A Cost of the Diet analysis in Turkana district of Kenya

Location: Kerio Agropastoral livelihood zone, Turkana
Date of data collection: June 2012
Date of Report: March 2013
Date of HEA data collected: June 2012
Lead agency: Save the Children with support from Oxfam
Funded by: ECHO

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EUROPEAN COMMISSION
Humanitarian Aid

Oxfam

Acknowledgments

The Cost of the Diet analysis was led by Amy Deptford with support from Rachel Evans and Catherine Louis.

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The analysis and this report were written by Amy Deptford.

The analysis was funded by ECHO as part of the 'Filling the Gap' grant.

Thanks to Oxfam for their warm welcome and for making the practical arrangements for the analysis to take place.

Last but by no means least, this analysis would not have been possible without the willing help of the market traders of the agropastoral livelihood zone and of the women who participated in the focus group discussions. Their time, hospitality and insights are greatly appreciated.

Suggested citation:

Save the Children UK, (2013). *A Cost of the Diet analysis in the Kerio agropastoral livelihood zone of Turkana.* London.

Executive Summary

Introduction

This Cost of the Diet analysis has been conducted as part of an integrated study with a Household Economy Approach (HEA), funded by the ECHO 'Filling the Gap' grant and Save the Children UK. The aim of this analysis was to assess the degree to which economic constraints might prevent households in the agropastoral livelihood zone of Turkana district from having access to a nutritious diet.

The data collection and analysis set out to answer the following questions:

- What is the cost of a nutritious diet for a typical household in the agropastoral livelihood zone of Turkana?
- What nutrients have the greatest influence on the cost of a nutritious diet?
- Are there any neglected or underutilised foods that could decrease the cost of a nutritious diet?
- How affordable is a nutritious diet for a typical household in different wealth groups?

In addition, the Cost of the Diet software was used to assess how nutrition, food security and social protection interventions might contribute to improved access to a nutritious diet by households.

Turkana County is the poorest county in the country with 94% of the population living below the poverty line (Kenyan Government, 2006). Turkana is an arid area with temperatures as high as 40°C during the dry season. The HEA in the agropastoral livelihood zone reported that the basis of the economy was growing crops such as maize and sorghum; rearing livestock for milk, meat and blood; and selling bush products (FEG, 2012).

The HEA estimated that 25% of households in this livelihood zone were classified as very poor, 38% poor, 22% were in the middle category and 15% were considered better-off (FEG, 2012). The results from the HEA also found that wealth was associated with larger and more diverse herds comprising both large and small stock. Middle-income and better-off households own a full range of livestock: camels, cattle, sheep and goats. By contrast, poor households own very small herds of sheep and goats (FEG, 2012). Land is not the primary determinant of wealth and production outcomes have varied considerably in past years, due to floods and drought.

Turkana experienced a serious drought in 2011 as a result of failed rains. As a result the prevalence of wasting was 33% in south Turkana in May 2011 (MoPHS *et al.,* 2011a), a critical public health problem. In response, many agencies scaled up their emergency nutrition interventions which, coupled with a heavy rainfall at the end of 2011 reduced the prevalence of wasting to 15% in December 2011 (MoPHS *et al.,* 2011b). The prevalence of stunting in 2012 was 25% (MoPHS *et al.,* 2012), which is classified by WHO as medium severity (WHO, 1995).

The HEA (FEG, 2012) reported that sources of foods in this livelihood zone differed depending on wealth. For very poor households, the most important source of food was food aid, which provided 40% of energy requirements. The results also showed that this wealth group did not rely very much on food purchased in the market to provide their energy because of the high reliance on food aid to provide these requirements. As the middle and better off households received less food aid, they relied on markets to purchase 32% and 46% of their energy requirements respectively (FEG, 2012). The HEA found that energy requirements were met by 99%, 100%, 105% and 111% for very poor, poor, middle and better off households respectively.

Methods

Six market surveys and two dietary pattern surveys and focus group discussions were conducted. The market price, seasonal availability and consumption patterns of all local foods was collected, excluding herbs, spices and condiments. For the purpose of the training, retrospective price data were collected to cover a period from June 2012 – July 2011.

With these data the cost of three theoretical diets were estimated using the Cost of the Diet software for a typical household of 7 individuals, which represented very poor and poor households as identified by the HEA: a lowest cost diet that only meets recommended average energy requirements; a lowest cost diet that meets recommended intakes for energy and nutrients (MNUT); and a lowest cost diet that meets recommended intakes for energy and nutrients based upon typical dietary habit of households in the agropastoral zone of Turkana (LACON).

A nutritious diet for the typical family was defined as one which provides the total of: the estimated average requirement (EAR) for energy; the safe individual intake of protein; 30% of total energy intake from fat; the reference nutrient intake (RNI) of vitamins and minerals; and the safe intake for vitamin A, all specified by the World Health Organization (2004; 2007; 2008).

The annual cost of the foods selected by the software were expressed as a percentage of the estimated annual cash income and expenditure from the HEA (FEG, 2012) undertaken in the same livelihood zone, to estimate the affordability of a nutritious diet for households in each wealth group.

Key findings

A nutritious diet based upon typical food habits is three times more expensive than a diet that only meets energy requirements. The minimum cost of an energy only diet was estimated at between 122 – 527 KSH (1.40 -6.20 USD[1]) per day, depending on the season, and included ten of the 40 foods found in the markets. The minimum cost of a MNUT diet was estimated at 495 - 914 KSH (5.80 -10.70 USD) per day, depending on the season, and included 16 of the 40 foods found in the markets. The minimum cost of a LACON diet was estimated at between 925 – 1,275

[1] Exchange rate used was 1 USD = 85.44 KSH

KSH (10.80 -14.90 USD) a day, depending on the season, and included 26 of the 40 foods found in the markets.

It is important to note that the recommended requirements used as targets by the software are greater than the actual needs of 97% of all individuals, which is why the cost of the diets are high.

The results from the cost of the diet analysis show that the MNUT diet was 2.1 times more expensive than the energy only diet, meaning that it cost twice as much money to meet recommended protein, fat and micronutrient requirements compared with only meeting energy requirements. The LACON diet was 1.5 times more expensive than the MNUT diet which means that the constraints applied to the software to reflect typical dietary habits have made it harder for the software to meet recommended nutrient intakes.

The recommended intakes of iron cannot be met by the LACON diet for the child aged 12-23 months. The results of the LACON diet for the 12-23 month old child showed that the requirements for iron was not met by 13-25%, but if there are no constraints applied to the foods in the software, characterised by the MNUT diet, then the requirements for iron can be met. This indicates that the current, typical dietary habits of children in the community would not meet the RNI for iron using local foods.

For the rest of the family it is possible to obtain a nutritious diet using local foods. However, vitamin C, iron and calcium are the most difficult nutrients to meet requirements for. These nutrients are also the most expensive and increase the cost of the diet substantially as the software includes large quantities of expensive dried fish, cow's milk and lentils to meet requirements. This is emphasised by the analysis of the food groups that contributed the most to a nutritious diet, which for both the child aged 12-23 months and the rest of the family, were meat, fish, poultry and eggs and dairy.

The availability of nutritious foods in the market is constrained by poor road infrastructure. The software included large quantities of banana, cabbage, tomato and orange in the LACON diet to meet essential nutrient requirements. However, one of the most striking findings from the market surveys was the lack of fruit and vegetables. Several focus group discussion participants reported that this was due mainly to poor supplies as the distances to the main markets and transport costs meant that traders only collected fruit and vegetables once a week, but they were often too expensive for poor families to purchase. Furthermore, many fruit and vegetables perished quickly, affecting what traders bought back to the village.

Even with food aid, none of the wealth groups can afford a nutritious diet based upon typical food habits plus their non-food expenditure. The results from the estimates of affordability found that a nutritious diet plus essential non-food expenditure accounted for 316%, 271%, 222% and 221% of the income of the very poor, poor, middle and better off households' respectively. In terms of cash, very poor and poor households potentially require an additional 276,200 KSH (3,200 USD) a year and 257,000 KSH (3,000 USD) a year respectively to purchase a fully nutritious diet.

Breast milk provides essential nutrients in a young child's nutritious diet. In the analysis of the LACON diet for a 12-23 month old child, breast milk met over half the child's need for of fat and vitamin C, and contributed substantially to energy, vitamin B2, niacin, and calcium requirements.

The options for models were limited by what can be grown in the environmental, the lack of livelihood opportunities and the market and road infrastructure in this zone. Of the five interventions modelled, to increase the availability of spinach, kale, cowpea leaves and tomatoes for very poor households had the biggest potential to reduce the cost and improve the quality of the diet. However, more information is needed on how much water such an intervention would require and how this would be made available.

The Hunger Safety Net Programme potentially improves very poor household's ability to afford the LACON diet by 39% however, an additional 258,200 KSH (3,000 USD) a year would still be required to meet all nutrient requirements to 100%.

Recommendations and conclusions

Investment in improving road and market infrastructure in this livelihood zone is one of the most important recommendations. This was also one of the main recommendations made by the HEA study (FEG, 2012). Currently, roads are either non-existent or in a very poor condition. There is a lack of markets in this zone in general and those that do exist in remote villages sell mainly cereals, pulses and oil and are almost devoid of fruit, vegetables, dairy and animal products, the most nutritious foods available in this livelihood zone as identified by the Cost of the Diet software. Until access to remote villages by road is improved, it is unlikely that the availability of these nutritious foods in the market will improve and access will remain poor.

Promoting the benefits of exclusive and continued breastfeeding until the age of 2 years is essential, as emphasised by the cost of the diet results for the 12-23 month old child. However, breast milk is not a rich source of iron. Making iron rich foods such as meat and offal more accessible in terms of their price and physical presence in the market needs to be undertaken so that the consumption of these foods can be advocated for.

It is recommended that market surveys of the key 40 foods are done in each season to better understand the seasonal cost and availability of foods found on the market and the potential impact on households that purchase the majority of their food from the market. The seasonal fluctuations in the daily cost of a nutritious diet have not been effectively captured in this study because retrospective data collection methods during the market survey were used for training purposes only.

1. Introduction

1.1 Kenya

Since independence in 1960, Kenya has been one of the most successful countries in Africa with steady economic growth and a growing tourism industry. However, since 1996 it has suffered from 12 disasters, mostly due to internal and cross border conflicts over terrorism, natural resources, economics and the environment (FAO and WFP, 2010). The most recent crisis was the 2011 horn of Africa famine which affected approximately 3.75 million people in north east Kenya (WFP, 2012).

Kenya has a population of 38.3 million, of whom 46% live below the poverty line and 80% live in rural areas (UNICEF, 2012). It is among the world's 30 poorest countries and ranks 153 out of 177 on the Human Development Index (UNICEF 2012). Income inequalities between the rich and the poor, is also an issue with the top 10% of Kenyans earning 44% of the national income, whilst the bottom 10% earns less than 1%. As a result, the Global Hunger Index for this country falls within the 'serious' category at 18.9 and has only increased by 2 points since 1990 (International food policy research institute, 2011).

Strategies such as the Kenya National Nutritional Action Plan 2011-2017 (Government of Kenya, 2011) have been developed focussing specifically on the improvement of nutrition outcomes based upon needs at different stages of the life cycle. The objectives of such strategies are to improve women's nutrition throughout their lifecycle; promote optimal infant and young child feeding practices; promote appropriate nutrition for school children and adolescents; promote healthy lifestyles across the population; and improve nutrition care and support for the elderly (Government of Kenya, 2011).

1.2 Aim of the analysis

This analysis is the result of a regional Cost of the Diet capacity building training in Turkana and Nairobi, Kenya funded by the ECHO 'Filling the Gap' grant and Save the Children UK. The objectives of the training were to:

- Teach participants how to plan a Cost of the Diet assessment
- Teach participants about what information is required for a Cost of the Diet assessment and participate in practical data collection in the field
- Teach participants how to analyse the data collected using the Cost of the Diet software and how to model potential interventions
- Teach participants about the links between the Cost of the Diet and the Household Economy Approach (HEA)

The aim of the Cost of the Diet analysis was to assess the degree to which economic constraints might prevent households in the agropastoral livelihood zone of Turkana from having access to a nutritious diet. The data collection and analysis set out to answer the following questions:

- What is the cost of a nutritious diet for a typical household in the agro pastoral livelihood zone of Turkana?

- What nutrients have the greatest influence on the cost of a nutritious diet?
- Are there any neglected or underutilised foods that could decrease the cost of a nutritious diet?
- How affordable is a nutritious diet for a typical household in different wealth groups?

In addition, the Cost of the Diet software was used to assess how nutrition, food security and social protection interventions might contribute to improved access to a nutritious diet by households.

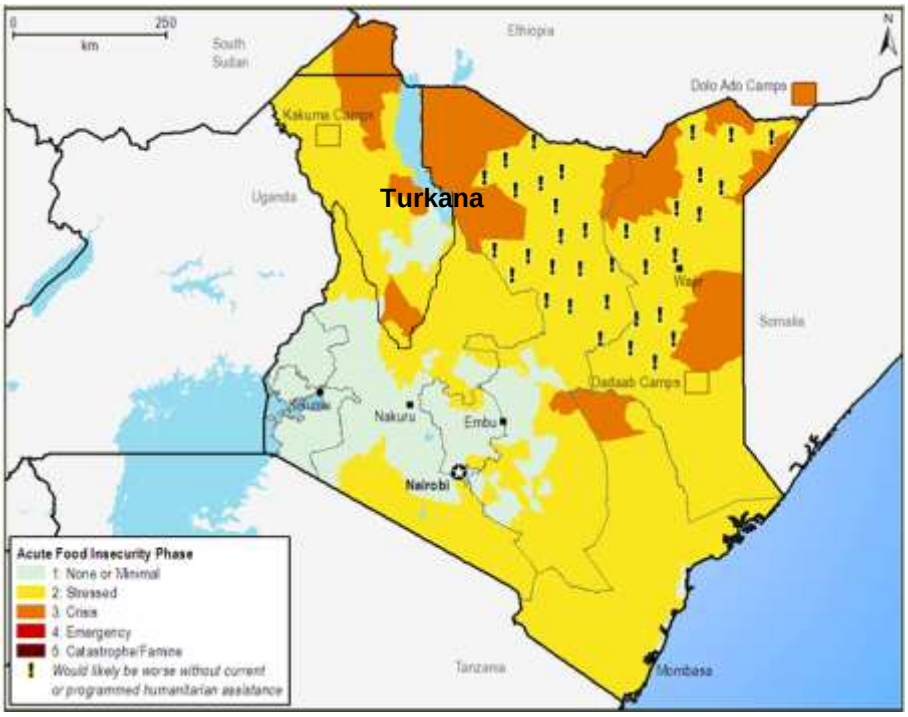
2. Overview of the Study Area

2.1 Introduction to Turkana District and the agropastoral livelihood zone

Turkana County is in the Rift Valley province of Kenya, situated in the north western region of the country. The region borders Uganda, Sudan and Ethiopia to the East, North East and North West respectively. Turkana has a population of approximately 1,014,100 (Kenyan Government, 2009). Despite the progress made by many organisations, Turkana remains the poorest county in Kenya (Kenyan Government, 2006). Although numerous organisation working in the area for many years, the Kenya Household Budget Survey in 2006 found that 94% of the population in Turkana live below the poverty line and only 19% can read and write compared with the national average of 79% (Kenyan Government, 2006).

Turkana is an arid area with temperatures as high as 40°C during the dry season. In recent years, average rainfall has been poor at 120-150mm per year but varies considerably. Traditionally the economy has been based upon nomadic pastoralism, but failed rains and drought, most recently in 2011, have killed livestock resulting in erratic migration and compromised pastoral livelihoods. Consequently according to FEWSNET, many areas of Turkana are in the 'stressed' phase of food insecurity whilst some localised areas are in the 'crisis' phase (FEWSNET and KFSSG, 2012). Figure 1 is a map of Kenya illustrating the food security situation.

Figure 1. Map of Kenya illustrating the food security situation in the country (FEWSNET and KFSSG, 2012). Used by kind permission of the Food and Agriculture Organization.



There are several factors influencing the food security situation in Turkana. The first is high food prices, as crop production is low in agropastoral areas due to a lack of water and poor agronomic practices employed by farmers (FEWSNET and KFSSG,

2012). In addition, conflicts and insecurity have disrupted livelihood activities, leading to loss of lives, displacement of households and loss of livelihood assets (FEWSNET and KFSSG, 2012).

Approximately 60% of the population in Turkana practices pastoralism by rearing goats, camels, cattle, sheep and donkeys. Agro-pastoralism makes up 20% of the population's livelihood (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011a). These individuals keep small herds of livestock and also grow crops such as beans, sorghum and maize. Along the edge of Lake Turkana, households practice fishing as their main source of livelihood, whilst the remaining 8% of the population have formal employment.

The most recent Household Economy Approach (HEA) survey divided Turkana into the following six livelihood zones (FEG, 2012):

- Central Pastoral
- Border Pastoral
- Kerio Riverine Agro-Pastoral
- Turkwell Riverine Agro-Pastoral
- Lake Turkana Fishing
- Lodwar Urban

A Cost of the Diet assessment was undertaken in the Kerio agropastoral livelihood zone located in south east Turkana due to ease of access. This zone has a population size of approximately 99,657 people (Kenyan Government, 2009) and features the Kerio river and the adjacent riverine forest, the resources of which, determine the livelihood activities in this area (FEG, 2012). The river's water level and flow varies seasonally in conjunction with rainfall in the Cherigani Hills, but provides enough water for irrigation and forest growth, sustaining herds and farms. Growing crops like maize, sorghum, rearing livestock for milk, meat and blood and selling bush products therefore form the basis of the economy in this area (FEG, 2012). However, herd insecurity as a result of frequent raiding and pressure on resources around settlement areas means that sustaining large herds cannot be supported.

2.2 Prevalence of undernutrition

Data was not available for south Turkana on all major nutrition indicators, so data for the Rift Valley have been used.

In 2011, Turkana County experienced a serious drought as a result of failed rains in the previous year. Consequently the prevalence of global acute malnutrition or GAM (the sum of the prevalence of severe and moderate acute malnutrition at a population level) in south Turkana was 33% in May 2011 (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011a). This is classified as a critical public health problem by the World Health Organization (WHO) (WHO, 1995). In response, many agencies scaled up their emergency nutrition interventions which, coupled with a heavy rainfall at the end of 2011 reduced the level of GAM to 15% in December 2011 (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b). Data from a nutrition survey in July 2012 indicates that these rates increased slightly to 17% and are still

classified by the WHO as a serious public health problem (WHO, 1995). The prevalence of stunting (children with a z-score of height-for-age less than -2) is 25% (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2012), which is classified by the World Health Organization (WHO) as medium severity (WHO, 1995). Severe acute malnutrition is a result of acute undernutrition whereas stunting is due to long term or chronic undernutrition plus an element of inter-generational undernutrition, as small mothers tend to give birth to small babies.

2.3 Micronutrient deficiencies

The coverage of vitamin A supplements for children under the age of 5 is 69%, which is below the WHO's acceptable level of coverage, which is 80% (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b). This suggests that deficiency may occur. Another proxy indicator for vitamin A deficiency is the prevalence of pregnant women with night blindness: only 2.2% of pregnant women in the Rift Valley reported this problem, which is not of public health significance (Kenya National Bureau of Statistics, 2009). However, recent data on night blindness in pregnant women could not be found for Turkana so the 2.2% presented may not be representative of the agro pastoral livelihood zone.

Recent statistics on the prevalence of anaemia in south Turkana could not be found, however proxy indicators of the condition would suggest that it may be an issue in the area. Only 4.5% of children in the Rift Valley province were found to have been given iron supplements in the most recent Demographic and Health Survey (Kenya National Bureau of Statistics, 2009). Iron supplements are often needed once exclusive breastfeeding has ended to ensure that a deficiency does not occur. Thirty three per cent of women in the Rift Valley province reported that they had not taken iron supplements during their last pregnancy, 53% took supplements for less than 60 days, and less than 3% took supplements for 60 or more days (Kenya National Bureau of Statistics, 2009). Malaria is also endemic in Turkana but bed net ownership in 2011 was good in the south of the district with 63% of households reporting that children under the age of 5 were using bed nets (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b).

2.4 Infant feeding and care practices

The timely initiation of breastfeeding among children of 0-23 months was low at 55%. This is linked to practices such as the naming of the child that is given priority before breastfeeding in this culture (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b). Although the findings of nutrition surveys suggest that nearly all the children in south Turkana (98%) are breastfed at some point during their infancy, only 40% are exclusively breastfed for the first 6 months of life as recommended by the WHO (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b). This means that 60% of children are given something else to drink or eat other than breast milk, a practice that increases the risk of diarrhoeal disease. The rates of continued breastfeeding are better as 86% of children at 23 months were still being breastfed (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b).
The WHO recommends that complementary feeding should begin after reaching six months of age. In 2011 only 27% of infants in south Turkana had been given other foods (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011a). This could be

associated with the drought during this period and may not be representative of current practices. The diversity of the food provided to these children was also reported as being limited. A dietary diversity indicator is used to assess the quality of the diet. It is based on the premise that the greater the number of food groups included in the diet, the more likely it is that the diet will provide the recommended requirements for nutrients. For the diet to achieve minimum dietary diversity, it is recommended by the WHO that foods from four out of seven foods groups should be consumed by a child of 6-23 months. Only 19% of children in south Turkana received foods from at least four food groups. Meal frequency was also low, with only 20% of children in south Turkana receiving food three or four times a day (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011a). This indicates that children in the area may not be receiving the adequate quantity or quality of food required for their growth and development.

Diarrhoeal diseases are one of the leading causes of malnutrition and death among young children in developing countries. A nutrition survey conducted by MoPHS, Oxfam GB, World Vision, Merlin and IRC, (2011b) reported that, 16% of children under the age of five in south Turkana had suffered from diarrhoea in the two weeks prior to the survey. To combat the effects of dehydration, the WHO promotes the use of oral rehydration therapy (ORT) whilst increasing intakes of food and other drinks. In 2009, 40% of children in the Rift Valley province with diarrhoea were given this treatment (Kenya National Bureau of Statistics, 2009). Furthermore, in 2009 the Demographic and Health Survey found that during bouts of diarrhoea, 22% of children were given more liquids, 29% were given the same amount of liquids, and 44% of children were given less liquid during diarrhoea. Also, 5% of children were given more food, 31% were given the same amount of food and 53% were given less food (Kenya National Bureau of Statistics, 2009). Some of these practices are not ideal so training parents to make oral rehydration solutions from sugar, salt and clean water and teaching them to sustain children's food intake during illness could help to prevent malnutrition.

2.5 Hygiene and sanitation

The main causes of diarrhoeal diseases are inadequate sanitation and poor hygiene. MoPHS, Oxfam GB, World Vision, Merlin and IRC, (2011b) reported that 89% of households in south Turkana were drinking unsafe water. Sanitation practices also need improvement as the majority of households (75%) did not have access to a latrine with many defecating in open fields or bush. Furthermore 45% of caretakers did not wash their hands with water and soap after using the toilet (MoPHS, Oxfam GB, World Vision, Merlin and IRC, 2011b).

According to the Global Atlas of Helminth Infections (www.thiswormyworld.org), the risk of soil transmitted helminths in Turkana is very low because the area is so arid. Mass treatment is therefore unnecessary.

2.6 Household profiles and key economic characteristics

The HEA, completed a month prior to this study divided the population of the agropastoral livelihood zone of Turkana into four wealth groups: very poor, poor,

middle and better-off. As shown in Table 1, the HEA estimated that 25% of households were classified as very poor, 38% poor, 22% in the middle category and 15% were considered better-off. The typical household size differs between the wealth groups: 7 members for very poor and poor, 9 for the middle and 13 for better off households. (FEG, 2012).

Table 1 shows the main characteristics of households in the livelihood zone. It shows that wealth is defined principally by livestock assets. The results from the HEA found that wealth is associated with larger and more diverse herds comprising of both large and small stock. Middle-income and better-off households own a full range of stock: camels, cattle, sheep and goats. By contrast, poorer households own very small herds of sheep and goats (FEG, 2012). Land is not the primary determinant of wealth because, for those registered in land schemes, the allocation of land was the same for all households (14 basins per household) (FEG, 2012). Furthermore, production outcomes have varied considerably in past years, affected by floods and drought.

With larger herds comes the need and ability to house more wives and children. Consequently, better-off households are also large households. The HEA found that in some villages, better- off households would prioritise their children's help with herding livestock over sending them to school (FEG, 2012).

Table 1. The characteristics of households in agropastoral livelihood zone of Turkana by wealth group

Wealth group	% of the population	Typical household size	Typical no. of wives
Very poor	25	7	1
Poor	38	7	1
Middle	22	9	1-2
Better - off	15	13	1-3

Wealth group	Typical basins cultivated/wife/ year	Livestock holdings	Income sources (sales of)
Very poor	14	3-8 shoats, 5-20 poultry	Bush products, chicken/shoats, labour
Poor	14	0-1 cows, 5-12 shoats, 5-10 poultry	Bush products, chicken/shoats, crops
Middle	14	0-5 camels, 2-6 cows, 10-35 shoats, 5-10 poultry	Livestock, milk, bush products, crops
Better - off	14	0-6 camels, 4-12 cattle, 25-55 shoats	Livestock, milk, trade, crops

2.7 Food sources

The HEA (FEG, 2012) showed that sources of foods differed depending on wealth in this livelihood zone. For very poor households, it was found that the most important source of food was food aid, followed by their own cop production and purchase

which provided 40%, 35% and 20% of kilocalorie requirements respectively. Milk, meat and blood from their own herds only provided 1% of very poor household's total energy requirements (FEG, 2012). This is because they owned a small number of sheep or goats and did not own any milking camels or cattle.

The percentage of energy provided by own crop production did not differ considerably by wealth group as land holding size was similar for all households. Poor and middle income households obtained 41% of their energy requirements from crops whilst better-off households obtained 45% of their energy requirements from this source. The types of crops consumed were maize, sorghum, cowpeas and their leaves and green grams. Cash crops, such as vegetables, are not grown due to weak market infrastructure and were therefore not widely consumed (FEG, 2012).

The results from the HEA found that the importance of milk, meat and blood in providing energy requirements was higher in wealthier groups. However, in general the contributions of these products was small compared to the central pastoral zone, and accounted for 2%, 9% and 14% of total energy requirements met by the middle, poor and better-off wealth groups respectively (FEG, 2012).

The results from the HEA (FEG, 2012) also showed that poor wealth groups did not rely very much on food purchased on the market to provide their energy requirements. This was due to the high reliance on food aid to provide these requirements. In absence of this food source these households would had to have purchased approximately 50-60% of their energy requirements from the market. As the provision of food aid reduced with increasing wealth middle and better off households relied on markets to purchase 32% and 46% of their energy requirements respectively (FEG, 2012). Market purchases consisted mainly of the staple food (primarily maize grain and maize meal), both in terms of the amount of money spent and in terms of contribution to energy requirements. Other commonly purchased foods included beans, oil and sugar (FEG, 2012).

Markets in the agropastoral livelihood zone are very poorly developed. Reliance of own crop production to provide energy is high in all wealth groups because access to markets is poor and market demand for the products is low. There are several reasons for this. The first is a lack of outside investment, for example, the roads where the markets exist are very poor, there is little market infrastructure and a lack of regular livestock and other markets (FEG, 2012). Secondly, the markets are isolated from any large urban centre of demand. The areas of Uganda and Ethiopia, for example, that boarder Turkana, are also sparsely populated and poorly integrated into their own national markets. This offers little in the way of opportunities for either import or export (FEG, 2012).

2.8 The seasons in the agropastoral livelihood zone of Turkana

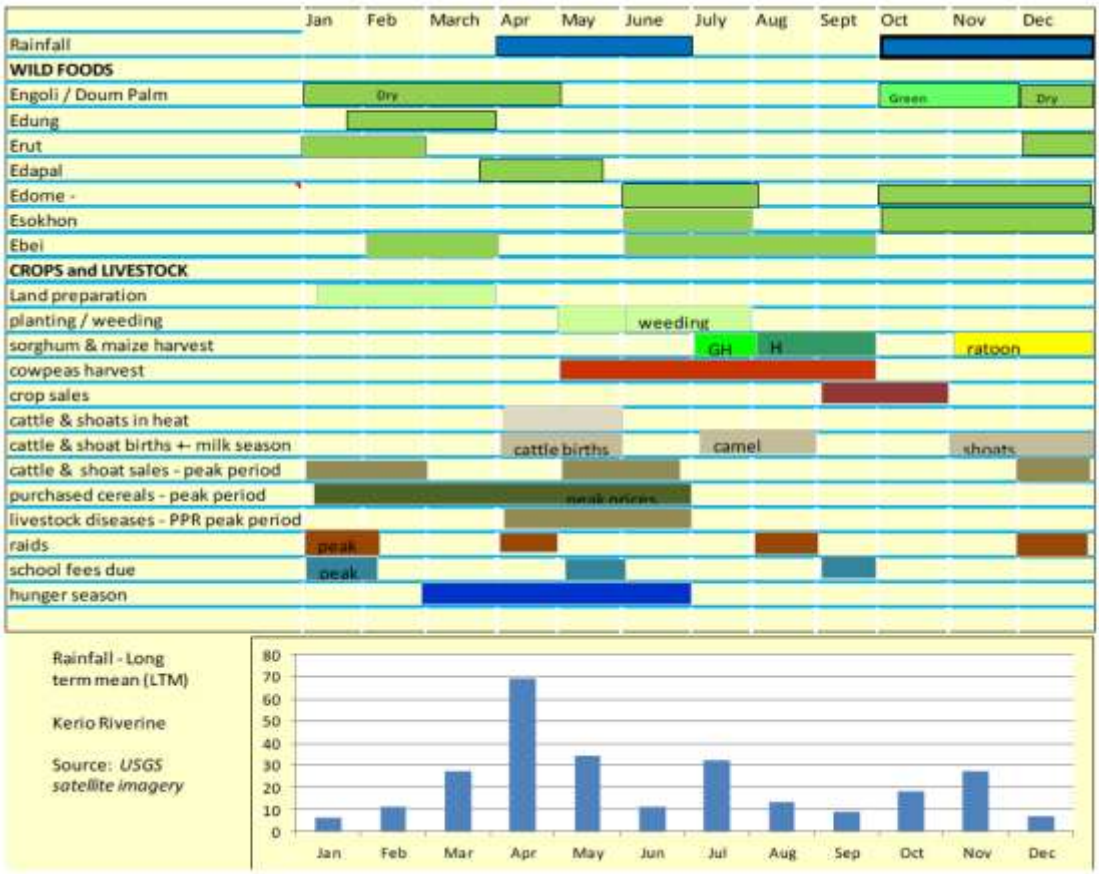
The timing of rainfall determines the seasons in Turkana. There are usually two rainy seasons: long rains from March to May (a*kiporo*) and short rains from October to November (a*kicheres*). The outcome of the rainy seasons determines livelihood activities in this zone. The rain is essential in controlling the condition of the rangelands and therefore overall livestock condition and migration patterns of pastoral households. Rainfall in the Cherigani Hills is also vital for the Kerio riverine

ecosystem, which controls the irrigation of crops and therefore production outcomes and forest growth (FEG, 2012).

The 'hunger season' lasts from March – June: this is the period before the sorghum and maize harvest where the price of these crops is double their post-harvest price. It is also the period when livestock diseases are at their peak and livestock are therefore most at risk from falling ill or dying (FEG, 2012).

Figure 2 shows a seasonal activity calendar developed during the recent HEA (FEG, 2012) in this livelihood zone. This calendar illustrates the timing of key activities during the year.

Figure 2. A seasonal calendar for the agropastoral livelihood zone of Turkana developed during the HEA



2.9 Nutrition programmes in Turkana District, Kenya

Save the Children do not currently work in Turkana but there are several other organisations investing resources in improving food security and livelihoods in this area. In 2005 the Kenyan Government published a 10 year strategy document for arid and semi-arid lands, which includes Turkana district. Several areas for improvement were documented including improving road infrastructure, minimising conflict over land ownership, strengthening livestock and crop production by

improving irrigation and water harvesting and improving livestock disease control (Kenyan Government, 2005).

Agencies such as the Wold Food Programme have been regularly distributing relief food throughout Turkana for approximately 30 years. This food has recently been targeted at more vulnerable groups such as the elderly, disabled and orphans (FEG, 2012).

Oxfam are also active in the area, implementing cash transfers, cash for work programmes and distributing food through local traders. The organisation is also working to improve broken water systems that are close to pastures as well as deworming and vaccinating livestock against disease (Oxfam, 2011).

3. Methods

3.1 Location

Figure 3. Livelihood zone map of Turkana (FEG, 2012)

A livelihood zone is defined as an area within which people share broadly the same patterns of access to food (FEG, 2012). Cost of the Diet assessments are often conducted in a livelihood zone because the foods that are available and people consume are homogenous. The Cost of the Diet assessment took place in the agropastoral livelihood zone of Turkana, labelled KAP in Figure 3. This zone is a riverine belt in *Lokori* Division of Turkana East. The central feature of the zone is the Kerio river and the adjacent riverine forest (FEG, 2012).

The data were collected in the villages of *Lokori, Katilia, Lotubae, Morulem, Elelea* and *Lokwii* in Turkana District, Kenya. These villages were selected based upon the timing of the markets which had to operate on the 3 days that data collection was taking place within the training schedule. The Cost of the Diet consultant was also reassured that the villages were typical of the livelihood zone.

The assessment took place in June 2012 during the long rainy season called *akiporo*. It is during this season that cereal purchase is at its highest, that cowpeas are harvested and the planting and weeding for crops such as sorghum and maize takes place (FEG, 2012).

3.2 Data collection and sources

This section describes the data collected to undertake an analysis of the cost of the diet.

3.2.1 Market survey to collect price data
Surveys were conducted in the villages mentioned in section 3.1.

Prior to collecting price data, a comprehensive list of all food items available in the district was developed using key informants and the knowledge of local participants in the analysis. This was followed by a field trial in the market of *Klaskamer* (data not included) where participants practiced data collection methods whilst adding items to the food list. The resulting comprehensive food list was then used to collect data on price and weight in the remaining markets.

For the purpose of the training, retrospective data was collected from June 2012 – July 2011 so that participants could be trained in how to analyse and interpret seasonal data. The seasons and periods used were taken from the standard seasonal calendar for Turkana provided by the Kenya Food Security Steering Group (2012)

and do not reflect the fluctuating rainfall experienced in 2012 and 2011, shown in Figure 2:

Season 1 – June 2012 – April 2012: *Akiporo*
Season 2 – March 2012 – January 2012: *Akamu*
Season 3 – December 2011– October 2011: *Akicheres*
Season 4 – September 2011 – July 2011: *Ait*

To collect the information needed to estimate the cost of the diet, market traders were asked the price of the smallest unit of each food item that they sold during each season, assuming that the poor were likely to be able to afford this amount. The poor typically buy foods in small amounts as they cannot afford bulk purchases.

Three samples of each food were weighed using electronic scales that had a precision of 1g (Tania KD-400, Tanita Corpoation, Japan). Where possible in each market, weight and price data were collected from four traders giving a possible total of four prices and 12 weights for each food item found in every market. Market traders were then asked questions about annual trends in prices, seasonality and changes in the demand and supply of commodities. This data were entered into an Excel spread sheet every evening after collection, which averaged the price and weight of each food across every market. The final averaged weight and price for each food was then divided to calculate the cost per 100g of each food item by season.

Each food item identified in the market survey was then selected from the food composition database in the Cost of the Diet software, choosing the variety consumed in the region nearest to Kenya if there was more than one type available to select. All price data were converted to cost per 100g and then entered for each season into the Cost of the Diet programme.

3.2.2 Interviews and focus group discussions to collect typical food consumption

To estimate a diet that is nutritious but takes into account typical food habits of households in the agropastoral livelihood zone, the software needs to be told how many times a week it can or cannot include a food. This is called the minimum and maximum constraints, which need to be determined for each food found on the market. For example if the minimum constraint for Irish potato is set at 5 and the maximum is set at 14 this means that the software must include potato in the diet no less than 5 times a week but no more than 14 times a week (twice a day).

To create the minimum and maximum constraints for each food found on the market, a one hour interview based upon a questionnaire and focus group discussion was carried out. The questionnaire was based upon the food list generated by the market survey and aimed to determine how often the foods were consumed. The questions asked during the focus group discussion were based on early observations from the market data, comments from traders, and responses to the questionnaire. In particular, information was collected on the wild foods consumed, on household production of food, on cultural taboos, on 'normal' consumption patterns, and on key staples. The discussions were held in two villages, *Lokorko* and *Elelea* and each

group consisted of 8 women, 2 from each wealth group identified by the HEA, all of whom were responsible for preparing food for the household.

During the interview the women were asked to state the frequency with which they ate each item of food on the list. The frequency options given were never, sometimes (1-4 times a week) or often (more than five times a week). The responses were given a numerical score: 'never' was awarded 0 points, 'sometimes' 1 point and 'usually' 2 points, then the total for each food item from all 8 respondents was calculated. This meant that each item could receive a minimum total score of 0 and maximum of 16. A total score of 0-1 points was translated into a maximum constraint of 0, 1-8 points was translated into a maximum constraint of 7 (a food eaten once a day) and a total score of 9-16 points was translated into a maximum constraint of 14 (a food eaten twice a day).

During the focus group discussions the women stated that maize was the staple food of people in the agropastoral livelihood zone of Turkana. The results from the HEA (FEG, 2012) found the same. This food was entered into the diet a minimum of 7 times per week and a maximum of 14 times per week. The women also stated that wheat, milk, beans, lentils, cabbage and vegetable fat were commonly consumed foods. To reflect this, these foods were given a minimum constraint of 0 and a maximum constraint of 14, allowing the software to include these foods up to twice a day.

It is important to note that the constraints applied are intended to reflect typical dietary patterns rather than reflect economic constraints, because the Cost of the Diet is a tool to illustrate a diet that could be achieved if economic limits were removed.

3.2.3 Specification of a typical family

A typical household was identified during the focus group discussions as a part of the HEA, a month prior to this study. As shown in Table 2, the household size is larger in wealthier groups. For the purpose of the analysis a household size of 7 individuals, a man, a woman and 5 children, representing very poor households was used. As the estimates of household income for this typical family are based on an energy requirement of 7 x 2,100 kcals, or 14,700 kcal in total, the Cost of the Diet method identifies a family of the same individuals that require as close to 14,700 kcal as possible. This typical household economy analysis/Cost of the Diet (HEA/CoD) family consists of:

- An adult man, aged 30-59y, weighing 50 kg and moderately active (2,750 kcal/d)
- An adult woman, aged 30-59y, 45 kg, moderately active (2,300 kcal/d) and lactating (418 kcal/d)
- A baby (either sex) aged 12-23 months (894 kcal/d)
- Child (either sex) aged 7-8 years (1,625 kcal/d)
- Child (either sex) aged 9-10 years (1,913 kcal/d)
- Child (either sex) aged 11-12 years (2,250 kcal/d)
- Child (either sex) aged 13-14 years (2,575 kcal/d)

The total energy requirement of this family is 14,724 kcal/d.

Because the Cost of the Diet is dependent on the numbers, age and degree of physical activity of the individuals selected for this 'typical' family, which is arbitrary, and to illustrate the possible range in the cost of the diet, a CoD/HEA family was specified in the same way for 5, 6, 8, 9 and 10 members and two other families were specified to cover the highest and lowest energy needs for families of between 5 and 10 members.

A minimum or low energy family was selected by choosing the youngest, smallest family for each number of individuals between 5 and 10; and a maximum or high energy family was selected by choosing the oldest, largest family between 5 and 10 members.

The specification of the HEA/CoD, minimum and maximum energy families of between 5 and 10 members are shown in Appendix 1 and are recommended as standard families for all Cost of the Diet analyses. This ensures that the analysis can be aligned with any HEA and that a possible range in energy needs can be covered.

3.2.4 Requirements for energy and micronutrients

The needs of individuals for energy are taken from a database embedded in the Cost of the Diet software that specifies the estimated average requirement (EAR) recommended by the WHO and FAO (2004) for individuals by age, sex and activity level. As this intake is based on the estimated average requirement, the probability that any given individual's requirement is met is 0.5 or 50%.

The needs of individuals for protein are taken from a database embedded in the software which specifies the safe individual intake recommended by the WHO and FAO (2007) for individuals by age and sex. This intake is defined as the 97.5th percentile of the distribution of individual requirements, so the probability that any given individual's protein requirement is met is 0.975 or 97.5%.

The needs of individuals for vitamins and minerals (collectively called micronutrients) are taken from a database embedded in the software which specifies the recommended nutrient intake (RNI) proposed by the WHO and FAO (2004) for individuals by age and sex. This intake is defined as the 97.5th percentile of the distribution of individual requirements, so the probability that any given individual's requirement is met is 0.975 or 97.5%. The recommended intake of vitamin A is specified as the recommended safe intake, as there are no adequate data to derive mean and standard deviations of intake (WHO/FAO, 2004).

The needs of individuals for fat are specified as 30% of total energy intake (WHO, 2008).

For the purpose of this analysis, a diet selected by the Cost of Diet software which meets all of the requirements described above is called a 'nutritious' diet.

3.3 The Cost of the Diet software

The cost of the diet is a method developed by SC UK to calculate the minimum amount of money a typical household would need to purchase their requirements

for energy, protein, fat and micronutrients, with the probabilities specified above, using locally available foods. The cost of food grown at home and consumed at home is included in the calculation by applying market prices. Menu driven software developed that applies linear programming routines in Microsoft Excel 2003[2] is used to minimise the cost of locally available foods to meet these nutrient requirements. The Cost of the Diet software generates a hypothetical diet using a combination of foods that will enable a family to meet their energy and nutrient requirements as recommended by the WHO and the FAO (2004) at the lowest possible cost. As mentioned, this is defined as a 'nutritious' diet. As the software can select amounts of foods that are not realistic in terms of the frequency with which foods are eaten, for example by specifying that a particular food is eaten three times a day every day, the frequency with which each food is consumed can be adjusted to reflect typical dietary patterns.

3.3.1 Energy only diet

When estimating an energy only diet, the software calculates a lowest cost diet that meets only the average energy requirements of the family. The analysis is not used to promote an energy only diet because it is very unlikely to meet all micronutrient requirements, but it is useful to illustrate:

- The potential for micronutrient deficiencies in a diet that only tries to provide energy
- The additional cost of meeting all nutrient requirements, including micronutrients

3.3.2 Minimum cost nutritious diet (MNUT)

When estimating a MNUT diet, the software calculates the lowest cost combination of foods which meets the average energy requirements and the recommended micronutrient intake of the typical family. This diet does not reflect people's typical dietary patterns but it is useful to illustrate:

- The differences in diet composition and its cost when compared with a diet that takes into account typical dietary patterns.
- The extra cost of micronutrients when compared to the energy only diet

3.3.3. Locally appropriate cost-optimised nutritious diet (LACON)

When creating a LACON diet, the software calculates the lowest cost combination of foods which meet the average energy requirements and the recommended micronutrient requirements, whilst adhering to the minimum and maximum constraints which set the number of times a week specific food items can be included in the diet. This diet therefore does reflect people's typical dietary patterns and is useful to illustrate:

- The extra cost of meeting average energy and recommended nutrient intakes when typical dietary habits such as the main staple, foods commonly consumed and food taboos are taken into account

Table 2 below summarises the characteristics of each diet.

[2] Available from Save the Children, UK upon request

Table 2. A summary of the diets analysed using the Cost of the Diet software.

Diet name	Definition	Energy needs met	Fat at 30% of energy	Protein needs met	Micro-nutrient needs met	Reflects a typical diet
Energy only diet	A lowest cost diet that only meets the average energy requirements of the members of the household	X				
Minimum cost nutritious diet (MNUT)	A lowest cost diet that meets the average energy and the recommended nutrient requirements of the household	X	X	X	X	
Locally appropriate cost-optimised nutritious diet (LACON)	A lowest cost diet that meets the average energy and the recommended nutrient requirements of the household and reflects cultural consumption patterns	X	X	X	X	X

The average cost of all diets were calculated and are given in Kenyan shillings (KSH) rounded to the nearest 100 KSH.

The Cost of the Diet software can also be used, for example:

- To estimate the cost of a typical local diet;
- To estimate the minimum cost of a diet for any given individual and for specified households of multiple individuals;
- To take into account seasonal variations in food prices when costing the diet;
- To identify seasonal gaps in nutrient intake;
- To develop models of the impact of potential interventions that might enable households to meet their nutrient requirements.

A Cost of the Diet assessment is most useful when chronic malnutrition and micronutrient deficiencies have been identified as a nutritional problem and the availability or affordability of nutritious foods are likely to be among the underlying causes.

3.4 Estimating the affordability of diets

3.4.1 Estimating affordability according to annual income

The cost of a nutritious diet becomes a more meaningful figure when compared with the income and purchasing power of the poorest members of the community. A diet may be inexpensive in comparison to other contexts, but if it is beyond the means of the poor, then the risk of malnutrition remains.

Estimates of cash income were made during the HEA (FEG, 2012). For the purpose of the present analysis, in addition to the estimated cash income, the cash value of all food that is consumed but not purchased was estimated based on the market cost of

the same foods. This monetises all food grown or produced by the household, food paid in kind in exchange for labour, or food provided as gifts.

As mentioned previously, the HEA found that household size was larger in wealthier households. To ensure that affordability was not under or overestimated, the cost of the diets was estimated for the household sizes detailed in Table 3.

Table 3. The household size of each wealth group used to estimate the cost of the diets to estimate affordability

Wealth group	Household size
Very poor	7 individuals
Poor	10 individuals
Middle	15 individuals
Better-off	22 individuals

Each family was aligned with the HEA using the methods described in section 3.2.3.

Table 4 shows these estimate of income and own production for the four wealth groups.

Table 4. Total estimated income in KSH of a typical household in four wealth groups rounded to the nearest thousand.

	Very poor	Poor	Middle	Better-off
Annual Cash Income	35,100	47,800	114,300	176,200
Annual Own Produce	92,700	102,500	159,500	233,800
Total Annual Income	127,900	150,300	273,700	410,000

3.4.2 Estimating affordability after accounting for non-food expenditure

The income figures in Table 4 represent the total and potential income as food by households in different wealth groups. However, households have many needs in addition to food, some of which are critical for their survival. The 'non-food expenditure' (NFE), is defined as the annual cost of essential non-food items required by each specified wealth group. These figures are estimated by subtracting the staple food and non-staple food expenditure figures, generated by the HEA, from the total annual expenditure figures for each wealth group, again, generated by the HEA. By subtracting the non-food expenditure from the total annual income figures presented above, a more realistic indication of what amount households may have available to spend on food can be estimated. Table 5 shows the total income of each wealth group after subtracting household's needs for essential non-food items.

Table 5. Total income and non-food expenditure by wealth group.

	Very Poor	Poor	Middle	Better-off
Total annual income	127,900	150,300	273,700	410,000
Non-food expenditure (NFE)	9,300	12,300	40,300	52,300
Total annual income - NFE	118,600	137,900	233,400	357,700

The difference between the total estimated annual income plus non-food expenditure and the annual cost of a nutritious diet was defined as the 'affordability' of the diet.

4. Results

The list of foods identified and used in the Cost of the Diet analysis with the price per 100g in all four seasons can be found in Appendix 2. The list of all food found in the markets in the agropastoral livelihood zone, the portion sizes, minimum and maximum constraints entered into the Cost of the Diet Software can be found in Appendix 3.

The field team collected data on 40 foods found in the markets: 10 cereals, 2 pulses, 6 vegetables, 2 fruits, 6 animal products, 6 dairy products, 1 tuber, 4 fats/oils, tomato concentrate, sugar and iodised salt. The results from the interviews and focus group discussion found that maize was the main staple food in the agropastoral livelihood zone of Turkana and was imported from other areas of Kenya.

As mentioned, food aid rations provide 40% and 26% of a very poor and poor household's energy requirements. These rations consist of maize, a pulse such as kidney beans or lentils, oil, sugar and iodised salt. Many of the women interviewed stated that milk was consumed frequently, but in small amounts as most was sold. For very poor families, meat was rarely consumed as it was too expensive on the market and their animals were more important as a source of income.

The main difference between this zone and the central pastoral zone was that fruits such as mango, oranges and bananas and fish are found in at least one of the markets aided by Lake Turkana and irrigation practices. The most common vegetables sold were cabbage, tomatoes and onions.

Table 6 shows the energy density of the main staple foods eaten in the agropastoral livelihood zone of Turkana with their cost in Kenyan Shillings (KSH) per 100 kcal of raw and cooked food and per 10g of protein.

Table 6. The energy density and cost of the main staple foods eaten by people in the agropastoral livelihood zone of Turkana District, Kenya, ranked in terms of cost per 100 g from low to high

		Cost in KSH		
Staple Food	**Energy in kcal per 100g**	**Per 100 kcal raw**	**Per 100 kcal cooked**	**Per 10g protein**
Maize	362	1.6	4.9	7.2
Vegetable oil	862	2.0	2.0	0.0
Sorghum	332	2.1	2.1	6.8
Goat milk	69	2.8	2.8	5.4
Beans	326	3.3	8.5	4.8
Wheat	339	4.5	4.5	11.1
Lentils	311	6.9	6.9	8.8

4.1 The cost of the diet

4.1.1 Energy only diet

Table 7 shows the analysis of the cost of the diet by family group and by season.

The minimum cost of a diet that meets only a household's energy need has been estimated at between 122 – 527 KSH per day, depending on the season, and features only ten of the 40 foods found in the markets within the agropastoral livelihood zone. The annual cost of the diet for the typical family is estimated to be 118,400 KSH.

Table 7 shows that the daily cost of the diet varies by season considerably with season 2 being 4.3 times more expensive than season 4 for example. This is due to the seasonal availability of milk which was identified by the software as a cheap, energy dense food which was not available in seasons 2 and 3.

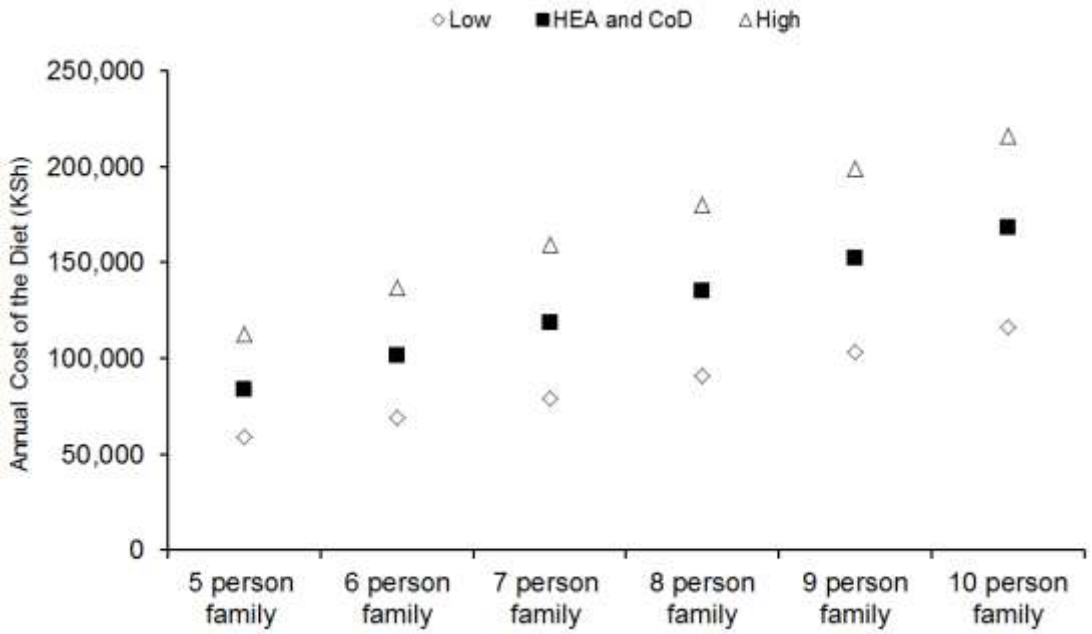
Table 7. The lowest cost diet for the HEA/CoD family in the agropastoral livelihood zone in Turkana District, Kenya, that meets only their energy requirements. The annual costs have been rounded to the nearest 100 KSH.

Age group	**Season 1** ***Akiporo***	**Season 2** ***Akamu***	**Season 3** ***Akicheres***	**Season 4** ***Ait***	**Annual cost**
12-23 month-old	8	17	15	5	4,100
Rest of Family	189	510	428	117	114,300
Overall	197	527	443	122	118,400

It should be noted that the cost of the diet of the child aged 12-23 months only includes the cost of the solid complementary foods the child is given, it does not include the costs of breast milk which are calculated within the average extra energy and nutrients required by the mother each day (418 kcal/day).

The composition of the typical household selected for the Cost of the Diet analysis consists of a family of two adults and five children whose energy intake is aligned with the energy intake used in the HEA. Figure 4 shows how the annual cost of the energy only diet for the HEA/CoD family varies by the number of individuals in the household from five to ten and for families with the minimum and maximum energy requirements. The cost for a family of seven members could range from 79,300 to 159,300 KSH depending on their sex, age, body weight and physical activity.

Figure 4. The annual cost of an energy only diet based upon mean energy values for household of between five and ten members and low, HEA and Cost of the Diet and high average energy requirements.



The key foods in the energy only diet are wheat flour, sorghum and camel milk, which provide 70% of the energy only diet in terms of quantity. Although it only provides 0.1% total quantity of the diet, sheep milk provides 25% of the total energy in this diet. This is mainly because it is the only food included by the software in season 4 and is 2.5 times more energy dense than camel's milk. As mentioned camel or sheep milk were not in seasons during season 2 and 3. Liver, three types of fat and wheat flour are therefore included during these seasons to make up for the shortfall in energy.

Table 8 shows the absolute weight and cost of the foods selected for the family for the whole year for the energy only diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Table 8. The absolute weight and cost of the foods selected for the HEA/CoD family for the whole year for the energy only diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Food List	Quantity (kg)	% quantity	Cost KSH	% cost	% energy	% protein	% fat
Liver	41.0	2.4	10,852	9.6	1.0	5.9	0.5
Maize, dried, raw	71.3	4.1	3,633	3.2	5.1	4.6	0.9
Margarine, fortified	34.4	2.0	8,612	7.6	4.4	0.0	8.7
Milk, camel	216.0	12.5	3,672	3.2	3.5	8.6	4.3
Milk, sheep, whole	626.1	36.3	10,644	9.4	25.0	25.0	40.2
Sheep, raw	68.3	4.0	12,012	10.6	3.6	9.2	5.2
Sorghum, wholegrain	248.0	14.4	9,921	8.8	16.4	20.4	2.6
Vegetable, fat	68.9	4.0	13,262	11.7	12.1	0.0	24.1
Vegetable, oil	35.3	2.0	11,270	10.0	6.0	0.0	12.4
Wheat, flour	316.9	18.4	29,315	25.9	22.9	26.1	1.1
Total	1,726.2	100.0	113,197	100.0	100.0	100.0	100.0
% of requirements met					100.0	157.5	170.0

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12
Liver	83.1	21.1	2.9	35.2	12.6	10.9	31.2	88.0
Maize, dried, raw	0.0	0.0	15.2	4.6	8.4	14.9	6.3	0.0
Margarine, fortified	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milk, camel	2.7	20.2	4.7	1.4	0.0	0.0	4.6	0.0
Milk, sheep, whole	13.4	58.7	17.1	44.5	11.9	21.9	24.4	9.8
Sheep, raw	0.0	0.0	1.9	2.2	9.5	10.5	1.0	2.3
Sorghum, wholegrain	0.1	0.0	40.8	8.0	31.2	32.9	12.3	0.0
Vegetable, fat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vegetable, oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wheat, flour	0.0	0.0	17.4	4.1	26.4	8.9	20.2	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
% of requirements met	558.4	22.1	73.8	121.5	119.3	48.5	33.7	765.4

Food List	% calcium	% iron	% zinc	% copper
Liver	0.2	15.7	7.1	41.3
Maize, dried, raw	0.3	10.4	4.9	6.0
Margarine, fortified	0.0	0.0	0.0	0.0
Milk, camel	0.0	0.0	33.2	0.0
Milk, sheep, whole	92.9	9.6	24.0	3.8
Sheep, raw	0.2	5.8	7.1	1.2
Sorghum, wholegrain	3.7	42.6	15.2	3.7
Vegetable, fat	0.0	0.0	0.0	0.0
Vegetable, oil	0.0	0.0	0.0	0.0
Wheat, flour	2.8	15.9	8.5	44.0
Total	100.0	100.0	100.0	100.0
% of requirements met	64.2	42.3	168.4	

Although the energy only diet meets the recommended intakes for energy and fat by design, it lacks several essential micronutrients. Figure 5 shows that for a child aged 12 – 23 months in all seasons the RNIs for vitamin C, vitamin B6, folic acid and iron are not met. The recommended intakes for vitamin B1, niacin and zinc are not met during 2, 3 and 4. The requirements for vitamin B2 and calcium are not met in seasons 1, 2 and 3. The requirements for vitamin B12 are not met in seasons 1 and 3 and the intakes for magnesium are not met for seasons 2 and 3.

Figure 5. The percentage of energy and the recommended nutrient intakes for micronutrients met by an energy only diet for a 12-23 month old child.

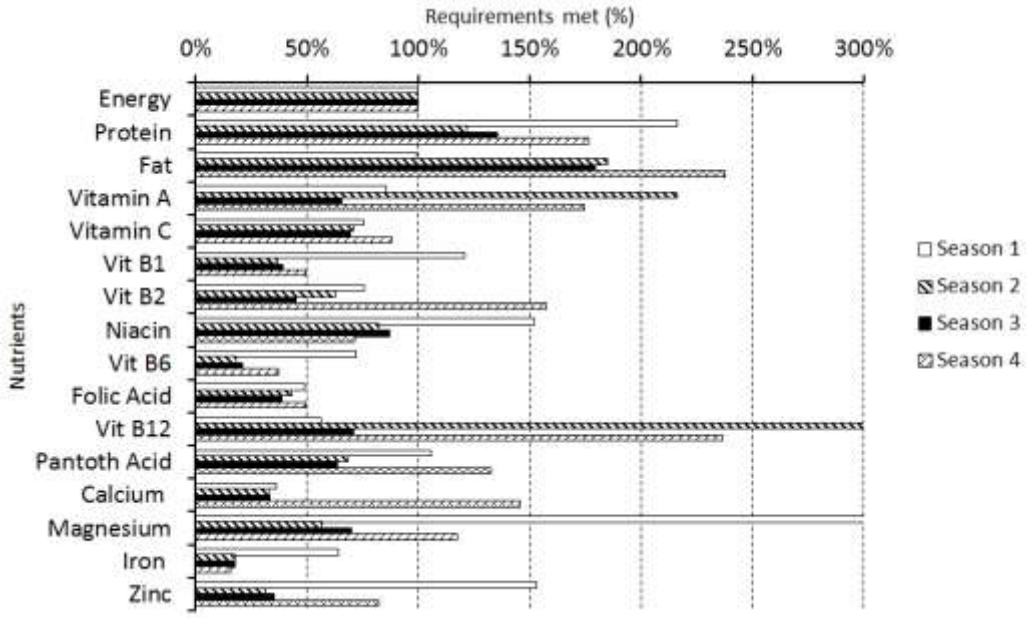
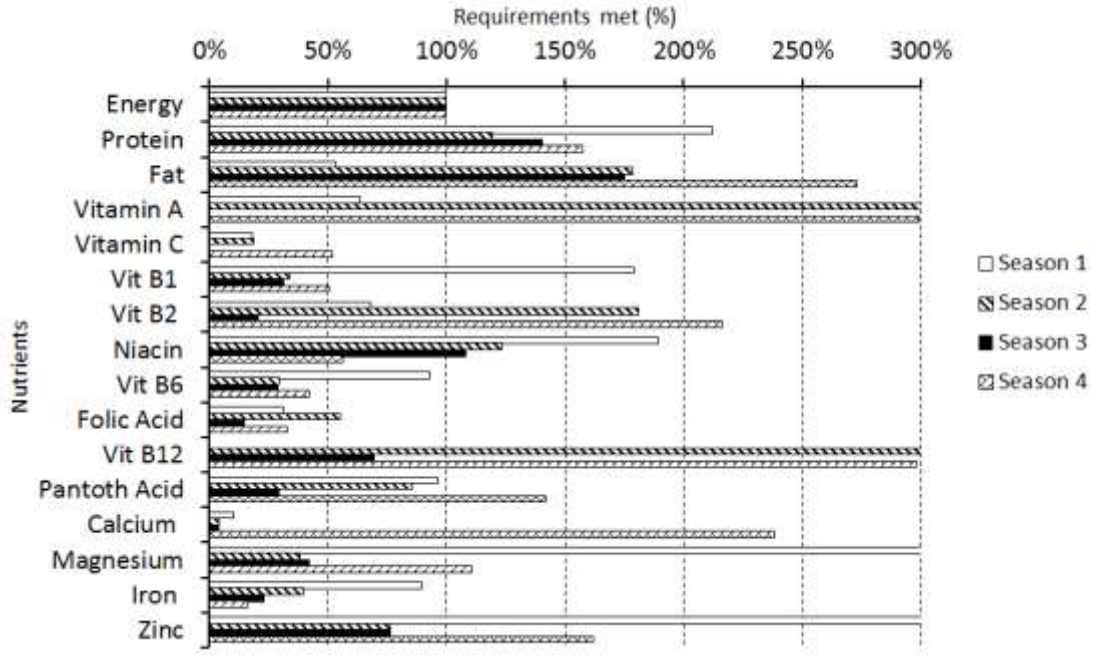


Figure 6 shows that for the rest of the family, a diet that only meets the need for energy, leads to a shortfall in requirements for vitamin C, vitamin B6, folic acid and iron in all seasons of the year. The intakes for vitamin A, vitamin B2 and vitamin B6 are not met in seasons 1 and 3 whilst in seasons 1, 2 and 3 the intakes are not met for pantothenic acid and calcium. The requirements for fat are not met in season 1, and the intakes for calcium are not met in season 4. Finally, a diet that only meets the needs for energy, leads to a shortfall in magnesium during seasons 2 and 3.

Figure 6. Percentage of energy and recommended nutrient intakes for micronutrient met for the rest of the family by an energy only diet.



4.1.2 Minimum cost nutritious diet (MNUT)

The minimum cost of a nutritionally adequate diet that meets the average energy requirements and the RNIs for micronutrients is estimated to cost between 495 and 914 KSH per day, depending on the season. Table 9 shows the costs by family members and by season. However this diet includes 16 of the 40 found in the market in the agropastoral livelihood zone of Turkana, some of which have to be eaten at three meals a day, every day, which is unlikely.

Table 9. The lowest cost diet for the HEA/CoD family in agropastoral livelihood zone of Turkana that meets needs for energy and micronutrient but does not take into account the typical diet. The annual costs have been rounded to the nearest 100 KSH.

Age Group	Season 1 *Akiporo*	Season 2 *Akamu*	Season 3 *Akicheres*	Season 4 *Ait*	Annual cost
12-23 month-old	29	44	40	39	13,900
Rest of Family	547	870	766	456	242,300
Overall	576	914	806	495	256,200

The key components of the diet, selected by the Cost of the Diet software in the largest quantities are sorghum, sheep meat and camel and cow milk. The software has identified several foods as rich sources of essential micronutrients. For example, small dried fish have been included in this diet as an important source of calcium, vitamin B12, protein and niacin, whilst oranges have been included in the diet as a cheap source of vitamin C. The software has included liver in the MNUT diet which is the primary source of vitamin A, vitamin B12 and copper in this diet and also provides large amounts of iron and zinc.

Table 10 shows the absolute weight and cost of the foods selected for the family for the whole year for the MNUT diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Table 10. The absolute weight and cost of the foods selected for the family for the whole year for the MNUT diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Food List	Quantity (Kg)	% quantity	Cost KSH	% cost	% energy	% protein	% fat
Bean, kidney, raw	72.1	3.2	6,749	2.8	4.7	6.8	0.4
Cabbage, green	61.6	2.7	3,803	1.6	0.3	0.3	0.1
Fish, small, dried	50.1	2.2	44,696	18.6	3.3	12.4	2.2
Goat, raw	16.8	0.7	3,842	1.6	0.6	1.2	1.0
Lentil, whole	208.1	9.1	46,050	19.2	12.9	21.2	1.1
Liver	27.4	1.2	6,591	2.7	0.6	2.1	0.5
Maize, dried, raw	16.4	0.7	833	0.3	1.2	0.6	0.3
Mango	12.8	0.6	742	0.3	0.1	0.0	0.0
Milk, camel	203.7	8.9	3,463	1.4	3.3	4.3	5.3
Milk, cow, powder	2.4	0.1	2,109	0.9	0.2	0.2	0.3
Milk, cow, whole	386.1	16.9	21,619	9.0	5.1	5.2	6.9
Milk, sheep, whole	295.2	12.9	5,017	2.1	11.8	6.2	24.9
Orange	136.2	6.0	9,258	3.9	0.9	0.3	0.1
Sheep, raw	252.5	11.1	51,774	21.6	13.4	18.0	25.1
Sorghum, whole grain	485.1	21.3	23,021	9.6	32.0	21.1	6.7
Vegetable fat	54.8	2.4	10,601	4.4	9.6	0.0	25.2
Total	2,281.1	100.0	240,176	100.0	100.0	100.0	100.0
% of requirements met					100.0	298.4	129.5

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12
Bean, kidney, raw	0.0	2.2	8.4	3.0	5.6	6.2	15.9	0.0
Cabbage, green	0.1	12.8	1.1	1.0	0.4	1.9	0.8	0.0
Fish, small, dried	0.0	0.0	1.4	3.7	12.6	5.7	0.9	17.1
Goat, raw	0.0	0.0	0.3	0.5	1.2	1.1	0.0	0.6
Lentil, whole	0.1	10.8	27.3	10.9	17.9	27.6	66.5	0.0
Liver	81.7	3.1	1.0	20.2	4.3	2.9	3.9	63.6
Maize, dried, raw	0.0	0.0	1.8	0.9	1.0	1.4	0.3	0.0
Mango	0.3	2.9	0.1	0.1	0.1	0.3	0.1	0.0
Milk, camel	3.8	4.2	2.3	1.1	0.0	0.0	0.8	0.0
Milk, cow, powder	0.2	0.2	0.2	0.8	0.2	0.3	0.1	0.2
Milk, cow, whole	4.2	4.0	4.4	18.1	4.4	6.4	1.5	4.4
Milk, sheep, whole	9.3	6.1	4.2	18.0	2.9	4.1	2.1	5.0
Orange	0.1	53.6	2.3	1.1	0.5	1.5	2.0	0.0
Sheep, raw	0.0	0.0	3.6	7.0	17.8	15.3	0.7	9.1
Sorghum, whole grain	0.3	0.0	41.5	13.4	31.1	25.5	4.5	0.0
Vegetable fat	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
% of requirements met	380.6	100.0	141.7	141.9	234.2	122.7	181.3	708.7

Food List	% calcium	% iron	% zinc	% copper
Bean, kidney, raw	1.9	9.6	4.9	12.6
Cabbage, green	0.1	0.2	0.1	0.2
Fish, small, dried	39.1	4.1	6.3	6.3
Goat, raw	0.0	0.7	1.2	0.3
Lentil, whole	3.8	32.4	17.6	39.2
Liver	0.1	4.4	3.0	25.7
Maize, dried, raw	0.0	1.0	0.7	1.3
Mango	0.0	0.0	0.0	0.3
Milk, camel	0.0	0.0	19.7	0.0
Milk, cow, powder	0.9	0.1	0.2	0.0
Milk, cow, whole	20.4	1.3	3.7	0.0
Milk, sheep, whole	26.4	1.9	7.1	1.7
Orange	2.5	0.2	0.3	1.5
Sheep, raw	0.3	9.0	16.5	4.3
Sorghum, whole grain	4.3	35.2	18.7	6.8
Vegetable fat	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
% of requirements met	106.4	100.0	267.7	

Figure 7 shows that the RNI is exactly 100% for calcium, iron and vitamin C for the young child in all seasons of the year. This analysis identifies iron, vitamin C and calcium as the most difficult micronutrients to obtain from the diet for the 12-23 month old in a nutritious diet that is not constrained by typical dietary patterns.

Figure 7. The percentage of energy and the recommended nutrient intakes for micronutrients met by a MNUT diet for a 12-23 month old child.

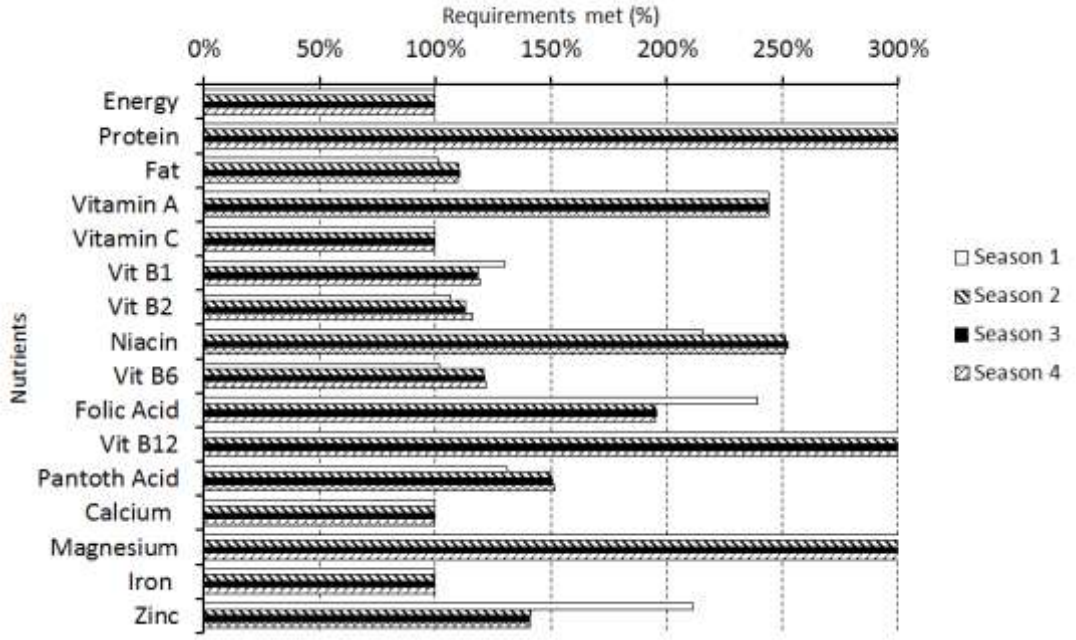
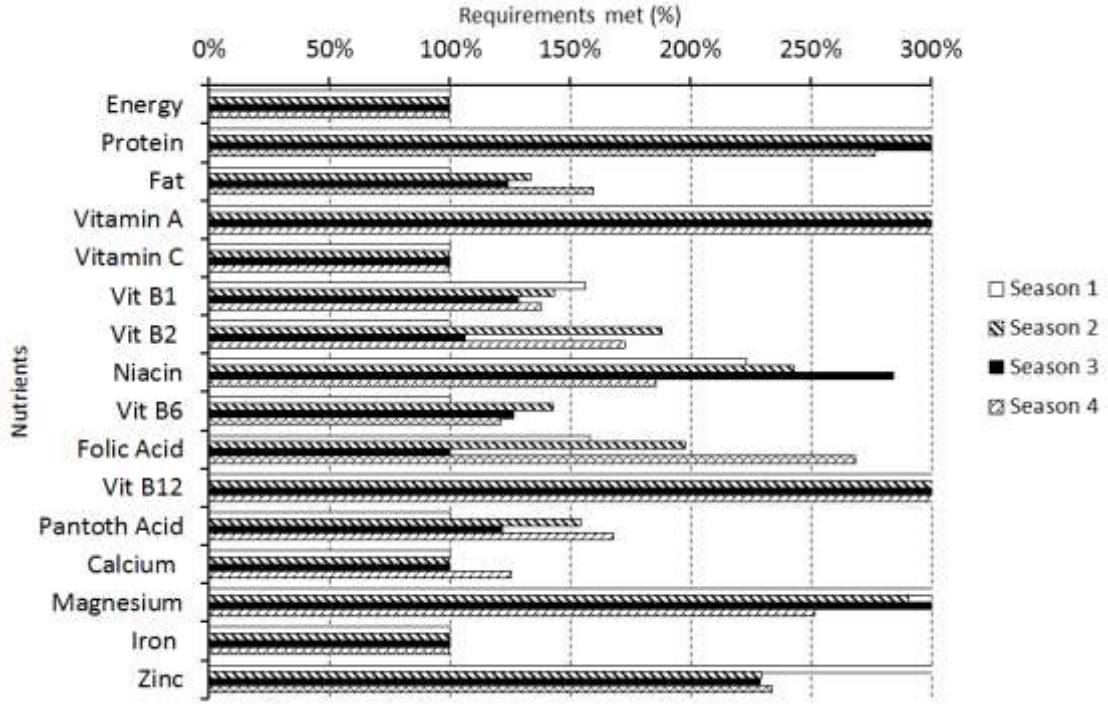


Figure 8 shows that for the rest of the family the RNI is exactly 100% for iron and vitamin C in all seasons of the year. Furthermore the RNI for fat, vitamin B2, vitamin B6 and pantothenic acid is exactly 100% in seasons 1. This is due to the seasonal availability of the different varieties of milk. Camel milk found only in season 1 does not provide as much fat or B group vitamins as cow or sheep milk which are included in the other seasons. The RNI for folic acid is met by 100% in seasons 3 and in seasons 1, 2 and 3 for calcium. These nutrients are therefore the hardest for the software to meet requirements for in the agropastoral zone of Turkana, when a nutritious diet is not constrained by typical dietary patterns. However it should be recognised that the recommended amounts used as targets by the software are greater than the actual needs of 97% of all individuals.

Figure 8. The percentage of energy and the recommended nutrient intakes for micronutrients met by a MNUT diet for the rest of the family.



4.1.3. Locally appropriate cost-optimised nutritious diet (LACON)

The MNUT diet specified in section 4.1.2 above was not chosen to be typical of the foods eaten by people in the agro pastoral zone; the diet reflects the least expensive way for the typical family to meet the specified amounts of energy and micronutrients using all foods available in the market, but in unconstrained amounts.

Table 11 shows the breakdown of costs by family members and by season for a culturally acceptable diet (LACON). The estimated minimum amount of cash that a family of seven, including a child aged 12-23 months, would need to be able to purchase this diet from the market is between 925 – 1,275 KSH a day and includes 26 of the 40 foods found in the market in the agropastoral livelihood zone of Turkana.

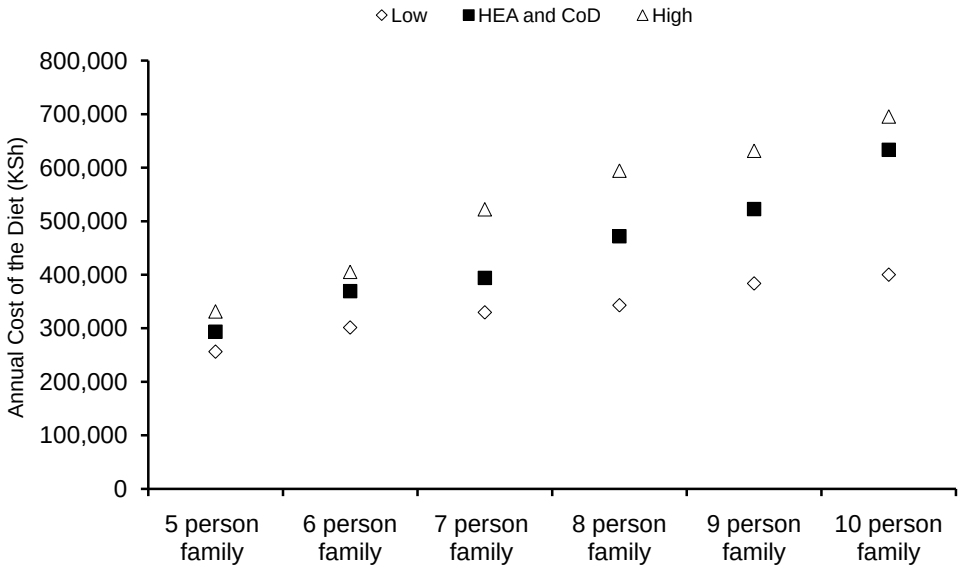
Table 11. The lowest cost diet for the HEA/CoD family in agropastoral livelihood zone in Turkana that meets needs for energy and micronutrients and is adjusted to account for usual dietary habits. The annual costs have been rounded to the nearest 100 KSH.

Age group	Season 1 *Akiporo*	Season 2 *Akamu*	Season 3 *Akicheres*	Season 4 *Ait*	Annual cost
12-23 month-old	50	44	42	37	15,900
Rest of family	956	1,045	1,233	888	378,300
Overall	1,006	1,089	1,275	925	394,200

Figure 9 shows how the annual cost of the LACON diet for the HEA/CoD family varies by the number of individuals in the household from five to ten and for families

with the minimum and maximum energy requirements. The cost for a family of seven members could range from 329,500 KSH to 522,100 KSH depending on their sex, age, body weight and physical activity

Figure 9. The annual cost of a diet that meets average energy requirements and the RNI of micronutrient for households of between five and ten members for the low energy, HEA/CoD and high average energy requirement families.



The cost of the diet of the child aged 12 to 23 months represents the additional foods needed meet the recommended energy and nutrient requirements in addition to breast milk, the cost of which is included in the cost of the mother's diet. It is important to note the essential contribution of breast milk in this diet for children aged 12-23 months. Although breast feeding should be partial at this age and only contributes 60% of the average energy requirements, it makes the greatest contribution to a child's intake of energy (38%), fat (61%), vitamin C (57%), vitamin B2 (20%), niacin (21%) and calcium (32%). Breast milk contains little iron however, so it is important that iron-rich complementary foods are given to the child.

Table 12 shows the absolute weight and cost of the foods selected for the family for the whole year for the LACON diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Table 12 shows a diet that meets average energy requirements and meets or exceeds the RNIs for micronutrients at lowest possible cost, based on market prices in June 2012. Although the diet contains a variety of different foods, only three are specified in very large amounts: maize (10% by weight and 23% by energy), UHT cow's milk (22% by weight and 7% by energy) and fresh cow's milk (25% by weight and 8% by energy).

Table 12. The absolute weight and cost of the foods selected for the family for the whole year for the LACON diet with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Food List	Quantity (kg)	% quantity	Cost KSH	% cost	% energy	% protein	% fat
Banana, large, unripe	69.2	2.0	7,475	2.0	1.6	0.2	0.1
Bean, kidney, dried, raw	40.8	1.2	3,817	1.0	2.6	3.7	0.3
Cabbage, green, raw	73.8	2.2	5,474	1.5	0.3	0.3	0.2
Egg, chicken, whole, local	117.7	3.5	31,534	8.4	3.2	5.3	6.3
Goat, raw	103.3	3.0	26,353	7.0	3.9	7.3	7.4
Intestine	55.1	1.6	11,758	3.1	1.0	3.1	1.2
Lentil, whole	275.6	8.1	58,700	15.6	17.0	26.9	1.7
Liver	23.5	0.7	5,670	1.5	0.6	1.7	0.5
Maize, dried, raw	330.7	9.7	19,263	5.1	23.8	10.8	6.7
Margarine, fortified	11.5	0.3	4,019	1.1	1.5	0.0	4.7
Milk, camel	176.1	5.2	2,993	0.8	2.9	3.6	5.7
Milk, cow, powder, whole	34.4	1.0	31,807	8.5	3.3	3.3	5.6
Milk, cow, UHT	558.0	16.4	77,065	20.5	7.3	7.2	12.3
Milk, cow, whole	624.7	18.4	34,981	9.3	8.2	8.1	13.8
Milk, goat, fresh whole	498.3	14.6	8,969	2.4	6.8	7.3	11.6
Millet, finger	32.5	1.0	3,316	0.9	2.1	0.9	0.2
Onion, w/stalks	23.0	0.7	3,766	1.0	0.1	0.1	0.1
Orange	45.9	1.3	3,123	0.8	0.3	0.1	0.0
Potato, English, raw	114.8	3.4	6,373	1.7	2.1	0.9	0.1
Salt, iodised	4.1	0.1	245	0.1	0.0	0.0	0.0
Sheep, raw	103.3	3.0	20,634	5.5	5.5	7.1	12.7
Sorghum, wholegrain, red	49.0	1.4	2,815	0.8	3.2	2.0	0.8
Sugar, refined	0.7	0.0	133	0.0	0.1	0.0	0.0
Tomato, ripe, fresh	23.0	0.7	2,066	0.6	0.1	0.1	0.0
Vegetable fat, kimbo	13.9	0.4	2,719	0.7	2.4	0.0	7.9
Vegetable oil	0.1	0.0	26	0.0	0.0	0.0	0.1
Total	3,403.1	100.0	375,105	100.0	100.0	100.0	100.0
% of requirements met					100.0	311.6	105.1

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% Folic acid	% vit 12
Banana, large, unripe	0.6	7.5	0.8	0.6	0.8	3.2	1.0	0.0
Bean, kidney, dried, raw	0.0	1.2	3.8	1.0	3.1	2.5	7.4	0.0
Cabbage, green, raw	0.1	14.6	1.0	0.7	0.4	1.6	0.8	0.0
Egg, chicken, whole, local	3.9	0.0	1.6	8.7	3.5	2.5	2.5	3.9
Goat, raw	0.0	0.0	1.4	1.9	7.2	4.6	0.2	4.6
Intestine	0.0	0.0	0.6	0.7	3.1	2.0	0.1	2.0
Lentil, whole	0.1	13.6	29.1	8.6	22.7	25.7	72.6	0.0
Liver	70.1	2.6	0.7	10.3	3.6	1.7	2.7	64.6
Maize, dried, raw	0.0	0.0	29.7	10.9	19.1	19.3	4.5	0.0
Margarine, fortified	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milk, camel	3.3	3.5	1.6	0.6	0.0	0.0	0.6	0.0

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% Folic acid	% vit 12
Milk, cow, powder, whole	2.8	2.4	2.4	7.2	2.8	2.9	0.8	3.4
Milk, cow, UHT	6.1	5.5	5.1	15.6	6.1	6.5	1.8	7.5
Milk, cow, whole	6.8	6.2	5.7	17.5	6.9	7.3	2.0	8.4
Milk, goat, fresh whole	5.5	4.9	5.7	11.5	6.5	4.8	0.3	1.2
Millet, finger	0.0	0.0	2.0	0.8	1.0	1.5	0.2	0.0
Onion, w/stalks	0.2	1.6	0.1	0.1	0.2	0.2	0.5	0.0
Orange	0.0	17.3	0.6	0.2	0.2	0.4	0.5	0.0
Potato, English, raw	0.0	14.8	2.9	0.4	2.8	6.7	0.6	0.0
Salt, iodised	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sheep, raw	0.0	0.0	1.2	1.7	7.0	4.4	0.2	4.4
Sorghum, wholegrain, red	0.0	0.0	3.4	0.8	3.0	1.8	0.4	0.0
Sugar, refined	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tomato, ripe, fresh	0.2	4.3	0.3	0.2	0.2	0.4	0.2	0.0
Vegetable fat, kimbo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vegetable oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
% of requirements met	380.6	104.8	175.7	238.1	243.8	174.6	219.8	598.8

Food List	% calcium	% iron	% zinc	% copper
Banana, large, unripe	0.1	0.7	0.2	1.0
Bean, kidney, dried, raw	0.9	5.4	2.7	5.5
Cabbage, green, raw	0.1	0.3	0.2	0.2
Egg, chicken, whole, local	2.0	4.2	2.8	0.3
Goat, raw	0.1	4.0	7.1	1.3
Intestine	0.1	1.8	3.0	0.6
Lentil, whole	4.2	42.9	22.9	39.9
Liver	0.0	3.8	2.5	17.0
Maize, dried, raw	0.6	20.5	14.1	20.0
Margarine, fortified	0.0	0.0	0.0	0.0
Milk, camel	0.0	0.0	16.7	0.0
Milk, cow, powder, whole	11.1	0.8	2.5	0.0
Milk, cow, UHT	24.3	1.8	5.3	0.0
Milk, cow, whole	27.2	2.0	5.9	0.0
Milk, goat, fresh whole	25.3	1.6	3.5	5.4
Millet, finger	2.6	1.6	0.9	1.3
Onion, w/stalks	0.0	0.3	0.1	0.0
Orange	0.7	0.1	0.1	0.4
Potato, English, raw	0.2	0.8	0.8	5.0
Salt, iodised	0.1	0.0	0.0	0.0
Sheep, raw	0.1	3.7	6.6	1.3
Sorghum, wholegrain, red	0.4	3.6	1.9	0.5
Sugar, refined	0.0	0.0	0.0	0.0
Tomato, ripe, fresh	0.0	0.2	0.1	0.3
Vegetable fat, kimbo	0.0	0.0	0.0	0.0
Vegetable oil	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
% of requirements met	129.0	100.0	272.2	

Figure 10 shows that the RNI for iron has only been met by 75% in seasons 1, 3 and 4 and by 87% in season 2 for the 12-23 month old child. The RNI is exactly 100% for calcium in all seasons of the year, for zinc in seasons 1 and 3 and for vitamin C in season 2 for the young child.

Figure 10. The percentage of energy and the recommended nutrient intakes for micronutrients met by a LACON diet for a 12-23 month old child

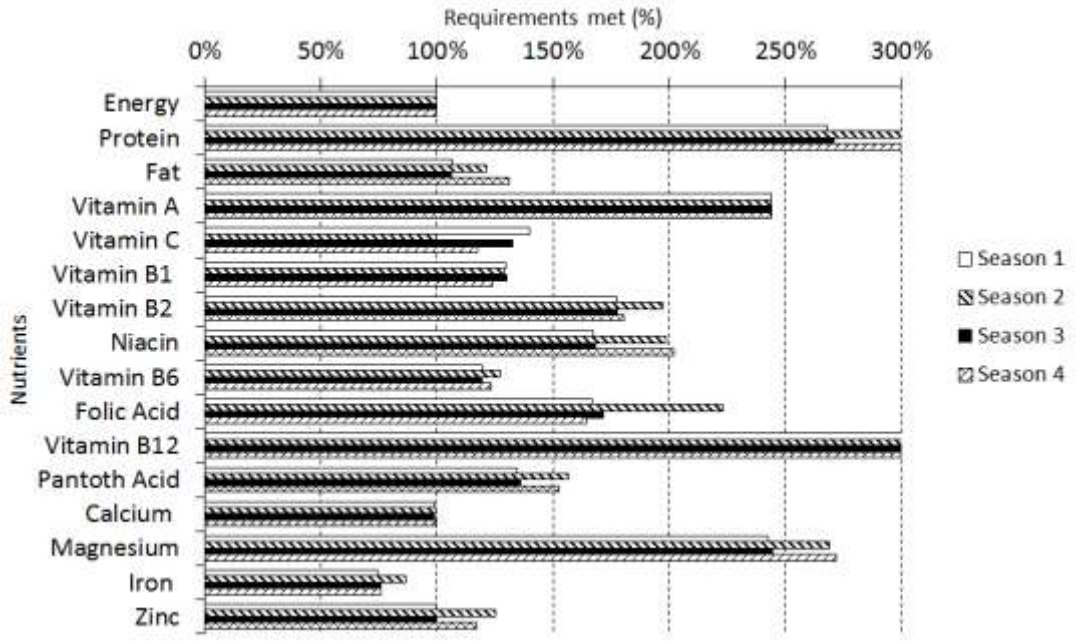
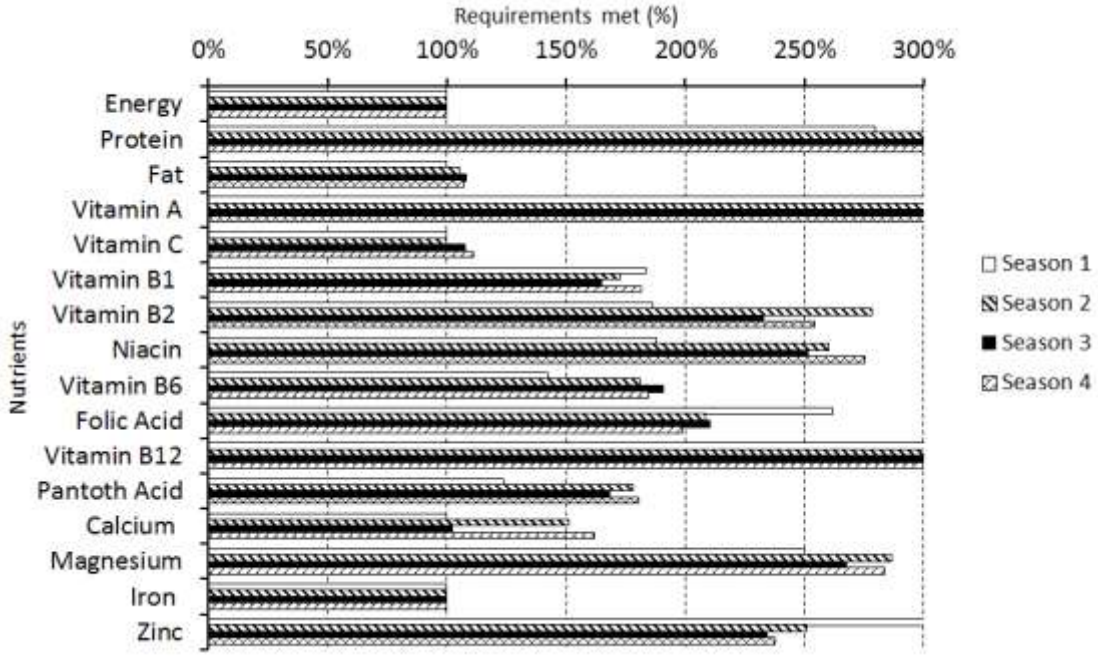


Figure 11 should that the requirement for iron is also only just met in all seasons, for vitamin C in seasons 1 and 2 and for calcium in season 1 for the rest of the family. This analysis therefore identifies iron, vitamin C and calcium as the most difficult micronutrients to obtain from the diet.

Figure 11. The percentage of energy and the recommended nutrient intakes for micronutrients met by a LACON diet for the rest of the family

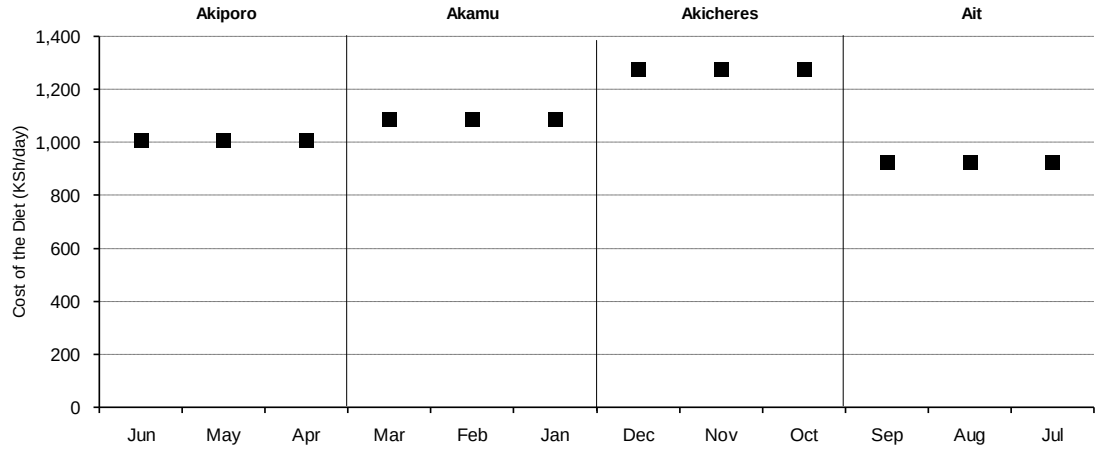


4.2 Seasonal fluctuations in the LACON diet

Figure 12 shows the cost of the LACON diet by season of the year. It shows that the cost of a nutritious diet is lowest during the dry season of *Ait*. This is during the period of the dry harvest where products such as maize and sorghum become more available particularly in Morulem, Lotubae and Elelea (FEG, 2012). The increased availability of these products on the market therefore reduces their market price, reducing the cost of the diet.

Typically the hunger season falls between March – June (FEG, 2012). This does not seem to have been captured by this assessment as figure 12 shows that in 2011 December and October were the most expensive seasons. This may have been affected by the distribution of food aid during the lean period.

Figure 12. The cost of the LACON diet by season of the year.

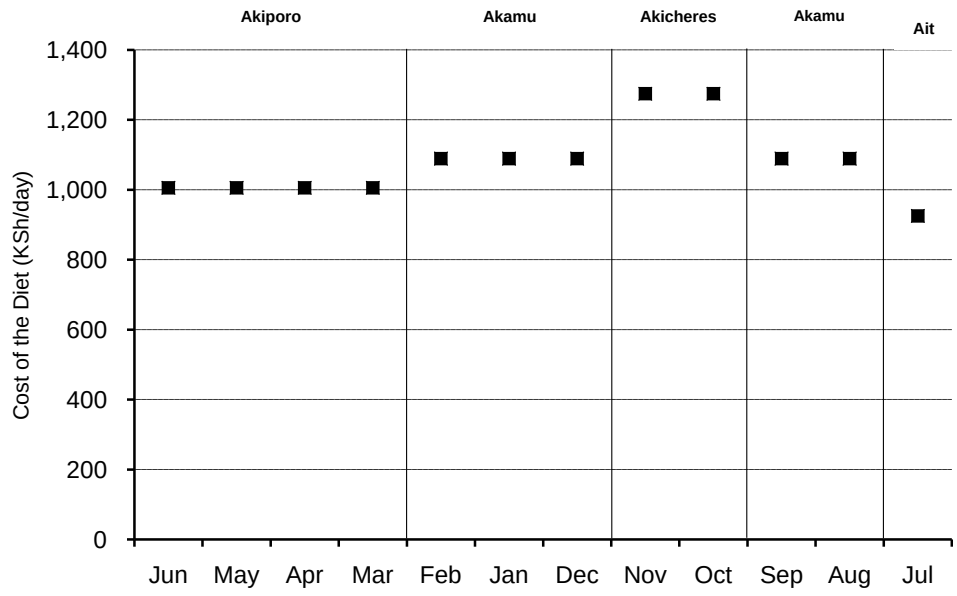


As mentioned in section 3.2.1 the seasons and periods used for this analysis were taken from the standard seasonal calendar for Turkana, provided by the Kenya Food Security Steering Group (2012) and do not reflect the fluctuating rainfall experienced in 2012 and 2011.

It is important to note that the inhabitants of Turkana do not follow the standard seasonal calendar and will continue to call the seasons *Akiporo* and *Akicheres* until the rains stop entirely. This greatly affects the collection of retrospective data during the market survey as the seasons are used to prompt trader's recollection of food prices. Figure 13 shows the cost of the LACON diet by season using the seasonal calendar produced by the HEA which better reflected the reference year's seasons.

Figure 13 shows greater fluctuations in the daily cost of the diet compared to Figure 12, emphasising the fall in the cost of the diet for the family during the season of Ait. The annual cost of the diet was calculated using a weighted average, based upon the daily cost of the diet and the length of the seasons. It is therefore important to note that using the HEA seasons does not greatly affect the annual cost of the three diets and, increasing them by 1%.

Figure 13. The cost of the LACON diet by the HEA's seasons of the year



4.3 Contribution of food groups to the cost of the LACON diet

Most of the cost of the LACON diet is due to foods that provide micronutrients. This can be judged from the fact that it costs 275,800 KSH (330%) more than the basic, energy only diet, which provides some micronutrients.

Figure 14 shows that dairy products are the most costly element of the LACON diet for a child aged 12 to 23 months. This is because of the inclusion of cow, camel and goat milk, which accounted for 40% of the overall cost of the, but needed to be included as important sources of vitamin B2, protein, fat and calcium. Meat, fish, eggs and poultry also contribute to 20% of the overall cost of the LACON diet, but are included because they provide essential sources of vitamin A, vitamin B12 and vitamin B2.

The same data for the rest of the family shown in Figure 15 reveal that dairy products contribute the most to the cost of the LACON diet for the same reasons as the 12-23 month old diet. Meat, fish, poultry and eggs are also costly because they are not widely available and therefore expensive on the market.

Figure 14. The weekly cost of foods each week selected by the Cost of the Diet software for the LACON diet which meets needs for energy and micronutrients in a culturally acceptable diet for a 12-23 month old child.

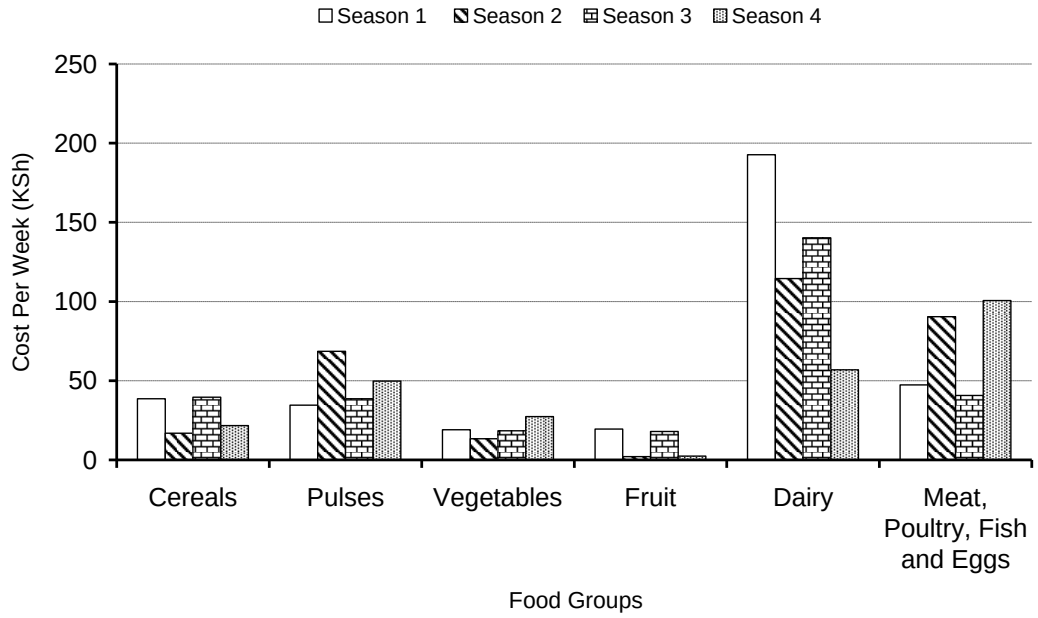
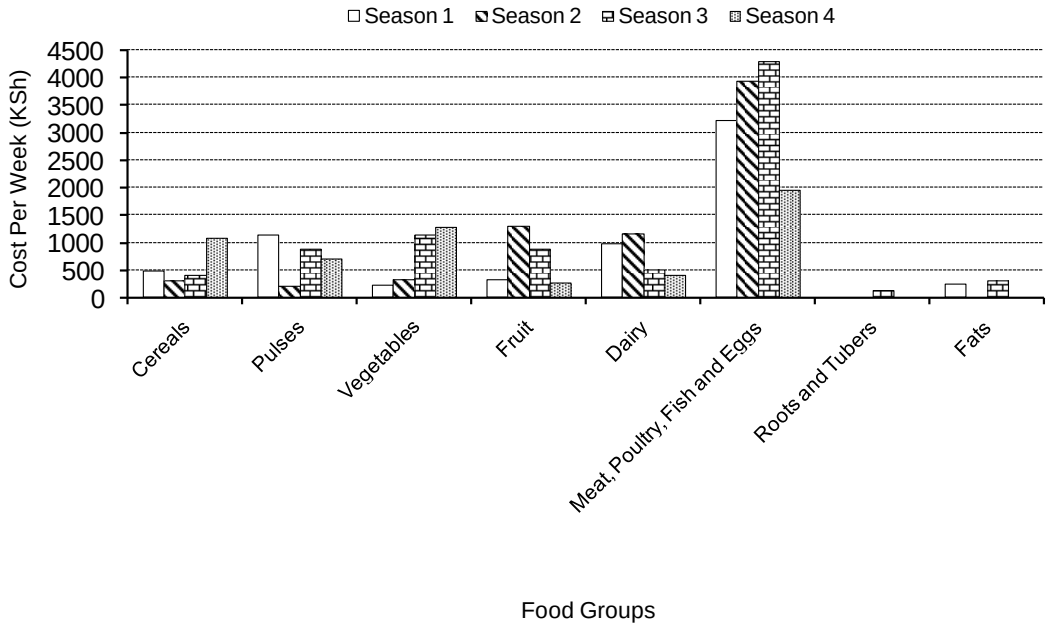


Figure 15. The weekly cost of foods each week selected by the Cost of the Diet software for the LACON diet which meets needs for energy and micronutrients in a culturally acceptable diet for the rest of the family



4.4 Affordability of the diets

In order to calculate affordability, the cost of the diet plus non-food expenditure is subtracted from the total income, all of which are estimates based on multiple assumptions and variable parameters. Table 13 shows the estimated affordability of the diet per year if the non-food expenditure specific to each wealth group are applied to the cost of the three diets calculated in this analysis.

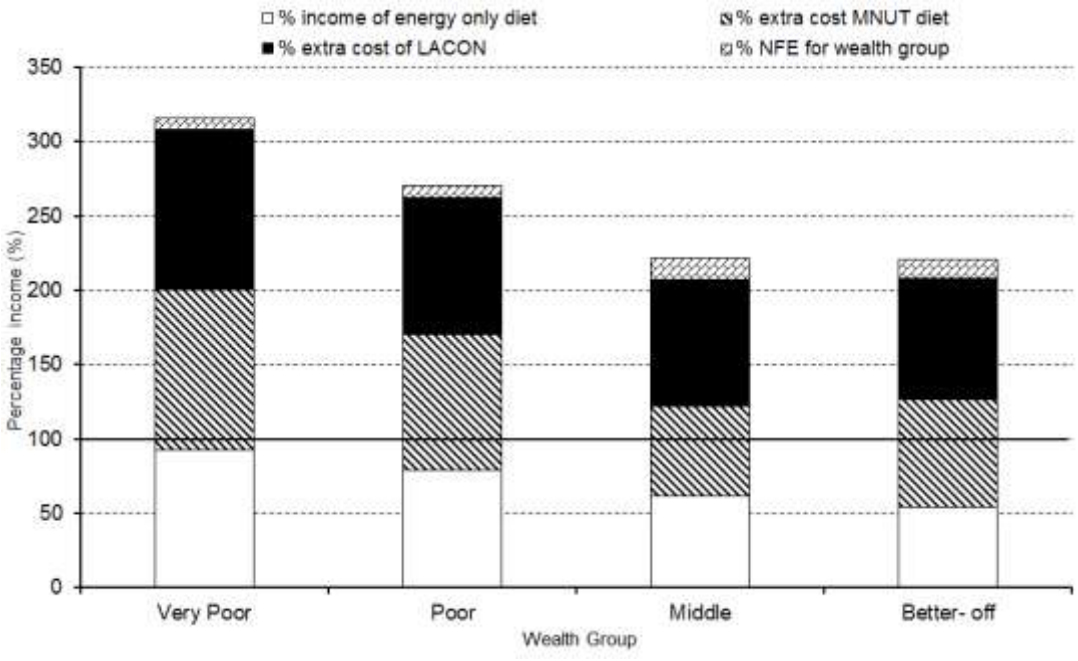
Table 13 shows that all wealth groups cannot afford a nutritious diet plus essential non-food expenditure, which accounts for 316%, 271%, 222% and 221% the very poor, poor, middle and better off households' income respectively.

Table 13. The estimated incomes by wealth group, non-food expenditure (NFE) and the costs of three diets estimated by the Cost of the Diet software for households in the agropastoral livelihood zone of Turkana District, Kenya in June 2012.

Wealth Group		**Very Poor**	**Poor**	**Middle**	**Better- off**
Annual income		127,900	150,300	273,800	410,000
Wealth group NFE		9,300	12,300	40,300	52,300
Total income – NFE	(a)	118,600	137,900	233,400	357,700
Cost of energy only diet	(b)	118,400	118,400	168,300	222,700
Excess or shortfall NFE	(a)-(b)	200	19,600	65,200	135,000
Cost of MNUT diet	©	256,200	256,200	333,198	518,500
Excess or shortfall NFE	(a)-(c)	-137,600	-118,300	-99,800	-160,700
Cost of LACON diet	(d)	394,200	394,200	566,500	852,500
Excess or shortfall NFE	(a)-(d)	-275,600	-256,200	-333,000	-494,800
Spending on food					
Cost of energy only diet		118,400	118,400	168,300	222,700
% income of energy only diet		93	79	61	54
Extra cost of MNUT diet		137,800	137,800	164,900	295,700
% extra cost MNUT diet		108	92	60	72
Extra cost of LACON		138,000	138,000	233,300	334,000
% extra cost of LACON		108	92	85	81
Non-food expenditure		9,300	12,300	40,300	52,300
% NFE for wealth group		7	8	15	13
Total		316	271	222	221

Figure 16 shows the gaps between estimated income and expenditure for the wealth groups and their typical household size, presented in Table 13 in the agropastoral zone of Turkana. The black solid line represents 100% of income.

Figure 16. The affordability of an energy only, MNUT and LACON diet based on the numbers presented in Table 13.



4.5 Modelling nutritional interventions

The Cost of the Diet software can be used to examine the effect of changing variables and assumptions to assess their effect on the cost and affordability of each diet, but usually the most nutritious, LACON, diet. For example the effect of activities to generate income, the effect of changing the cost of foods and the effect of providing foods that have a higher nutrient content could all be examined in terms of their effect on the cost and composition of the diet. Such models can illustrate the potential for activities to improve the diet either through nutritional interventions or by poverty alleviation. The models presented can help to generate ideas and test assumptions about the impact of activities on household nutrition, and to set targets and indicators. All the models described here are theoretical and, in reality, the situation will be influenced by numerous external factors that cannot be included in the model, so the actual effect on the Cost of the Diet may be different.

Four interventions were modelled to examine the effects on the composition and cost of the diet:

- The impact of Oxfam's greenhouse intervention in the cost and the quality of a nutritious diet
- The impact of the Hunger Safety Net Programme on the affordability of a nutritious diet
- The impact of removing food aid and increasing the staple price by 50% and 100% on the affordability of a nutritious diet
- Applying the average prices of the major food groups to each of the constituent foods to see which are selected by the cost of diet software presumably based on their nutritional value.

As the analysis above showed that none of the wealth groups can afford a nutritious diet. However, the possible effects of these interventions were examined for the very poor and poor wealth groups, unless otherwise specified.

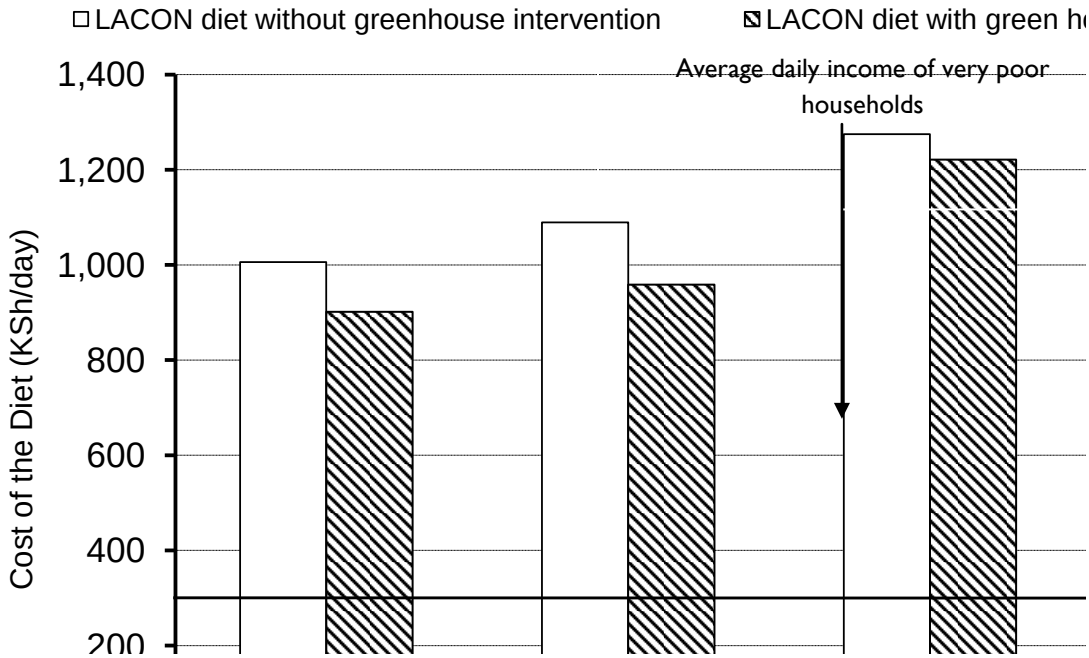
4.5.1 Modelling the impact of Oxfam's greenhouse intervention on the cost and the quality of the diet

As mentioned, one of the most striking observations made by the market surveys was the lack of fruit and vegetables in the markets. Although there was more fruit and vegetables available in this zone, compared to the central pastoral zone, these commodities were still scarce. The software has identified that vitamin C and iron are the most difficult micronutrients to meet requirements for using foods available on the market which could be improved by increasing the availability of green leafy vegetables and fruits such as oranges and tomatoes. Oxfam has recently been working on several projects in the agropastoral zone, which aim to improve the availability of fruit and vegetables in the area. One such project is a greenhouse intervention, targeted at very poor households, which aims to increase the availability of cowpea leaves, kale, tomatoes and spinach.

To model this scenario, it was assumed that households involved with the project would consume 3 portions a week of free cowpea leaves, kale, tomatoes and spinach. The main assumption for this scenario made was that enough water would be available to carry out this intervention, which in reality, may not be the case.

Figure 17 shows that including these vegetables in the diet for free led to a 4-59% decrease in the daily cost of a nutritious diet, depending on the season. In terms of cash, this decrease in cost in season 1 to 4 was 104 KSH a day, 131 KSH a day, 54 KSH a day and 343 KSH a day. The bold black line in Figure 17 represents average daily income for very poor households. Although it is unlikely that daily income is static it does show that although the cost of a nutritious diet has reduced, it is still unaffordable for this wealth group.

Figure 17. A bar chart showing cost of the most nutritious, LACON diet, with and without consuming kale, cowpea leaves, tomatoes and spinach three times a week, over the four seasons of the year in the agropastoral livelihood zone of Turkana district, Kenya



The results showed that these vegetables replaced the need for banana, cabbage, onion, goat milk and sugar and reduced the amount of margarine in the diet. The results also show that the intervention has the greatest impact on the cost of the diet in season 4. This is mainly due to the quantity of chicken egg in the diet being reduced by 43% because the green leaves provided a cheaper source of vitamin A, folic acid, calcium and zinc.

Table 14 shows the absolute weight and cost of the foods selected for the family for the whole year for the LACON diet with the green house intervention, with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Table 14. The absolute weight and cost of the foods selected for the family for the whole year for the LACON diet with the green house intervention, with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Food List	Quantity (kg)	% quantity	Cost KSH	% cost	% energy	% protein	% fat
Bean, kidney, dried, raw	20.2	0.7	1,892	0.6	1.3	2.0	0.1
Egg, chicken, whole, local	69.5	2.3	17,970	5.6	1.9	3.4	3.1
Goat, raw	103.3	3.5	26,353	8.3	3.9	7.9	6.2
Intestine	55.1	1.9	11,758	3.7	1.0	3.4	1.0
Kale, raw	59.1	2.0	0	0.0	0.4	0.5	0.1
Leaf, cowpea	59.1	2.0	0	0.0	0.4	1.0	0.1
Lentil, whole	275.1	9.3	58,591	18.4	17.0	29.2	1.4
Liver	20.6	0.7	4,963	1.6	0.5	1.6	0.4
Maize, dried, raw	330.7	11.1	19,263	6.0	23.8	11.8	5.7
Margarine, fortified	11.5	0.4	4,019	1.3	1.5	0.0	3.9
Milk, camel	154.4	5.2	2,625	0.8	2.5	3.4	4.2
Milk, cow, powder, whole	23.0	0.8	20,761	6.5	2.2	2.4	3.2
Milk, cow, UHT	517.8	17.4	70,219	22.0	6.8	7.3	9.6
Milk, cow, whole	624.7	21.0	34,981	11.0	8.2	8.8	11.6
Milk, sheep	234.3	7.9	3,983	1.3	9.4	5.2	20.4
Millet, finger	58.3	2.0	5,945	1.9	3.8	1.7	0.4
Orange	14.1	0.5	959	0.3	0.1	0.0	0.0
Potato, English, raw	57.4	1.9	3,444	1.1	1.1	0.5	0.0
Salt, iodised	2.8	0.1	162	0.1	0.0	0.0	0.0
Sheep, raw	103.3	3.5	20,634	6.5	5.5	7.7	10.6
Sorghum, wholegrain, red	30.7	1.0	1,694	0.5	2.0	1.4	0.4
Spinach	59.1	2.0	0	0.0	0.2	0.6	0.1
Tomato, ripe, fresh	49.2	1.7	0	0.0	0.2	0.2	0.1
Vegetable fat, kimbo	25.8	0.9	5,021	1.6	4.5	0.0	12.3
Vegetable oil	11.1	0.4	3,243	1.0	1.9	0.0	5.3
Total	2,970.1	100.0	318,490	100.0	100.0	100.0	100.0
% of requirements met					100.0	286.2	125.3

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12
Bean, kidney, dried, raw	0.0	0.6	2.1	0.5	1.7	1.3	3.7	0.0
Egg, chicken, whole, local	2.3	0.0	1.0	5.7	2.3	1.6	1.5	2.5
Goat, raw	0.0	0.0	1.5	2.1	7.9	4.8	0.2	5.0
Intestine	0.0	0.0	0.7	0.8	3.4	2.1	0.1	2.1
Kale, raw	4.3	22.5	0.7	0.7	0.7	1.7	0.4	0.0
Leaf, cowpea	3.0	18.1	1.3	2.0	1.1	6.5	3.3	0.0
Lentil, whole	0.1	12.8	31.4	9.4	25.2	26.8	72.4	0.0
Liver	61.2	2.1	0.7	9.9	3.4	1.6	2.4	61.3
Maize, dried, raw	0.0	0.0	32.0	12.0	21.1	20.1	4.5	0.0
Margarine, fortified	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Milk, camel	2.9	2.9	1.5	0.6	0.0	0.0	0.5	0.0

Food List	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12
Milk, cow, powder, whole	1.8	1.5	1.7	5.2	2.1	2.1	0.5	2.5
Milk, cow, UHT	5.6	4.8	5.1	15.9	6.3	6.3	1.7	7.6
Milk, cow, whole	6.8	5.8	6.2	19.2	7.6	7.6	2.0	9.2
Milk, sheep	7.4	4.4	2.9	9.3	2.4	2.4	1.4	5.1
Millet, finger	0.0	0.0	3.9	1.5	1.9	2.7	0.3	0.0
Orange	0.0	5.0	0.2	0.1	0.1	0.1	0.2	0.0
Potato, English, raw	0.0	6.9	1.6	0.2	1.5	3.5	0.3	0.0
Salt, iodised	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sheep, raw	0.0	0.0	1.3	1.9	7.8	4.6	0.2	4.8
Sorghum, wholegrain, red	0.0	0.0	2.3	0.6	2.1	1.2	0.2	0.0
Spinach	3.7	4.4	1.2	2.0	0.8	2.3	3.7	0.0
Tomato, ripe, fresh	0.4	8.2	0.7	0.4	0.5	0.8	0.4	0.0
Vegetable fat, kimbo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vegetable oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
% of requirements met	380.6	111.5	162.9	217.1	219.6	167.1	220.0	551.3

Food List	% calcium	% iron	% zinc	% copper
Bean, kidney, dried, raw	0.5	2.7	1.4	2.9
Egg, chicken, whole, local	1.3	2.5	1.7	0.2
Goat, raw	0.1	4.0	7.4	1.4
Intestine	0.1	1.8	3.1	0.6
Kale, raw	0.3	0.9	0.3	2.2
Leaf, cowpea	0.8	3.2	0.6	2.6
Lentil, whole	4.7	42.8	23.6	42.4
Liver	0.0	3.3	2.3	15.8
Maize, dried, raw	0.7	20.5	14.6	21.3
Margarine, fortified	0.0	0.0	0.0	0.0
Milk, camel	0.0	0.0	15.2	0.0
Milk, cow, powder, whole	8.4	0.5	1.7	0.0
Milk, cow, UHT	25.7	1.7	5.1	0.0
Milk, cow, whole	31.0	2.0	6.1	0.0
Milk, sheep	19.7	1.5	5.8	1.1
Millet, finger	5.4	2.8	1.7	2.5
Orange	0.2	0.0	0.0	0.1
Potato, English, raw	0.1	0.4	0.4	2.6
Salt, iodised	0.1	0.0	0.0	0.0
Sheep, raw	0.1	3.7	6.8	1.4
Sorghum, wholegrain, red	0.3	2.2	1.2	0.4
Spinach	0.4	2.9	0.9	1.8
Tomato, ripe, fresh	0.0	0.4	0.1	0.8
Vegetable fat, kimbo	0.0	0.0	0.0	0.0
Vegetable oil	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
% of requirements met	113.3	100.0	263.3	

For the 12-23 month old, this intervention improves the intakes of iron in the diet by 2-3% for season 1 to 3 and by 16% in season 4. Vitamin C requirements for the child

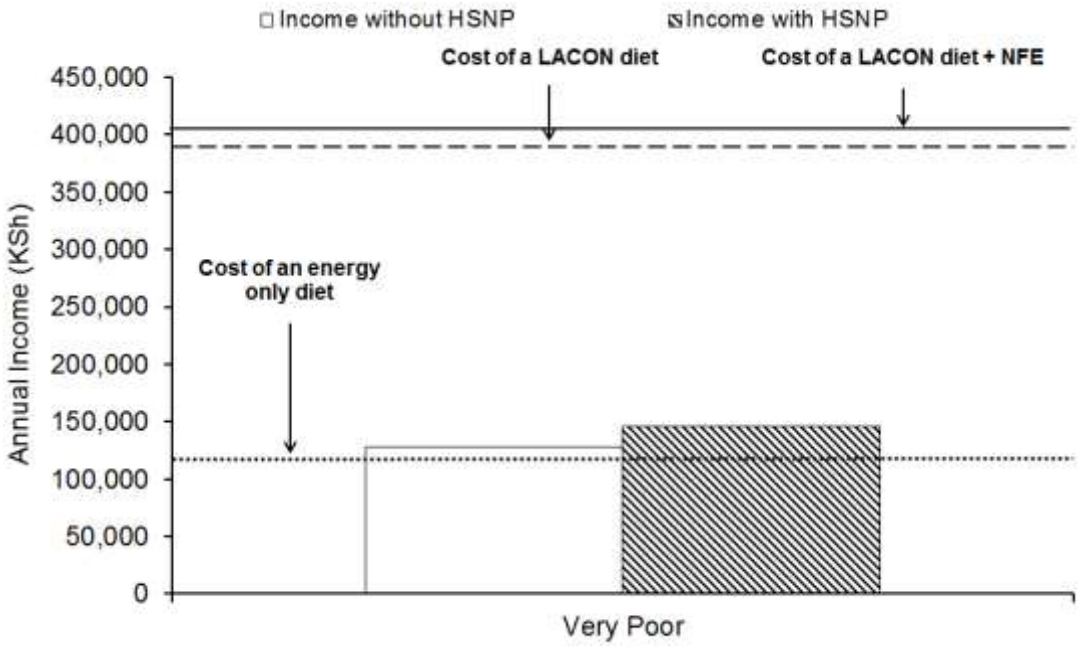
are also increased above the RNI in all seasons of the year as a result of the intervention. For the rest of the family, vitamin C requirements in season 1 and 2 which were only met by 100% by the LACON diet, increase slightly by 2 and 3% respectively as a result of this intervention. This intervention does not have an impact on increasing iron intakes for the rest of the family.

4.5.2 *Modelling the impact of the Hunger Safety Net Programme on the affordability of the diet*

The Hunger Safety Net Programme (HSNP) is a social protection project in the Arid and Semi-Arid Lands (ASALs), including Turkana. The HSNP is intended to reduce dependency on emergency food aid by sustainably strengthening livelihoods through cash transfers. Beneficiaries of the programme receive 3,000 KSH every two months or 18,000 KSH each year. To model the potential impact of this intervention, the additional income was added to this wealth group's annual to model the impact of this intervention on the affordability of the diet. It is important to note that the main assumption made in this model is that all of the cash transfer will be spent on food for the household, which may not be likely in reality.

Figure 18 shows the effect that this additional income could have on the affordability of the energy-only and nutritious (LACON) diets for very poor households. The results show that although an energy only diet is affordable, buying a nutritious diet, plus expenditure on non-food items, would still require an additional 177% of the income of the very poor, down from 316%. Although this shows a 39% improvement in the affordability of a nutritious diet, an additional 258,200 KSH a year is still required.

Figure 18. The income of very poor households before and after the HSNP cash transfer to provide 18,000 KSH a year.



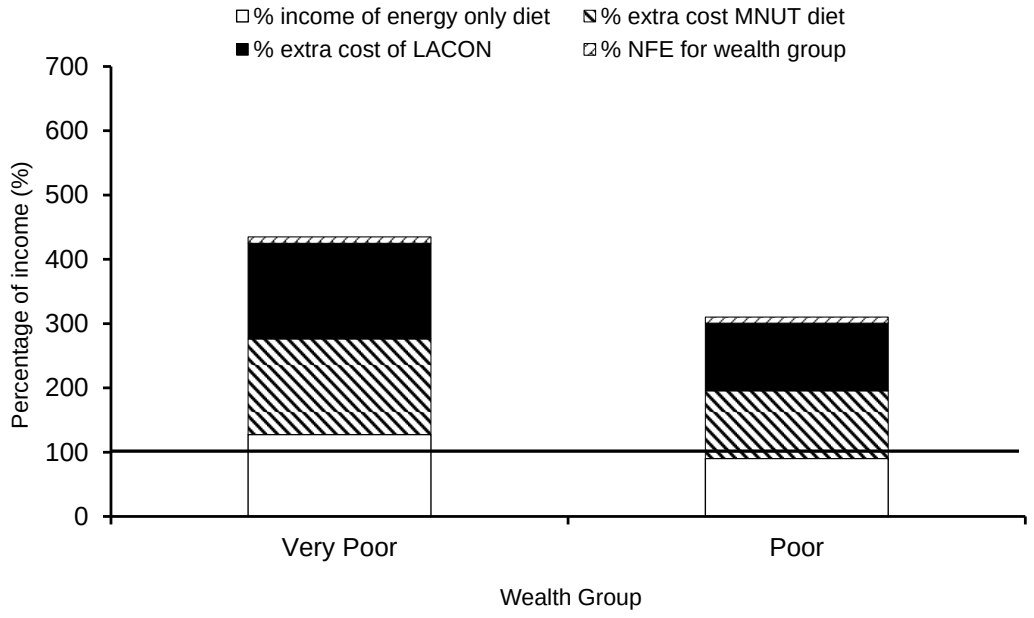
4.5.3 Modelling the impact of removing food aid from the diet on the affordability of the diet

The results from the HEA (FEG, 2012) showed that very poor households did not rely very much on food purchased on the market to provide their kilocalorie requirements because of their reliance on food aid. In absence of this food source these households would potentially have to purchase approximately 50-60% of their kilocalorie requirements from the market. The impact of this on the affordability of an energy only, MNUT and LACON diet was modelled using the Cost of the Diet software.

To model this scenario, the monetary value of food aid estimated for the very poor and poor wealth groups was removed. This altered these wealth groups annual income from 127,900 KSH and 150,300 KSH a year to 92,700 KSH and 131,000 KSH for the very poor and poor wealth groups respectively. This is a reduction of 35,200 KSH a year for the very poor and 19,300 KSH a year for the poor.

Figure 19 shows the impact that removing food aid has on the affordability of the three diets for very poor and poor households. Very poor households are no longer able to afford an energy only diet and their non-food expenditure, which would require an additional 28% of their income, or 100,300 KSH a year. This equates to a 35% reduction in the affordability of a diet that only meets energy needs. The impact of removing food aid from the diet on poor households is less as their reliance on this food source is not as high. However almost 90% of this wealth group's income would have to be spent on an energy only diet. The affordability of the MNUT diet for poor households has worsened by 41% and an additional 137,500 KSH would be required. The bold black line represents 100% of income.

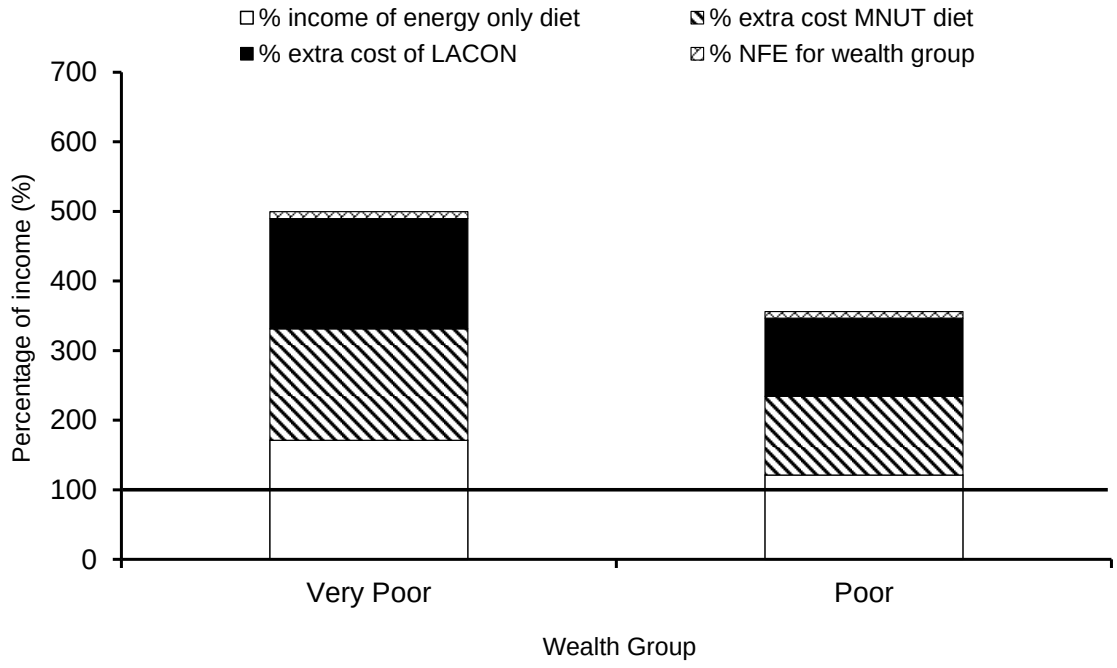
Figure 19. The affordability of an energy only, MNUT, LACON diet and non-food expenditure when food aid is removed.



In reality, if food aid provisions ceased, all households would need to purchase more staple food from the market. This increase in demand may have an impact on the price of these foods as their availability may reduce. Figure 20 therefore shows the impact on the affordability of the three diets if food aid is removed and the price of staple foods increased by 50%. To model this price increase, the cost per 100g of the staple foods was increased by 50%.

Figure 20 shows that, with an increase of the price of staple foods, neither the very poor nor the poor wealth groups can afford a diet that only meets energy needs. Very poor households would need an additional 71% of their income, or 65,800 KSH whilst poor wealth groups would need an additional 21% of their income or 27,500 KSH. Very poor households would require an additional 390% of their income or 361,700 KSH to be able to purchase a LACON diet whereas poor wealth groups would need an additional 247% of their income or 323,600 KSH. The bold black line represents 100% of income. It is also important to note that manifestations of acute malnutrition such as wasting may occur in both wealth groups should energy needs not be met.

Figure 20. The affordability of an energy only, MNUT, LACON diet and non-food expenditure when food aid is removed and the price of staple foods increase by 50%

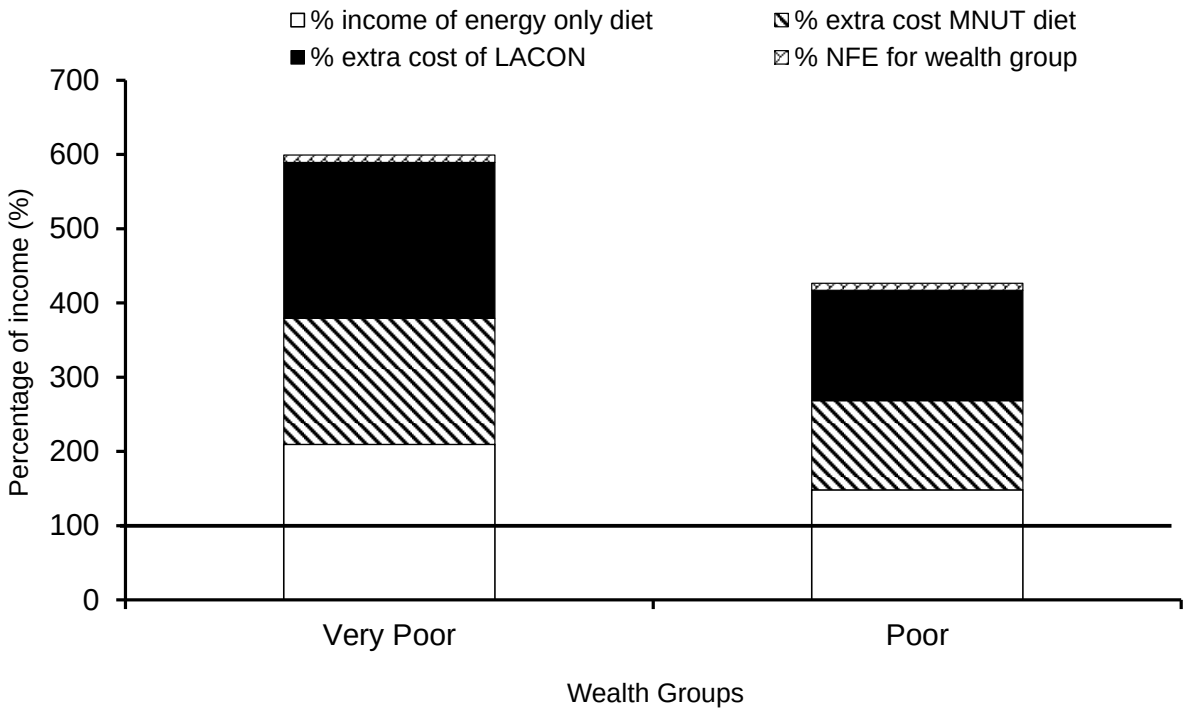


The final stage of analysis for this scenario was to analyse the impact on the affordability of the three diets if food aid provisions ceased and the price of staple foods increased by 100%. Again to model this price increase, the cost per 100g of the staple foods was increased by 100%.

Figure 21 shows that with an increase of the price of staple foods by 100%, very poor household's ability to afford a diet that only meets energy needs becomes more unrealistic. These households would need an additional 110% of their income, or

102,000 KSH whilst poor wealth groups would need an additional 48% of their income or 62,900 KSH. Very poor households would require an additional 489% of their income or 453,500 KSH to be able to purchase a LACON diet whereas poor wealth groups would need an additional 317% of their income or 415,300 KSH. The bold black line represents 100% of income.

Figure 21. The affordability of an energy only, MNUT, LACON diet and non-food expenditure when food aid is removed and the price of staple foods increase by 100%



4.5.4 The application of average prices of food groups

The aim of this analysis was to see what foods were chosen by the Cost of the Diet software in each of the main food groups when the price of each food group was standardised by taking the average. This served to eliminate differences in cost so that the software should chose foods based upon their nutrients composition alone. Table 15 shows the average cost of the food groups in ascending order. When the prices are averaged, the cheapest food group is roots at 5.88 KSH per 100g. The most expensive are dairy products, which are 6.2 times more expensive at 36.33 KSH per 100g. This process roughly maintains the ratio in the price between the different food groups but serves to minimise the inclusion of expensive foods.

To ensure that food items were selected based upon nutrient content alone, the minimum constraints, which specify how many times a food item should be included in the diet were removed.

Table 15. The average cost of the food groups, entered into the software to identify which foods are the most nutritious regardless of their price.

Food Groups	Cost (KSH/100g)	Ratio Roots = 1
Roots	5.88	1
Manufactured	5.98	1.0
Fruit	7.90	1.3
Cereals	21.98	3.7
Pulses	15.46	2.6
Vegetables	15.71	2.7
Sugar	18.90	3.2
Animal	34.74	5.9
Fat	36.32	6.2
Dairy	36.33	6.2

Table 16 shows that when the average food group prices are entered into the software the minimum cost of a diet that meets a household's energy and nutrient need is estimated at 803 KSH per day and features only 8 of the 40 foods included in the software. The analysis also shows that the price does not fluctuate during the seasons despite the seasonal availability of foods such as milk. The annual cost of the diet for the typical family is estimated to be 294,000 KSH.

Table 16. The cost of a diet that meets the average energy and recommended nutrient requirements when the average food group prices are applied to the software.

Age Group	Season 1	Season 2	Season 3	Season 4	Annual Cost
12-23 month-old	35	35	35	35	12,900
Rest of Family	768	768	768	768	281,800
Overall	803	803	803	803	294,700

Table 17 shows the absolute weight and cost of the foods selected for the family for the whole year for a nutritious diet with the prices averaged by food group, with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Table 17 shows that by averaging the prices of food items by food group the number of foods in the diet has been reduced by two thirds. One of the main differences in this diet is the replacement of the dairy products with small dried fish which now contributes to 93% of calcium requirements for the household. Small dried fish have also been identified as a source of protein, vitamin B2, niacin, vitamin B6, vitamin B12 and zinc providing 51%, 27%, 54%, 32%, 55% and 43% of the total requirements of these nutrients respectively. This would suggest that small dried fish are one of the most nutrient rich animal products found in the market in this livelihood zone. Orange has been introduced into this diet as a source of vitamin C (providing 54% of

total requirements), replacing cabbage and potato. Interesting pasta has been included in this diet, providing 31% of energy requirements and a moderate contribution to protein, vitamin B1, niacin and copper. Although these food items were of limited availability in markets in the agropastoral livelihood zone of Turkana, this model does highlight potential sources of nutrient rich foods that may have been excluded from previous analysis because of their cost.

Table 17. The absolute weight and cost of the foods selected for the family for the whole year for a nutritious diet with the prices averaged by food group, with the percentage contributed by each food in terms of weight, cost, energy, protein and fat, the percentage contribution of each food for eight vitamins and four minerals and the percentage of the total requirements met for each nutrient, averaged over the four seasons.

Food Items	Quantity (kg)	% quantity	Cost KSH	% cost	% energy	% protein	% fat
Fish, small, dried, fresh water	276	19.0	95,740	34.3	18.3	51.8	15.4
Lentil, whole	396	27.3	61,276	21.9	24.5	30.6	2.6
Liver	33	2.3	11,443	4.1	0.8	1.9	0.7
Milk, cow, powder, whole	10	0.7	3,475	1.2	0.9	0.7	1.6
Orange	138	9.5	10,886	3.9	0.9	0.3	0.1
Pasta	435	30.0	44,415	15.9	31.5	14.4	2.6
Tomato, concentrate	35	2.4	5,509	2.0	0.4	0.3	0.2
Vegetable fat, kimbo	129	8.9	46,773	16.7	22.6	0.0	76.7
Total	1,452	100.0	279,516	100.0	100.0	100.0	100.0
% of requirements met					100.0	393.0	100.0

Food Items	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12
Fish, small, dried, fresh water	0.0	0.0	10.0	26.9	53.7	32.2	3.5	55.0
Lentil, whole	0.1	20.5	66.3	27.3	26.3	54.2	87.4	0.0
Liver	98.1	3.8	1.6	31.7	4.0	3.6	3.2	44.6
Milk, cow, powder, whole	0.8	0.7	1.0	4.4	0.6	1.2	0.2	0.5
Orange	0.1	54.3	3.0	1.5	0.4	1.6	1.4	0.0
Pasta	0.0	0.0	15.8	6.3	14.3	5.0	3.6	0.0
Tomato, concentrate	0.9	20.7	2.3	1.9	0.7	2.4	0.7	0.0
Vegetable fat, kimbo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
% of requirements met	380.6	100.0	111.2	108.4	303.3	119.2	262.7	1215.4

Food Items	% calcium	% iron	% zinc	% copper
Fish, small, dried, fresh water	93.1	22.3	43.1	14.9
Lentil, whole	3.1	61.7	41.7	31.8
Liver	0.0	5.3	4.5	13.2
Milk, cow, powder, whole	1.6	0.2	0.9	0.0
Orange	1.1	0.2	0.4	0.7
Pasta	1.0	9.2	9.2	38.6
Tomato, concentrate	0.0	0.9	0.3	0.9
Vegetable fat, kimbo	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
% of requirements met	245.9	100.0	215.0	

5. Key Findings

The results from the cost of the diet analysis show that the MNUT diet was 2.1 times more expensive than the energy only diet, meaning that it cost twice as much money to meet recommended protein, fat and micronutrient requirements compared to only meeting energy requirements in the agropastoral livelihood zone of Turkana. The LACON diet was 1.5 times more expensive than the MNUT diet which means that the constraints applied to the software to reflect typical dietary habits have made it harder for the software to meet recommended nutrient intakes.

The data collection team found 40 foods on the market in the agropastoral livelihood zone of Turkana. The team who collected data in the central pastoral livelihood zone of Turkana also found the same number of foods in the markets. However, in comparison to other areas of East Africa, such as Rwanda where 82 foods were found or Tanzania where 51 foods were found, this does show a limited availability of food in general in this zone. The main foods available in the markets are therefore imported foods such as cereals, oils and pulses, typically provided in food aid rations, which is what the current diet of poor households in this livelihood zone is predominantly based on.

The current diet may not be particularly diverse, in terms of the number of food groups consumed, but it is not necessarily lacking in all essential nutrients. Maize is the main staple food, providing a source of starchy carbohydrates, with beans and lentils, a source of protein. Milk is consumed when it is in season to provide essential protein, fat, vitamin A and B group vitamins and calcium. Oils and fats are essential in the diet to promote the absorption of fat soluble vitamins, whilst meat and offal are eaten occasionally and are an important source of iron and vitamin B12. The main issue with the current diet is its lack of fruit and vegetables, which would provide vitamin A, folic acid and vitamin C.

The results highlight the importance of the foods that households are currently consuming. For example, the software has shown that lentils provide inexpensive sources of protein, zinc and copper; maize and liver are important sources iron which is required to promote the transportation of oxygen in blood; liver has been identified as an inexpensive source of ß-carotene, a precursor of vitamin A and vitamin B12 whilst lentils and red kidney beans provide folate, which is needed to make red blood corpuscles and prevent neural tube defects in pregnant women. Maize, liver, cow's milk and lentils provide a large proportion of the water soluble B-group vitamins; while orange also provides a large proportion of vitamin C. Fresh cow's milk is a good source of fat, vitamin B2 and calcium.

An additional 10 foods were included by the software in the LACON diet to meet average energy and recommended nutrient requirements. This is primarily due to small dried fish being excluded from this diet analysis as a result of the focus group discussions where the women stated that they never consumed this food because it was too expensive to purchase and was only available in *Lokori* market. In the MNUT diet, dried fish provided 12% of protein and niacin requirements, 17% of vitamin B12 and 39% of calcium requirements. By removing this food, 9 additional foods have been included in the LACON diet to meet the requirements for these

nutrients: chicken eggs, intestine, UHT cow's milk, goat's milk, millet, maize, banana, potato and iodised salt.

One of the issues with both of the nutritious diets (MNUT and LACON) is that the foods that have been identified need to be eaten in large quantities to meet recommended nutrient intakes, which may be unrealistic for poor households. For example the MNUT diet has identified liver as an inexpensive source of vitamin A, vitamin B12, iron, zinc and copper. However, to provide the percentage of these nutrient requirements presented in the results, households would be required to eat liver 3 times a week. This is not realistic for very poor households who rarely slaughtered their animals unless there was a celebration or for sustenance during the 'hunger season'. This was emphasised by the HEA results, which showed that 1% and 2% of energy requirements were provided by consuming livestock products in very poor and poor wealth group's food summary (FEG, 2012).

Another example of a food that is included in unrealistic quantities was milk. The LACON diet includes a total of 1890 Kg of milk from camel, cow and goat for a household of 7. Cow's milk is contributing to the majority of this quantity (600 Kg), however the HEA study (FEG, 2012) found that very poor and poor families could not afford to keep any cattle and on average, middle and better off households owned 2 or 3 dairy cows respectively The HEA study estimated that each cow produced 1.5 litres of milk a day. The amount of milk included in a nutritious diet, by the software would therefore only be achievable for better off wealth groups. This does not include the milk that is sold as a source on income of which 51% is sold in middle wealth group families and 37% in better off families (FE, 2012). Furthermore, fresh cow's milk was also only found in *Lotubae* market. The cost per 100g may therefore be unrealistically low as the sample of prices was small. However, the software has identified milk as an important source of energy, fat, vitamin A, soluble B group vitamins, calcium and zinc.

The software has identified calcium, iron and vitamin C as the nutrients that are the most difficult to meet recommended intakes for using foods available on the market for a child aged 12-23 months. They have been identified because the RNI has either been met by 100% or below this. In the LACON diet for this child, the RNI for calcium and vitamin C has been met by 100% but the RNI for iron has only been met by 75-87%, depending on the season. This finding is interesting because the RNI for this nutrient was met by 100% in the MNUT diet for the same child. This shows that the current, typical dietary habits of the community in the agropastoral zone are restricting the software's ability to meet iron requirements using local foods. The primary reason for this is because in the LACON diet, maize has replaced large quantities of sorghum that were included in the MNUT diet to reflect the fact that it is the main staple food in this livelihood zone. The quantity of sorghum in the diet has therefore reduced from 24 Kg a year in the MNUT diet to 1.3 Kg a year in the LACON diet. Consequently the percentage of iron intakes met by sorghum has reduced from 28% in the MNUT diet to 1.9% in the LACON diet. As maize is not as rich in iron as sorghum (containing 3.5 mg/100g compared to 4.1 mg/ 100g) the software has not been able to meet this shortfall using other foods within the minimum and maximum constraints.

The software has also identified calcium, iron and vitamin C as the nutrients that are the most difficult to meet recommended intakes for using foods available on the market for the rest of the family. These nutrients are also the most expensive and will increase the cost of the diet as the software tries to find foods to meet their requirements. This is emphasised by the analysis of the food groups that contributed the most to a nutritious diet which for both the child aged 12-23 months and the rest of the family were meat, fish, poultry and eggs and dairy . However, it should be recognised that the recommended intakes used as targets by the software are set very high and are greater than the actual needs of 97% of all individuals.

Another limitation of the results is that food aid distribution may be making a contribution to micronutrient intakes through the use of fortified foods, which has not been effectively captured in this analysis. This is because the inclusion of food aid in the diet has been treated as a 'free' source of food which has been monetised and included in the income figures as described in section 3.4. To determine the impact that food aid has on contributing to micronutrient requirements, the standard ration for a household of seven people would need to be included in the software at a cost of '0'.

The results demonstrate the possible fluctuation in the daily cost of a nutritious diet by season. However these fluctuations cannot be justified using the seasonal calendar produced by the recent HEA study. This may be due to the inherent disadvantages associated with collecting retrospective data whereby traders are expected to remember the price of all foods in previous seasons. Traders are also expected to recall the seasonal availability of foods which may differ depending on the trader and their memory. The results in Appendix 2 also suggest that only the availability of milk differs depending on the season which for fruits such as mango and orange may not be the case.

The results from the cost of the diet show that all wealth groups in the agropastoral livelihood zone of Turkana can afford a diet that meets energy requirements. This was also implied by the results from the HEA study, which reported that households in all wealth groups were able to meet their energy requirements from foods. However, the results show that none of the wealth groups can afford a nutritious (LACON) diet plus their expenditure on essential non-food items. It is unusual in a Cost of the Diet study for none of the wealth groups to be able to afford a nutritious diet and justifies the need for interventions which aim to increase annual income of households or reduce daily the cost of the diet.

The gap in the affordability of the LACON diet, expressed in cash for very poor (276,200 KSH a year) and poor households (257,000 KSH a year), is very large and would be impossible to close through cash transfers alone. The result from the HSNP cash transfer scenario demonstrates this. As mentioned, alternative ways of increasing income or reducing the cost of the diet therefore need to be researched. The models presented in the report do begin this thought process but in general the modelling opportunities were limited due to environmental constraints and the lack of livelihood opportunities in this zone.

Having said this, the scenario models identify the potential for a greenhouse intervention that encourages the consumption of kale, cowpea leaves, spinach and tomatoes in reducing the cost and improving the quality of a nutritious diet. However, the main limiting factor for this scenario is ensuring that enough water could be made available to undertake this intervention. The average food price model identified small dried fish as one of the most nutritious foods found on the market. This food is particularly rich in protein, vitamin B12 and calcium. The differences between the cost and the foods selected for the MNUT and LACON diet as a result of excluding this food to reflect typical food habits also emphasise its nutritional benefits. However the availability of this food in the livelihood zone was limited. Also, with road infrastructure currently limiting the transportation of nutritious foods in the livelihood zone, it is unlikely that households will be able to access dried fish until the quality of the roads is improved.

The results from the food aid model emphasise the importance of this food source for very poor and poor households in meeting their basic requirements for energy, especially when modelled against a rise in the cost of the basic staple. The results suggest that food aid distributions cannot be stopped without serious consequences on poor household's ability to afford a nutritious diet. It is important to remember that to model this scenario, the monetary value of food aid estimated for the very poor and poor wealth groups was removed and the cost of the staple increased in the software. This model can therefore only imply the impact of removing food aid on the affordability of the three diets and not from a nutritional status perspective.

6. Recommendations and Conclusions

The results from the Cost of the Diet analysis show that it is possible for households to obtain their recommended intakes of energy, fat, protein and micronutrients, apart from iron for the 12-23 month old child, from foods found in the local markets. However, household's access to the nutritious foods selected by the software is restricted by poverty and poor road infrastructure.

Therefore, one of the most important recommendations to be made in this report is the need to invest in improving road and market infrastructure in this livelihood zone. This was also one of the main recommendations made by the HEA study (FEG, 2012). Currently, roads are either non-existent or in a very poor condition. There is a lack of markets in this zone in general and those that do exist in remote villages sell mainly cereals, pulses and oil and are almost devoid of dairy and animal products: the most nutritious foods available in this livelihood zone as identified by the Cost of the Diet software. Until access of remote villages by road is improved, it is unlikely that the availability of these foods in the market will improve and access will remain poor.

The results on the affordability of the diet has shown that potentially none of the wealth groups identified by the HEA study in the agropastoral livelihood zone of Turkana can afford a nutritious diet that takes into account typical dietary habits. The current cash transfer amount given in the HSNP does make some contribution to improving the affordability of a nutritious diet but it is not enough to close this gap. The results from this model provide justification for increasing the amount of money given to households; however it is recommended that more research is undertaken to determine the monetary value of this increase. Other ways of increasing income or reducing the cost of the diet therefore need to be considered.

The scenarios modelled in this report show the potential for Oxfam's greenhouse intervention on reducing the daily cost of the LACON diet for the household and improving intakes of essential nutrients such as vitamin C and iron for children under the age of two. However, more information is needed on how much water this intervention would require and how this would be made available and also the output costs to the household should this intervention be implemented, which has not been included in this scenario. The software has shown the potential impact that small dried fish may have on reducing the daily cost of the diet and improving intakes of essential micronutrients such as protein, niacin, vitamin B12 and calcium. Increasing the availability of this food in the market, perhaps through links with fish producers in the Turkwell Riverine livelihood zone could be explored, assuming that road infrastructure is good enough to transport these products.

The cost of the diet results for the 12-23 month old child emphasise the importance of continued breastfeeding until the age of 2 years. In the analysis of the LACON diet, breast milk provided over half of fat and vitamin C intakes and contributed to energy, vitamin B2, niacin, and calcium requirements. Promoting the benefits of exclusive and continued breastfeeding is therefore highly recommended. However, breast milk is not a rich source of iron, emphasised by the finding that this requirement could not be met by 100% for the child aged 12-23 months. Making iron rich foods such as meat and offal more accessible in terms of their price and physical

presence in the market needs to be undertaken so that the consumption of these foods can be advocated for.

The seasonal fluctuations in the daily cost of a nutritious diet have not been effectively captured in this study because retrospective data collected methods during the market survey were used for training purposes. However, this analysis does show that the cost of a nutritious diet is potentially most expensive during March to June or *akiɲoro.* The HEA found that wealthier households used the market to purchase almost half of their energy requirements. The seasonal fluctuation of food prices may therefore greatly impact these household's access to food sold in markets. Interventions that aim reduce foods prices or improve a household's income; with a focus on nutrition outcomes may have the greatest impact when the cost of the diet is at its most expensive during March to June or *akiɲoro*. Having said this, if this study is repeated it is recommended that a data collection team undertakes a market survey during each season to better understand the seasonal cost and availability of foods found on the market and the potential impact on those households that purchase the majority of their food from the market. It is also recommended that the potential contribution that food aid makes to micronutrient intakes through the use of fortified foods is modelled in a seasonal Cost of the Diet analysis.

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Appendix 1. Family members chosen from the WHO database of average energy requirement used to create households with low and high average energy requirements plus a household with an energy requirement closest to the number of people x 2,100 kcal (HEA/CoD family).

Family size		**5 individuals**			**6 individuals**			**7 individuals**			**8 individuals**			**9 individuals**			**10 individuals**		
Household member	**Kcal/day**	**Low**	**HEA & Cost of the Diet**	**High**	**Low**	**HEA & Cost of the Diet**	**High**	**Low**	**HEA & Cost of the Diet**	**High**	**Low**	**HEA & Cost of the Diet**	**High**	**Low**	**HEA & Cost of the Diet**	**High**	**Low**	**HEA & Cost of the Diet**	**High**
Woman is lactating	418	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Baby (either sex) 12-23 months	894	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Child (either sex) 2-3 years	1,088	X			X			X			X			X			X		
Child (either sex) 3-4 years	1,200	X			X			X			X			X			X		
Child (either sex) 4-5 years	1,300				X			X			X			X			X	X	
Child (either sex) 5-6 years	1,400							X			X			X	X		X		
Child (either sex) 6-7 years	1,500										X	X		X			X	X	
Child (either sex) 7-8 years	1,625								X					X	X		X		
Child (either sex) 8-9 years	1,763					X						X					X	X	
Child (either sex) 9-10 years	1,913		X						X						X				
Child (either sex) 10-11 years	2,075					X						X						X	
Child (either sex) 11-12 years	2,250		X						X						X				X
Child (either sex) 12-13 years	2,413					X						X				X		X	X
Child (either sex) 13-14 years	2,575								X				X		X	X			X
Child (either sex) 14-15 years	2,725									X		X	X			X		X	X
Child (either sex) 15-16 years	2,838						X			X			X		X	X			X
Child (either sex) 16-17 years	2,913			X			X			X			X			X		X	X
Child (either sex) 17-18 years	2,950			X			X			X			X			X			X
Man, 18-29y, 50 kg, light activity	2,300	X			X			X			X			X			X		
Man, 30-59y, 50 kg, mod active	2,750		X			X			X			X			X			X	
Man, 30-59y, 60 kg, vig active	3,450			X			X			X			X			X			X
Woman, 18-29y, 45 kg, light activity	1,850	X			X			X			X			X			X		
Woman, 30-59y, 45 kg, mod active	2,300		X			X			X			X			X			X	
Woman, 30-59y, 55 kg, vig active	2,850			X			X			X			X			X			X
Total average energy requirement		7,749	10,524	13,474	9,049	12,612	16,312	10,449	14,724	19,037	11,949	16,837	21,612	13,574	18,962	24,024	15,337	21,037	26,274
HEA energy specification			10,500			12,600			14,700			16,800			18,900			21,100	

Appendix 2. All the foods that were found in the markets in the agropastoral livelihood zone of Turkana, Kenya and the costs per 100g reported by market traders

Food list	Season 1	Season 2	Season 3	Season 4
MAIZE, DRIED, RAW (KENYA)	5.10	6.70	5.50	6.00
MAIZE, FLOUR, DRY (KENYA)	5.70	6.40	4.30	5.70
MAIZE, WHITE, FLOUR (INDONESIA)	7.10	7.90	7.50	7.60
SORGHUM, WHOLE GRAIN, RED (SENEGAL)	6.70	8.10	6.70	6.70
RICE, RAW (KENYA)	11.35	11.70	11.40	10.70
PASTAS (MEXICO)	25.40	23.50	24.10	24.80
MILLET, FINGER (KENYA)	10.20	11.30	10.20	11.30
WHEAT, LOCAL (INDIA)	14.70	16.50	16.20	13.60
WHEAT, FLOUR, ALL-PURPOSE, 72% EXTRACT. (KENYA)	10.25	9.85	8.65	9.65
BEAN, KIDNEY, DRIED, RAW (KENYA)	9.36	10.56	9.06	9.50
LENTIL, WHOLE (EGYPT)	19.00	22.10	21.70	22.40
MANGO (EGYPT)	5.80	5.80	7.00	5.80
ORANGE (EGYPT)	6.80	6.80	6.80	6.80
BANANA, LARGE, UNRIPE (KENYA)	10.80	10.80	10.80	10.80
PEAR, AVOCADO (INDONESIA)	15.00	20.00	15.00	15.00
CABBAGE, GREEN, RAW (KENYA)	6.60	8.30	6.00	7.30
TOMATO, RIPE, FRESH (SENEGAL)	9.00	10.90	12.90	9.00
ONION TUBER (KENYA)	9.30	12.40	15.50	12.40
ONION W/STALKS (INDIA)	14.90	16.40	16.40	16.40
MILK, COW, WHOLE (INDONESIA)		5.60		
MILK, CAMEL (MALI)	1.70			
MILK, GOAT, FRESH, WHOLE (SENEGAL)				1.80
MILK, SHEEP, FRESH, WHOLE (SENEGAL)				1.70
SHEEP, RAW-EP (SENEGAL)	24.70	24.70	17.60	17.60
GOAT, RAW (KENYA)	26.80	26.80	22.90	26.80
LIVER (EGYPT)	26.50	26.50	20.80	22.70
INTESTINE (EGYPT)	24.00	24.00	20.00	20.00
EGG, CHICKEN, WHOLE, LOCAL (EGYPT)	29.20	30.20	25.30	26.40
POTATO, ENGLISH, RAW (KENYA)	6.20	6.20	6.00	5.10
VEGETABLE OIL (INDONESIA)	29.30	36.60	29.30	33.00
VEGETABLE FAT, KIMBO (KENYA)	19.50	19.30	19.20	19.70
MARGARINE, FORTIFIED (INDONESIA)	35.00	25.00	35.00	35.00

Food list	Season 1	Season 2	Season 3	Season 4
SALT, IODIZED (KENYA)	5.70	6.10	6.10	6.00
MILK, COW, PWD, WHOLE (KENYA)	87.50	96.20	93.30	96.20
MILK, COW, UHT (KENYA)	17.00	12.30	11.30	11.30
FISH, SMALL, DRIED, FRESH WATER (MEXICO)	86.00	79.90	92.20	92.20
TOMATO, CONCENTRATE 28% (SENEGAL)	32.10	32.10	32.10	32.10
SORGHUM, WHOLE GRAIN (SENEGAL)	4.00	8.00	4.00	3.00
SUGAR, REFINED (MEXICO)	16.70	19.10	19.40	20.40
OIL, VEGETABLE (WFP SPECS) (SUPPLEMENT)	62.70	62.70	59.90	59.90

Appendix 3. The list of all food found in the markets in the agropastoral livelihood zone of Turkana, the portion sizes, minimum and maximum constraints entered into the Cost of the Diet Software.

Food list	Portion sizes	Minimum constraints	Maximum constraints
BREAST MILK (GENERIC)	523	7	7
MAIZE, DRIED, RAW (KENYA)	36	7	14
MAIZE, FLOUR, DRY (KENYA)	23	0	14
MAIZE, WHITE, FLOUR (INDONESIA)	23	0	14
SORGHUM, WHOLE GRAIN, RED (SENEGAL)	36	0	14
RICE, RAW (KENYA)	36	0	7
PASTAS (MEXICO)	36	0	7
MILLET, FINGER (KENYA)	36	0	7
WHEAT, LOCAL (INDIA)	36	0	14
WHEAT, FLOUR, ALL-PURPOSE, 72% EXTRACT. (KENYA)	23	0	14
BEAN, KIDNEY, DRIED, RAW (KENYA)	15	0	14
LENTIL, WHOLE (EGYPT)	15	0	14
MANGO (EGYPT)	42	0	7
ORANGE (EGYPT)	5	0	7
BANANA, LARGE, UNRIPE (KENYA)	21	0	7
PEAR, AVOCADO (INDONESIA)	42	0	0
CABBAGE, GREEN, RAW (KENYA)	15	0	14
TOMATO, RIPE, FRESH (SENEGAL)	10	0	7
ONION TUBER (KENYA)	5	0	7
ONION W/STALKS (INDIA)	5	0	7
MILK, COW, WHOLE (INDONESIA)	136	0	14
MILK, CAMEL (MALI)	136	0	14
MILK, GOAT, FRESH, WHOLE (SENEGAL)	136	0	14
MILK, SHEEP, FRESH, WHOLE (SENEGAL)	136	0	14
SHEEP, RAW-EP (SENEGAL)	15	0	7
GOAT, RAW (KENYA)	15	0	7
LIVER (EGYPT)	8	0	7
INTESTINE (EGYPT)	8	0	7
EGG, CHICKEN, WHOLE, LOCAL (EGYPT)	20	0	7
POTATO, ENGLISH, RAW (KENYA)	25	0	7

Food list	Portion sizes	Minimum constraints	Maximum constraints
VEGETABLE OIL (INDONESIA)	5	0	14
VEGETABLE FAT, KIMBO (KENYA)	5	0	14
MARGARINE, FORTIFIED (INDONESIA)	5	0	7
SALT, IODIZED (KENYA)	0.3	0	14
MILK, COW, PWD, WHOLE (KENYA)	5	0	7
MILK, COW, UHT (KENYA)	136	0	7
FISH, SMALL, DRIED, FRESH WATER (MEXICO)	10	0	0
TOMATO, CONCENTRATE 28% (SENEGAL)	5	0	0
SORGHUM, WHOLE GRAIN (SENEGAL)	36	0	7
SUGAR, REFINED (MEXICO)	0.3	0	7
OIL, VEGETABLE (WFP SPECS) (SUPPLEMENT)	5	0	7