiation value (S.V)	171.6
Iodine value (I.V)	71.2
Acid value (A.V)	0.98
Peroxide value (Pe.V)	20.6
Refractive index at 25oC	1.4649
Density	0.9108
Crude protein content of the cake	65.8

system or by filtration of the mechanically extracted seed oil provides a potentially valuable source of vegetable oil which can be used for edible and other industrial purposes. The high crude protein of 65.8% also indicates the potential for utilization of the flour as an alternative protein sources for both man and livestock nutrition.

Feeding and further toxicological studies on the oil and the protein is recommended before commercial production is undertaken. The species is now recommended for domestication to increase the potential for oil and protein production in the country.

### Acknowledgement

This project was funded by Agricultural Research Fund (ARF) of Kenya Agricultural research Institute, KARI and The Jomo Kenyatta University of Agriculture and Technology, JKUAT. We are grateful to both institutions.

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# Community Capacity Support Programme(CCSP)

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

## Background of community capacity support programme

The Community Capacity Support Programme (CCSP) originated from Nutrition Rehabilitation Centres established by the Red Cross Society during the Emergency Period in the 1950s to assist destitute mothers and their children with food relief. In 1972, the Red Cross Society asked the Government of Kenya and UNICEF to finance the centres. In 1974, the Government of Kenya decided to take over five of the centres in central and western Kenya, following the recommendations of an evaluation done by the Institute of Development Studies, University of Nairobi. The centres were renamed Family Life Training Centres under the Family Life Training Programme of the then Ministry of Culture and Social Services. The programme expanded by establishing new centres and incorporating those run by voluntary agencies such as the Catholic Mission. The Danish Government came on board in the mid 1980s and started giving both financial and technical assistance. In the process, it helped to construct three more centres. By 1990, a total of 14 centres had been established in 13 districts.

Impact studies and evaluations of the programme between 1987 and 1991 revealed that the centres were having minimal impact in terms of reducing malnutrition in the communities they were serving. It was therefore recommended that the programme should adopt a more community oriented and preventive approach to the problem of malnutrition. Once again the Danish Government agreed to support this approach.

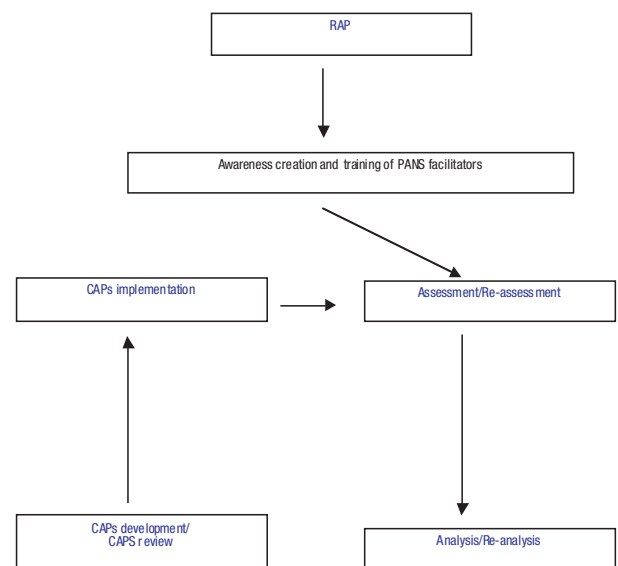
In 1995, the programme started the process of shifting its focus from residential rehabilitation to a community-based approach, which targets improved community nutrition by addressing a broad range of social development issues. The process involved piloting a community based nutrition project in Makueni District. A Participatory Approach to Nutrition Security (PANS) process was developed during this time in collaboration with the Applied Nutrition Programme (ANP) of the University of Nairobi. In developing the PANS process, the programme adopted some elements from the following methodologies:

- Participatory Rural Appraisal (PRA),
- Participatory Evaluation Process (PEP),
- Participatory Poverty Assessment (PPA),
- Participatory Learning and Action (PLA),
- Gender analysis,
- Survey methodologies.

Positive aspects of the different elements were then consolidated into the PANS process, which has been replicated with modifications in 13 programme districts.

Below is a full description of the PANS process in a step-wise manner.

Stages of the PANS process



### Step 1: RAP (Rapid Assessment Process at the District Level)

- The information is preferably collected from secondary sources but where un-available, primary data can be collected.
- The information includes:
  - Health and nutrition,
  - Income levels,
  - Basic education,
  - Food availability,
  - Social institution,
  - Other areas relevant to nutrition security.
- The information is used for awareness creation and area targeting.

## Step 2: Awareness Creation and Training of PANS

### Facilitators

The information from the rapid assessment process is used for awareness creation about the magnitude of poverty and malnutrition at the district, divisional, locational and at sub-locational levels. The awareness creation targets leaders at the district, divisional and at locational levels but at sub-locational level, it targets all community members. Identification of target areas is also discussed during all the awareness sessions. During the awareness sessions at the district and at the divisional levels, the District Facilitation teams (DFTs) and Divisional PANS teams (DPTs) respectively are formed. Subsequently the teams undergo training in the PANS process.

## Step 3: Assessment (Community Data Gathering)

Community members are facilitated by the DPTs with technical backstopping from DFTs to collect relevant information using various participatory tools i.e. for spatial data, time or social data. In the process of using the tools, the community members are facilitated to bring out important issues and problems within the village. The DPT and some community members compile a list of all problems and suggested solutions.

## Step 4: Analysis (Problem and Solution Analysis and Ranking)

The DPT helps the community members to get an in-depth understanding of the problems and possible solutions (cause-effect relation) using flow diagrams, problem analysis matrix, and focus group discussions. The community members then ranks the agreed list of problems and solutions.

## Step 5: CAP's (Community Action Plan) Development

During this stage, all relevant stakeholders and more community members are invited. Using the prioritized list of solutions as a basis, the community develops the plans.

At the end of this stage, the DPT ensures that there is a committee in place (the Village Development Committee - VDC) to oversee the CAP's implementation. The formation of specific project committees is guided by the emerging activities in the action plans.

## Step 6: CAP Implementation

The activities at this stage will include:

- Identification of community resource persons (CRPs) by the community.
- Baseline Household Survey.
- Training of CRPs in their relevant areas.
- Developing systems for monitoring and evaluation.
- After training, each CRP group or project committee prepares an activity plan.

- Actual implementation at community level starts:
- Co-ordination and supervision by VDC and DPT members
- Resource mobilization by VDC
- CAPs reviews and Annual General Meetings

General trends in CAPs development indicate that the common activities both at community and at household level include those under Household Food Security (Organic farming, establishment of demonstration farms, poultry keeping, kitchen gardening, vegetable preservation, drip irrigation and food processing), Health (Establishment of community growth monitoring centers, Bamako initiatives, Traditional birth attendants services, pit latrines, dish racks, leaky tins, boiling of water and milk before consumption, increased clinic attendance), Water and Sanitation (Construction of dams, protection of water springs, Roof catchments, wells) and Socio-economic (Energy saving Jikos, use of food warmers and table banking).

In an effort to supplement the community's' own mobilized resources in implementing some of the above mentioned activities within CAPs, the programme has set aside a small fund known as community initiative fund (C.I.F) of Ksh.330,000 per community.

## Organizational Development (OD) for VDCs

In order to strengthen the co-ordination and the supervisory roles of the VDCs, CBNP as a programme makes deliberate efforts to strengthen the organizational capacities of the VDCs. This involves the VDC capacity assessment process which is a systematic self-assessment process that is undertaken with the help of DPTs to determine how the VDCs compares to a "model" organization in terms of best practice of organizational development. Such assessments provide VDCs with opportunities to identify where they are weak and where support may be required to enhance effective organizational functioning.

The programme has developed a VDC Capacity assessment tool, which recognizes that certain core aspects of organizational functioning are common to all simple organizations. The tool therefore uses the following key questions covering core areas for the VDC assessment:

- How do we govern our VDC?
- How do we manage our VDC?
- How do we manage our human resources?
- How do we manage our projects?
- How do we manage our finances?
- How are our external relations?
- How sustainable are our activities and our VDC?

The self-assessment leads to action. This tool also provides an opportunity for a visioning exercise that facilitates the VDC's to define their own capacities and how far they wish to go in these capacities. The information derived from the VDC capacity assessment provides a basis for planned change and a means to enhance communication and planning between VDCs and their partners.

## Strengths/Good practices

The multi-sectoral approach: The ability of the programme to bring together officers from different ministries and agencies for the

purposes of implementing a wide range of activities aimed at addressing the underlying causes of nutrition insecurity.

**Empowerment:** Through the programme the communities have come to recognize their rightful position in development and started demanding services from the concerned service providers

**Capacity building:** The programme has made it a matter of policy to strengthen community institutions i.e. Village Development Committees (VDCs) and Project Committees (PCs) as well as the technical support from the service providers (mainly from the government departments) at the community level. Strengthening community institutions involve facilitating acquisition of knowledge and skills by community members to be able to plan and implement their own activities. At the service providers level, it involves supporting the advisory and follow-up activities.

The programme through the PANS process, especially the RAP process, has been able to target the most needy communities in the programme districts.

### **Challenges/Lessons learnt**

The programme has heavily depended upon the support of one donor (Danida) hence limiting its horizon in terms of expanding into new areas.

The multi-sectoral are working without any formal agreements between the Department of Social Services (DSS) and the other government departments. Cooperation of team members therefore depends entirely on the goodwill of the officers of the other departments. Hence the collaboration is not institutionalized and this sometimes affects implementation of activities especially when there are transfers.

The use of the district and divisional teams requires that they be trained in the PANS process. The total training including the practical application of the tools takes not less than three months. The implication are that substantial resources are required especially when one takes into account the re-training of the teams that is required due to transfers.

The government staff deployed at community level are insufficient. The community resource persons trained are volunteers who are not motivated hence affecting implementation of community activities.

The Community Initiative Fund (CIF) to communities is underutilized. Communities are not used to accounting for funds given to them and the 50% community contribution is high for some communities where the poverty levels are high.



# The Joy and Challenges of Capacity Building for Better Nutrition in Africa.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Purpose:** Is to conscientize the nutrition fraternity and relevant partners to recognize the need for tangible support in capacity building at institutions of higher learning for better nutrition in Africa.

**Objective:** To articulate the experience of capacity building in nutrition in Africa using the Applied Nutrition Programme of University of Nairobi as a case.

**Design:** Case study.

**Setting:** Applied Nutrition Programme, Department of Food Technology and Nutrition University of Nairobi, Kenya

**The Experiences:** In response to lack of critical mass of qualified nutrition professionals for effective mainstreaming of nutrition at community and national levels in Africa, the Applied Nutrition Programme of the University of Nairobi, since 1985, has been providing sound nutrition training at postgraduate degree level, to international students; mainly from Africa and with some from New Zealand, Sweden and Brazil. The Programme also conducts capacity building in form of short courses for Government Ministries, development partners and communities and will be launching a BSc degree programme in nutrition and dietetics this year (2005). The capacity building venture has helped integrate regional indigenous nutrition knowledge and local technologies with mainstream nutrition training, producing graduates who know both their subject and field. The Programme has expanded into nutrition in emergencies, interventions, dietetics, food as a human rights and nutrition policy, inline with its goal of contributing to regional development. Lack of consistent long-term funding is a major challenge. Others include the rigid nature of donor funding, increasing competition for students and delay, though in the phase-out, in timely completion of the degree programme.

**Conclusion:** There is adequate demand for training and the Programme has the potential to meet a substantial portion especially if provided with the necessary support. The Programme is flexible and vibrant in keeping with the dynamism that nutrition, health and development challenges require. There is a need to define and impart a critical portion of nutritional knowledge to all working in development in Africa.

**Recommendations:** The nutrition fraternity must define a package of critical nutrition knowledge for developmental communication, increase opportunities for training and lobby for responsive policy and partnership environment that supports all aspects of capacity building including technical, infrastructure, information communication technology, equipment and scholarships either in form of direct funding or through commissioned assignments.

## Introduction

The Applied Nutrition Programme (ANP) is a teaching, and development research oriented programme with the production of high quality multidisciplinary trained nutritionists through its degree programmes in Applied Human Nutrition and Dietetics as its core business. In addition, the programme has, since inception, been involved in research and development of prototype intervention designs. The history of ANP dates back to 1985 when the University of Nairobi, with the assistance of the Government of the Federal Republic of Germany, through the German Technical Assistance (GTZ) initiated a two-year training programme leading to a Master of Science (M.Sc.) degree in Applied Human Nutrition. The Programme principally targets Anglophone countries, but is open to qualified individuals from Francophone African countries with good background in English and other international students. Prior to 2001, ANP had been the only programme offering applied human nutrition at master's degree level in Africa [1].

The ANP is situated in the scenic Upper Kabete Campus of University of Nairobi in the College of Agriculture and Veterinary Sciences and is located approximately 15 km from Nairobi's city centre. It is a semi-autonomous unit within the Department of Food Technology and Nutrition in the Faculty of Agriculture.

The ANP was born out of the recommendations of a fact finding mission of six experts from the United Nations University (UNU), together with the Administrative Committee on Co-ordination, Sub-committee on Nutrition (ACC/SCN) in 1979, to four African countries (Ethiopia, Kenya, Sudan and Tanzania). The team recommended the establishment of a post-graduate (M.Sc.) training programme in nutrition at the Faculty of Agriculture, University of Nairobi. In response and on behalf of the University of Nairobi, the Dean of the Faculty of Agriculture applied and obtained funds in 1980 through the German Technical Assistance (GTZ) to establish a centre for research and training in foods and human nutrition. A needs assessment that was conducted in Kenya, Uganda and Zambia preceded the inception of the Programme.

The overlying aim of establishing the Programme was to assist in the improvement of nutrition training, nutrition policy and performance for sustained development through production of high quality multidisciplinary trained nutritionists. The main objective was therefore to provide participants with abilities to:

Assess nutritional problems within communities from a multidisciplinary point of view.

Suggest and work out realistic and feasible intervention measures addressing the identified priority problems.

Conceptualize, design and implement studies, analyze data and write up the results in form of research communication.

Vision and Mission of ANP are ingrained within that of the Faculty of Agriculture, hence its vision is: "To be a leading vibrant centre in sustaining agriculture, food, nutrition and environmental sciences and stewardship. Its mission: "To maintain leadership role in the pursuit of knowledge; specifically in applied human nutrition and dietetics,

through relevant and quality training, teaching and research for sustainable development” [2].

The purpose of this paper is to conscientize the nutrition fraternity and relevant partners to recognize and hence appreciate the need for tangible support in capacity building at institutions of higher learning for better nutrition in Africa. Its object is to articulate the experience of capacity building in nutrition in Africa using the Applied Nutrition Programme of University of Nairobi.

The paper was designed as a case study that utilised primary data by combining both qualitative and quantitative approaches that were made vivid through recounts of personal experiences by both the staff and the alumni of the programme (Box 1). The Applied Nutrition Programme, Department of Food Technology and Nutrition University of Nairobi, Kenya was the setting.

Between 1985 and 2000, the two-year programme structure offered first year of coursework based on didactic learning while the second year was dedicated to implementation of an original research project. This had two phases: the fieldwork on one hand and data processing/analysis, thesis write-up and its evaluation, on the other. The loopholes in this structure resulted in delayed completion of the programme where most of the students took more than the two scheduled years to complete.

### The Experience

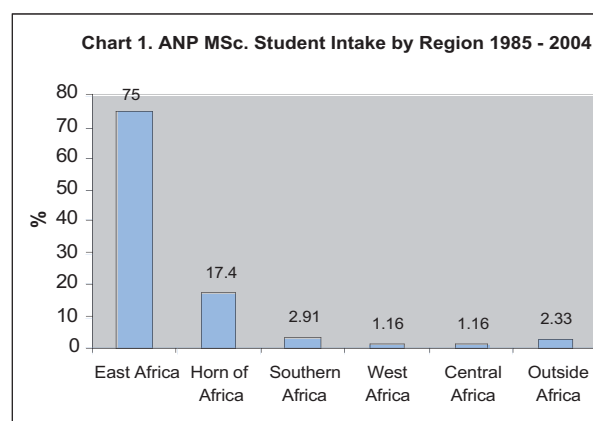
For over a decade, the ANP greatly benefited from substantial and smaller funding input from a number of development partners that included the governments of Germany, Holland, Canada and Denmark, the USAID and from organizations such as the United Nations University, Sight & Life and UNICEF. The funding went into both infrastructure and human capacity development and was pivotal in propping the programme while consolidating itself for sustainability. In the interface from too much dependency on donor funding, a number of development organizations; that included, GTZ, Catholic Relief Services, UNICEF and CARE played key roles in providing commissioned assignments that brought additional resources to ANP. Additionally, a number of organization led by GTZ, DAAD, German Foundation for International Development, the UNU provided scholarships that enabled the Programme to support a number of local as well as international students as reflected in Chart 1. The support from the University, the government and the development partners enabled ANP to sustain a sufficient number of students as it evolved into the sustainable entity that it is today. To date, however, UNU and DAAD remain valued scholarship sources for non-Kenyan students. Nevertheless, this does not mean that ANP does not have financial constraints, indeed funding is a major challenge.

Between 1985 and 2004, the ANP trained at the MSc. level over 160 persons, that include 111 Kenyans, 14 Ethiopians, 11 Somalians and, respectively nine Tanzanians and Ugandans among others (Table 1). It has overseen the implementation of 160 original student research projects whose findings have been shared through peer reviewed journal publications and dissemination at local and international conferences and workshops. The research projects, having been implemented in various countries in Africa bear a regional aura as reflected in Table 1 and Chart 1.

**Table 1: Number and Percentage of Students Admitted 1985-2005**

Year	85/86	87/88	89/90	91/92	93/94	95/96	97/98	99/01	02/03	03/04	04/05	Total	%
Kenya	9	7	7	9	8	9	10	23	10	10	9	111	67.3
Tanzania	1	1	2	1	1	2	1	-	-	-	-	9	5.5
Uganda	1	1	-	2	2	2	1	-	-	-	-	9	5.5
Sudan	-	-	1	2	2	-	-	-	-	-	-	5	3.0
Somalia	-	1	2	2	2	-	-	1	1	1	1	11	6.7
Malawi	-	-	-	1	-	-	-	1	-	-	-	2	1.2
Zambia	-	-	-	-	1	-	-	-	-	-	-	1	0.6
Zimbabwe	-	-	-	-	1	1	-	-	-	-	-	2	1.2
Ghana	-	-	-	1	-	-	-	-	-	-	1	2	1.2
Ethiopia	-	1	2	1	1	2	2	-	2	1	14	8.5	
Rwanda	-	-	-	-	1	-	-	-	-	-	-	1	0.6
DRC	-	-	-	-	-	-	1	-	-	-	-	1	0.6
Switzerland	-	-	1	-	-	-	-	-	-	-	-	1	0.6
Netherlands	-	1	-	-	-	-	-	-	-	-	-	1	0.6
Brazil	-	-	-	1	-	-	-	-	-	-	-	1	0.6
New Zealand	1	-	-	-	-	-	-	-	-	-	-	1	0.6
<b>Total</b>	<b>12</b>	<b>12</b>	<b>15</b>	<b>20</b>	<b>19</b>	<b>14</b>	<b>16</b>	<b>28</b>	<b>11</b>	<b>13</b>	<b>12</b>	<b>172</b>	
<b>Percentage</b>	<b>7.3</b>	<b>7.3</b>	<b>9.1</b>	<b>12.1</b>	<b>11.5</b>	<b>8.5</b>	<b>9.7</b>	<b>17.0</b>	<b>6.7</b>	<b>7.9</b>	<b>7.3</b>	<b>100.0</b>	

**Chart 1: ANP MSc. Student Intake by Regions 1985-2004**



Funding deficits remain the template for challenges for ANP as most of the others arise from or a related to inadequate funding. These include, scholarships, staffing, teaching facilities and their accessories (such as electronic media for teaching).

Having highly qualified and well exposed staff combines as an asset as well as a threat and not being ‘well paid’ as universities lecturers complicates the situation. Due to this ANP has lost a number of lecturers to the gain of well paying employers. A number of students have failed to complete the degree programme as their priorities change when they get ‘good’ jobs.

ANP has been interacting with development partners including communities and other stakeholders in ventures of which the ‘Nutribusiness Project’ and the development of the ‘community based approach to nutrition programming (CBNP)’ were exemplary. The University of Nairobi collaborated with the both Tuskegee and Penn State Universities of United States of America and with communities (specifically women) in Murang’a and Bomet districts in a Project, dubbed ‘The Nutribusiness’. The goal was the development of a nutritionally appropriate weaning product that the women could produce; out of locally produced/available ingredients; in a factory setting for consumption and sale aimed at both nutritional and income improvement at the household level. In the CBNP project, the ANP in collaboration with DANIDA and selected communities in Makeni district developed a prototype intervention, the CBNP, that was piloted in the district and later replicated into other districts.

ANP has been involved with partners in other development ventures that have included development of curriculum, training/teaching

manuals and handbooks (e.g., with Kenyatta University, SOMANet and NECTAR Programme/University of Wageningen). Its latest inclusion being in transfer of technology from the experimental to utilization at the household level inform of inter-departmental efforts and with Kenya Medical Research Institute (KEMRI).

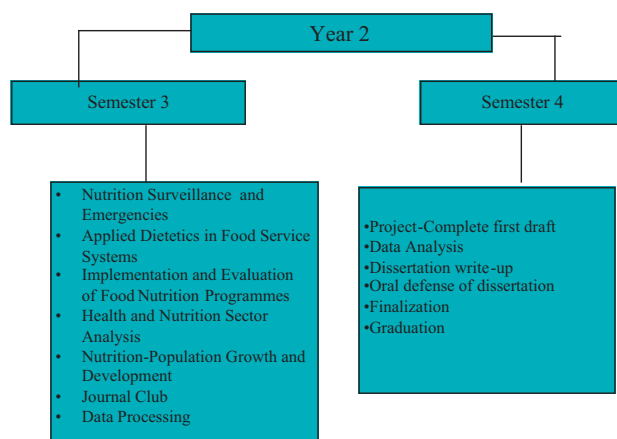
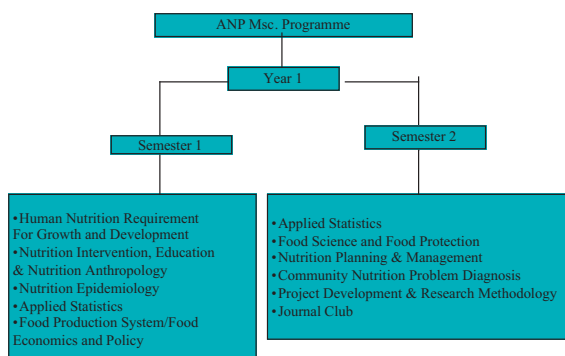
### Programme Quality Assurance

Prior to 2001, the Programme comprised a two-year M.Sc. programme but as cohorts of students graduated it became increasingly obvious, that both the structure and the scheduling of the course units were an impediment to students' timely completion of the degree programme. A monitoring tool was developed in 1995 and applied to document progress of students as well as identify points at which delays occur.

The results of showed that the write-up period and the process of examination of theses were the main bottlenecks; the students were not using time efficiently in the post data collection/fieldwork period and the evaluation process after submission of the theses was also inefficient. These two, in tandem with the lessons learnt between 1985 and 1998 and the 1999-2000 programme review were targeted for the reengineering that culminated in the re-structuring of the course in the year 2001 to make it more time-efficient and customer (students and employers) friendly.

The restructuring included switching to a four-semester system and modification of the thesis examination process that enhanced the celerity with which completion is achieved. This has demonstrated that the hard working time-sensitive students can complete the M.Sc. Programme in scheduled time. The changes included engendering fieldwork with coursework, which means that the students complete data collection before embarking on Semester-3 coursework, while data processing is done in tandem with the coursework. The number of course units covered in Semester-3 is therefore the least. In the previous approach, students were left free to manage write-up time but this is where the use of time during the two-year programme was most wasteful. The current schedule is more structured with clearly set out benchmarks for gauging progress. The examination process of the dissertation was also modified to a more time and quality efficient format. The structure of the programme since 2001 is shown in Chart 2 in which the different courses are identified by name. It also shows the scheduling of courses giving a visual picture of programming of the course. In the Chart it can be seen that fieldwork comes at the end of Semester-2. The modified programming also allows students to formally take leave of absence from studies and re-join later. Modifications were also made to improve the quality of the content while the identified best practices have been rolled-out to sustain the high quality and profile of the programme.

Chart 2: M.Sc. ANP Course Schedule



Therefore, for the purpose of sustaining high quality performance in training and other development dimensions, ANP applies a number of strategies:

ANP has undergone reviews by panels of international experts on two occasions and was found to compare well with major centres offering training in the field of applied human nutrition. The views and recommendations of the panels, where it has been feasible, have been incorporated.

ANP uses external examiners to ensure that assessment of students is up to standard and examinations are fair. This ensures that the scope of content is adequate, that areas of weakness are acknowledged while offering recommendations that ANP acts upon.

ANP is run by a team of highly qualified staff (five out of its six core staff are PhD degree holders) that is vibrantly aware and appreciates the value of well trained persons working in the area of applied nutrition in the context of the dynamic nature of knowledge. To keep well honed, the team participates in research, conferences, development of training materials, short courses as facilitators and learners and in government mechanisms (such as the Inter-ministerial coordinating committee on food and nutrition) and checking-out websites among others.

The feedback that ANP gets from development partners and colleagues in the field of agriculture, health, development and others keeps the programme on track.

Integral to this is the overall strong desire and quest of the University of Nairobi for high quality education that serves as the launching pad for ANP, epitomised in the recently introduced performance based evaluation of staff by both peers and students. This superimposes the student based evaluation of lecturers that ANP introduced at its inception to keep the staff informed of their performance and of more value to trigger-off desire for improved performance.

Despite the challenges, many encouraging programme facets exist, that include, the joy of seeing high quality trained nutritionist as outputs of the programme with many holding key positions, the constructive feedback from their employers that mingles affirmation of good quality products with input on how to improve among others.

### Conclusion

The overall experience thus leads to the conclusion that there is adequate demand for training and ANP has the potential to meet a substantial portion especially if provided with the necessary support. The Programme is flexible and vibrant in keeping with the dynamism that nutrition, health and development challenges present. There is need to



define and impart a critical portion of nutritional knowledge to all working in development in Africa.

## **Recommendation**

Thus the recommendation that a package of critical nutrition knowledge for developmental communication be defined in tandem with an increase in opportunities for training and creation of responsive policy and partnership environments that support all aspects of capacity building including technical, infrastructure, information communication technology (ICT), equipment and scholarships either in form of direct funding or through commissioned assignments.

## **Way Forward**

As a way forward, in response to demand for highly trained nutritionist and dieticians, internationally, ANP joins others in playing a role in closing the gap between demand and supply. It thus, from this year (2005), will be introducing a Bachelor of Science (B.Sc.) degree that will produce personnel who will be competent in applied human nutrition and dietetics. ANP also plans to offer certificate courses in dietetics in emergencies, food pharmacy, nutrition in sports and monitoring and evaluation.

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# The Socio-demographic Profile and Identification of the Training Needs of the Caregivers Participating in the Home Garden Project in the Vaal Triangle, South Africa

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

\*Vaal University of Technology, South Africa

\*M. Selepe, \*L. Makhado, \*S. Hendriks and \*R. Rutengwe

## Summary

**Objectives:** To determine the socio-demographic profile and economical status of the caregivers participating in the home garden project. Secondly to identify their training needs in order to develop an appropriate home gardening training programme.

**Methods:** A baseline survey, using both quantitative and qualitative methods was employed. One hundred and forty three households were randomly selected but only 91 successfully completed the training needs questionnaires and 79 completed the socio-demographic questionnaires administered by trained fieldworkers. The data was analysed using the SPSS © version 12.0

**Results and implications:** Nine percent of the caregivers were males and 91% females. One percent of the caregivers did not know their education level, 35.4% studied until primary level, 32.9% had standard 6-8 education level and 2.5% had tertiary qualifications. Sixty eight percent were self-employed, 53.2% spent about 8USD on food and 5.1% spent 25-40 US\$ on food weekly. Twenty nine percent were single, 41.8% were married legally or traditionally and 7.6% refused to give their marital status. Thirty eight percent of the household had a monthly income of between 16-83US\$ and 12% had an income of 167-500US\$ per month. The results also showed that 72.5% had some knowledge on home gardening whereas 29.7% had skills on home gardening, 69.2% had no know knowledge regarding planting management. There was an indication that this community is in favour of home gardening and 87.9% will produce vegetables for their families. Their self-rating indicated that training is needed.

An intervention study to address household food inaccessibility and nutrition status will be based on these results as well as dietary intake and blood samples that will be drawn and evaluated. These results will form the basis of the training programme to be implemented in this community.

## Introduction

This study forms part of a large-scale home gardening research project undertaken in an urban informal settlement in the Vaal Triangle, South Africa. The study was initiated as a follow up intervention of a community-based integrated nutrition research project aiming at promoting sustainable production and consumption of fruit and vegetables, in order to improve livelihoods, food and nutrition security and health outcomes of the urban poor, especially children and women.

A survey of literature indicated that there was limited information on urban agriculture, and there is little data on the extent and value of output generated by urban agriculture is even harder to find [1,2].

However, Dima et al. [3] indicated detailed information about the scope and extent of peri-urban and urban agriculture in a number of areas in Africa and other parts of the world. This finding agreed with Agropolis [4], reporting that millions of people are now farming in cities in developing countries. They grow crops on unused land by the road-

side, raising animals in abandoned buildings and recycling organic waste into compost. Studies conducted between 1990 and 1994, showed that land under open space cultivation in Harare increased by 92.6% [2]. Thus, a total of 9288 hectares were cultivated. Many other studies have shown that the practice of urban food production cuts across all income groups. Both the poor and the rich are involved in the activity [2,5].

Urban agriculture is increasingly being seen as an important component of urban development and urban environmental management. Urban agriculture is an alternative source of employment, household income, and food and nutrition security among many low-income urban dwellers [6,7]. Investments in urban agriculture in South Africa are negatively influenced by a paucity of information on available land and farming opportunities and lack of policy [8].

Much of the South African population lives in peri-urban and urban areas characterised by extremely poor socio-economic and environmental conditions [8]. Urban food production activities in these disadvantaged communities are still limited [8]. Agricultural skills among the peri-urban and urban poor are seriously under-utilised [8]. Urban agriculture can benefit urban environments through recycling wastes, stabilising drainage and making productive use of green spaces [1].

Agropolis [4] supports the concept of urban food production that offers real benefits to communities and argues that the benefits of urban food production are considerable. Urban agriculture is a rational response by the urban poor to the inability of the formal economy to provide sufficient real income for survival in the cities and other urban areas [3]. Food production on small plots adjacent to human settlement is an age-old survival strategy in the developing world [9]. The same source reported that food gardens make a substantial, though rarely appreciated contribution to the food security of the poorest segments of society.

A situation analysis in the Vaal Triangle concluded that high unemployment rates, poverty, chronic household food insecurity and a high prevalence of malnutrition, existed [10]. Effort to increase food availability will bring overall benefits to the community, and it was for these reasons that this study was conducted.

## Methods

This is a community-based study. This study was conducted in an urban informal settlement, in the Vaal Triangle. The area has a population of  $\pm$  6000 people. This area was randomly selected for the preceding baseline survey on the basis of reflecting a typical informal settlement in Gauteng, size ( $n = 1260$  households) and geographical positioning, by a stakeholders' (which included local councillors, educators, ministers and the community) workshop [11]. It is one of the poorest and oldest informal settlements in the Gauteng province, South Africa.

One hundred and forty three households were randomly selected from households which have children aged between two to five years olds, but only 91 caregivers (adults within a household who take care

of these children) successfully completed the training needs questionnaires and 79 caregivers completed the socio-demographic questionnaires administered by trained fieldworkers. The socio-demographic questionnaire included questions on age, income level of the family, employed number of people per household and the number and ages of the children in the household. The training needs questionnaire included questions on knowledge and skills on home gardening, knowledge on soil management, knowledge regarding planting management and knowledge regarding storage after harvesting and preparation of vegetables. The data were analysed using the SPSS ® version 12.0

## Results, Discussion and Implications

Nine percent of the caregivers were males and 91% females. One percent of the caregivers did not know their education level, 35.4% had primary level education, 32.9% had junior secondary education, and 16.5% high school education and 2.5% had tertiary qualifications. Out of the 79 households, 68.45% of the caregivers were self-employed, 53.2% spent 8US\$ on food and 5.1% spent 50US\$ on food weekly. Twenty nine percent of the caregivers were single and 7.6% refused to give their marital status. Forty eight percent of the household had a monthly income of between 16-83US\$ and 15.2% had an income of 167-500US\$ per month. Forty two percent of the households had three to four people sharing one sleeping room and 19% of the households had more than 4 people sharing one sleeping room.

The results also showed that 72.5% of the caregivers had some knowledge on home gardening whereas only 29.7% displayed skills on home gardening such as how to prepare the area for planting, removing the weeds and watering the garden. Sixty nine percent of the caregivers responded that they had knowledge on soil management whereas 69.2% had no know knowledge regarding planting management and only 13.2% had knowledge regarding storage after harvesting and preparation of vegetables. Out of 91 households only 29.7% had worked in a garden before.

## Conclusions

Most of the caregivers from this community had primary education, but still with this level of education, 72.5% had a knowledge regarding home gardening and 69.2% had knowledge on soil management. Employment rate in this community was very low whereby 10% were unemployed, 5% were formally employed and 68.4% were self-employed and this was confirmed by the amount of money spent on food and income per household. Due to employment status most people could not afford to build houses, therefore 42% indicated that 3-4 people were sharing a sleeping room.

The amount of money spent on food per week was very low, that is about 1USD per day that is equivalent to a loaf of bread or a pint of milk indicating poverty.

An intervention study to address household food inaccessibility and nutrition status will be based on these results as well as dietary intake and blood samples that will be drawn and evaluated. There was an indication that this community is in favour of home gardening and 87.9% would produce vegetables for their families. Their self-rating indicated that training is needed on the following topics: gardening skills, planting management, storage after harvesting and preservation of vegetables. These results will form the basis of the training programme to be implemented in this community.

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**Table 1. Socio-demographic profile of caregiver**

	<b>Variable</b>	<b>Frequency</b>	<b>Percent (%)</b>
Gender	Males	7	8.9
	Females	72	91.1
	<b>Total</b>	<b>79</b>	<b>100</b>
Education level	None	8	11.4
	Primary school	28	35.4
	Std 6-8	26	32.9
	Std 9-10	13	16.5
	Tertiary education	2	2.5
	Don't know	1	1.3
	<b>Total</b>	<b>79</b>	<b>100</b>
Marital status	Unmarried	23	29.1
	Married	33	41.8
	Divorced	5	6.3
	Separated	3	3.8
	Widowed	4	5.1
	Living together	5	6.3
	Other	6	7.6
	<b>Total</b>	<b>79</b>	<b>100</b>
Employment status	Unemployed	8	10.1
	Self-employed	54	68.4
	Wage earner	4	5.1
	Retired	6	7.6
	Other	7	8.9
	<b>Total</b>	<b>79</b>	<b>100</b>
Money spent on food per week (USD)	<8	42	53.2
	8-16	18	22.8
	17-24	11	13.9
	25-32	4	5.1
	33-40	4	5.1
	<b>Total</b>	<b>79</b>	<b>100</b>
Household income per month (USD)	None	3	3.8
	16-83	38	48.1
	83-167	19	24.1
	167-500	12	15.2
	Don't know	7	8.9
	<b>Total</b>	<b>79</b>	<b>100</b>
Usual income per month	Yes	<b>40</b>	<b>50.6</b>
	No	<b>39</b>	<b>49.4</b>
	<b>Total</b>	<b>79</b>	<b>100</b>
Number of people per sleeping room	0-2 persons	31	39.2

**Table 2. Training needs profile of home gardeners**

	<b>Variable</b>	<b>Frequency</b>	<b>Percent (%)</b>
Knowledge regarding home gardening	Yes	66	72.5
	No	25	27.5
	<b>Total</b>	<b>91</b>	<b>100</b>
Skills on home gardening	Yes	27	29.7
	No	63	69.2
	Did not give an answer	1	1.1
	<b>Total</b>	<b>91</b>	<b>100</b>
Knowledge of soil management	Yes	63	69.2
	No	28	30.8
	<b>Total</b>	<b>91</b>	<b>100</b>
Knowledge of planting management	Yes	28	30.8
	No	63	69.2
	<b>Total</b>	<b>91</b>	<b>100</b>
Knowledge regarding storage after harvesting and preservation of vegetables	Yes	12	13.2
	No	79	86.8
	<b>Total</b>	<b>91</b>	<b>100</b>
Have you worked in a garden before	Yes	27	29.7
	No	63	69.2
	Did not answer	1	1.1
	<b>Total</b>	<b>91</b>	<b>100</b>



# Production of trichothecenes and zearalenone by *Fusarium* species occurring in Equatorial Barley (*Hordeum vulgare* L.) grown in Kenya.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Traditionally Malted barley (*Hordeum vulgare* L.) is the principle ingredient in clear beer. Infestation of barley in the field by molds of the *Fusarium* genus is a worldwide problem. Incidences of *Fusarium* toxins have been encountered in clear beers. The objective of this study was to investigate the occurrence of *Fusarium* molds in Equatorial barley grown in Kenya and the ability of the isolates to produce mycotoxins. Grain samples were obtained from newly delivered barley lots originating from two barley-growing regions in Kenya (i.e. Olchoro–Mau Escarpment and Timau– Mt Kenya) and in storage grain from Kenya Maltings Ltd., Nairobi. The barley kernels were surface sterilized and plated on Potato Dextrose Agar and Synthetic Nutrient Agar for isolation and identification of *Fusarium* spp. The isolates were identified to species level based on cultural and morphological characteristics. In addition, the isolates were screened in-vitro on rice cultures for their ability to produce Type A trichothecenes (T–2 toxin, HT–2 toxin, Diacetoxyscirpenol), Type B trichothecenes (deoxynivalenol and nivalenol) and Zearalenone. *Fusarium* molds were isolated from all the regions sampled but at different levels of contamination, 50%, 33.3% and 25% for Timau, Olchoro and in-storage samples respectively. The distribution of the species showed some regional specificity. *F. graminearum* and *F. poae* predominated in Olchoro region. All strains of *F. graminearum* produced both deoxynivalenol and zearalenone. *F. poae* strains did not produce detectable amounts of the mycotoxins. However, the two unidentified isolates of *Fusarium* spp. isolated from Timau samples produced deoxynivalenol only. The study has shown that toxigenic *Fusarium* spp. do occur in Equatorial barley grown in Kenya.

**Key words:** barley, *Fusarium*, trichothecenes, zearalenone, Kenya

## Introduction

Barley (*Hordeum vulgare* L.) grown in Kenya is solely used for malting by East Africa Breweries Limited (EABL). It is grown exclusively by EABL contracted farmers or by those privately registered by the company. Barley production takes place in the Rift Valley province and Mt Kenya region of Eastern province (Upper Timau and Lower Timau) [1].

Most genera of cultivated plants are susceptible to diseases caused by *Fusarium* species including all members of the Gramineae family [2]. *Fusarium* head blight (scab) has re-emerged as a devastating disease of wheat and barley throughout the world [3]. The disease has been reported worldwide wherever cereals are grown [4].

In addition to being pathogenic to plants, which may cause severe crop yield reduction, many *Fusarium* species are also capable of producing mycotoxins as secondary metabolites. Among these toxins are trichothecenes such as deoxynivalenol (DON), nivalenol (NIV), T–2 toxin, HT–2 toxin and diacetoxyscirpenol (DAS). Other toxins include zearalenone (ZEN), fumonisins and fusarins. *Fusarium* toxins have been shown to cause a variety of toxic effects in both laboratory animals and livestock and on some occasions, they have been suspected to cause toxicity in humans. ZEN is associated with hyperestrogenism in farm animals while trichothecenes have been linked to hemorrhagic syndrome and alimentary toxic aleukia in farm animals and humans, respectively [5]. *Fusarium* toxins are commonly detected in cereals, maize, rice and beer [4]. DON has been found to occur widely in beer in Europe, Canada and USA. ZEN is not common in clear beers; however, it has been found in African native opaque beers derived from grains [6]. Much of the documented work on occurrence of the *Fusarium* toxins has been carried out in the temperate countries of Europe and North America and Asia.

Barley is the main cereal subjected to malting as the principal raw material in brewing. The high moisture content at the germination stage provides a conducive environment for microbial proliferation [7]. Any attempt to chemically control fungal growth also interferes with the barley physiological and biochemical processes hence reducing the malt quality. It also raises concern over chemical residues in the beer. Presence of *Fusarium* and other molds in barley has also been associated with 'gushing' (uncontrolled foaming) and off-flavor in beer [2, 7]. Therefore, barley destined for malting has to be of optimum microbial quality and free from mycotoxins.

Studies have shown natural contamination of barley with toxin producing *Fusarium* strains can lead to *Fusarium* toxins in beer. The mycotoxin which best survives the brewing process is DON. One study using barley infected with *F. graminearum* found out that most of the DON (86%) in the naturally contaminated barley was rinsed off during steeping, but DON levels in the green malt after 5 days of germination increased by up to 114% of the levels in the original barley, kilning had little effect on DON levels, and 80–90% of DON was subsequently recovered in the finished beer [6]. Most of the ZEN in malt has been found to end up in spent grain, however, ZEN which finds its way into the wort is largely metabolized to b-zearalenol by brewing strains of

*Saccharomyces cerevisiae* [6, 8].

The profile of secondary metabolites varies from one *Fusarium* species to another but variations within the species also exists. Profiles of secondary metabolites have become an important tool when combined with morphological characteristics in *Fusarium* taxonomy [4].

Recent investigations in Kenya have revealed the presence of different species of *Fusarium* and fumonisin toxin in maize [9]. DON producing *F. graminearum* strains have also been frequently isolated from wheat samples collected in the different wheat growing areas in Kenya [10]. Bearing in mind that barley growing also takes place in wheat production areas; the possibility of *Fusarium* infection in barley is high. The present studies investigated the occurrence of *Fusarium* spp. in Equatorial barley grown in two different regions in Kenya. *Fusarium* isolates were morphologically identified to species level. In vitro assays on rice cultures were conducted to check the ability of the isolates to produce trichothecenes and zearalenone. Initial screening for mycotoxins was done using thin layer chromatography and confirmed using high performance liquid chromatography. The study was done with the aim of shedding light on the types of *Fusarium* species affecting barley and to highlight the potential threat posed by *Fusarium* to the barley growing and brewing industry in Kenya.

## Materials and Methods

Samples of newly delivered barley from two different regions in Kenya (Olchoro– Mau escarpment region, and Timau– Mt. Kenya region) and pre-steep grain (from storage silos without a common history) were obtained from Kenya Maltings Limited, Nairobi. The samples of newly delivered barley were obtained from different lots delivered to the plant whereas the storage samples were from different silos. After collection the samples were stored under refrigeration at 5°C and plated for isolation of *Fusarium* within one week.

## Isolation and Identification of *Fusarium*

Isolation was done by direct plating of barley seeds on Potato Dextrose Agar (PDA), after surface sterilization for 5 minutes with 10% commercial bleach (Jik®) active ingredient- sodium hypochlorite at 3.5%, in sterile distilled water. The seeds were then rinsed twice with sterile distilled water, transferred to the solid media using sterile forceps and incubated at 25°C for 7 days. 5 seeds were placed in each plate; all the experiments were carried out in duplicates. Daily observations were made to ensure that the colonies were isolated before spreading out. Identification was done by culturing the isolates on Synthetic Nutrient agar (SNA)-(KH<sub>2</sub>PO<sub>4</sub> 1.0g, KNO<sub>3</sub> 1g, MgSO<sub>4</sub>·7H<sub>2</sub>O 0.5g, KCl 0.5g, glucose 0.2g, saccharose 0.2g and agar 20.0g per liter of distilled water) and PDA for microscopic and cultural characteristic respectively [11, 12].

## In vitro culturing of *Fusarium* isolates for toxin production

*Fusarium* isolates were cultured on 50g of rice in 250ml conical flasks. Two moisture and temperature regimes were used: (a) 20ml of distilled water were added to 50g of rice with a moisture content of 13.3% (determined using oven drying method [13]) to give an initial moisture content of 38.1%, the rice was capped with aluminum foil, allowed to set for 1 hour and then autoclaved for 30 min at 121°C.

After cooling the cultures were inoculated with a mycelium plug 11 mm in diameter obtained with a sterile core borer from actively growing edge of a pure culture on PDA. The plug was placed at the center of the flask and pushed deep to ensure it contacted the moist rice. The cultures were recapped with sterile aluminum foil then incubated at 25°C in the dark for 35 days. (b) 30ml of distilled water were added to 50g rice (same lot as used above) to give an initial moisture content of 45.8%; the same sterilization and inoculation procedure was followed as outlined above. The cultures were then incubated at 25°C for 14 days and then transferred to 4°C for 21 days.

## *Fusarium* toxins Analysis

Trichothecenes: Extraction of the cultures was done according to Association of Official Analytical Chemists (AOAC) method 986.18 for DON in wheat [14]. Column clean up was performed using charcoal-alumina-celite columns. A mixture of both type A and type B trichothecenes standards (Sigma-Aldrich Chemicals Co., Germany) was also dissolved in Acetonitrile:Water (84:16) and treated same as the sample extract.

## Thin Layer Chromatography (TLC)

A slight modification of AOAC method was done to accommodate concurrent analysis for Type A and B trichothecenes as described by the Dual Column Quantitative TLC Method for Type A and B Trichothecenes -Method Code: tri-tl-01.00.2 (Romer® Labs, Inc. MO, USA) as outlined below.

(a) Type B trichothecenes (DON and NIV): The residue in the glass vial obtained from column clean up and concentration was dissolved in 100 ml of acetone:methanol (2:1). Stoppered and vortexed for 30 seconds. 10 ml were spotted along side DON and NIV standards on silica gel 60 precoated glass plates (0.25 mm layer thickness, E Merck, Darmstadt, Germany). The plates were developed in toluene: acetone (1:2) mobile phase. The plates were air dried and observed under long wave (366 nm) UV light for interfering compounds. They were then sprayed with 15% aluminum chloride in methanol, air-dried and heated at 150°C until the standards were fully visible under UV long wave 366 nm (Funa UV light, Model SL-800G, Japan). Finally, the plates were observed for presence of fluorescing spots with equivalent R<sub>f</sub> values to the toxin standards.

(b) Type A trichothecenes (T-2 toxin, HT-2 toxin and DAS): The remaining solution from above was evaporated under a stream of nitrogen, dissolved in 90 ml of toluene:acetonitrile (97:3), stoppered and vortexed for 30 seconds. 10ml were spotted along side T-2 toxin, HT-2 toxin and DAS standards on a reverse phase RP-18 precoated glass plates (0.25 mm layer thickness, E Merck, Darmstadt, Germany). The plates were developed in methanol:water:acetic acid (25:15:1) mobile phase, air-dried and observed for interfering compounds under long wave UV (366 nm). This was followed by spraying with 10% sulfuric acid in methanol, air-drying and heating at 150°C until the standard spots were fully visible under long wave UV (366 nm). The TLC plates were observed for presence of fluorescing spots with equivalent R<sub>f</sub> values to the toxin standards.

Deoxynivalenol confirmation and quantification: For the DON positive samples, the acetonitrile:water extract was pretreated with anhydrous ammonium sulphate to remove early eluting polar compounds [15]. The sample was then cleaned up in charcoal:alumina:celite column. Standards at five different concentrations were dissolved in acetonitrile:water (84:16) and treated the same as the sample extract to obtain a calibration curve. Analysis was done on High Pressure Liquid

Chromatography (HPLC) under the following conditions: Column: RP-18 (0.5 mm) 4.6 mm x 250 mm column (E Merck, Darmstadt, Germany). Mobile Phase water:methanol:acetonitrile (90:5:5), Flow rate 0.9 ml min<sup>-1</sup>: Shimadzu system controller SCL-6A, SPD-10A UV-Vis detector set at wavelength of 220 nm and range 0.0050 AUFS, LC- 6A pump and Column oven CTO-6A maintained at 40°C (Shimadzu Corporation, Japan).

Zearalenone: Screening of the cultures for zearalenone production was done by TLC according to AOAC official method 976.22 for zearalenone in corn [14].

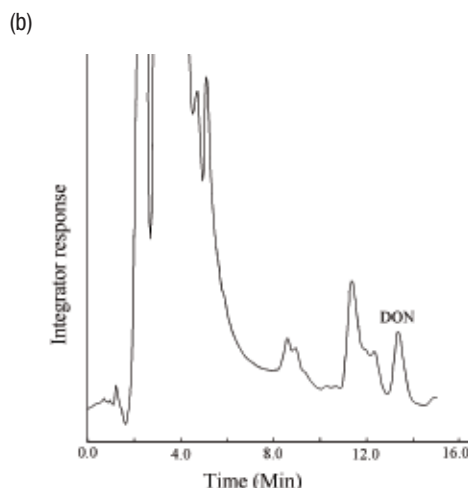
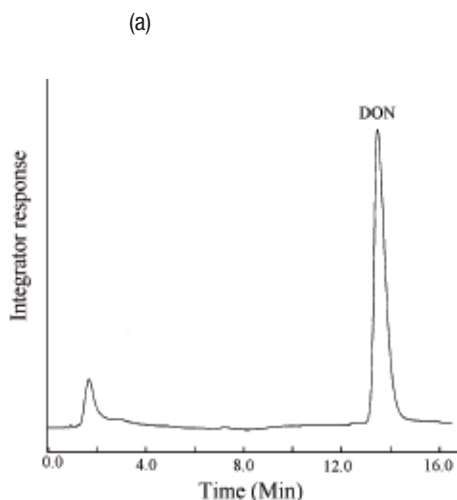
Confirmation and quantification of zearalenone was done according to the HPLC method 985.18 of the AOAC for zearalenone in corn [14], under the following HPLC conditions; Column: RP-18 (0.5 mm) 4.6 mm x 250 mm column (E Merck, Darmstadt, Germany), Mobile phase: methanol:acetonitrile:water (1:1.6:2), flow rate 0.7ml min<sup>-1</sup>: Shimadzu SCL-10A system controller, LC-10AS pump, Column oven CTO-10A maintained at 40°C, RF-1501 spectrofluorophotometer detector fitted with a flow cell, set at 236 nm (excitation) and 418 nm (emission) (Shimadzu Corporation, Japan).

**Results**

25% of stored barley, 33.3% of samples originating from Olchoro in Mau escarpment region and half of those from Timau in Mt Kenya region were contaminated with molds of the genus *Fusarium* (Table 1). *F. graminearum* and *F. poae* predominated in the samples from Olchoro in the Mau escarpment region. *F. clamydosporum* was isolated from the in storage sample. The two *Fusarium* isolates not conclusively identified in these studies were obtained from barley kernels originating from Timau in Mount Kenya region.

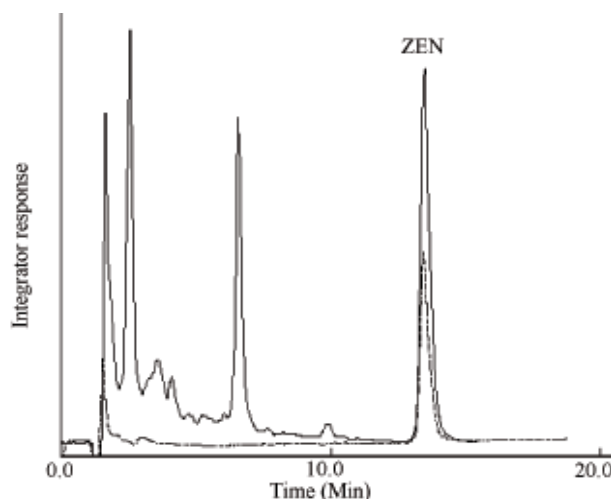
All isolates of *F. graminearum* produced deoxynivalenol and zearalenone in the rice cultures (Table 2, Fig. 1 and 2). Two unidentified isolates of *Fusarium* spp. occurring in barley kernels from Timau in Mt. Kenya Region produced DON only. All *F. poae* strains did not produce detectable amounts of any of the mycotoxins assayed for.

**Fig 1. HPLC chromatogram profiles of Deoxynivalenol (DON) analysis**



(a) Pure DON standard, retention time 13.5 min. (b) Sample from *F. graminearum* culture extract

**Fig 2. HPLC chromatogram profiles of Zearalenone (ZEN) Analysis:**



Solid trace (*F. graminearum* culture extract), broken line (zearalenone standard). Zearalenone retention time (13.4 min), shown by the overlapping peaks in the figure.

Strains of *F. graminearum* and the two unidentified *Fusarium* isolates produced varying amounts of DON and zearalenone in vitro in the rice cultures (Table 3). The HPLC method offered an extra confirmation step for the type of toxin in addition to quantification.

**Discussion**

The results indicate that toxigenic species of *Fusarium* do occur in equatorial barley grown in Kenya. *F. graminearum* and *F. poae* are the predominant species in Olchoro region. DON producing *Fusarium* spp. occurred in samples originating from Timau in Mt. Kenya region. Olchoro region in the Rift valley has a warm climate and this appears to favor *F. graminearum* compared to Timau region, which is cooler. In warm regions of the world, including parts of USA, Australia and Central Europe, *F. graminearum* is generally regarded as the most common species causing *Fusarium* head blight [2]. It has also been



observed that changes in weather conditions can cause a shift in dominant species found in cereals. In a study carried out in The Netherlands, in 1991 and 1993, where samples consisted of wheat, barley, oats rye and triticale, *F. culmorum* and *F. avenaceum* dominated in 1991, while in 1993 *F. poae*, *F. culmorum* and *F. crookwellense* predominated, this was attributed to different climatic conditions observed during the two cropping years [16]. Prolonged wet weather during anthesis, especially resulting from above normal precipitation has been linked on many occasions to *Fusarium* head blight epidemic [2]. Despite the recognition of *Fusarium* spp. field infestation on food grains as a worldwide menace, there is limited information available on the occurrence of toxigenic *Fusarium* spp. in the main cereals grown in Kenya. A variation in predominant *Fusarium* species in five wheat-growing regions in Kenya has been observed, *F. graminearum* was found to be dominant in the warmer regions, the isolates obtained were found to produce DON. [10]. A study carried out on maize from Western Kenya also found out high incidences of potentially toxigenic *Fusarium* spp. and presence of Fumonisin B1, a *Fusarium* toxin, in maize samples, however, no screening of the ability of individual isolates to produce different mycotoxins was done [9]. Presence of *Fusarium* isolates in stored barley indicates that the inoculum carried over from the field can survive the storage period between harvesting to the break of dormancy when the grain is ready for malting. The high water activity created by malting conditions would then lead to a rapid proliferation of the molds.

Screening of the *Fusarium* strains for toxin production showed that all the strains of *F. graminearum* produced both DON and ZEN, whereas the two unidentified *Fusarium* isolates produced DON only. All the species isolated in these studies are potential mycotoxin producers, however, in the present studies, some isolates did not produce detectable amounts of toxin in the in vitro rice cultures. *F. poae* has been shown to produce DAS, T-2 toxin, HT-2 toxin and NIV whereas *F. clamydosproum* produces moniliformin [4, 17].

The frequent occurrence of DON and zearalenone producing *Fusarium* species warrants routine analysis of barley for *Fusarium* contamination, DON in beer and zearalenone in spent grain used as animal feed. Additionally, there is a need to create awareness to the farmers, malting and brewing industry on the presence of *Fusarium* within the barley growing regions and formulate early warning mechanisms to prevent heavy grain losses if the right climatic conditions facilitating heavy infestation prevail.

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**Table 1. *Fusarium* species isolated from Kenyan barley**

Fusarium spp.	Sample Origin		
	Olchoro	Timau	Instorage
<i>F.graminearum</i>	3	0	0
<i>F. poae</i>	2	0	1
<i>F.clamydospo rum</i>	0	0	1
<i>Fusarium</i> spp.	0	2	0
% of samples Contaminated	33.3(n=9)	50 (n=4)	25 (n=8)

(+) positive for the tested mycotoxin. (-) mycotoxin not detected  
 ND- Not Detected, NA- Not analyzed,

**Table 2. In vitro screening for mycotoxin production by Fusarium isolates in rice cultures**

Fusarium code and strain	Source	DON	NIV	DAS	T-2 toxin	HT-2 toxin	ZEN
1s (F. graminearum)	Olchoro	+	-	-	-	-	+
3s2 (F. graminearum)	Olchoro	+	-	-	-	-	+
5s1 (F. graminearum)	Olchoro	+	-	-	-	-	+
C (F. clamydosporum)	Storage	-	-	-	-	-	-
F (F. poae)	Storage	-	-	-	-	-	-
3s1 (F. poae)	Olchoro	-	-	-	-	-	-
5s2 (F. poae)	Olchoro	-	-	-	-	-	-
A (Fusarium sp.)	Timau	+	-	-	-	-	-
4f (Fusarium sp.)	Timau	+	-	-	-	-	-

**Table 3. Mean concentration (ng/g fresh wt. rice) of mycotoxins produced in vitro by Fusarium isolates in Rice Culture**

Fusarium Strain	Deoxynivalenol ng/g		Zearalenone ng/g	
	A	B	A	B
F. graminearum strains				
1S	881	900	155	177
3S2	NA	506	109	ND
5S1	525	1032	1006	213
Fusarium spp.				
4F	884	867	ND	ND
A	951	659	NA	NA

Experiments were carried out in duplicates. Data in column A represents values from rice culture with initial moisture content of 38.1% incubated at 25°C for 35 days. Values in column B are from rice cultures with initial moisture content 45.8% incubated at 25°C for 14 days then 4°C for 21 days.

# Bacterial Contaminants of Beef From Butcheries in Nairobi, Kenya.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Key Words

Nairobi, Kenya, Bacterial contaminants of food, Beef pathogens, Foodborne diseases

## Declaration

This paper has not been published or submitted for publication in any other journal.

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## ABSTRACT

**Background:** Meat comprises the musculature of “red meat” mammals. Food-borne outbreaks in Kenya of bacterial aetiology implicate meat and meat products among other foods. Use of chopping boards and knives in meat preparation and subsequent use of the same in preparation of other raw foods is likely to be the source of bacterial contamination.

**Objective:** The study aimed at isolating and identifying aerobic bacterial contaminants of beef from butcheries in Nairobi.

**Methods:** Beef was purchased from stratified sampled butcheries within Nairobi and its surroundings. Butchery characteristics were observed during purchase and samples were transported to the laboratory in a cool box. Isolation and identification of the bacteria was done using standard microbiological procedures.

**Results:** There is significant bacterial contamination in beef. A total of 331 bacterial species were isolated from 42 beef samples. The distribution of bacterial load had a significant variation among the three butchery categories with low class having the highest number (148) followed by middle class (138) and high class having the least (45). The types of bacteria identified were pathogenic (42%), opportunistic pathogens (36%), commensals (19%) and environmental contaminants (3%).

**Conclusion:** Beef is a common meal for many people including the vulnerable group i.e. the sick, aged, children and the immunocompromised. With 36% of isolates being opportunistic pathogens and 42% pathogenic, much care is therefore required when handling beef in presence of other foods to avoid cross contamination.

## INTRODUCTION

Meat comprises the musculature of “red meat” mammals. Proportions of muscle, fat and connective tissues vary from one breed to another even within a species. Good quality meat is generally indicated by a low value of aerobic plate count [1]. Greater significance of quality of meat is obtained by numbers (plate count), coliforms and *Escherichia coli* counts and absence of coagulase positive staphylococci. In addition, good quality comprises of absence of *Salmonella* species, *Shigella* species, anaerobes, moulds, yeasts and other possible pathogenic organisms [1,2].

The pH of meat is dependent on the amount of lactic acid formed during post-mortem glycolysis, which in turn is dependent on the amount of glycogen present in muscles at slaughter. Lower pH values are particularly important in maintaining the microbiological stability and safety of cured meat products [3]. Water comprises 75% of muscle; other substrates including carbohydrates, amino acids and lactic acids all provide important microbial growth factors [4,5].

Coliforms, *Escherichia coli*, enterococci, *Campylobacter* species, *Staphylococcus aureus*, *Clostridium perfringens*, *Listeria monocytogenes*, *Yersinia enterocolitica* and *Salmonella* species are often pres-

ent in fresh tissues, since the slaughtering process does not include a bactericidal step [3]. However, good sanitary practices during slaughter, trimming of visible faecal contamination and washing of carcasses with or without sanitizers are the approaches usually employed to minimize contamination of carcasses [6].

Sources of bacterial contaminants can be from human hands and clothing, air, equipment, other ingredients (spices), carcass surfaces such as skin (hide), viscera, captive bolt pistols, pitching rods and skinning knives [1,2]. Soil, floors, surfaces in processing plants and water used to wash the carcasses may also be a source of contamination by bacteria [3,7]. Contaminated meat from a single carcass may also contaminate large batches of ground beef in the process of blending a mixture of meats of several animals from different farms during the production of ground meats [8].

In Kenya during the period 1970 – 1993 few food-borne outbreaks of bacterial aetiology were confirmed to be caused by *Staphylococcus aureus*, *Clostridium perfringens* and *Clostridium botulinum*. In other unconfirmed outbreaks tentative diagnosis made was *S. aureus*, *Bacillus cereus*, *Salmonella* species and *Bacillus anthracis* and implicated foods were milk, milk products, meat and meat products, maize flour, bread, vegetables and lemon pie pudding [9].

Use of chopping boards and knives in meat preparation and subsequent use of the same in preparation of raw foods (salads and fruits) is likely to be the source of bacteria contaminating meat. Other than gastrointestinal food-borne infections systemic infections may occur where microorganisms are introduced through wounds on hands or accidental cuts during meat handling. Gastrointestinal tract infections may also progress to systemic bacteraemia in immunosuppressed persons. Identification of common bacterial contaminants of meat provides an insight into potential meatborne pathogens that may cause disease outbreaks.

## MATERIALS AND METHODS

### Sampling:

Samples of 2 Kg beef (minimum purchasable in most butcheries) were purchased from different butcheries within Nairobi and its surroundings. Selection of butcheries was done by stratified sampling. Three strata: high (supermarkets), middle (town butcheries) and low (slum butcheries) class were the subgroups within which simple random sampling were done by balloting to select butcheries in each stratum. Butchery characteristics were observed during beef purchasing.

### Laboratory Procedures:

Meat purchased from the butchery and packed by the butcher was transferred into sterile plastic polythene bag and transported to the laboratory in a cool box within 30 minutes of purchase.

### Isolation of bacteria

Bacteria targeted for isolation were those in the genera *Staphylococcus*, *Streptococcus*, *Pseudomonas*, *Aeromonas*, *Enterococcus* and *Enterobacteriaceae*. Culture media used were quality controlled.

Swabbing of the meat surface was done using sterile cotton swabs held with a flame sterilised pair of forceps. The swabs were then inoculated onto 5% sheep blood agar, MacConkey agar (Pronadisa, Conda Laboratories, S.A.), *Salmonella Shigella* agar

(Pronadisa, Conda Laboratories, S.A.) and Thioglycolate Citrate Bile Salts Agar (Difco Laboratories, Detroit, USA). After inoculation onto agar media one swab was introduced into a screw cap test tube containing alkaline peptone water and another into a screw cap test tube containing selenite F broth. Loosely capped, the tubes were incubated at 37°C for 24 hours aerobically for enrichment. The inoculated plates after streaking were incubated at 37°C for 24 hours aerobically with the exemption of the blood agar plate that was incubated at 37°C for 24 hours in 5% carbon dioxide. After incubation subculturing from alkaline peptone water to thioglycolate citrate bile salts and from selenite F to *Salmonella Shigella* agar and MacConkey agar was done and the plates incubated at 37°C for 24 hours aerobically.

### Identification of bacteria

Gram staining was done and further identification of gram-positive cocci was done by catalase test performed using 10% hydrogen peroxide. Coagulase test was performed using rabbit plasma on *Staphylococcus* species for identification of *S. aureus*.

*Streptococcus* species were tested for their ability to give  $\alpha$ ,  $\beta$ , and  $\gamma$  haemolysis on sheep blood agar. Susceptibility to 0.04µg bacitracin and optochin disks (Oxoid Ltd., Basingstoke, United Kingdom) on Mueller-Hinton agar/blood agar (Pronadisa, Conda Laboratories, S.A.) at 37°C for 24 hours in 5% carbon dioxide.

Gram-negative rods were identified by biochemical tests and confirmation done by use of API 20NE and API20E (bioMérieux, Basingstoke, United Kingdom) system in accordance with the manufacturer's instructions.

## RESULTS

### Sampling and butcheries features.

Forty two beef samples were purchased from different butcheries. All the beef samples were purchased on a similar day of the week (Mondays) and the sample collection period was characterized by rainy nights.

At the time of purchasing several observations were made and analysis done to compare their differences between middle and low class butcheries. High class butcheries were excluded from the analysis since beef was displayed packed. Wearing of dust coats by butchers, wrapping of beef using polythene before wrapping with print paper, sole sale of beef and presence of a cashier to handle money are practices that did not differ significantly between middle class butcheries and low class butcheries ( $p > 0.05$  by Fisher's Exact test). Presence of house flies was significantly higher in low class butcheries compared to middle class butcheries ( $p < 0.05$  by Fisher's Exact test). The above observations were analysed to assess their contribution to bacterial load. Bacterial load were compared between butcheries wrapping beef with polythene paper first versus those wrapping with print paper first, those with house flies present versus absent, those with butchers having dust coat won versus not won and those that had sale of beef only versus those selling beef and other foods. No significant difference was obtained between any set of the observations ( $p > 0.05$  by Unpaired t-Test and Mann Whitney Rank Sum test)

Butcheries that sold raw meat and other foods varied; some sold raw meat and roast meat served with vegetable salad "kachumbari" while others sold raw meat and vegetables such as onions, kales and onions within the same premise and handled by the butcher. Cross-handling of the different foods without intermediate hand washing was observed in all the butcheries involved in the sale of meat and

other foods.

All butcheries where beef was purchased had glass caging. Meat was displayed hanging or placed on the table surface or both ways and in some butcheries meat was refrigerated (Table 1).

Among the unique observations made, one worth noting was passage of an open sewage system at the entry to two butcheries within the low class category of butcheries.

The total number of bacteria species isolated from the 42 beef samples were 331. The distribution of the bacteria load among the three different butcheries categories were as shown in Figure 1.

The distribution of bacterial load had a significant variation among the three butchery categories with low class having the highest number (148) followed by middle class (138) and high class having the least (45) ( $p < 0.05$  by ANOVA). Comparison between two classes of butcheries at a time (high versus middle class, middle versus low class and low versus high class) all had significant variation ( $p < 0.05$  by MannWhitney test).

Bacteria isolated and identified comprised of 27 different genera and species identified varied within a single genus. Among the characterized bacteria, high class, middle class and low class butcheries had 14, 21 and 24 bacteria genera, respectively (Table 2).

Species types identified among the genera in Table 2 above were *Acinetobacter junii*/johns, *Acin. Iwoffii*, *Acin. baumannii*, *Aeromonas caviae*, *A. hydrophila*, *A. salmonicida*, *A. sobria*, *Chryseomonas luteola*, *Citrobacter freundii*, *Enterobacter cloacae*, *Flavobacterium indologenes*, *Flav. odoratum*, *Klebsiella oxytoca*, *K. pneumoniae*, *Leclercia adecarboxylata*, *Listonella damsela*, *Moraxella phenylpyruvica*, *M. lacunata*, *Oligella urethralis*, *Pasteurella pneumotropica*, *Past. aerogenes*, *Proteus mirabilis*, *P. vulgaris*, *Providencia alcalifaciens*, *Prov. rettgeri*, *Burkholderia cepacia*, *Pseudomonas fluorescens*, *Ps. putida*, *Ps. stutzeri*, *Ps. vesicularis*, *Serratia marcescens*, *Shewan putrefaciens*, *Sphingomonas paucimobilis*, *Coagulase positive S. aureus*, *Coagulase negative Staphylococcus*, a, g, and b - haemolytic *Streptococcus*, *Vibrio cholerae* serotype Inaba, *Vibrio metschnikovii*, *V. parahaemolyticus*, *V. vulnificus*, *V. alginolyticus*, *Weeksella zoohelcum* and *W. virosa*.

Pathogenic organisms had the highest isolation rate of 42% with the lowest being environmental species at 3% (Table 3).

The proportions of pathogenic and opportunistic bacteria isolated from low, middle and high class butcheries did not differ significantly ( $p > 0.05$  by Chi square test).

## DISCUSSION

Beef samples purchased from forty two different butcheries were contaminated with bacteria. Characteristics of butcheries observed such as sale of beef only or with other foods, wearing of protective clothing or not, handling of both money and meat by the butcher and beef packaging styles all had no significant difference between middle class and low class butcheries ( $p > 0.05$ ). In contrast there was significantly higher bacterial load in low class butcheries than in middle class butcheries ( $p < 0.05$ ). The characteristics are therefore, not important indicators of bacterial load in beef and may hence not be relied upon to judge the level of beef contamination. Presence of house flies was significantly higher in low class than were in middle class butcheries ( $p < 0.05$ ). This correlates with the bacterial loads in the two butchery classes. Presence of houseflies in butcheries would therefore be indicative of likelihood of higher bacteria contamination. Despite the correlation of houseflies with higher bacterial loads in low class butcheries, comparison of bacterial loads in butcheries in general with and without flies (not considering the class they belong) indi-

cates that there is no association between presence of houseflies and high bacterial load ( $p > 0.05$ ). This may imply that though the houseflies may influence bacterial load in beef other factors related to the environment are likely to be the main contributors and the flies merely act as agents.

Bacterial contamination levels observed during the study may be at the lowest level since sampling was done at a period with no dust blowing due to presence of rains. Bacteria that were isolated and identified are of medical and public health importance with 42% and 36% comprising of pathogenic and opportunistic pathogens, respectively. Pathogenic bacteria species that were isolated belonged to the genera *Aeromonas*, *Moraxella*, *Pasteurella*, *Providencia*, *Staphylococcus*, *Streptococcus* and *Vibrios*.

*Aeromonas* are involved in both intestinal and extraintestinal human infections [7]. *Aeromonas* spp are of medical significance since consumption is likely to cause gastroenteritis of which this might be occurring but unnoticed or misdiagnosed.

Bacteria of the genus *Moraxella* are normal commensals of the human upper respiratory tract and are occasionally recovered from the skin and urogenital tract [8]. The type species of the genus; *Moraxella lacunata* was first isolated from cases of conjunctivitis [9]. It is occasionally associated with epidemics, especially among adolescent girls who share makeup [10]. Its isolation from beef is thus questionable since possibility of infections from it cannot be overlooked. The incorrect identification of *Brucella melitensis* as *Moraxella phenylpyruvica* through the use of API20NE rapid identification tests has resulted in several cases of laboratory-acquired brucellosis [1,12,13]. In this study *Moraxella phenylpyruvica* was identified using API20NE and considering its source being beef there is a possibility of the organism to be a *Brucella* spp.

*Pasteurella* species have been associated with human infections [14]. *Pasteurella* have been isolated from lesions in many parts of the human body, especially animal bite wounds [15]. In animals, they cause fowl cholera, haemorrhagic septicaemia, mastitis, septic pleuropneumonia, snuffles, and other focal infections. Both normal and diseased wild and domestic animals are the reservoirs for most human infections [16,17]. The organisms are thus likely to be acquired by contact with the contaminated beef or accidental cuts during handling of beef. Their presence in the beef may be as a result of slaughter of an infected animal or a normal animal that is a carrier.

*Providencia alcalifaciens* and *P. rettgeri* which varied habitats were identified. *P. alcalifaciens* is occasionally found in faeces of normal healthy humans but more often in the stools of patients with diarrhoea and gastroenteritis. It can invade intestinal mucosal cells and cause diarrhea in rabbits and can also invade HEp-2 cells where it has limited multiplication before causing condensation of actin filaments [18,19]. The bacteria may therefore be causing infections in humans with beef being the original reservoir. *P. rettgeri* is part of the normal faecal flora of a number of reptiles and amphibians and may be found in contaminated water. Its presence in beef is therefore likely to have come from contaminated water.

*Staphylococcus* species were distributed in all butchery categories. *Coagulase positive S. aureus* comprised of 10% of the *Staphylococcus* species. Ingestion of staphylococcal toxin when present in beef may result in gastrointestinal illness. Skin infections may also occur through accidental cuts when handling contaminated beef or through an open wound getting in contact with the beef.

Twenty five percent of *Streptococcus* species were b-haemolytic on sheep blood agar. *Streptococcus suis* serotype 2 is often b-haemolytic on horse blood agar, but a-haemolytic on sheep blood agar and produces Lancefield's group R, S or T carbohydrate antigen [20]. Human infections with this organism are seen in meat handlers and

may include presentations of septicaemia or meningitis [21]. Thus, the a-haemolytic *Streptococcus* species isolated are likely to be *S. suis* and hence potential pathogens. They are thus of health concern and their presence in beef should be viewed with the seriousness it deserves.

Non-toxigenic *Vibrio cholerae* have been isolated from clinical specimen in several countries and their pathogenic and epidemic importance as well as their clinical and public health significance remain unclear and controversial [22,23,24]. However, in a more recent study of environmental non-toxigenic *Vibrio cholerae*, most isolates were found to have the *hlyA* gene indicating the potential of these strains to cause mild gastroenteritis [25]. The isolation of *Vibrio cholerae* O1 serotype Inaba from beef without any outbreak being reported within the area may imply that the isolate is a non-toxigenic *V. cholerae*. This issue can be resolved by determining the presence of *toxR* and absence of *ctx*, *zot* and *tcp* genes by polymerase chain reaction. *V. parahaemolyticus*, has long been recognized as a major cause of acute diarrhoeal disease [26]. Its presence in beef predisposes a consumer to risk of acquiring the infection. *V. vulnificus* is the most virulent of the non-cholera vibrios. It is primarily associated with a severe, distinctive soft tissue infection or septicemia, or both, rather than diarrhoeal illness [27,28]. *V. alginolyticus* has been etiologically associated with cellulitis and acute otitis media or externa [29]. Thus, its presence in beef would cause infection by contact in case one scratches the ears with fingers contaminated with bacteria from beef.

The opportunistic pathogen genera isolated were: *Acinetobacter*, *Chryseomonas*, *Citrobacter*, *Enterobacter*, *Klebsiella*, *Leclercia*, *Proteus*, *Pseudomonas*, *Burkholderia*, *Sphingomonas* and *Serratia*. *Acinetobacter* species are ubiquitous, free-living saprophytes found in soil, water, foods and the clinical environment [30]. Their isolation would be expected to have been as a result of contamination from a wide variety of sources. The organism has limited virulence factors and is thus considered an opportunistic pathogen in humans [31].

The isolation rate for *Chryseomonas luteola* was 8.2%. It is an uncommon opportunistic pathogen that was previously known as CDC group Ve-1, *Pseudomonas luteola* and *Chryseomonas polytricha*. By 16-S ribosomal-RNA sequencing, *C. luteola* and *Flavimonas oryzihabitans* share considerable sequence homology with *P. aeruginosa* [32]. Though considered uncommon, its high isolation rate in the present study may be an indication that it is not uncommon and could be of clinical importance. Reported infections due to the bacteria include bacteremia, peritonitis (associated with appendicitis and colon cancer as well as catheters), osteomyelitis, endocarditis and meningitis [33,34]. Possibility of bacteremia occurring from the organism when present in beef cannot be overruled since an accidental cut when handling the beef may introduce the bacterium into blood circulation.

*Proteus* species are widely distributed in nature and constitute an important part of the flora of decomposing matter of animal origin. They are constantly present in rotten meat and sewage and very frequently isolated in the faeces of man and animals [35].

*Pseudomonas* species are associated with opportunistic infections [36]. Among the fully characterised species of *Pseudomonas*, *P. vesicularis* were the most common and are known to colonize hospital environments (36). The presence of *Pseudomonas* species in beef is not a major health hazard since these organisms are present in various environments and are involved in meat spoilage.

*Burkholderia cepacia* is ubiquitous in nature and can be isolated from surface water and soil (37). Its isolation in beef may thus be from contamination by soil or water.

*Klebsiella*, *Enterobacter* and *Serratia*, belong to the tribe *Klebsiellae* (38). These organisms are colonizers of the human gastrointestinal tract and are capable of causing a wide variety of clinical

syndromes, including urinary tract infection, pneumonia and bacteraemia. They are rarely associated with disease in the normal host but are a major cause of nosocomial and opportunistic infection (39). Thus, they are of less importance to healthy individuals but can be a cause of worry to the immunosuppressed.

Although uncommon, *Citrobacter* has been associated with significant nosocomial infection, particularly involving the urinary and respiratory tracts of debilitated, hospitalized patients (40, 41).

Commensals and environmental bacteria contributed 19.43% and 2.84% of the isolates, respectively. *Oligella urethralis* is a commensal of the genitourinary tract (GUT) and most clinical isolates are from the urine, predominantly from men (42). Though a commensal organism, its presence in beef is of much concern as it indicates low hygienic standards of the butcher or beef handlers. The organism being a urinary tract commensal may have been introduced to the beef on failure to wash hands after visiting the toilet by the meat handler. *O. urethralis* isolates were from the low class butchereries including the two butchereries reported to have had a sewage system passing nearby their premise. This may give credence to the importance of the bacteria as a hygienic standard indicator.

*Weeksella zoohelcum* is part of the normal oral flora of dogs and other animals and most clinical isolates come from bite wounds [43,44]. A case report of meningitis following multiple dog bites is the only report of an invasive infection caused by this organism [45]. *W. virosa* has been isolated from the genital tract and urine of women and is usually not a pathogen [46,47]. The organisms are therefore unlikely to be of major health concern.

*Flavobacterium* is one of the organisms involved in liquid egg spoilage [48] and together with *Erwinia* comprises the most common organisms in leaves [49]. Their isolation would hence be considered of little medical importance.

*Micrococcus* species are widely distributed in nature but their primary habitat is the mammalian skin [50]. *Micrococcus lylae*, have been isolated from blood and surgical specimens of patients associated with heart diseases and septic complications following cardiac surgery [51]. Despite such reports implicating the bacteria as a cause of infections their role as opportunistic pathogens has not been proven.

*Shewanella putrefaciens* is frequently isolated as part of a polymicrobial infection and its pathogenic role is often unclear. Lower extremity cellulitis in association with chronic ulcers or after burns is one of the more commonly described presentations [52]. Although the organism is widely distributed in the environment, it is not known to be a threat to human health.

*Sphingomonas paucimobilis* has been implicated in nosocomial outbreaks associated with contaminated water and contaminated ventilator temperature probes [53,54]. Presence of the bacteria in beef would be of concern to the immunocompromised.

The fact that 42.2% of fully characterised bacteria are pathogenic is alarming. This indicates that infections from bacteria present in beef may be occurring but are largely unnoticed. There is also the possibility that the pathogens are present but in such low numbers that they do not cause any illness or disease. It could also be that proper beef handling is done or proper cooking and roasting is achieved such that the bacteria are eliminated. Proper handling may likely hold more weight than the low bacteria counts since, beef is likely to serve as an enrichment medium that would facilitate faster multiplication of bacteria; after all, beef is often used in the preparation of microbiological media.

Beef being considered as one of the most nutritious foods is commonly prepared for the sick that are likely to be immunocompromised. With 35.54% isolation of opportunistic pathogens, much care is required when handling beef and other foods to avoid cross-contami-

nation especially if to be consumed by the sick.

In a study carried out to obtain the nationwide beef microbiological baseline data in the United States the organisms targeted were *Salmonella*, *S. aureus* (coagulase positive), *Clostridium perfringens*, *E. coli* O157:H7, *Campylobacter jejuni/coli*, *Listeria monocytogenes* and *E. coli* (Biotype I). The organisms were targeted on the basis of their association with human illnesses reports [55]. Isolation rate of the organisms from 2,112 carcasses in the study was *E. coli* (Biotype I) 15.8%, *C. perfringens* 8.3%, *S. aureus* 8.4%, *L. monocytogenes* 11.3%, *Salmonella* 2.7% and *E. coli* O157:H7 was not recovered. Isolation rate of *C. jejuni/coli* was 1.1% from 2,109 carcasses [55]. In the current study, which targeted aerobic bacteria, *E. coli* and *Salmonella* were not recovered. Coagulase positive *S. aureus* were recovered in three of the forty two (7.1%) beef samples. There is no statistically significant difference between the isolation rates of *S. aureus* and *Salmonella* in the current study and that of United States ( $p=0.996$  and  $0.553$  for *S. aureus* and *Salmonella* respectively by Chi square). Isolation of *E. coli* (Biotype I) was significantly higher in the United States than was in the current study ( $p=0.01$  by Chi square). Though the study in United States targeted organisms commonly reported to cause infections there is a possibility that they missed out other possible pathogens present in beef. The pathogenic organisms obtained in the current study and have been reported previously in other studies to cause infections should be studied in a clinical setting to determine their prevalence and whether they are involved in human infections in Kenya.

## Acknowledgement.

Appreciation goes to the Institute of Tropical Medicine and Infectious Disease, Kenya Medical Research Institute and Jomo Kenyatta University of Agriculture and Technology for their facilities and administrative support.

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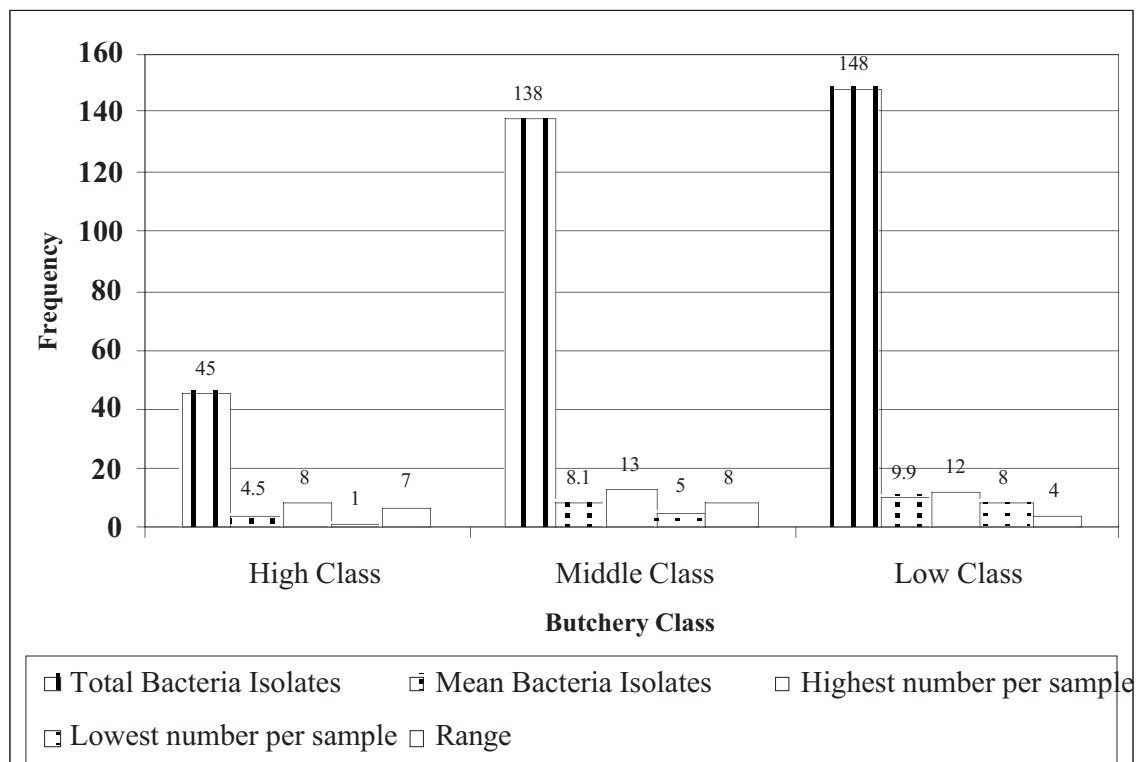
**Table 1. Butcheries meat storage methods.**

Butchery Room class	temp	Refrigerated/ frozen	Surface	Hanging placed	
High Class -		10	-	-	
Middle Class	15	2		14	13 <sup>1</sup> /3 <sup>a</sup>
Low Class 15		0	15	5 <sup>1</sup>	
<b>Total</b>	<b>30</b>	<b>12</b>		<b>29</b>	

<sup>1</sup>Butcheries with beef hung and placed on table surface at the same time.

<sup>a</sup>Butcheries with hung and no table surface placed beef.

**Figure 1. Bacterial loads in different butchery categories, Nairobi, 2004**



**Table 2. Distribution of bacteria genera within butchery classes, Nairobi, 2004.**

	High class	Middle class	Low class	Total	Species Types	Isolation rate %
Micrococcus	3	16	14	33	1+	10.0
Staphylococcus	2	16	12	30	2+	9.1
Chryseomonas	5	9	13	27	1	8.2
Aeromonas	-	11	14	25	4	7.6
Pseudomonas	5	7	10	22	4+	6.7
Vibrio	2	7	9	18	4	5.4
Streptococcus	2	2	4	8	-	2.4
Providencia	-	6	2	8	2	2.4
Acinetobacter	-	2	4	6	3	1.8
Proteus	-	3	2	5	2	1.5
Weeksella	-	2	2	4	2	1.2
Flavobacterium	1	2	-	3	2	0.9
Klebsiella	-	-	3	3	2	0.9
Oligella	-	-	3	3	1	0.9
Pasteurella	1	-	2	3	3	0.9
Burkholderia	2	-	-	2	1	0.6
Moraxella	-	1	1	2	2	0.6
Enterobacter	-	1	1	2	1	0.6
Erwinia	1	-	1	2	1	0.6
Citrobacter	1	1	-	2	1	0.6
Shewanella	-	-	1	1	1	0.3
Sphingomonas	1	-	-	1	1	0.3
Listonella	-	1	-	1	1	0.3
Leclercia	-	-	1	1	1	0.3
Listeria	1	-	-	1	1	0.3
Bordetella/Alcaligenes	-	-	1	1	1	0.3
Serratia	-	1	-	1	1	0.3
Gram negative coccobacilli	-	1	4	5	-	1.5
Gram negative rods	5	18	16	39	-	11.8
Gram positive coccobacilli	-	1	-	1	-	0.3
Gram positive rods	8	7	10	25	-	7.6
Gram variable rods	-	-	3	3	-	0.9
Unidentified a	5	23	15	43	-	13.0
Total bacteria isolates	45	138	148	331	331	100.0
Total bacteria genera	14	21	24			

a Only the colony morphology was described. Bold type: present in all butchery classes.

**Table 3. Isolation rates of different bacterial classes.**

<b>Bacteria Classification</b>	<b>n</b>	<b>Isolation rate</b>			
		<b>% C</b>		<b>% T</b>	
Pathogenic	89	42		27	
Opportunistic pathogen	75	36	23		
Commensal	41	19		12	
Environmental	6	3		2	
Unclassified	120	-		36	
<b>Total</b>	<b>331</b>	<b>100.00</b>		<b>100.00</b>	

**% C** – Denominator 211 (Sum of characterized bacteria).

**% T** – Denominator 331 (Total bacteria isolates).



# Effect of training Kenyan small-scale French bean farmers on modern food safety management systems

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## ABSTRACT

**Background:** French beans are the most important export horticultural crop in Kenya both in value and volume. In 2001, the value of fresh produce exports from Kenya was in excess of \$ 210 Million. In the early 80's, between 70-85% of horticultural exports came from small-scale farmers, but current estimates are down to 40%. The reason for this decline is due to safety concerns from major European markets (supermarkets). Small-scale farmers clearly lack resources, facilities and knowledge that can enable them to meet European standards and demonstrate adequate and acceptable levels of food safety assurance.

**Objectives:** The main objective of the work was to find out ways of harmonizing small-scale farmers' production practices with the food safety practices so as to enhance the safety of their export products by training them on Good Agricultural Practices.

**Methods:** The reported study was conducted on two groups of small-scale farmers. One group was trained on food safety Good

Agriculture Practices (GAP), before the commencement of the field study and throughout the production cycles and another group was not given any training and was used as a control. Samples were taken from the two groups for microbial quality and chemical residue analysis.

**Results:** Samples from the trained group had significantly lower ( $p < 0.001$ ), E coli contamination of 6 cfu/g, ( $n=24$ ,  $SD=2.52$ ) compared to samples from the control group, with E.coli contamination of 14 cfu/g, ( $n=24$ ,  $SD=8.76$ ). However, only 10 % of the total farmers in the two groups had produce with contamination at the borderline (20-100cfu/g E.coli) given by the Public Health Laboratory Service (PHLS, UK). The rest (90%) had acceptable (0-20cfu/g E.coli) contamination levels in their produce. Twenty-one pesticide compounds were analysed for MRLs, and three were detected in the samples from the two groups. Endosulphan was found to be in highest concentration in the treatment group; with average levels of 0.16 ppm (EU MRLs is 0.05 ppm) whereas Cypermethrin and Dicofof concentrations were 0.019 ppm and 0.04 ppm respectively (EU MRLs are 0.05 ppm and 0.02 ppm respectively). From the control group Dicofof concentration was 0.035 ppm and Cypermethrin was 0.021 ppm. The concentration of Dicofof and Endosulphan residues in the French bean samples from both study groups was significantly higher ( $P < 0.001$ ) than EU MRLs for French beans.

**Conclusion:** The results of microbial contamination on French beans showed that, small-scale farmers' microbial contamination problems are more perceived than real. The study elucidated a clear lack of pesticide regulatory measures at the field level. There is need to put up a better structural support in control of pesticide.

**Key words:** French beans, Good Agricultural Practice (GAP), Maximum Residue Levels (MRLs), small scale farmers.

## INTRODUCTION

French beans are the most important export horticultural crop in Kenya in terms of value and volume [1]. Most horticultural export farmers in Kenya are small-scale producers who are contracted by major horticultural exporters as their producers. French beans are planted alongside other crops and on average small scale farmers have between 0.5– 2.5 acres [2]

Although the incidence of food borne illness in fresh produce is low, this does not make it safe. In the last two to three years, consumers in the European markets have been demanding for more responsibility and transparency in the safety of imported fresh produce.

Progress in food science and technology as well as rise in global trade has met with an increase in emerging critically important enteric pathogens, e.g. *Escherichia coli* O157:H7, *Salmonella* spp, *Campylobacter* spp, *Listeria monocytogene*, to name a few. Likewise, the rise in the number of vulnerable people such as the elderly, the immunocompromised individuals, the undernourished and others with underlying health problems have also made food safety an area of great concern [3].

*E. coli* is normally present at higher numbers than other potential pathogens and is easier to detect, and hence its use as an indicator of potential hazards from faecal contamination [4]. Some important sources of microbial contamination are animal and human faeces, irrigation water and personnel hygiene both at production and at post harvest operations.

Current human problems associated with pesticide residues like mutagenic, carcinogenic and/or teratogenic potential on long term exposure and consumption of contaminated foods have increased consumer demands for food which is free from pesticide residues [5].

The reaction of the UK importers to these consumer food safety demands has been to push them down the supply chain, to the export suppliers. This is due to perceived concerns that unlike large scale farmers who have clear advantages of facilities, trained manpower and economies of scale which can enable them to demonstrate food safety assurance through traceability programmes, small-scale farmers who clearly lack these facilities may not be able to adequately meet European standards and demonstrate acceptable levels of food safety assurance. However, these perceptions are not backed up by data on the degree of food safety risk associated with production by small-scale farmers. A food safety management guide was developed for training small-scale farmers so as to give credibility to the safety of their produce and thus retain access to the valuable source of income associated with export markets. Food safety assurance is recognised as being vital for ensuring economic and social productivity [6].

## MATERIALS AND METHODS

### Location of the study area

Kirinyaga District, which is in the Central Highlands of Kenya, characterised by a cool bracing climate with mean annual maximum and minimum temperatures of 26.1°C (79°F) and 10°C (50°F), respectively was selected for the study. In the absence of a reliable rainfall pattern, many farmers have switched to practising all year round irrigation mainly for high value export commodities. This study focussed on two groups, one contracted by an export company, which was termed, the treatment group and the other, the control group, which was self organised through the help of the area Horticultural Crops Development Authority (HCDA) field manager. Each of the groups had twenty-four (24) farmers. In order to avoid training information filtering from one group to another, the two groups were chosen from different localities within a distance of 20 km. The treatment group was used for the experiment and was trained on food safety guidelines as proposed in the food safety management guide. The control group did not receive any training. A French bean season runs for approximately 45 ± 2 days, which makes a total of over 140 days for the whole of the field experimental work.

### Training

The main food safety areas covered during the training were:

Harvest and grading practices in relation to post harvest microbial contamination

Field facilities like field toilets and hand washing facilities as part of personal hygiene in light of their role in faecal contamination.

Manure management and composting procedures for its potential as a source of faecal contamination.

Irrigation water source and methods

Record keeping for purpose of traceability.

### Microbial Analysis

French bean (*Phaseolus vulgaris*, variety Army) samples were collected from each of the 24 members in the two groups. A field sample of 200 g from each of the farmer at each sampling period was taken and this was used for both microbial and residue analysis. At the packing shed sampling was done from each of the farmer's harvest as they sorted and graded their produce. Samples from each farmer were put into a sterile food bag and carried in a cool box from the field to the laboratory. Analysis was done within 8 hours. Rinse method technique for fresh produce was used for the detection and enumeration of *E. coli* as provided in the protocol for the Zimbabwe project. Rapid detection and enumeration of *E. coli*, was done as recommended by WASO committee under specification WASO 6391-1988 and WASO 9308-1990 [7]. A 25 g of sample was suspended in 50 ml of diluents. Surface rinsing of the samples was done with a stomacher (Seaward 400, UK) for 30 seconds. A membrane (cellulose acetate membrane of 0.45 µm pore size, Watman, UK) filter was placed aseptically onto filter equipment. 2 ml of the diluent was filtered through the membrane and then transferred aseptically onto the surface of a labelled TBA plate. Incubation was done at 44 ± 1°C for 24 hours for *E. coli* detection and determination. At the end of incubation the membrane filters were picked from the agar plates and transferred onto the lid of the petri dish and flooded with Kovac's reagent. After about 5 minutes in daylight, indole positive colonies (pink in colour) were counted and presumed as *E. coli* count.

### Pesticide Residues Analysis by GC

Organochlorine, organophosphorous and pyrethroid in French beans were analysed by gas chromatography. The GC, model 6890, Hewlett Packard, USA, equipped with an electron capture detector, ECD- Ni 63 and a nitrogen-phosphorous detector (NPD) was used in this study. The ECD maximum temperature was 330°C, with a constant makeup nitrogen gas flow of 60.0 ml/min. The capillary column used was 30 m long, model number: JWS 122 - 5032, with column maximum temperature of 325°C. The oven initial temperature was 100°C, which was held for 1 minute and increased by 5°C/min to 290°C and then held for 3 minutes. The detector temperature was 330°C. Operating time of the split less mode was 1.10 min and the run time was 27 minutes. The nitrogen phosphorus detector (NPD) maximum temperature was 325°C, with a constant make up hydrogen gas with a flow of 3.2 ml/min and airflow of 60.0 ml/min. A capillary column, BD-5, serial No: 8697585, model No: JWS 122 - 5032, with a column maximum temperature of 325°C was used for concentration determination. The column length was 30.0 m, diameter of 250.0 µm and nominal film thickness of 0.25 µm. Oven temperature was 50°C, which was held for 10 minutes and then increased to a final temperature of 250°C and held for 5 minutes. The operating time of the split less mode was 1.10 minutes and the run time was 26 minutes.

### Sample extraction with Ethyl Acetate

A French bean sample (30g) was chopped and put into a maceration jar. Ethyl Acetate (60 ml) was added in the presence of 5g sodium hydrogen carbonate (NaHCO<sub>3</sub>- Sigma, UK) and anhydrous sodium sulphate, 35g (Na<sub>2</sub>SO<sub>4</sub>- Sigma, UK), added. A high-speed macerator (HAM Kokusan homogeniser) was used to blend for 5 minutes. Sodium sulphate was added to remove water from the sample and sodium hydrogen carbonate acted as a buffer. The temperature during extraction maintained at 27-33°C. The slurry was transferred to a fume hood to let the solvents separate from the solid material for 20 minutes. The mixture was separated by filtering through a cotton wool plug into a 25-ml glass-stoppered measuring cylinder. The filtrate (25 ml) was evaporated in a Rotary evaporator (Ribby, Model RE 100B, UK) to near dryness. This was rinsed with 2 ml of ethyl acetate, transferred to a test tube and re-concentrated to give a final volume of 1ml using dry nitrogen gas. It was then transferred to a 5ml vial for storage at ± 2°C to wait for clean up. (USFDA, NRI, Pesticide analysis manuals)

The clean up method employed in this study used a florisil column. In this, a chromatography column (0.25-mm internal diameter) was clamped vertically, rinsed with hexane and the rinse collected in a beaker. The stopcock was closed and fresh hexane poured to a height of 15cm. Approximately 20 g of florisil (BDH, UK) was poured into the column and this was allowed to settle evenly in the hexane. An even layer (1 cm thick) of sodium sulphate was added to the top of the florisil to form a protective cap and the column rinsed again with hexane. A round bottomed flask (500ml capacity) was placed under the column to collect the elute. The stopcock was opened and hexane allowed to flow at a steady rate of approximately 5ml/min (USFDA, NRI, Pesticide analysis manuals). Elution of extracts was done using hexane (5ml), which was added to the prepared extract. The column was rinsed down with two consecutive aliquots (5 ml) of hexane at different fractions. The first fraction was made up of diethyl ether, (200ml of 6% v/v) in hexane and this was added down against the walls of the column and as the solvent level drained down, the stopcock was adjusted to maintain the required flow rate.

Eluent from this column was collected in a 500 ml round bottomed flask. The second fraction, diethyl ether in hexane (200 ml of 30% v/v) was likewise added. Eluent from this second fraction was collected in a second round-bottomed flask (500ml capacity). Each eluent was evaporated with a rotary vacuum evaporator (RIBBY, model RE 100B, UK) at 40° C to near dryness. The extracts were then rinsed with hexane and transferred to a volumetric flask (5-ml) and the volume adjusted to the meniscus mark with hexane. Samples were stored frozen at ±2° prior to analysis by GLC (USFDA, NRI pesticide analysis manuals).

1 μl of sample extract was injected (split less) into the GC column for analysis with the ECD and NPD to determine the concentration of pesticide residue levels in mg/kg (ppm). (Cox, 2001). Standard solution mixtures prepared in hexane at a concentration of 0.01 - 0.05 ppm were injected into the GC. A concentration for each was determined based on the chromatogram obtained using the Hewlett Packard workstation. Data produced on the chromatograms was analysed and identification of pesticide residues was done by comparing the sample retention times and area with those of the injected standards. The concentration of each in the sample was calculated from the reference standard chromatograms and quantification of the residues for those samples found positive, was done using the formula:

$$\frac{V1 \cdot S \cdot V2}{V3 \cdot W}$$

- V1= Volume (μl) of standard injected
- V2= Final volume (ml) in which sample was reconstituted in
- V3= Volume (μl) of sample injected
- S= Concentration of standard (ppm)
- W= Effective weight of sample (g)

(USFDA, NRI, pesticide analysis manual)

## Results and Discussion

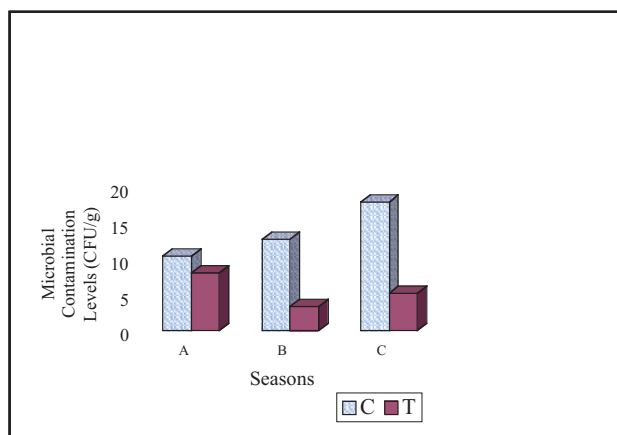
### E. coli Contamination

Samples from the treatment group had mean E.coli contamination levels of 6 cfu/g (n=24, SD=2.52), compared to samples from the control group which had mean E.coli contamination levels of 14 cfu/g (n=24, SD=8.76). A two-way Analysis of Variance (ANOVA) test done showed a significance difference (P<0.001) in contamination levels between samples from the trained group and the untrained group, (Fig 1).

However, training alone could not be attributed to the low level of E.coli contamination without appreciating other underlying factors that gave farmers in the treatment group a comparative advantage over farmers in the control group.

From baseline survey done before commencement of the study, farmers in the group chosen as the treatment group had carried out French bean farming for an average of three years. They had thorough contact with horticulture field extension workers and received information on the export market requirements. This could be seen in the well-designed grading shed that they had constructed together with pit latrine and running water for hand washing during grading. It was therefore possible to practice and implement food safety training because basic hygiene facilities were in place. On the contrary, the control group farmers had no prior knowledge about export horticulture that could have enabled them to have in place facilities like a grading shed, toilet and running water. French bean grading in the control group farmers took place about anywhere in the field or home-stead or by the roadside as they waited for willing buyers. These places could not guarantee hygiene and the produce was therefore exposed to contamination risk.

**FIG 1 Variation in Ecollevels French Bean samples Between The Trained Group (T) and The Untrained Group (C) in Three Seasons**



Results in Fig1 above, showed a decline in E. coli contamination from season A, which was the first study season, for the treatment group through to season C, the last study season. However, the decline was not consistent as during the third season, C as E. coli contamination increased instead of decreasing as farmers became more familiar with food safety principles. An increase in rainfall during the months of February/ March, when the final harvesting was taking place could probably account for the increase in E. coli contamination during the third season. In rainy weather, the effect of soil splashes onto produce resulted in muddy and soiled produce. To avoid export companies rejecting their produce due to soil/mud, small-scale farmers resort to field washing. However, river water used for field washing of French beans could not be guaranteed as completely safe from microbial contamination, and especially during the rain seasons when there was the likelihood of floods. This together with use of dirty washing containers could have combined to increase the risk of microbial contamination during this season. However, E. coli contamination in the French bean samples from the two study groups was below the level given by Public Health Laboratory Services (UK), on acceptable number of E. coli (cfu/g) in fresh produce. Only10% French bean samples had E. coli contamination levels in the borderline class (20-100 cfu/g) and the rest of the samples (90%) had E. coli contamination below the 20 cfu/g, which is in the acceptable range. Most of the small-sale farmer's production activities needed minimal modification and if this could be carried out, then it would help to have small-scale farmers producing as per market requirements.

### Pesticide Residues

Of the 21 compounds analysed for, only 3 compounds were detected in the French bean samples from the two groups. Results in Table 1 show the distribution (percentage) of farmers under each compound detected on French bean samples for each group. French bean samples from farmers in the treatment group had more pesticide residue contamination for the three compounds detected. From the



results, 73% of the samples had Cypermethrin residues, 27% had Dicofol residues, and 20% had Endosulphan residues, as compared to samples from farmers in the control group, 60% who had Cypermethrin residues, 33 % Dicofol residues and none had Endosulphan residues.

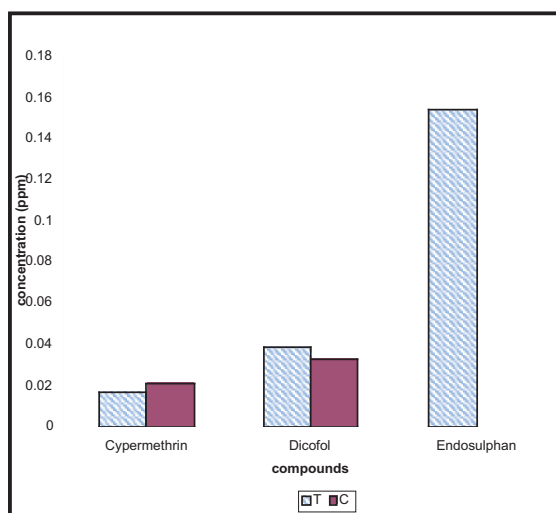
**Table 1 Distribution (%) of French bean samples detected with pesticideresidues in the two study groups**

Group	% number of samples detected with Pesticide residues		
	Cypermethrin	Dicofol	Endosulphan
T	73%	27%	20%
C	60%	33%	0

Samples from the treatment group showed high pesticide residues, and this could have been due to the fact that farmers were in a better position to purchase chemicals since they were engaged in export production as contract farmers with the result that they fetched better prices for their produce as compared with those in the control group. The farmers in the control group may not have needed to spend money on chemicals, as they were not guaranteed prices that could cover for the costs of such an input. They may have been forced to sparingly use chemicals meant for other farming operations e.g. tomatoes or rice farming.

**FIG 2. Comparison of Concentration of Pesticide Residues Detected in French Bean Samples Between The Trained Group (T) and The Untrained Group (C) During The Study**

**Seasons**



The largest pesticide concentration was Endosulphan, with an average concentration of 0.154 ppm (n=15, SD=0.34), Fig 2, from farmers in the treatment group. The Maximum Residue Levels (MRLs)

given by EEC, Directives 76/895/EEC, 86/362/EEC, 86/363/EEC & 90/642/EEC for endosulphan in French beans is 0.05 ppm. The concentration of this compound was therefore higher than EU MRLs and Analysis of variance (ANOVA) done against EU MRL showed that its concentration was significantly higher, (P<0.001). However, concentration of Cypermethrin (0.02 ppm) from French bean samples for both study groups was within the EU MRLs, of 0.05 ppm. The concentration of Dicofol in samples from the treatment group was 0.04 ppm and 0.03 from the control group. EU MRL for Dicofol is 0.02 ppm, showing that Dicofol was present in high concentration in samples from both study groups. Analysis of Variance (ANOVA) against EU MRLs for Dicofol showed that the concentration was significantly higher at (P<0.001).

Both Cypermethrin and Endosulphan are pyrethroid insecticides, which are sprayed onto produce close to harvest. Their presence in the samples could have most likely be from lack of strict observance of waiting periods, although Dicofol is more persistent and should be used with caution on such a short term crop. When farmers fail to observe pre-harvest intervals as given in the pesticide labels, this introduces possibility of residues in harvested produce, because the chemical compounds have not been allowed to undergo complete breakdown.

Keeping farm records which showed dates of chemical application and harvest due dates could have helped in knowing when to harvest. Farmers generally lacked training on record keeping. Training on good agricultural practice emphasised the need for follow up on record keeping, pesticide chemical application methods and use of approved chemicals. Farmers' ignorance, poverty, illiteracy, poor prices and lack of support from the industry are believed to be responsible for the farmer's choice of pesticide and method of application [1]. Misappropriation, more than use of inappropriate chemicals was the main problem in the field among the small-scale farmers studied in this experiment. Lack of money played a big role as it forced farmers to resort to buying chemicals they could afford without checking whether it was appropriate for French beans or not. Most export companies have realised the problem and have resorted to providing farmers with chemicals as part of the inputs, which are then deducted from the farmer's proceeds. But this method does not always work as farmers sometimes find this kind of arrangement expensive and result to buying chemicals not approved for use on French beans.

The move by some export companies to hire field agronomists to train small-scale farmers to strict adherence to pesticide application details as outlined by each company could make a difference in the pesticide problem on produce from Kenya. The big challenge that farmers and exporters are facing is on how to harmonise company requirements with what chemical manufacturers or chemical merchants are selling to the farmers to avoid contradictions. Educating farmers on the damage caused by pesticide abuse both to consumer and producer health, ecosystem and pest build up is a task that needs to be addressed by not just the export industry but by all stakeholders. This would be more effective if government intervention on issues related to pesticide policies/ regulations were more pronounced in terms of training and surveillance on products being used in the country's horticulture sector, in view of the importance of horticulture to the country's economy in terms of foreign earnings. Consultations between exporters and small-scale farmers on acceptable pesticides in the market were not up to date. There was need for this to be done on a regular basis through training and education on market requirements. The small-scale farmers need to be given training on pest and disease control through Integrated Pest Management (IPM) procedures and proper follow-up so as to realise the ultimate goal of reducing pesticides residues in fresh produce.

## CONCLUSION

The results of microbial contamination on French beans showed that, small-scale farmers' microbial contamination problems are more perceived than real. Even for farmers who did not have good grading and field facilities as well as other basic infrastructure, *E. coli* contamination levels were detected in only 10% of the samples. These results were at the borderline of acceptable cfu/g as provided under the Public Health Laboratory Services (PHLS, UK) guidelines. This however, does not undermine the need to train small-scale farmers on pre and post harvest hygiene principles.

The study elucidated a clear lack of regulatory measures and mechanisms at the field level and that is the cause of problems such as the unregulated sales of pesticides. There needs to be a better structural support in matters of control of sales and utilisation of pesticide. Small-scale farmers lack support from the stakeholders in matters of training and support or implementation of improved food safety assurance. Sometimes, training is left to the relevant exporter who may not be able to carry out training due to the heavy financial commitment required to employ food safety specialists. Lack of trained field personnel in the area of pesticide use made it difficult to pass appropriate information to small-scale farmers. Due to lack of trained personnel in agronomy and chemical use, the farmers get contradictory instructions or misleading information especially from pesticide vendors.

Lack of price controls often make farmers look for cheaper chemicals, which could be adulterated, unregistered or restricted. Implementations of good farming techniques require capital, which most small-scale farmers cannot afford. There was also a clear lack of uniform export market standards, (for example within the EU) which in most cases confused farmers on which standards to implement. Farmers would tend to go for the least strict market, as this would require least inputs, and this helped to bring about a situation that created a general breakdown of good farming practices. Lack of an active horticulture industry laboratory service provider, who could be relied on to analyse and communicate results within a good time frame, was also a limiting factor in implementing good farming practices as there were no results showing need to reform current practices. Most exporters as yet do not appreciate the importance of laboratory analysis for fresh produce, which places them at a disadvantage with the rest of the global food producers who take matters of food analysis more seriously. Due to lack of credible analytical work, there is no convincing data that can help the industry defend itself if need be.

## RECOMMENDATIONS

1. There is need for better communication between farmers, researchers and stakeholders on integrated pest management procedures and methods to reduce the current abuse on pesticides. Introduction of new products e.g. plant extracts (Bio-algae) or Bio-pesticides which are more environmentally friendly and non-toxic to both human, plants, animals and the environment needs to be looked into.
2. Manufacturers, government agencies and industry stakeholders must co-operate to come up with ways of teaching small-scale farmers better ways of pesticide application and other good farming practices to harmonise with the rest of the world food producers.
3. There is need to teach small-scale farmers on how they can treat field water in instances where they have to wash their produce as well as use of clean harvest equipment. Use of chlorine tablets at the field is one method that can help farmers use safe water and minimise microbial hazards in French beans.
4. More practical involvement is needed in implementing the current codes of practices is required.
5. There is need to introduce simple analytical tests for example, ELISA (enzyme linked immunosorbent assay) or thin-layer chromatography (TLC), which are able to work in places with irregular supply of electricity or insufficient money for GLC methods. These easy, alternative and adaptable methods can help in screening and monitoring food safety problems in fresh fruits and vegetables in a developing country like Kenya.
6. There is need for removal of the current monopoly of export seed breeder/importer to other importers/breeders to reduce the current high seed price that small-scale farmers have to put up with. This would ease the financial constraints that affect small-scale producers.
7. Continuous training to keep up with global market requirements must be done if the small-scale farmers and the general horticultural industry are to be sustained.
8. Harmonisation of market requirements and better co-ordination between stakeholders will help global market standards to be more readily implemented at the producer level.

## ACKNOWLEDGEMENT

This publication is an output from research project funded by the United Kingdom Department for International Development (DFID, R7528 Crop Post Harvest Research Programme) for the benefit of developing countries. The views expressed are not necessarily those of DFID

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# Levels of Fluoride in Soils and Water in Some Parts of Eastern and Central Province of Kenya and Their Implication to Human Health.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Low amounts of ingested fluorides are important for prevention of dental caries. However, at high levels, fluoride becomes toxic to human beings. Soils vary in their fluoride content, depending on geographical location and soil type. The objective of this study was to determine fluoride content in soil and water. Soil and water samples were obtained from Thika and Mwingi Districts of Central and Eastern Provinces, respectively, three divisions from each district were chosen. From each of the divisions' four water samples and three soils sample were taken for analysis. The mean fluoride content in 18 soil samples analysed was 24.1 mg/100 g. The highest fluoride content in soil was that from a sample from Juja (29.8 mg/100 g) the lowest was 8.8 mg/100g from a sample from Kamwangi division in Thika district. Juja soil samples had the highest fluoride content, while samples from Kamwangi had low fluoride content, with a mean fluoride content of 28.2 mg/100 g and 15.8 mg/100 g, respectively. The highest fluoride content in water samples was that from a sample in Central division in Mwingi, which was 2.7 mg/100 g. The lowest fluoride content in water samples was that from a sample in Gakoe in Thika district, which was 0.007 mg/100 g. Central division in Mwingi District had the highest fluoride content in water samples, with a mean of 0.17 mg/100 g. Both Gakoe and Kamwangi areas had low mean fluoride content of 0.02 mg/100 g and 0.03 mg/100 g, respectively. The mean fluoride content for all the sites, apart from two is higher than the recommended acceptable levels by WHO. The soils in some of the areas with low fluoride levels are extremely acidic. This could lead to active uptake of fluoride in some crops leading to high levels of fluoride in foods consumed in the project site.

## Introduction

Fluoride is the most reactive of non-metals and the most electronegative element, and therefore almost never occurs in nature in its elemental state. It combines with all elements, except oxygen and the noble gases to form fluorides. Inorganic fluorides are present in all soils and water as well as in the plants and animals consumed by human for food [1]. The geology of Kenya makes it one of the countries in the world where fluoride occurs in highest concentrations, not only in rocks and soils but also in surface and ground water [2].

Application of phosphate fertilizers, sewage sludge and some pesticides also add fluoride to soil [3]. In some parts of the world, deposits of rocks containing high level of fluoride cause a large increase in fluoride content in water and foods.

Fluoride is particularly associated with thyroid gland dysfunction [4]. It also affects the skeletal and bone tissue [5]. It has also been implicated in premature ageing of the human body [6]. The "Times" reported a scientific study, which revealed that aluminium and fluoride in water could be responsible for the alarming increase in Alzheimer's disease and pre-senile dementia [4]. This confirmed the long held suspicion that fluoride has the ability to act synergistically with other toxic

minerals in drinking water [4]. The upper limit for fluoride consumption is 0.05-0.07mg F/Kg body weight /day, as recommended by WHO [3].

Salinity and sodicity problems are common in the ASAL where they have naturally formed under the prevailing climatic conditions and due to high rates of evapotranspiration and lack of leaching water. About 40% (25 million ha) of the land of Kenya is covered by soils that have salinity and/or sodicity problem(s). Soils that have sodicity or/and salinity problems encourage selective uptake of some minerals by some plants leading to plant toxicity problems. Therefore a soil could have low levels of fluoride but due to salinity and/or sodicity of the soil it could have selective uptake of fluoride leading to high levels of fluoride in the certain crops.

The objective of this study was to determine fluoride content in soil and water in parts of Eastern and Central province of Kenya.

## Materials and Methods

Soil and water samples were obtained from Mwingi District in Eastern Province and Thika District in Central Province. Three divisions were sampled from each district. In Thika, Gakoe, Kamwangi and Juja divisions were sampled, while in Mwingi District Nu, Central and Nguni divisions were sampled. These divisions contrasted in soil fertility and rainfall patterns. In Thika District, Gakoe is cooler and at a higher altitude. It is a high potential area in terms of agriculture and a tea-growing zone. Kamwangi is at a lower altitude and a coffee-growing zone. Juja is semi arid with lower rainfalls than both Gakoe and Kamwangi.

The Mwingi Nu area is more agriculturally potential than both Central and Nguni Divisions. Central Division grows mainly green grams and maize while both Nu and Nguni divisions grows mainly sorghums and millets. Nu has many water springs, while Nguni and Central division has shallow wells and bore holes. From each division, four sites were sampled for water and three sites were sampled for soil. 500-g soil and 500 ml water samples were collected. The soil samples were collected randomly. Samples were collected from major drinking water points from each site. Soils from 5 randomly selected parts of each sampling site were homogeneously mixed to give one sample. The soil was collected at the depth of 15 cm. For extraction of fluoride in soil, 20 ml of 0.2 m Ammonium oxalate at pH 3 was added to a 0.5-g soil sample, this was shaken for 4 h in darkness, filtered and washed in deionised water [7].

It was then topped to 25-ml by distilled water. SPADNS method was used for the determination of fluoride in all samples. In this method, 5-ml spadns/acid zirconyl mixture was added to the 25-ml sample. The absorbance of the samples was read on the spectrophotometer at 570 nm. The fluoride content was determined from a standard curve drawn from absorbance of standard solutions prepared. There was no prior preparation of the water sample; they were directly analyzed for fluoride by SPADNS method.

To measure soil pH, soil was mixed with distilled water in the ratio

1:1. The mixture was shaken for 30 minutes, it was then centrifuged and pH read using a pH meter. [8]

### Results and Discussion

The soil fluoride content ranged from a maximum of 29.8 mg/100 g, in the soil sample from Juja to a minimum of 8.8 mg/100 g in the sample in from Kamwangi. Juja has many big flower farms, which use fertilizers. There is a possibility this could be contributing to the high levels of fluoride in this area. Gakoe and Kamwangi areas had soils of low fluoride contents.

The lowest soil pH recorded was 4.2 from a soil sample in Gakoe area, while the highest pH recorded was 7.9 from a site from Central in Mwingi District. Generally soils from Gakoe and Kamwangi area had low pH. The soils with a pH less than 4.5 are classified as extremely acidic while those with pH between 4.5-5.5 are classified as strongly acidic. From these results the soils, which are acidic, also have low fluoride content. It has been shown that, plants can actively take up fluoride from acidic soils, even if they have low fluoride content.

The fluoride content in water samples ranged from a minimum of 0.07 ppm to a maximum of 2.7 ppm. The highest fluoride content in water samples was that from a sample in Central Division in Mwingi, while the lowest fluoride content in water samples was that from a sample in Gakoe in Thika district. The mean fluoride content for all the sites apart from two was higher than the recommended acceptable levels by WHO. The areas with high fluoride content in soil also have high fluoride content in water.

### Conclusions

Soil fluoride content was highest in Juja (28.2 mg/100 g) and lowest in Kamwangi (15.8 mg/100 g). The highest soil pH was from a site in Nguni, Mwingi District (7.9), and lowest from a site in Gakoe (4.2). Low soil acidity appeared to be positively correlated with low fluoride content in soil. Water samples from Mwingi had the highest fluoride content (1.7 ppm), while those from Gakoe had the lowest mean fluoride content (0.2 ppm). The mean fluoride content for all water samples apart from those from Gakoe and Kamwangi areas had higher levels than the recommended levels for drinking water by WHO. The recommended level is 1 ppm in fluoridated water supplies.

### Recommendations.

Some of the soils analyzed are extremely acidic. Fluoride is actively taken up by certain crops especially in acidic conditions, it follows its important to investigate the fluoride content in foods grown in the project site as well as processed foods consumed in the same sites. It is also important to classify the soil and not just place it in geographical locations. This will help understand the relationship between different soil types and their fluoride content. It is also important to investigate the relationship between intensive flower farming in Juja and soil fluoride levels. Finally, there is need to relate these fluoride levels with disease conditions related to fluoride content.

**Table 1: Fluoride content in soil samples (mg/100 g).**

Sites	Origin of soil/site					
	Nuu	Nguni	Central Mwingi	Kamwangi	Gakoe	Juja
1	23.9	28.5	29.4	8.8	21.1	26.1
2	26.7	29.0	26.2	17.5	27.7	28.8
3	26.6	21.8	27.8	21.1	14.0	29.8
Mean	25.7	26.4	27.8	15.8	20.9	28.2

**Table 2: Soil pH**

Sites	Origin of soil/site					
	Nuu	Nguni	Central mwingi	Kamwangi	Gakoe	Juja
1	7.5	7.7	6.8	4.4	4.7	7.2
2	7.7	7.8	7.9	5.5	5.1	7.1
3	7.1	7.2	7.4	5.7	4.2	6.8
Mean	7.0	7.6	7.4	5.2	4.7	7.0

**Table 3: Fluoride contents in water samples (ppm)**

Sites	Origin/site					
	Nuu	Nguni	Central Mwingi	Kamwangi	Gakoe	Juja
1	0.6	1.3	2.2	0.5	0.4	0.9
2	2.0	1.7	0.8	0.2	0.2	1.4
3	1.5	0.7	1.1	0.3	0.2	1.6
4	0.6	0.8	2.7	0.3	0.07	0.3
Mean	1.2	1.1	1.7	0.3	0.2	1.1

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# Effects of The Mother's Hiv Status on Birth Weight of Babies Case Study at The Province Hospital, Nakuru, Kenya Subtheme: Nutrition, Immunity and Hiv

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Introduction

A mother's health and nutritional status affects birth outcomes and the infant's future health. HIV infection also adversely affects pregnancy outcome.

## Objectives

To investigate birth outcomes of mothers of known HIV status.

## Design

Longitudinal observational study.

## Setting

Antenatal clinic at the Provincial Hospital, Nakuru, Kenya.

## Main outcome measure

Birth outcome of pregnant women of known HIV status, measured by weight of infant at birth.

## Subjects

193 women who attended the antenatal clinic and delivered between February and October 2004

## Results

Birth outcomes of women of known HIV status were assessed. No significant differences were found between the birth weight of HIV positive and negative women. Most of the women were young (60.7% were 25 years or less) and about half of them had previous children. Antenatal clinic attendance for the first time per trimester was 5.2%, 21.2%, 73.6% for first, second and third trimester respectively.

## Conclusion and recommendations

More emphasis needs to be made on the importance of antenatal clinic visits. Maternal HIV status does not seem to have an observed effect on birth outcome in this study. Therefore, any antenatal interventions should be directed at all women irrespective of their HIV status.

## Objective

Investigate birth outcomes of mothers of known HIV status.

## Introduction

### Birth outcome

Weight at birth can be said to reflect the uterine experience. It is a good indicator not only of the mother's health and nutritional status but also the newborn's chances of survival [1]. Two processes determine birth weight: duration of gestation and rate of fetal growth. Gestational age is difficult to determine in developing countries because of late or infrequent access to prenatal care, inadequate documentation of the date of the last menstrual period and unavailability of early ultrasound examination [2]. Impaired fetal growth in the womb predisposes the

infant to low birth weight.

Low birth weight is defined as a birth weight of less than 2.5 kilograms [3]. Low birth weight infants who survive their childhood may suffer cognitive impairment, developmental problems, and a much higher burden of disease due to impaired immune function compared to infants born of normal weight [4]. In the developing world, low birth weight stems primarily from the mother's poor health and nutrition [5]. Inadequate weight gain during pregnancy is particularly important since it accounts for a large proportion of intra uterine growth retardation, therefore leading to low birth weight [6]. In developing countries, an estimated 30 million infants (23.8% of 126 million births per year) are affected by the problem every year, while in contrast the rate is only 2% in developed countries [3].

## HIV and birth outcomes

With the AIDS epidemic, little is known about the impact of maternal HIV status and birth outcomes. The spread of HIV may also be adding to the burden of low birth weight, particularly in sub-Saharan Africa where the prevalence of HIV is high and low birth weight is common. This is because HIV compromises nutritional status of an individual and with pregnancy the effects will be made worse, adversely affecting the birth outcome [7].

Various studies from sub-Saharan Africa have reported that HIV-infected pregnant women are at increased risk of delivering low birth weight and preterm babies. The infants are also at risk of intrauterine growth retardation. These poor outcomes have also been associated with mother to child transmission of HIV and increased mortality of children [8]. HIV infection adversely affects pregnancy outcome, with infants born to HIV infected women having significantly lower mean birth weight and length regardless of the infants HIV status, compared with infants born to uninfected women. Paediatric HIV further reduces birth weight [9].

## Methodology

A longitudinal observational study was carried out at the Provincial Hospital, Nakuru, Kenya. Women attending antenatal clinic were interviewed at various stages of pregnancy. Human immunodeficiency virus (HIV) testing was done through the Prevention of Mother to Child Transmission of HIV Clinic (PMCTC). Only those women who accepted to be tested and knew their status were recruited into the study. Informed consent was obtained from the women and they were assured of anonymity and confidentiality.

Pregnant women were interviewed from February to October 2004. All women were interviewed at the start of the study and only those who attended subsequent antenatal clinics were followed until delivery. The women who delivered during this period, irrespective of their HIV status were 193. Pretested structured questionnaires were used for the interviews in order to obtain personal data on socio-economic and demographic characteristics of the women. Women's



weights were also taken (to the nearest 0.5kg) during these visits. Babies born in hospital had their weights taken (to the nearest 0.1kg) immediately after birth.

### Results

Out of the women interviewed within the period, 193 babies were born at the hospital. Of these babies 42.5% (n = 82) were female and 57.5% (n =111) were male. Ninety two percent (n =178) were hospital deliveries while 7.8% (n =15) were home deliveries. Only 7.3% (n=14) were caesarian section deliveries while 92.7% (n =179) were normal deliveries. Babies of low birth weight (<2.5 kg) were 8.3%(n =16) while 33.7% (n = 65) had birth weights between 2.5-3.0kg and 50.3% (n =97) had weights above 3.0 kg (Weight distribution in Table 1).

All the mothers knew their HIV status, 80.8% (n=156) were negative while 19.2% (n=37) were positive. Of these mothers, 60.7% (n=117) were aged 25 years or less, 23.8% (n=46) were between 26-30 years, and 15.5% (n=30) were more than 30 years old (age distribution in Table1). Only one woman (2.7%) was on antiretroviral therapy during pregnancy. Nevirapine given during labour was taken by 65% (n=24) of the women, while 35% (n=13) were not given. After delivery, 73% (n=27) of the babies were given nevirapine while 27% (n=10) were not given. Most of the women (98.4%, n=190) had some form of education. Of the married women, 77.8% (n=150) of their husbands had some form of income and only 6.2% (n=12) had no income. In contrast, 26.4% (n=51) of the women had some form of income while 73.6% (n=142) had no income at all.

More than half the women (53.9%, n=104) were not first time mothers, with previous deliveries of between one and six (Table 1). The children ranged between 1 and 14 years (Table 1). Antenatal clinic visits for the first time were 5.2% (n=10) during the first trimester, 21.2% (n=41) during the second trimester, while 73.6% (n=142) visited the clinic during the third trimester. There were no statistically significant differences between HIV positive and negative mothers for mean age (p= 0.741 95% CI, (-2.21886,1.58130)) and mean birth weight (p= 0.142 95% CI, (0.04815,0.33392)). Infant mortality within 10 months for the HIV negative and positive mothers was 2.6% (n=4), 10.8% (n=4), respectively.

**Table 1**  
**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Weight at birth	178	1.80	4.80	3.1073	.50355
Age in years	193	15.00	39.00	4.9585	5.25578
Age of last child	104	1.00	14.00	4.5288	2.81796
No. of previous children	104	1.00	6.00	1.7981	1.20178
Gestation at first clinic	193	1.00	9.00	6.0933	1.67755

### Discussion

Women attending the clinics were very young and most of them were not first time mothers. For those with children, the average number was 1.7 with an average age of 4.5 years implying that birth spacing was not a major problem in this group and the number of previous children was also small. During delivery, most of the women used the healthcare facilities ensuring proper care for both mother and baby.

From the results, it is very clear that more emphasis needs to be made on the importance of antenatal clinic visits as women attend the antenatal clinic for the first time too late in pregnancy. This makes it difficult to monitor the woman’s weight gain during pregnancy and therefore prevent any complications of pregnancy. It is also difficult to give women nutrient supplements early in pregnancy when it is most crucial and also intervene if the woman is HIV positive. Early antenatal visits would assist in proper follow-up of mothers during pregnancy, leading to better birth outcomes and health of the mother.

Although the hospital had a policy of giving mothers nevirapine during labour, some did not take it due to various reasons. Only one woman was on antiretroviral therapy during pregnancy implying that something urgent needs to be done in order to reduce perinatal transmission. Maternal HIV status does not seem to have an observed effect on birth outcome. This could be due to the fact that previously assessed nutritional status was not very different between the HIV positive and negative women.

### Conclusion

In conclusion, a more comprehensive and mother friendly antenatal care package needs to be re-emphasized in the hospital in order to improve birth outcomes for both the mother and infant irrespective of maternal HIV status. HIV therapy during pregnancy should be an urgent priority if rates of perinatal transmission are to be reduced. More still needs to be done in order to reduce low birth weight and infant mortality. Therefore, any antenatal interventions should be directed at all women irrespective of their HIV status.

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We, the authors, hereby declare that this paper has not been presented or published elsewhere.



# Potential of Kitchen Gardening in Alleviating Micronutrient Malnutrition in Ngong' Division, Kajiado District, Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Summary

**Objective:** To determine the potential of kitchen gardening in improving micronutrient (vitamin A, iron and zinc) status among children aged 9-59 months in low-income peri-urban populations.

**Design:** Cross-sectional comparative study of micronutrient intake and status of children residing in kitchen gardening with those in none kitchen gardening households of similar social-economic status

**Methodology:** Twenty-four hour dietary recall and laboratory analysis of blood samples were conducted on 28 and 38 children residing in kitchen and non-kitchen gardening households, respectively.

**Results:** Children from the kitchen gardening households consumed significantly more vitamin A and zinc ( $p=0.024$  and  $p=0.021$  respectively) than those from non-kitchen gardening households in the 24-hours period preceding the study. Significantly higher proportion of the study children consumed less than 75% of the RDI for vitamin A ( $p=0.023$ ) and zinc ( $p=0.026$ ) among the non-kitchen gardening households as compared to those in kitchen gardening households. Prevalence of vitamin A and iron deficiency was lower in study children residing in kitchen gardening households as compared to those in non-kitchen gardening households ( $p=0.001$  and  $0.021$  respectively). The mean serum retinol, serum ferritin and serum zinc level were higher for study children in kitchen gardening households ( $p=0.000$ ,  $0.039$  and  $0.002$  respectively) as compared to those in non-kitchen gardening households. There was a significant correlation between kitchen gardening and serum retinol ( $r=0.503$ ), serum ferritin ( $r=0.346$ ) and serum zinc ( $r=0.449$ ) levels. Multiple regression analysis showed that serum retinol, serum ferritin and serum zinc levels were positively associated with kitchen gardening ( $\beta=0.381$ ,  $0.341$ ,  $0.116$  respectively).

**Conclusion:** There is high potential in kitchen gardening as a food based strategy for addressing micronutrient malnutrition among low-income peri-urban populations.

African Institute for Capacity in Agricultural Development (AICAD) funded the research.

## Introduction

The 1999 Kenya National Micronutrient Survey revealed that more than a third (35.7%) of the children had retinol levels below 20 mg/dl. The prevalence of moderate anaemia in Kenya in 1999 was 54%. The proportion of the population with low zinc status (less than 65 mg/dl) in 1999 was 50.8% [1].

Micronutrient malnutrition affects the development of the community. It compromises the immune function leading to high morbidity and mortality. It affects cognitive development leading to impaired school performance and mental achievement. It can also lead to impairment of growth, reproduction and work capacity. Some of these

effects are irreversible and therefore the community is permanently affected.

This article describes the findings of the study carried in Ngong division with an objective of comparing the micronutrient (Vitamin A, iron, and zinc) intake and status of children between 9-59 months in kitchen gardening and non-kitchen gardening households in Mathare and Gichagi villages of Ngong Division, Kajiado District in Rift Valley province, Kenya.

It was hypothesized that:

There is no significant difference in vitamin A, iron, and zinc intake between kitchen gardening and non-kitchen gardening households.

There is no significant difference in vitamin A, iron, and zinc status of children aged 9-59 months in kitchen gardening and non-kitchen gardening households.

## Sampling procedure

After registration of all households with children aged 9-59 months in the two study villages. The households were divided into two groups: those with Kitchen gardens and those without Kitchen gardens. Systematic sampling was then done to come up with a sample of 66 households, 28 in kitchen gardening and 38 in non-kitchen gardening households.

## Methodology

A 24-hr recall dietary assessment that has been regarded as suitable for estimating current food intakes [2,3] was done to determine the food intake of the index child. The conversion of volumes of food to grams was carried out as described in [4] before further analysis. The estimated vitamin A, iron and zinc intakes were then calculated using food composition tables [5,6] and compared with the Recommended Daily Intake (RDI). Based on [7], who states that the amount of nutrients most people require is below RDA, and about half the population would require less than 75% of the RDA, the proportion of children who consumed less than 75% of the RDA was also determined.

Serum retinol, serum ferritin, and serum zinc levels were determined for the study children through blood sample analysis. A haematologist from Kenya Medical Research Institute (KEMRI), Nairobi, did the venipunctures and blood collection. High Pressure Liquid Chromatography (HPLC) technique was used in the analysis of serum retinol levels at 325nm. Mini vidas was used to analyse serum ferritin levels while Flame Atomic Absorption spectrophotometer was used to analyse serum-zinc.

## Results

### Micronutrient Intake

Significantly higher percentage of children from kitchen gardening households consumed both root tubers ( $p=0.048$ ) green leafy vegetables ( $p=0.043$ ) than those from non-kitchen gardening households. Majority (85.7%) of the kitchen gardening households had consumed vegetables from their kitchen gardens during the 24-hour period preceding the study. There was significantly higher intake of vitamin A and zinc among study children in kitchen gardening households than those in non-kitchen gardening households in the preceding 24-hour period (Table I)

Children from the kitchen gardening households generally consumed higher levels of micronutrients than those from non-kitchen gardening households (Figure I). However, only vitamin A and zinc intakes were significantly higher ( $p=0.024$  and  $p=0.021$  respectively).

Figure II shows that significantly higher proportion of children consumed less than 75% of the RDI for vitamin A ( $p=0.020$ ) and zinc ( $p=0.032$ ) among the non-kitchen gardening households as compared to those in kitchen gardening households.

### Micronutrient Status of the Study Children

Blood samples were obtained from 25 (89.3 %) children of the 28 who had been selected from the kitchen gardening households and 32 (84.2%) children of the 38 from the non-kitchen gardening households. Table II shows that the prevalence of deficiencies of vitamin a, iron and zinc was higher among study children in non-kitchen gardening households than among those in kitchen gardening households. However, only serum retinol and serum ferritin were significantly different. The mean serum retinol, serum ferritin and serum zinc was significantly higher among children from kitchen gardening households than those in non-kitchen gardening households as shown in Table III.

Figure III, IV and V shows a comparison of the serum retinol, serum ferritin and serum zinc status of the study children in kitchen gardening households with those in non-kitchen gardening households. Figure III and V shows that study children in kitchen gardening households were better off than those in non-kitchen gardening households. There were also a few outliers, most of them being in kitchen gardening households, with high levels of serum ferritin.

Iron deficiency in presence of vitamin A deficiency was observed in a quarter (25.4%,  $n=55$ ) of the study children. More than three quarters (79%,  $n=14$ ) of the cases were in non-kitchen gardening households.

Spearman's correlation showed a positive correlation between kitchen gardening and the serum retinol, ( $r=0.503$ ,  $p=0.000$ ), ferritin ( $r=0.346$ ,  $p=0.010$ ) and zinc ( $r=0.449$ ,  $p=0.001$ ) levels. There was also a positive correlation between serum-retinol level and vitamin A supplementation ( $r=0.447$ ,  $p=0.023$ )

Based on the Simultaneous multiple regression analysis the following models could be used to predict the micronutrient status.

Serum retinol =  $6.53 + 0.372$  (mothers' level of education) +  $0.563$  (Vitamin A supplementation) +  $0.381$  (kitchen gardening)

Serum ferritin =  $0.66 + 0.314$  (kitchen gardening) Serum ferritin status did not seem to be significantly influenced by de-worming.

Serum zinc =  $1.29 + 0.116$  (kitchen gardening).

## Discussion

According to literature more than 70% of vitamin A in developing countries is derived from plant sources [8]. Sommer [9] notes that in addition to dietary intake of vitamin A, it is important to consider the types of food being consumed. In cases where carotenes are the main vitamin A source the quantities being consumed are crucial. Carotenes are less biologically active than retinol and less efficiently processed and absorbed in the gut. The inadequate intake of vitamin A among the study children could be as result of low quantities and poor food choices.

The results reveal significantly higher mean serum retinol, serum ferritin and serum zinc levels among children from kitchen gardening households. Other results indicated that the difference between the kitchen gardening and non-kitchen gardening households in the proportion of children who had received vitamin A supplementation was not significant. This implies better vitamin A, iron and zinc intakes among children from kitchen gardening households as compared to those from non-kitchen gardening households. This is in agreement with a study carried out in Thailand that showed that the proportion of children with haemoglobin levels of 11  $\mu\text{g}/\text{dl}$  or less was higher for non-kitchen gardening households than for kitchen gardening households [10].

The significant association between the micronutrient status and the kitchen gardening is prove that kitchen gardening influences the micronutrient status of the study children. Apart from providing direct access to food in an affordable way, kitchen gardening could also be freeing money for purchase of other foods. Animal products that are better sources of vitamin A, iron and zinc use the money that would have been used to buy vegetables. The money can also be used to meet health needs of the children and therefore prevent loss of nutrients due to infection.

The high prevalence of micronutrient deficiencies even among the kitchen gardening households could be as a result of seasonality of production of the vegetables. FAO [11] states that to improve micronutrient status, gardening must lead to increased consumption (demand) and production (supply) of micronutrient rich foods. To achieve this practical food preservation and processing methods such as sun drying should be adopted to avoid shortage during low production seasons.

The fact that more than a third of the study children are deficient in iron, contradicts the results of the 24-hour recall that shows that the consumption of iron in the study population is adequate. This could be associated with the low bioavailability of iron from plant sources. Howes, [12] states that iron and zinc fall in the category of nutrients with low bioavailability. He however notes that certain traditional home processing methods such as fermentation can increase their availability. The deficiency could also have resulted from the consumption of phenols (iron absorption inhibitors) in the form of beverages (tea mainly) with meals, as this is a common practice in the study population

## Conclusion

Production of vegetables and other foods in the kitchen gardens leads to: -

Improved access to food in an affordable way. The food produced contributes to the total diet and results in improved food intake.

Better micronutrient status of the children.

There is therefore a high potential in kitchen gardening as a food based strategy for addressing micronutrient malnutrition among the

low-income peri-urban populations.

The study therefore recommends that kitchen gardening be taught, demonstrated and encouraged the peri-urban communities.

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**Potential of kitchen gardening in alleviating micronutrient malnutrition in Ngong' division, Kajiado District, Kenya**

**Table I:**

Micronutrient	Intake per day (mean ± SD)		
	HH with KG, n=28	HH without KG, n=38	P- value (t-test)
Iron (g)	10.44 ± 1.51	10.83 ± 2.07	0.458
R.E	98.41 ± 7.489	68.22 ± 22.25	0.000**
Zinc (g)	10.76 ± 1.30	8.44 ± 1.06	0.001**

\*\* Significant at p<0.05 R.E = Retinol equivalents.

Micronutrient intakes of children aged 9-59 months among KG and NKG households

**Table II:**

Indicator	% in all households (n=55)a	% in kitchen gardening households (n=25)	% in non-kitchen gardening households. (n=30)b	P - value (X2 - test)
Serum retinol (less than 20µg/dl)	56.1	32	75	0.001*
Serum ferritin (less than 12µg/ L)	36.4	20.0	50.0	0.021**
Serum Zinc (Less than 65µg/dl)	69.5	54.2	80.6	0.055

\*Significant at p= 0.001. \*\* Significant at P < 0.05. an=57 for serum retinol level.

bn=32 for serum retinol.

Prevalence of micronutrient deficiencies among study children by household category

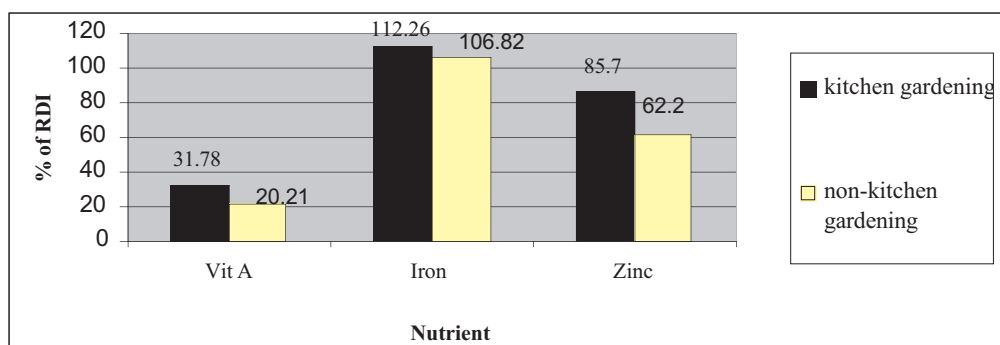
**Table III:**

Indicator	All households	Mean ± Standard deviation		P - value (For t-test)
Serum retinol (µg/dl)	19.33 ± 5.73	22.55 ± 3.27	16.01 ± 3.16	0.000*
Serum ferritin (µg/ L)	21.26 ± 22.47	28.74 ± 10.63	15.03 ± 7.82	0.032**
Serum Zinc (µg/dl)	58.71 ±19.41	67.71 ± 15.31	51.74 ± 10.61	0.002**

\*. Significance at p<0.001level \*\* Significance at p< 0.05level

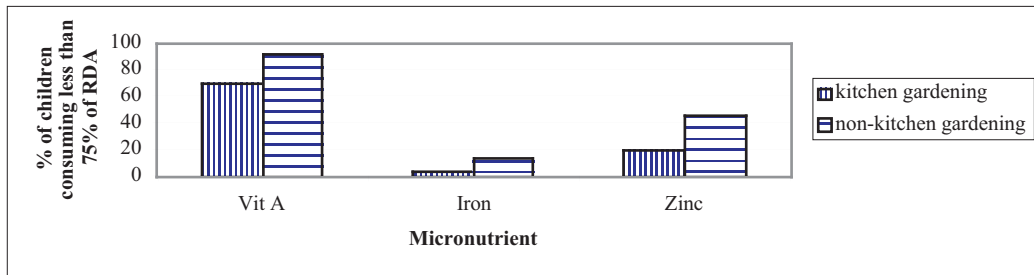
Mean serum retinol, ferritin and zinc levels of study children in kitchen gardening and non-kitchen gardening households.

**Figure I**



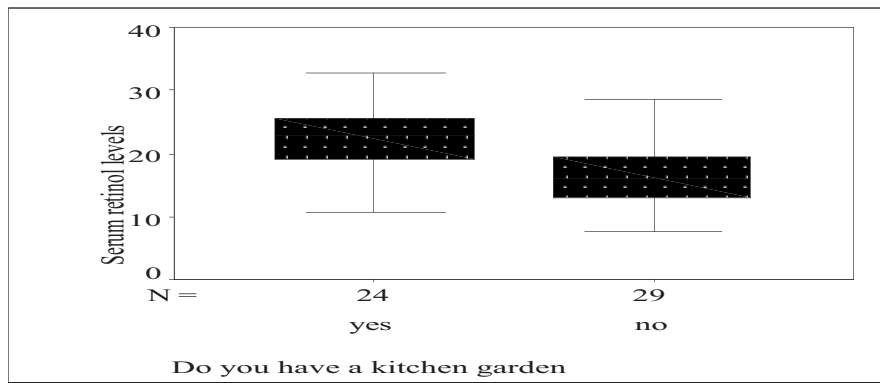
Mean daily intake of vitamin A, iron and zinc as a proportion of the RDI for children aged 9-59 months by household category.

**Figure II**



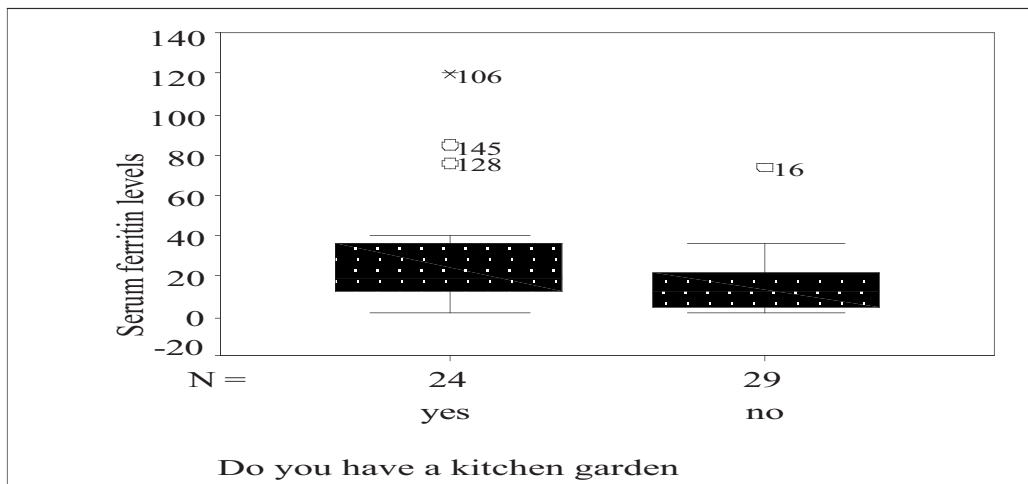
Proportion of children consuming less than 75% of the RDA by household category as revealed by the 24 – Hour recall

**Figure III:**



Comparison of serum retinol levels of the study children in KG and NKG households

**Figure IV**



Comparison of serum ferritin levels of study children in KG and NKG households



Figure V



Comparison of serum zinc levels of study children in KG and NKG households

# Utilization of Orange Fleshed Sweet Potato Flour in The Development of a Weaning Food.

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

Micronutrient deficiency, especially vitamin A, among weaned infants is a major nutritional concern in developing countries. A study was conducted to investigate the effect of  $\beta$ -carotene rich orange-fleshed sweet potato (OFSP), and process variables on bulk reduction and acceptability of porridge prepared from composite maize-soya bean flour. Two potato varieties, Zapallo and SPK004, were mixed in a 1:1 ratio to make the potato flour. Effects of peeling and drying temperatures on  $\beta$ -carotene and amylase activity were studied. A mixture of maize-soya bean flour (4:1) was prepared and blended with 20%, 40% and 60% OFSP flour. Peeling significantly reduced the  $\beta$ -carotene content of the flour from 29.4 mg/100 g to 28.3 mg/100 g but had no significant effect on amylase activity. Higher drying temperature decreased  $\beta$ -carotene content but had no effect on amylase activity. Crude protein, crude fat, crude fibre, ash, and moisture content decreased with an increase in the level of OFSP flour. Increase in the amount of OFSP flour proportion significantly increased  $\beta$ -carotene content, reduced viscosity, increased the sensory rating for flavour, sweetness, colour and acceptability for the porridge but decreased rating for textural appearance. Porridge from the 40% OFSP flour blend was the most preferred and had the lowest viscosity. Use of OFSP in maize-soya bean flour mixture could increase nutrient density and provide a cheap vitamin A supplemented weaning food for poor parents who would otherwise not afford commercial infant formulae.

Key words: OFSP,  $\beta$ -carotene, weaning, amylase, soyabean, sweet potato

## Introduction

Child malnutrition is a widespread health problem in developing countries caused mainly by low energy and nutrient density in weaning diets. The problem is also complicated by factors such as poor hygiene and sanitation, which often lead to high instances of disease [1]. This is common among communities characterized by poverty, inadequate diets and a high prevalence of infectious diseases [2].

Malnutrition can take a variety of forms that complement each other such as protein – energy malnutrition and deficiencies of micronutrients such as iodine, iron and vitamin A. Low energy intake is critical because lack of energy in the diet jeopardizes the use of protein for growth and maintenance. If the energy intake from other sources is inadequate, then protein is used as an energy source and not for its primary function of growth and maintenance. It is estimated that approximately 100 million preschool children suffer from moderate to severe forms of protein -energy malnutrition in developing countries [3]. Vitamin A deficiency is a major problem facing some 200 million young children in the developing world [1]. An early sign of deficiency of the vitamin is night blindness [4].

Maize (*Zea mays* L) is the staple food in Kenya consumed in various forms in different parts of the country. It can be eaten as a thin

gruel, which is an integral component of the child's diet. Rooney and Sermar [5] have reviewed food uses of whole maize and dry milled fractions. Nutritionally maize is low in protein and the protein is deficient in lysine and tryptophan, which reduce its utilization [6]. Maize is one of the best sources of metabolizable energy among the grains, mainly from its oil and carbohydrates. The oil is rich in polyunsaturated fatty acids [7]. Composition of soya bean (*Glycine Max* (L)) varies depending on the variety and growing conditions, but average figures are 40% protein, 35% carbohydrates, 20% lipids and 5% ash on a dry weight basis. Soya bean flour can be used to fortify maize protein on the basis of its lysine and tryptophan content, which are limiting in maize.

The first weaning food a child consumes is usually a soft or semi liquid food made from starchy staples such as maize, millet, sorghum, cassava, bananas and yams, which contain little protein and negligible amounts of micronutrients such as vitamin A, iodine and iron. The micronutrients are of major concern in the nutrition of infants and children.

During cooking of the staples, a lot of water is absorbed, making the food bulky and therefore difficult for the child to consume enough to get the required nutrients. Addition of water makes it thinner and easier to eat but also lowers the solids content thus lowering the energy and nutrient density of the food per unit volume. Thus, the child cannot consume the required amounts to supply the required nutrients. Attempts have therefore to be made to modify the starch in order to reduce its bulk. Addition of high-energy products such as oils and reducing sugars, amylase rich flours (ARFs) and fermentation has increased energy and nutrient density in high starch porridges. In the use of ARFs, the amylase enzyme hydrolyses some of the starch molecules thereby reducing the bulk and viscosity of the gruel. In Kenya, sweet potato is grown almost all over the country and in large amounts. It is therefore a convenient and cheap source of the enzyme. In addition, the starch in sweet potato readily undergoes enzymatic transformation into sugars. This is because sweet potato contains diastase, a mixture of alpha and beta amylases, which break down starch to shorter chain molecules [8].

Gichuki et al. [9] demonstrated that newly introduced sweet potato varieties ranging from white flesh to deep orange had higher yield than the majority of local varieties and had acceptable eating qualities. From the same study, regular intake (100 grams per day) of the yellow or OFSP roots having moderate  $\beta$ -carotene concentrations of 3 mg/100 g provided the allowed daily requirements of vitamin A for children less than five years of age. The biological activity of provitamin A carotenoids in OFSP is close to that of carrots and mangoes but lower than that of papaya and pumpkin [8]. OFSPs are therefore a competitive choice for improving the vitamin A nutritional status of a population. This paper therefore looks at the OFSP as a source of carotene and amylase activity.

## Materials and Methods

### Raw material selection

Maize and soya beans were purchased as whole grains from the local market and two varieties of OFSP that had been reported to be rich in  $\beta$ -carotene, SPK 004 and zappalo were obtained from KARI, Kakamega Research Station. Their  $\beta$ -carotene content and amylase activity were determined. The OFSP were placed under a shade to cure for 10 days. The analyses were carried out at the Dairy and Food Science & Technology laboratory in Egerton University, Njoro.

### Preparation of Flour

For OFSP flour, the root tubers were mixed in the ratio of 1:1, washed and mopped dry using a cloth and divided into two lots. One lot was peeled and the other was not. The potatoes were cut into thin slices and soaked in 0.2% (w/v) sodium metabisulphate solution to prevent enzymatic browning. The slices were then dried in a forced air circulation oven for 10 hours to a moisture content of 10% at the four different temperatures of 50, 60, 70 and 80°C. Dry flakes were milled using a laboratory hammer mill into fine flour.

Soya beans were cleaned and cooked in boiling water for 30 minutes to denature protease inhibitors, sun dried and ground into flour using a laboratory hammer mill.

Dry maize was cleaned and ground into flour using a laboratory hammer mill.

### Formulation of blends

The base flour for blending was prepared by mixing maize-soya bean flours in the ratio of 4:1 to give 16 % protein that is recommended for 6-12 months old children. Four blends were prepared from the mixture as follows.

Blend I – base flour only, Blend II 80% base flour blended with 20% OFSP flour,

Blend III 60% base flour blended with 40% OFSP flour and Blend IV, 40% base flour blended with 60% OFSP flour.

### Proximate Analysis

Determination of the proximate composition was done on Maize flour, soya bean flour potato flour and the four composite flours.

Total Amylolytic Activity was determined as described by Bernfield [10]. The enzyme was extracted from the root tubers using a method described by Hagenimana Vezina, and Simard [11], while  $\beta$ -Carotene was determined by spectrophotometry as described by Ameny and Wilson [12]. Concentrations of  $\beta$ -carotene and amylase activity were got from regression equations,  $y = 0.2388x + 0.084$  ( $R^2 = 0.972$ ) and  $y = 0.1329x + 0.0457$  ( $R^2 = 0.998$ ) obtained from standard curves developed using  $\beta$ -carotene from Sigma (St. Louis, MO, U.S.A.) and maltose, respectively.

### Preparation of porridge samples

Porridge containing 10% (w/v) flour concentrations was prepared from the four blends. For preparation of 1 litre of porridge, 100 g of flour was mixed with about 200 mls of water to form a slurry and the rest of the water brought to boil in a pan over a heater. The slurry was then poured into the boiling water slowly with continuous stirring to avoid lump formation and burn-on. The temperature of porridge dropped to 70°C. The pan was removed from the heater, covered and placed in a warm place for 20 minutes. The porridge was cooked by simmering for 10 minutes and cooled to 40°C. A sample was taken for viscosity determination and the rest was served to panellists at 40°C for sensory analysis

### Sensory analyses

Porridge samples were evaluated by 20 trained panellists consisting of mothers selected from Egerton University community. Line scale was used for scoring of texture, colour, flavour, thickness and sweetness. Overall preference of the porridge samples was based on a 9-point hedonic scale.

### Measurement of viscosity

A Funnel of Post-humus was used to measure relative viscosity, expressed as the time in seconds a given volume of porridge takes to pass through the funnel orifice.

### Experimental Design

A completely randomized design was used with a 4 x 2 factorial treatment, four drying temperatures and either peeled or unpeeled. The data was analysed using the General Linear Model (GLM) Procedure of SAS version 8 and Duncan's Multiple Range Test was used to determine differences between means at  $\alpha = 0.05$

## Results And Discussion

### Characteristic of sweet potato varieties that were used

Zapallo had significantly higher  $\beta$ -carotene and significantly lower amylase activity ( $p < 0.05$ ) than SPK 004 (1).

**Table 1: Mean  $\beta$ -carotene and amylase activity of fresh roots**

Variety	Mean1 $\beta$ -carotene (mg/100g)	Mean1 Amylase activity (units)
SPK 004	6.16 $\pm$ 0.13b	1.30 $\pm$ 0.05a
Zapallo	10.38 $\pm$ 0.32a	0.74 $\pm$ 0.03b

Means in the same column followed by the same letter are not significantly different at  $p = 0.05$ .

Mean1 = mean  $\pm$  SD

**Effect of peeling and drying on  $\beta$ -carotene and amylase activity**

The peeled roots had a mean  $\beta$ -carotene content of 28.35 mg/100 g, which was significantly lower than the 29.26 mg/100 g for unpeeled roots. This could be due to higher concentration of carotenoids and anthocyanin [8] in the skin than in the starchy interior of the tuber. Peeling had no significant effect on amylase activity (Table 2). This is in agreement with Ikemiya and Deobald [13] who reported that  $\beta$ -amylase activity is uniformly distributed throughout the inner tissues of the roots, whereas  $\alpha$ -amylase is concentrated more in the inner tissues. They also reported that the outer cork layer and skin contain low concentrations of both enzymes.

Increasing drying temperature significantly reduced  $\beta$ -carotene content of the roots (Figure 1). This is in agreement with Stefanovich and Karel [14] who reported that  $\beta$ -carotene concentration was reduced less at 60°C than at 70°C and 80°C. Lower temperatures also best preserved the colour of the roots. There was a slight decrease in amylase activity with increase in drying temperature although it was not significant. (Figure 2). According to Bouwkamp, [15] drier temperatures of 50°C to 73°C have been demonstrated to produce acceptable dehydrated products in terms of organoleptic properties. Drying at 50°C took a longer time than the rest of the temperatures and encouraged mould growth, which produced objectionable smell. The drying temperature of 60°C was therefore considered optimum in terms of quality preservation of  $\beta$ -carotene, amylase activity and organoleptic properties.

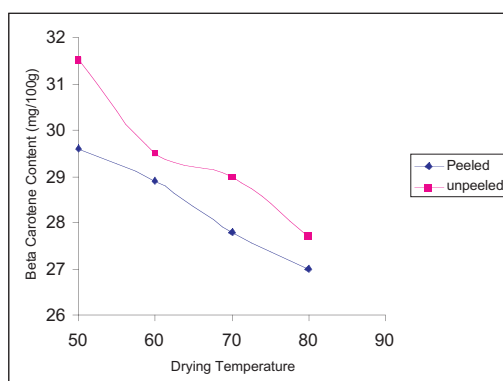
**Table 2: Mean  $\beta$ -carotene and amylase activity of peeled & unpeeled dried roots**

Treatment	Mean1 $\beta$ -carotene (mg/100g)	Mean1 Amylase activity (units)
Unpeeled	29.44 $\pm$ 1.33a	4.014 $\pm$ 0.265a
Peeled	28.35 $\pm$ 2.54b	4.008 $\pm$ 0.031 a

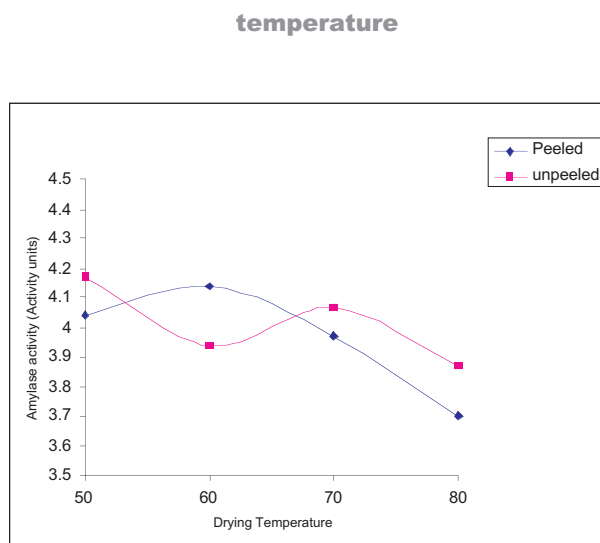
Means followed by the same letter are not significantly different at  $p = 0.05$

Mean1 = mean  $\pm$  SD

**Figure 1: Changes in  $\beta$ -carotene content of orange-fleshed sweet potato flour with drying temperature**



**Figure 2: Changes in amylase activity of orange-fleshed sweet potato flour with drying temperature**



**Proximate chemical composition of the flours**

The moisture, crude fat, crude fibre, crude protein and ash content of the flour blends (Table 3) were significantly different (P < 0.05).

Fat, protein, fibre and moisture content decreased with increase in OFSP in the blends.

This is mainly due to dilution effect since OFSP had lower concentrations of these components than the base flour. However, increasing the proportion of OFSP increased the  $\beta$ -carotene content (Table 4).

**Amylase activity and  $\beta$ -carotene content of the blends**

Amylase activity and  $\beta$ -carotene content of the blends increased significantly (P < 0.05) as the proportion of OFSP was increased (Table 4). The porridge viscosity decreased with increase in the proportion of OFSP flour. This reduction in viscosity allows use of more flour in the porridge and is likely to increase the nutrient density of the porridge and hence nutrient intake by the babies.

According to Woolfe [8] losses of total carotenoids, which contain many double bonds, are mainly due to oxidative degradation promoted by light, heat, metals and peroxides. Losses during boiling are fairly low. According to Bouwkamp [15], a Brazilian cultivar that contained 9mg total carotenoids/100g (fwb) (of which 80% was  $\beta$ -carotene) lost less than 10% of its carotenoids when placed in boiling water for 20 minutes. Determination of carotenoid losses alone does not give the provitamin A activity to be expected in the heated foods. In fresh vegetables, the all-trans isomeric forms of the carotenoids predominates and especially the all-trans  $\beta$ -carotene which has the highest biological activity. Thermal processing like cooking can cause conversion of part of the all-trans carotenoids to cis isomers, which have lower provitamin A activity than the all-trans forms [8]. The determination of total provitamin A potential of sweet potatoes therefore requires the knowledge of total carotenoids losses, the extent of isomer formation during cooking or processing and the calculation of the total activity of the various isomers finally present in the cooked food. If the loss of activity through isomerization and that through degradation are accounted for, the true loss of carotenoid activity will be greater than that shown by only

determining total carotene before and after processing [16].

Mean values in the same column followed by the same letter are not significantly different

**Table 3: Mean proximate chemical composition of flour from maize, OFSP, soya bean and blends I – IV.**

Sample	Moisture %	Crude fat %	Crude fibre %	Ash %	Crude protein %
Maize	9.54 ± 0.22 a	5.39 ± 0.336	9.46 ± 0.08b	1.20 ± 0.19f	11.23 ± 0.30d
OFSP	6.81 ± 0.31d	2.55 ± 0.30e	10.26 ± 0.19a	4.14 ± 0.25b	4.54 ± 0.24g
Soya bean	4.64 ± 0.24f	20.47 ± 0.40a	10.64 ± 0.61a	5.08 ± 0.06a	36.21 ± 0.39a
Blend I	8.36 ± 0.06b	8.06 ± 0.17b	8.95 ± 0.44b	2.10 ± 0.08e	16.07 ± 0.17b
Blend II	7.43 ± 0.25c	6.92 ± 0.46c	6.92 ± 0.14c	2.69 ± 0.10d	2.69 ± 0.10d
Blend III	6.79 ± 0.06d	6.65 ± 0.19c	6.67 ± 0.42cd	2.89 ± 0.15d	9.91 ± 0.11e
Blend IV	6.43 ± 0.07e	5.67 ± 0.38d	6.19 ± 0.47e	3.58 ± 0.14c	8.22 ± 0.14f
SE	0.11	0.19	0.19	0.09	0.16

**Table 4: Mean amylase activity,  $\beta$ -carotene content and relative viscosity of OFSP and composite flour blends**

Blend	$\beta$ -Carotene (mg/100g)	Amylase activity (units)	Relative Viscosity (Seconds)
I	6.30 $\pm$ 0.00e	0.98 $\pm$ 0.01e	29.46 $\pm$ 0.03a
II	15.34 $\pm$ 0.00d	2.19 $\pm$ 0.01d	27.29 $\pm$ 0.02b
III	18.15 $\pm$ 0.00c	2.67 $\pm$ 0.00c	26.12 $\pm$ 0.02c
IV	20.16 $\pm$ 0.00b	3.25 $\pm$ 0.00b	26.14 $\pm$ 0.02c
OFSP FLOUR	25.18 $\pm$ 0.10a	4.25 $\pm$ 0.00a	-

**Table 5: Mean values for sensory properties of porridge made from composite flour blends.**

Blend	Texture <sup>2</sup>	Flavour <sup>2</sup>	Thickness <sup>2</sup>	Sweetness <sup>2</sup>	Colour <sup>2</sup>	Preference <sup>3</sup>
I	2.39 $\pm$ 1.89c	2.60 $\pm$ 2.60c	10.44 $\pm$ 1.27a	3.62 $\pm$ 2.96a	3.99 $\pm$ 1.71c	4.95 $\pm$ 2.11b
II	4.76 $\pm$ 2.28b	4.51 $\pm$ 2.60bc	9.30 $\pm$ 1.80a	5.19 $\pm$ 3.70a	6.74 $\pm$ 2.39b	6.45 $\pm$ 1.10a
III	6.28 $\pm$ 3.14b	6.24 $\pm$ 3.22ab	6.77 $\pm$ 2.49b	5.00 $\pm$ 3.00a	9.29 $\pm$ 1.90a	7.35 $\pm$ 1.14a
IV	8.14 $\pm$ 2.95a	7.38 $\pm$ 3.73a	4.00 $\pm$ 1.63c	5.38 $\pm$ 1.94a	10.41 $\pm$ 2.52a	7.35 $\pm$ 0.67a

## Sensory evaluation

The rating in all the attributes except texture increased with an increase in the amount of OFSP flour in the blend (Table 5).

2 – Overall texture, flavour, thickness, sweetness and colour based on a 12.5 cm long line scale running from left to right, 3 – Overall preference based on a nine point hedonic scale

The flavour of any food ultimately determines its acceptance or rejection by the consumer. The flavour acceptable to the mothers is likely to be acceptable to the babies. An increase in sweetness during cooking is due to the disaccharide, maltose, which is formed by the

hydrolysis of starch during cooking [15]. However, increase in OFSP flour increased coarseness of the porridge. The coarseness of the samples was due to OFSP flour, which after grinding was not as fine as maize or soya beans flour. This was also indicated by most of the panellists, who suggested the need to improve on the product's consistency.

The addition of OFSP flour to maize-soya bean flour increased preference of the porridge samples (Table 5).

## Conclusion

Most of the research work already done has concentrated on the reduction of thickness of porridges using germinated cereals such as millet, wheat and sorghum. Examples include “power flour” in

Tanzania [17] and “Amylase Rich Food” (ARF) in India [18]. In this study OFSPs served as both a source of enzyme and  $\beta$ -carotene. It was established that blending maize-soya bean flour with OFSP flour could reduce viscosity of the resulting porridge, therefore enabling the use of more flour in the porridge without making it too thick for infant feeding. The addition of more flour will mean increased nutrient density in the porridge. The use of OFSP flour not only increases overall preference of porridge but also reduces viscosity and increases concentration of  $\beta$ -carotene, a precursor of vitamin A, in the diet.

## Acknowledgements

This work was financially supported by Egerton University.

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# Impact of Fermentation on The Bioavailability of Zinc in Some Selected Foods Commonly Consumed in Kenya

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## 1.0 Introduction

Deficiencies of zinc are a widespread public health problem in Kenya. A recent national survey revealed that 65% of the Kenyan population was zinc deficient [1], yet zinc is important for cell division and growth as well as optimum performance of the immune system. It is especially important during periods of rapid growth and for tissues with rapid cellular turnover and differentiation such as immune system and gastro-intestinal tract [2]. The prevalence of micronutrient malnutrition based on zinc deficiencies in Kenya is therefore unacceptably high. The capacity of foods and diets to meet zinc requirements depends on both zinc content in the foods and their bioavailability. Zinc bioavailability is the proportion of zinc in a food or diet that is available for intestinal absorption in a form that is physiologically useful [3]. The amount of zinc available for absorption from plant-based diets is often low, even when the intake of the trace minerals appears adequate. These plant-based foods may contain high levels of phytate, dietary fibre and polyphenols

There is lack of information on the effect of fermentation on zinc availability or phytate content in the Kenyan staple foods. This study aimed at yielding information on the changes of zinc availability and phytate content during various preparation methods of the staple foods. The specific objectives of the study were to:

Determine zinc content in the main staple foods that is maize, beans, sorghum, finger millet and kales, which are commonly consumed in Western and Central regions of Kenya.

Determine the changes in zinc bioavailability in these foods after fermentation.

Determine the effects of fermentation on phytic acid content.

## 2.0 Materials And Methods

### 2.1 Food Materials

The samples used in this study included maize grain (*Zea mays*), beans (*Phaseolus vulgaris*), kales (*Brassica oleracea* var. *Acephala*), sorghum (*Sorghum bicolor*), finger millet (*Eleusine coracana*) and tomatoes (*Lycopersicon esculentum*).

The samples were purchased from markets in central and western Kenya region.

### 2.2 Treatments

#### 2.2.1 Fermentation

Flours were obtained by grinding clean grains of maize, sorghum, finger millet and beans separately. These were mixed with an equal amount of distilled water on weight-to-weight basis.

The dough was allowed to ferment naturally at room temperature for 24, 48 and 72 hours as described by Makokha et al. [4].

The fermentation was done at room temperature. The fermented flour was used in the preparation of uji (thin Porridge).

#### 2.2.2 Preparation of staple foods

Uji (Thin Porridge): Water was boiled and then some flour in the form of a paste was added. The ratio of water to flour was 11: 1. The paste was added while stirring then the stirring continued until boiling started. Then the uji was left to boil for ten minutes.

#### 2.3 Laboratory analysis of samples

2.3.1 Total zinc content: The determination of total zinc in the fresh food samples that were obtained above was determined using the atomic absorption spectrophotometer [5].

A sample, 1g, was ashed in the muffle furnace for two hours. Then 50% nitric acid was added and evaporated to dryness and ashing done again for one hour. After cooling 50% HCl was used to transfer the sample to a 50-ml volumetric flask and 1% HCL used to make to volume.

An AA-6200 Atomic Absorption Flame Emission Spectrophotometer was used to determine the total zinc content using zinc lamps.

The readings from the spectrophotometer were used to calculate the total zinc contents using a standard curve.

2.3.2 Available zinc determination: The determination of zinc availability at human physiological condition in fresh, boiled and fried staple food samples was determined using the method described by Svanberg et al [6], as modified by Matuscheck et al [7].

1 g of sample was suspended in 10 ml of distilled water and 10 ml of 0.3 % pepsin solutions (in 0.1 M of HCL) was added and digested for 90 minutes at 37 ° C.

The pepsin solution contained physiological amounts of Na (49 mmol/l as NaCl), K (12 mmol / l as KCL), Ca (10 mmol/l as CaCl 2.2 H2O) Mg (2.4 mmol/l as Mgcl2 and phosphate (3.5 mmol / l as KH2PO4 ).

The pH was adjusted to 2.0 by 1.0 M NaoH and added 3 ml of pancreatic (0.012 g) and bile (0.075) solutions in 0.1 M NaHCO3 before adjusting the pH to 5.0.

The mixture was incubated for another 30 minutes and then adjusted to pH 6.0 before centrifuging at 50000 g for 20 minutes .

The supernant was filtered through 45 um filters and the soluble iron determined by atomic absorption spectrometry.

The analysis was done using atomic absorption spectrophotometry. Determinations were done using standard curves prepared for iron



and zinc.

2.3.3 Phytate determination: Phytate compounds were determined by the method described by Carlson et al [8].

A 0.5g sample of the flour of the samples was extracted with 10 ml of 0.5 mol/l HCl over night followed by centrifugation at 3500 g for 5 minutes and filtered.

The supernatant was collected and analysed for total phytate content by High- performance ion chromatography (HPLC).

The values were expressed in mg/100 g (dry weight). Phytates were analysed as inositol hexaphosphate.

2.3.4 Analysis of data: This was done using Costat and Genstat. The means, standard deviation, Analysis of variance (ANOVA), Duncan`s Multiple Range test and the least Significant tests were done to find out if there were significant differences.

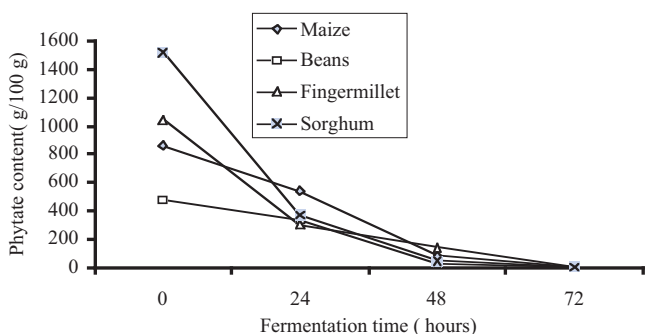
### 3.0 Results And Discussion

#### 3.1 Effect of fermentation on phytate content in staple food commodities

Fermentation of cereals is usually done at household level for periods ranging from 24 to 72 hours. In this study, the cereals and beans were fermented for specific time periods and phytate content analysed at appropriate time intervals. Figure 1 shows the changes in phytate content during fermentation for 24, 48 and 72 hours. Phytate content in maize, beans, finger millet and sorghum decreased by 41.4% and 91.0%, 38.4% and 86.8%, 71.9% and 86.8%, and 75.8% and 97.1% during fermentation for 24 and 48 hours, respectively. There was significant difference ( $p < 0.05$ ) in phytate reduction in all samples. There was no residual phytate after 72 hours.

During bread making, 92% of phytate hydrolysis occurs during the fermentation stage compared to 10% in non-leavened bread [9,10]. The results obtained in this study are in agreement with the observations made by Sandberg [11] that fermentation of maize, soybeans and sorghum reduces phytate content. The extent of phytate reduction depends on the type of fermentation. Sourdough fermentation reduced phytate amounts in rye bread by 86-98% [11].

**Figure 1: Changes in phytate content in staple cereals and beans during fermentation.**



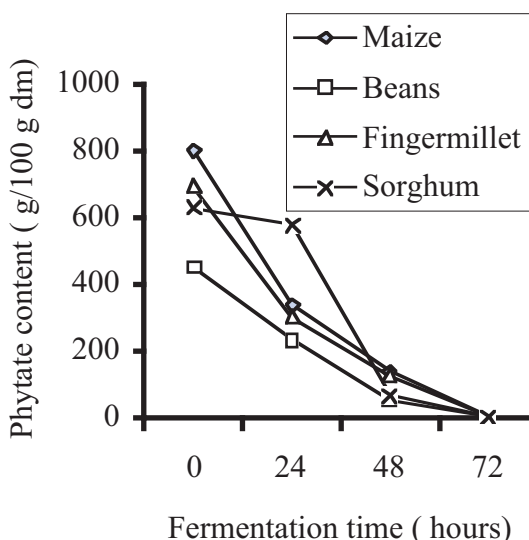
Conventional baking of whole wheat bread reduced phytate only by 50% [11].

In this study, the fermentation was done by natural microflora and the containers were covered with Para film. Marfo et al. [12] demonstrated that cassava, cocoyam and yam had fermentation reduce their phytate content by 88%, 98% and 68%, respectively, with reduction being rapid within the first 48 hours but much slower thereafter.

Thus processing into fermented foods will reduce the phytate level of root crops sufficiently to nullify its adverse effects [12]. In this study, there was reduction in phytate levels after fermentation and after 72 hours there were no residual phytates. Fermentation activates the enzyme phytase, thus promoting the hydrolysis of phytic acid [13].

The phytate content for porridge made from maize, beans, finger millet and

**Figure 2: Changes in phytate content in porridge made from staple cereals and beans during fermentation.**



sorghum reduced by 58.0% and 83%, 48.8% and 89.3%, 56.6% and 82.0% and 8.1% and 89.6%, for 24 and 48 hours, respectively (Fig. 2).

There was no residual phytate for porridge samples made from flour fermented for 72 hours. According to FAO [14], oven drying has less decreasing effect on the phytate content compared to fermentation. Reported reductions in the hexainositol phosphate and pentainositol phosphate content of fermented porridges prepared from white sorghum and maize were about 50% [6].

Other investigators reported phytate reductions after fermentation of 35– 40% for idli batter in India prepared from rice and black gram [15] and 52–98% for a variety of West African fermented products based on cassava, cocoyam, maize and assorted legumes [12,16] depending on preparation, storage and cooking conditions.

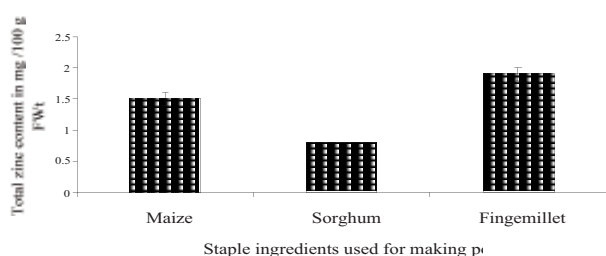
### 3.2 Effect of fermentation on available zinc in staple foods

Figures 3 and 4 show the total zinc content and available zinc content in porridge during fermentation respectively. Zinc availability also increased with increase in fermentation time. After 24 hours of fermentation, the zinc availability in porridge made from maize, sorghum and finger millet was 15%, 25% and 16% respectively.

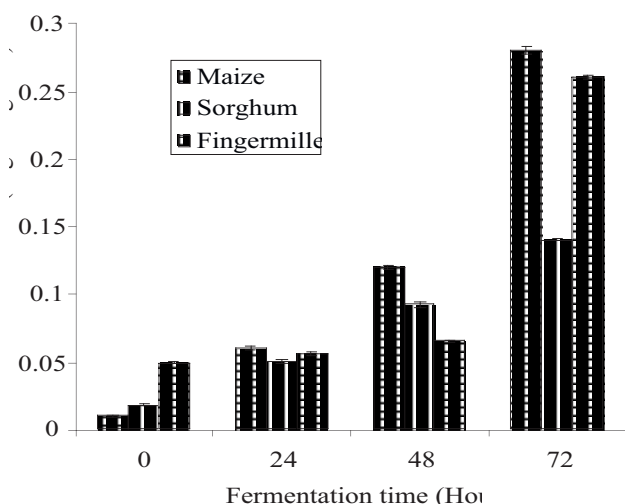
When fermentation was done for 48 hours, the zinc availability increased to 29.9%, 46% and 18.6% for porridge made from maize, sorghum and finger millet. After 72 hours of fermentation the zinc availability of porridge made from maize, sorghum and finger millet was 84.8%, 87.5% and 74.3% respectively.

Fermentation improves the bioavailability of zinc [11].

**Figure 3: Total zinc content of porridge made from fresh staple commodities.**



**Figure 4: Change in available zinc content in porridge made from staple ingredients during fermentation Time Hour. Vertical bars are means ±SD of two replications.**



According to [6], to date in vivo comparisons of the bioavailability of zinc in fermented versus unfermented staple plant-based foods are not available. According to [9], fermentation can hydrolyze most of the phytate in wheat so that the iron absorption is improved.

Prolonged fermentation of wholemeal bread reduced the total phytate content to the same level as that in low phytate control rolls. It subsequently increased the absorption of iron seven-fold, to the same bioavailability as the iron in the control bread, despite the five times higher total fiber content of wholemeal flour [9].

After comparing iron absorption with the phytate content of breads made from various types of flour and fermented in different ways, it was demonstrated that iron absorption was related to the final content.

About 90% of the phytate in the high-phytate flours had to be degraded before iron absorption increased substantially [9].

The fermentation process can provide suitable pH conditions for degradation of phytate [6]. In order to completely degrade the phytate sufficient time is needed within the optimum pH range [6]. In this case for fermentation 72 hours were needed. The organic acids produced during fermentation (lactic, acetic, butyric, propionic and formic acids) may also potentiate Zn absorption via formation of soluble ligands with zinc [17]. However fermented grain is mostly consumed as porridge, where the concentration of nutrients is relatively dilute. As a result it is not able to meet the recommended daily allowances for various groups of people.

### 4.0 Conclusion

Fermentation for 72 hours of the dough prepared from the grains eliminated all the phytate and resulted in high zinc availability in all the samples. However the porridge prepared from this dough cannot meet the recommended daily allowances for various nutrients.

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# Can Rosemary Spice (*ROSMARINUS OFFICINALIS*) Stabilize, $\beta$ -Carotene in a Protein-Rich Soybean-Based Product?

The Inaugural Nutrition Congress: Food and Nutrition for Health & Development

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## Abstract

**Background:** Addition of  $\beta$ -carotene-rich foods can be a feasible way to augment vitamin A content in products deficient in vitamin A. However,  $\beta$ -carotene is highly prone to oxidation and stereoisomerization that leads to losses. Rosemary spice is locally available and can be used as an antioxidant in organoleptically acceptable levels.

**Objective:** The effects of rosemary spice on the stability of  $\beta$ -carotene in a flour formulation with dried carrots as a source was investigated.

**Methodology:** A flour-based product containing 64% full-fat soya flour, 7% meat powder and 29% carrot flour were treated with dried and milled rosemary spice at rates of 0%, 0.1%, 0.2%, 0.3% and 0.4% on the basis of weight of the flour. They were then stored for a period of 7 weeks at 35°C and analyzed for  $\beta$ -carotene initially and thereafter at an interval of 2 weeks.

**Results:** At the end of 7 weeks, the sample with no rosemary spice recorded the lowest  $\beta$ -carotene content (7.22 mg/100 g  $\pm$  0.10). This was significantly different from samples having rosemary spice ( $p < 0.05$ ). In increasing order of  $\beta$ -carotene content sample with 0.1%, 0.3%, 0.2% and 0.4% had 10.64 mg  $\pm$  0.07, 10.74 mg  $\pm$  0.07, 10.87 mg  $\pm$  0.00 and 11.05 mg  $\pm$  0.10 per 100 grams of the flour respectively after 7 weeks of storage.

**Conclusion:** It is possible, within a storage period of 7 weeks at 35°C, to spare significant amount of  $\beta$ -carotene in a protein- $\beta$ -carotene-rich soya-based flour using rosemary spice.

**Key words:** Rosemary spice,  $\beta$ -carotene, spare

## Introduction

Vitamin A Deficiency is a public health problem in Kenya. One of the major contributing causes of vitamin A deficiency is low consumption of the vitamin A rich foods. Most foods consumed by the resource poor are lacking in vitamin A and proteins. Addition of  $\beta$ -carotene-rich foods can be a feasible way to augment vitamin A content in products deficient of the vitamin. However,  $\beta$ -carotene is highly prone to oxidation and stereoisomerisation that leads to losses. Rosemary spice is locally available and at organoleptically acceptable levels can not only be used as a flavouring agent but also as an antioxidant. The antioxidant potency of rosemary spice is attributed to rosmarinic, carnosol and carnosic acid [1]. There are indications however that the antioxidant activity of rosemary extract mainly depends on carnosic acid content [2]. This study is aimed at evaluating the effects of rosemary spice on the stability of  $\beta$ -carotene in a flour formulation with dried carrots as a source.

## Method

A flour-based product containing 64% full-fat soybean flour, 7% meat powder and 29% carrot flour were treated with dried and milled rosemary spice at rates of 0%, 0.1%, 0.2%, 0.3% and 0.4% on the basis of weight of the flour. They were then stored for a period of 7 weeks at 35°C (highest average temperature in Kenya) and analyzed for  $\beta$ -carotene initially and thereafter at an interval of 2 weeks using AOAC [3] method.

## Results and discussions

As shown in Table 1, at week 0 (immediately after processing), the  $\beta$ -carotene content of the samples were not significantly different ( $p < 0.05$ ). From week 1 through week 7 of storage at 35°C, sample R00, sample containing no rosemary spice exhibited the lowest  $\beta$ -carotene content among the samples and significantly differed with the rest of the samples ( $p < 0.05$ ). This demonstrates the potency of rosemary spice in sparing  $\beta$ -carotene degradation.

At the end of storage period (week 7), R00, sample with no spice, had the lowest  $\beta$ -carotene content but did compare favourably with sample R02. It is evident that in short term (from week 1 to week 5) at 35°C, samples with low and intermediate levels of rosemary spice (R01, R02 and R03) had higher  $\beta$ -carotene contents as compared to R00 and R04, the samples with the high level of rosemary spice. However, at week 7, R04 had the highest  $\beta$ -carotene content.

$\beta$ -carotene in samples stored at 40°C remained fairly stable.

As depicted in figure 1, samples having rosemary spice in the short run exhibited different levels of  $\beta$ -carotene content but in the long run, the proximity of their  $\beta$ -carotene contents improved. It appears that all samples with rosemary spice can be expected to have non-significantly different  $\beta$ -carotene levels in the long run due to depletion of the antioxidant attributive components of rosemary spice with time.

In short-run (between week 0 and 1), losses were extremely and relatively high in R00, sample with no spice. At the end of the 7th week

of storage, the losses among all samples were more comparable than in other weeks as shown in Figure 3. There were no definite patterns observed. In R00, sample with no spice, there was a constant decrease in losses.

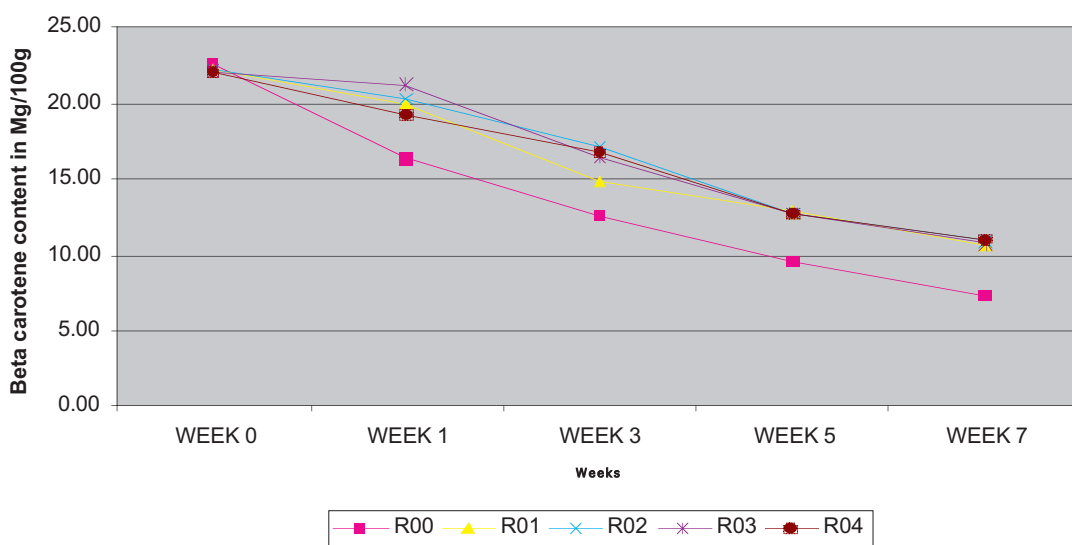
All samples contain 64% of soya flour, 29% carrot powder and 7% meat powder.

Acronyms: R00 contains no rosemary spice, R01 had 0.1%, R02 had 0.2%, R03 had 0.3% and R04 had 0.4% rosemary spice based on weight of the flour mixtures.

**Table 1:  $\beta$ -carotene content of flour mixtures stored at 35oC and 4oC over a period of 7 weeks.**

	$\beta$ -carotene content in mg/100g					
	Stored at 35oC					Stored at 4oC
Samples <sup>1</sup>	Week 0	Week 1	Week 3	Week 3	Week 7	Week 7
R00	22.47a±0.26	16.40e±0.25	12.60d±0.14	9.58c±0.10	7.22d±0.10	20.75d±0.10
R01	22.21a±0.13	19.84c±0.07	14.84c±0.32	12.87a±0.07	10.64c±0.07	24.63a±0.06
R02	22.24a±0.07	20.34b±0.26	17.17a±0.07	12.74d±0.13	10.87b±0.00	20.83d±0.00
R03	22.13a±0.78	21.27a±0.26	16.50b±0.20	12.68b±0.10	10.74b±0.07	22.58c±0.04
R04	21.97a±0.07	19.27d±0.39	16.80a±0.25	12.72a±0.10	11.05a±0.10	23.27b±0.13

**Figure 1:  $\beta$ -a-carotene degradation over a period of 7 weeks at a storage temperature of 35oC.**



**Conclusions**

Rosemary spice is potent in sparing  $\beta$ -carotene degradation in protein- $\beta$ -carotene-rich soybean-based flour.

In the short-run, and at storage temperature of 35oC, lower and intermediate levels of rosemary spice are more potent in sparing  $\beta$ -carotene degradation than high or low levels of the spice under the same conditions

**Recomendations**

Flour or flour mixtures should be fortified with locally available  $\beta$ -carotene rich foods and can be stabilized with spices with antioxidant potency such as rosemary spice

The potency of rosemary spice and other potential spices should be tested in other  $\beta$ -carotene sources other than carrots

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Figure 2: Changes (decreases) of  $\beta$ -carotene between weeks for samples stored at 35°C.

