A Cost of the Diet Analysis in Turkana County, Kenya

Central Pastoral Livelihood Zone

Location: Central Pastoral Livelihood Zone, Turkana County
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List of abbreviations

CotD – Cost of the Diet

EO – Energy only diet

FEG – Food Economy Group

FGD- Focus Group Discussion

FHAB – Food habits nutritious diet

GAM – Global Acute Malnutrition

GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit

HEA – Household Economy Analysis

HFCS – Household Food Consumption Score

HFIES – Household Food Insecurity Experience Scale

IFAS – Iron and folic acid supplementation

KAP – Knowledge, Attitude and Practices (Survey)

KDHS – Kenya Demographic Health Survey

KFSSG – Kenya Food Security Steering Group

KES – Kenyan Shillings

MDD-W – Minimum Dietary Diversity for Women

MIYCN – Maternal Infant and Young Child Nutrition

NUT – Micronutrient nutritious diet

SCNC – Sub-County Nutrition Coordinators

SMART – Standardized Monitoring and Assessment of Relief and Transitions

SRAF – Situation & Response Analysis Framework

WHO – World Health Organization

WRA – Women of reproductive age

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Executive Summary

Introduction

Situated in the North-West of Kenya, Turkana is one of the poorest regions of the country (poverty index of 94%[1]) and affected by persistently high rates of malnutrition. Between 2015 and 2017, Global Acute Malnutrition has increased from 21.2% to 24.7% in Turkana (although not statistically significant). A trend analysis of acute malnutrition over the course of 7 years (2010 –2017) showed how these prevalence rates have fluctuated, yet persistently exceeded WHO's emergency threshold (15%).[2] The persistently high rates of malnutrition and current upward trend indicate a critical situation in Turkana County, requiring further efforts being devolved in understanding and tackling the underlying determinants of this chronic issue.

In an effort to gain greater understanding of the underlying causes of malnutrition in Turkana County, Save the Children, funded by UNICEF, carried out a Cost of the Diet assessment to assess the extent to which access to a nutritious diet may be affected by economic constraints and availability of nutritious foods in the county.

For the purpose of this study, the Central Pastoral Livelihood Zone was selected, as not all zones could be covered during the survey due to resources and security limitations. The central pastoral livelihood zone is central to Turkana and lies across six of Turkana's sub-counties.

The aim of this study was to identify whether a nutritious diet can be achieved using locally available foods, to estimate the cheapest cost of a nutritious diet, and whether this diet can be afforded by households in the Central Pastoral Livelihood Zone in Turkana County.

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

- What is the cost of a nutritionally adequate diet for typical households?
- What is the cost of a nutritionally adequate diet for children 6 to 23 months of age?
- Can a nutritionally adequate diet be achieved using locally available foods?
- What nutrients have the greatest influence on the cost of a nutritious diet?
- What local foods are inexpensive sources of essential micronutrients and could be promoted?
- How affordable is a nutritious diet for a typical family? If not, what proportion of households' income would be required to achieve a nutritious diet?
- What is the effect of introducing new foods and can these contribute to closing any dietary gaps?
- What is the impact of wild foods in the local diet?
- What is the effect of potential interventions on the cost of the diet and affordability?

[1] Turkana County Government (2015). *Turkana County Action Plan 2015 – 2018.*
[2] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.

Methods

The Cost of the Diet (CotD) is a method and software developed by Save the Children to estimate the amount and combination of local foods that are needed to provide individuals or a family with foods that meet their average needs for energy and their recommended intakes of protein, fat and micronutrients (Deptford *et al*., 2017). The Cost of the Diet software selects a variety of foods that would enable a family to meet their nutrient requirements. In the analysis, three diets are calculated (Table 1): an energy only diet (a lowest cost diet that only meets the average energy requirements of the members of the household); a macronutrient nutritious diet (a lowest cost diet that meets the average energy and the recommended nutrient requirements of the household); and a food habits nutritious diet (a lowest cost diet that meets the average energy and the recommended nutrient requirements of the household and reflects cultural consumption patterns).

Table 1. Summary and definition of the diets calculated in the standard analysis of the Cost of the Diet assessment

Type of diet	Definition	Energy needs met	Fat at 30% of energy	Protein needs met	Micronutrient needs met	Reflects typical dietary habits
Energy only diet (EO)	*A lowest cost diet that only meets the average energy requirements of the members of the household.*	X				
Micronutrient nutritious diet (NUT)	*A lowest cost diet that meets the average energy and the recommended nutrient requirements of the household.*	X	X	X	X	
Food habits nutritious diet (FHAB)	*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

Ten market surveys, six village interviews and eight focus group discussions were conducted in the central pastoral livelihood zone. The market prices, seasonal availability and dietary habits of all foods available locally were collected (with the exclusion of herbs, spices and sugary snacks). For the purpose of calculating an annual cost of the diet, retrospective price data were collected to cover a period from April 2016 to March 2017.

With these data the cost of three diets were estimated using the Cost of the Diet software for a typical household of eight individuals, which represented very poor and poor households as identified by the HEA. Using the annual income and non-food expenditure data from the HEA, the affordability of the diets was estimated. The annual cost of the foods selected by the software and the non-food expenditure were expressed as a percentage of the estimated annual cash income (for all wealth groups identified in the HEA: very poor, poor, middle and better-off) in order to estimate the additional income that would be required in order to cover the cost of a food habits nutritious diet and non-food expenditure.

Key findings and recommendations

- **Poor infrastructure in Turkana is a barrier to gaining physical access to the foods.** The software was able to calculate a nutritious and food habits nutritious diet that met all the requirements of a standard household, meaning that there is sufficient diversity of foods in the region. However, the frequency with which these foods are available to households and the quantity with which these can be found in the markets is likely to be an obstacle to achieving a nutritious diet. The repairs of the A1 road (Lodwar to Kitale) will have a considerable impact on the households living in the central pastoral livelihood zone, as well as the wider county. Better roads will also allow for more efficient transportation of fresh produce and, possibly, decrease the extent of food degradation and nutrient depletion due to heat and travel conditions.

- **Inadequate diet and consequent poor nutritional status likely to be a heavily driven by financial factors due to a considerable affordability gap.** The analysis found that between 215,000 KES and 285,000 KES are needed to close the affordability gap and enable households to purchase a nutritious diet. The highest affordability gap was, surprisingly, identified for the middle wealth group, driven by the larger typical household size. These results may have generally been exacerbated by the current drought, and therefore are not necessarily reflective of a normal year (affordability gap may be narrower during non-drought years).
    - Very poor: 186% = **281,976 KES**
    - Poor: 130% = **253,175 KES**
    - Middle: 77% = **285,401 KES**
    - Better-off: 37%= **215,379 KES**

- **Current cash transfer of 2,700 KES for very poor and poor household is not sufficient to close the affordability gap, although reduces the deficit by 50% and 33% in each group, respectively.** Increasing the cash transfer for these groups to 10,000 KES a month would increase affordability, but would not be sufficient in closing the affordability gap. Based on the affordability analysis, the following monthly cash transfers would be needed to close the affordability gap:
    - Very poor: **21,000 KES/ month**

- Poor: **18,500 KES/ month**
- Middle: **24,000 KES/ month**
- Better-off: **18,000 KES/ month**

- **Interventions to increase cash income to be considered to close the affordability gap.** Current cash income and available livestock products are not sufficient for a family to access a nutritious diet. Avenues should be explored to allow households to increase their means to access nutritious foods, such as food for work or vouchers. Current food distribution is inconsistent and not sufficient to make a meaningful impact, but further food assistance should also be considered given the large affordability gap and generally hostile conditions across the central pastoral livelihood zone.

- **Livelihoods interventions, such as supplying households with chickens for increased egg consumption could decrease the cost of the diet, and therefore improve affordability.** The analysis showed a reduction in overall cost of the diet for very poor and poor households (from 413,299KES to 397,503KES a year) and could contribute to narrowing the affordability gap by 8 to 11%:

- **Subsidization of maize and beans (between 2.5% and 20% reduction in cost) showed limited impact on the reduction of the overall cost of the diet – between 0.17% - 1.66%.** However, if subsidy was available on a range of foods, it could potentially result in increased affordability. In combination with vouchers and/or other means to increase access to nutritious foods, it could lead to a meaningful impact. Nonetheless, food subsidies alone are unlikely to make a meaningful impact due to the considerable income deficit.

- **Milk consumption is crucial for households living in the central pastoral zone.** The analysis showed how milk (camel, goat, and sheep) can contribute greatly to meeting a nutritious diet and its contribution outweighs its cash value. A recalculated affordability gap shows a narrower gap when milk consumption is added to the diet:
  - Very poor **= 264,176 KES**
  - Poor = **219,890 KES**
  - Middle = **223,875 KES**
  - Better-off = **168,553 KES**
- **Given the importance of dairy in meeting key nutrient requirements, the current drought is likely to have gravely impacted the diets of households living in the central pastoral livelihood zone, as this will have decreased the production of milk.**

- **Reducing the risk of iron deficiency in children between 6 and 11 months through the promotion of iron rich foods (coagulated blood) and/or home fortification (multiple micronutrient powders).** Given the concerning results of the analysis that revealed that iron requirements for children 6 to 11 months could not be met, and based on the results of the modelling around the cost reducing potential of coagulated blood and/or multiple

micronutrient powders, such interventions should be considered to ensure adequate iron intake to aid healthy growth and development. The analysis revealed that as little as 6g of coagulated blood a day in a child's diet could drastically lower the cost of the diet (FHAB). As a pastoral community, there is potentially widespread access to this food, especially given the small quantities required for consumption. The analysis also revealed that multiple micronutrient powders also had a meaningful impact on the reduction of the cost of the diet. Nonetheless, the acceptability of coagulated blood and micronutrient sprinkles should be investigated prior to implementing these recommendation. Increasing the availability of iron rich foods in the livelihood zone could be an alternative avenue to using supplements; however, growing opportunities are very limited in the zone due to extremely arid conditions.

- **Reinforce messages on complementary feeding.** The analysis identified a vulnerability in children under two, as there are not sufficient iron rich foods in the area; additionally, majority of children do not receive adequate complementary feeding. Messaging around appropriate feeding practices should therefore be reinforced alongside interventions to increase availability of iron rich foods. Legumes played a significant role in meeting the nutrient requirements and an increase in consumption should be promoted.

- **Legumes and kale played a significant role in meeting the nutrient requirements and increased consumption should be promoted across all age groups.** Legumes made significant contributions in the diet (90% folic acid, 55% vitamin B1, 53% protein, 51% iron, 48% zinc, 43% vitamin B6, 36% niacin), therefore provide cheap access to nutrients. Additionally, kale was identified as an important source of vitamin A and vitamin C. Households could therefore be encouraged to consume more legumes and kale, favouring larger portions of these and avoiding excessively large portions of grain (e.g. maize meal). This is especially important in young children. Households are currently consuming these and promoting an increase in consumption of these could be beneficial and potentially easily integrated in the current diet in larger amounts.

- **Promotion of kale, legumes and coagulated blood should be coupled with a sensitization on how to prepare these foods**. For example, how to economize on fuel, rid them of anti-nutrients and phytates, which hinder absorption of nutrients, help digestion and, thus, maximize the nutritional value by, for example, sprouting of legumes. The households with children 6 to 23 months should also be supported to prepare nutritious recipes using locally available foods at their disposal including various food combinations.

- **Pulses (dried legumes) are especially important in the livelihood zone, as these are easier to transport than fresh food products, have a long shelf life and are widely consumed and accepted.** Stocking up on these products ahead of the lean seasons could improve affordability and increase access to nutrients.

- **Drying foods, such as vegetables and meat, could be used as a method to increase availability of food during the dry season, during which prices are highest.** Drying foods

could be a means for household to preserve foods during seasons of (relative) abundance and prepare for the lean (dry) seasons, using methods such as solar drying. Nonetheless, potential storing solutions should be investigated further. Transportation of dried goods could potentially be more economical and efficient, and may increase availability of key nutrients at a low cost across the zone.

- **Wild foods play an important role in the diet of households in the central pastoral zone.** However, this study does not fully capture the extent to which these foods contribute to the diet in reality. Furthermore, nutrient composition data for all of the wild foods available in the livelihood zone could not be found, so information was limited to a number of wild foods. Furthermore, more detailed information on seasonality and availability and acceptability of these foods should be gathered to allow for a more accurate analysis of the impact of these foods in terms of nutrient value and diet cost reduction.

- **A further investigation into availability and prices of foods during the rainy season is recommended.** This study could not fully capture the availability of foods during the rainy season and, more generally, seasonal fluctuations, as the data was gathered in the height of the dry season, when food availability was at its lowest, and in the midst of the drought. Further data gathered during a period during which food is more abundant would give a more integral analysis of availability.

- **Increase the capacity for households to store water and use of innovative solutions.** Although there is a general scarcity of water across Turkana County, increased safe water storage solutions could aid safe environments. Furthermore, innovative solutions, such as rolling water barrel could help decrease mother's workload.

- **Ensure results are fed back to the communities visited.** Upon visiting communities, residents voiced their discontent with previous surveys conducted in the areas, as no feedback process ever took place. Given their active collaboration and interest in the matter, it is recommended that the communities visited be informed of the results of the survey through the appropriate media (e.g. inform the village chief or elders). As only 10 communities were involved, the process would require very limited resources and ensure future collaboration with the communities who had kindly collaborated.

1. Introduction

1.1. Introduction

Located in the Eastern region of Africa, Kenya is home to over 46 million people and, with a projected growth of 6% in 2017, represents one of the most thriving economies in Africa.[3] The country is seeing a steady growth in middle class and rising incomes, as well as an increase in remittances and public investment in the transport sector. Kenya has so far met a number of MDGs targets, such as reducing child mortality rates and narrowing the gender gaps in education.[4] Nonetheless, 47% of Kenya's population currently lives below the poverty.[5]

One quarter of Kenya's population lives in arid and semi-arid regions, which cover 80% of the total land area of the country. These regions are affected by lack of infrastructure, poverty, disease and conflict. These areas are also affected by periods of drought, which in turn leads to losses in crop and livestock.[6]

Situated in the arid North-Western region of Kenya, Turkana is one of the worse affected regions, with a poverty index of 94%.[7] Approximately 60% of the population is considered pastoral, 20% agro-pastoral, 12% fishers and 8% live in the urban or peri-urban area and are involved in formal and informal forms of employment. Since the process of decentralization began in 2013, Turkana has benefited from higher investment in infrastructures and an increase in employment. Nonetheless, the county currently has poor infrastructure and its residents lack access to essential services.[8] One of the main challenges affecting Turkana people are the historically high trends of chronic and acute malnutrition in children under the age of five years. Recent trend analyses of malnutrition rates have shown fluctuations, yet little variation, since 2011, although from 2015 to 2017 the Global Acute Malnutrition (GAM) rates have increased by approximately 3.5% (from 21.2% to 24.7%); SAM rates have also increased by 1.1% (from 5% to 6.1%).[9] These trends have raised questions on the nature of malnutrition in Turkana and the determinants driving this trend.

[3]World Bank (2017). *Kenya Overview*. http://www.worldbank.org/en/country/kenya/overview
[4] Ibid.
[5] World Food Programme (2017). Kenya, Overview. http://www1.wfp.org/countries/kenya
[6] Ibid.
[7] Turkana County Government (2015). *Turkana County Action Plan 2015 – 2018.*
[8] Turkana County Government (2015). *Turkana County Action Plan 2015 – 2018*; *Turkana SMART Nutrition Survey* (2016).
[9] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.

1.2. Aim of the study

In an effort to gain greater understanding of the underlying causes of malnutrition in Turkana, Save the Children, funded by UNICEF, carried out a Cost of the Diet assessment to assess the extent to which access to a nutritious diet may be affected by economic constraints and availability of nutritious foods in the county.

The aim of this study was to identify whether a nutritious diet can be achieved using locally available foods, to estimate the cheapest cost of a nutritious diet, and whether this diet can be afforded by households in the Central Pastoral Livelihood Zone in Turkana County.

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- What nutrients have the greatest influence on the cost of a nutritious diet?
- What local foods are inexpensive sources of essential micronutrients and could be promoted?
- How affordable is a nutritious diet for a typical family? If not, what proportion of households' income would be required to achieve a nutritious diet?
- What is the effect of introducing new foods and can these contribute to closing any dietary gaps?
- What is the impact of wild foods in the local diet?
- What is the effect of potential interventions on the cost of the diet and affordability?

2. Overview of Turkana

2.1. Study area

Turkana County is an arid and semi-arid land with an average rainfall of 120 to 500mm a year and high temperatures approaching 40 degrees Celsius; the area is also prone to droughts. The County shares its international borders with Ethiopia, Sudan and Uganda to the North and West of the county; within Kenya, Turkana boarders the counties of Baringo, West Pokot and Samburu. Turkana is further subdivided into seven sub-counties: Turkana Central, Turkana South, Turkana North, Turkana East, Turkana West, Kibish and Loima. Scarcely populated, the county is home to approximately 850,000 inhabitants over an area of 77,000 kilometers squared.[10]

The livelihood zone map was defined in a meeting in 2012 with participants from the National Drought Management Authority, Ministry of Agriculture, Livestock and Fisheries, UNDP, World Vision, Oxfam, Child Fund and the Diocese of Lodwar. Turkana was divided in six livelihood zones[11] (Figure 1):

1. Central Pastoral;
2. Border Pastoral;
3. Kerio Riverine Agro-Pastoral;
4. Turkwell Riverine Agro-Pastoral;
5. Lake Turkana Fishing;
6. Lodwar Urban.

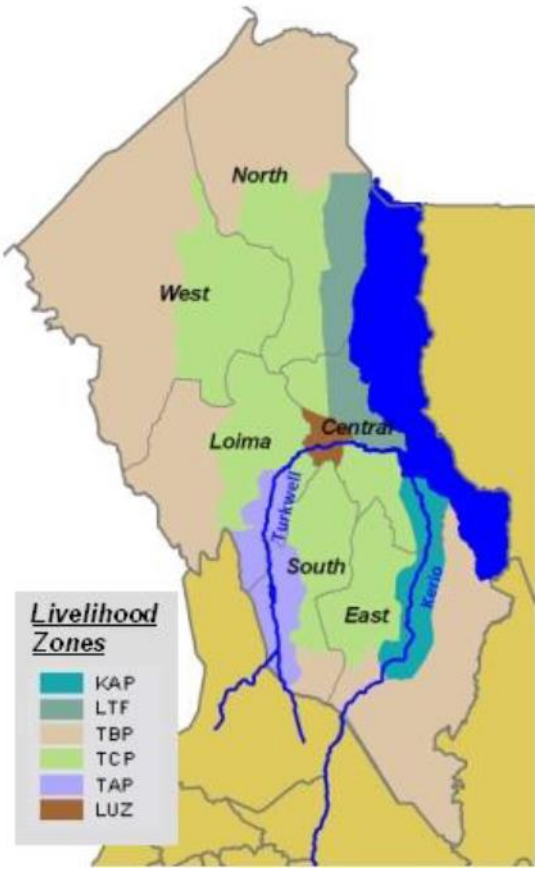


Figure 1. Livelihood mapping of Turkana County.

For the purpose of this study, the Central Pastoral Livelihood Zone was selected, as not all zones could be covered during the survey due to resources and security limitations. The zone (marked by the acronym TCP in Figure 1) is central to Turkana, lying across all six of Turkana's sub-counties. The main livelihood is pastoralism, although two thirds of Turkana people live off a combination

[10] Turkana County Government (2015). *Turkana County Action Plan 2015 – 2018.*
[11] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*

of self-employment (for example, the sale of charcoal or firewood), wild foods gathering and safety nets.

Although the central pastoral zone sees less rainfall than its neighboring zones, it is more secure than other areas, as it is less affected by cattle raiding than boarder zones. It also benefits from better access to the main markets and to services, such as health facilities and schools.[12]

Turkana is currently facing a drought due to below average short rains and a delayed onset of the long rains season. The shortage of rainfall has negatively impacted livestock productivity due to exacerbated dry conditions across the zone and causing widespread deaths of livestock. Furthermore, the drought will in turn delay land preparation and planting. According to the FEWS NET early warning system signals that many households are experiencing Crisis (IPC 3) outcomes in parts of Turkana. A situation and response analysis in late 2016 revealed that over 24,000 households in the central pastoral zone were facing survival and livelihoods protection deficits, especially as a result of reduced milk production due to limited pasture.[13]

2.2. Prevalence of malnutrition in children

Findings from the 2017 SMART survey[14] in Turkana County once again presented high rates of acute malnutrition in Turkana, indicating a critical nutrition situation. Furthermore, GAM rates have increased between 2015 and 2017, from 21.2% to 24.7%, although the difference is not statistically significant. At sub-county level, Turkana North has the highest GAM rates at 30.7%, followed by Turkana Central at 25.9%, Turkana South at 22.9%, and Turkana West at 15.3%. A trend analysis of acute malnutrition over the course of 7 years (2010 –2017) shows how GAM rates have fluctuated, yet persistently exceeded WHO's emergency threshold of 15%.[15] The prevalence of underweight (Weight-for-age) has also increased across Turkana county, from 31.1% in 2015 to 32.0% in 2017, although the difference is no statistically significant. Stunting increased from 25.3% to 28.2% from 2015 to 2016, although in the 2017 SMART survey the reported prevalence was lower than in 2015, at 23.2%, although these differences are not statistically significant.[16] The overall trend of these indicators shows that more efforts need to be devolved in understanding and tackling the underlying determinants of this chronic issue in Turkana.

2.3. Micronutrient interventions

Micronutrient deficiencies in Kenya currently pose a public health issue, both at county level and at national level.[17] Although data on micro-nutrient deficiencies in Turkana County is lacking, the

[12] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[13] HEA SRAF (2016). *Turkana drought situation and response analysis report*.
[14] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[15] Ibid.
[16] Turkana County Government (2016). *Turkana SMART Nutrition Survey*; Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[17] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.

supplementation data from the SMART surveys and the KDHS point to gaps more so in view of the inadequate intake of micronutrients from the diets of children. Micronutrient supplementation has been an ongoing intervention both at health facility level and through community based interventions to scale up in addition to promotion of nutritious diets at household level. Although major strides have been made to scale up micro-nutrient related interventions by the health and nutrition sectors, coverage still remains low and below the national targets. For instance the most recent SMART survey (2017) revealed a Vitamin A supplementation coverage of 66.1% among children aged 6 and 59 months which is below the national target of 80%. According to the MIYCN and KAP survey[18], consumption of iron rich foods in children aged 6 to 23 months was low in Turkana, with only 24.2% of children consuming iron rich foods or supplement.

In Turkana, just over half of the women of reproductive age reported taking iron and folic acid supplementation. According to the SMART surveys over the last two years, the proportion of women with children under 2 years taking iron and folate supplementation has increased: from 77.9% in 2015 to 82.0% in 2017. However, the proportion of women of reproductive age consuming a diversified diet (5 food groups and above) is currently 12.2%, thus exposing them to micro-nutrient deficiencies.

2.4. Infant and young child feeding and care practices

A MIYCN and KAP survey[19] conducted in 2014 showed that over two thirds of respondents (70%) reported initiating breastfeeding early (immediately after birth or within an hour) and almost all children (99%) were reported to have been breastfed at some point. Early breastfeeding initiation is at times delayed until the child has been named. Furthermore, 27% of children are fed foods other than breastmilk within the first three days of life. Exclusive breastfeeding also remains low at 32%, thus indicating a decrease from 35% prevalence in 2011. Almost one in five women felt it is necessary to feed a child foods or drinks other than maternal milk: 67% gave the child milk (other than their own), 20.5% plain water and 20% used a sugar and glucose solution. A practice of feeding the child goat fat or milk before maternal milk has also been reported. Most women introduce solid and semi-solid foods when the baby is 6 months old (86%); however, 17% delay introduction of foods other than breastmilk beyond 6 months of age. Generally, dietary diversity is poor in Turkana; only 52% of children aged 6 to 23 months receive an appropriate complementary diet and only 9.5% of children have a sufficiently diverse diet. The MIYCN KAP survey[20] also found that the minimum meal frequency for breastfeeding is 45% and 31% in children aged 6 to 8 and 9 to 23 months, respectively. Additionally, the minimum acceptable diet for these same age group was also very poor: 6% in children 6 to 8 months and 7% in children

[18] Ministry of Health, International Rescue Committee, Save the Children, World Vision (2014). *Knowledge Attitudes and Practices (KAP) and Communication for Development (C4D) Assessment in Turkana County.*
[19] Ministry of Health, International Rescue Committee, Save the Children, World Vision (2014). *Knowledge Attitudes and Practices (KAP) and Communication for Development (C4D) Assessment in Turkana County.*
[20] *Ibid.*

aged 9 to 23 months. Only one in four children between 6 and 23 months receive iron rich foods or supplements.[21]

Inadequate feeding of sick child is prevalent in Turkana, with 74% of mothers giving the child less milk during illness. The same is true with regards to feeding the child complementary foods, as 77% of mothers reported decreasing the amount of food given to the child. Mother's workload has been highlighted as a barrier to adequate feeding practices in children, as mothers have little time to dedicate special attention to the feeding of young children. One third of mothers reported storing food prepared to feed the child at a later time during the day, leading to an increase in the chances of food-borne diseases.[22]

According to the 2016 SMART survey, approximately 1 in every 2 of children under 5 years were reported to have been ill in the two weeks prior to the survey. In Turkana, the overall prevalence of diarrhea in children aged 6 to 23 months is 44.3%, with an average of 3.6 (SD ±3.9) occurrences of diarrhea in the last six months.[23] 72% of children that had been affected by diarrhea had been given therapeutic zinc supplementation.[24]

2.5. Water, Sanitation and Hygiene

According to the SMART nutrition survey (2016), only 58.6% of households in Turkana access their water through safe sources, such as piped water, borehole or protected shallow wells. The remaining 41.4% of households obtain their water from sources that would normally require treatment prior to drinking, such as rivers or springs (14.7%), unprotected wells (10.5%), shallow wells (10.4%), or earth pans (3.0%). The majority of households (92.1%) do not treat their water before drinking. Of the remaining households that treat water, majority use a chemical treatment (pur) following a cholera outbreak, and only 13.7% of households use boiling as a method of water treatment. Furthermore, only 76.6% of households store drinking water safely in closed containers.[25]

Only 57.1% of households have access to water within 500 metres from the house, equivalent to less than 15 minutes walking time; 29.5% live between 0.5 and 2 kilometres, and 12.8% walk over 2 kilometres. Almost half of households in Turkana (45.1%) queue for less than one hour for water. A third of Turkana residents queue between 30 and 60 minutes to fill water containers. At the time of the SMART survey (2017), 29.5% of households used the minimum of 15 litres of water required per person, per day, for drinking, personal hygiene and cooking purposes.[26] Given the current drought, the situation is likely to have deteriorated since.

[21] Ibid.
[22] Ibid.
[23] GIZ (2016). *Nutrition Baseline Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*
[24] Turkana County Government (2016). *Turkana SMART Nutrition Survey*.
[25] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[26] Ibid.

An assessment of hand washing found that only 10.2% of households washed their hands at four critical times (after visiting a latrine; after accompanying a child to the latrine; before cooking; and before eating). Additionally, 60.8% of households did not use soap when washing hands, only utilizing water. Open defecation is also a widespread issue in Turkana and little progress has been seen in reducing the prevalence. The survey recorded a prevalence of 84.9% of open defecation; the remaining households either used latrines, either shared, belonging to the neighbor or on own property.[27]

2.6. Food security and dietary diversity

According to a food security assessment carried out last year using FAO's Household Food Insecurity Experience Scale (HFIES), 89.1% of households in Turkana are severely food insecure, 5.9% moderately food insecure and 2.5% mildly food insecure, meaning that only 2.5% of households are food secure.[28] Due to the on-going drought that has affected the area, an overall deterioration of food security was predicted in the last short rains assessment in February 2017 (KFSSG), and an emergency response has begun to respond to the crisis.

The largest proportion of energy requirements are covered by market purchases, according to both HEA and GIZ baseline studies, although consumption of own livestock produce is significant, representing up to 40% of the household's energy needs in better-off households. Goat's milk provides between 4-14% of household's energy needs; camel's milk provides between 3-12%; and sheep's milk between 4-7%.[29] Under 20% of households consume vegetables, fruits, eggs, fish and organ meat; more common are cereals, oils and fats, milk and legumes.[30] The vast majority of households consumed a cereal based diet (87.1%) and generally consumed these more than 5 days a week. Dietary diversity among women is poor across Turkana, with 80% of women of reproductive age consuming less than the minimum of 5 food groups out of 10 (MDD-W score).[31] The household food consumption score (HFCS) is poor across Turkana, with 51.5% of households reporting borderline (31.5%) or poor (22.0%) food consumption scores.[32]

The GIZ study also found that 94.4% of households in Turkana do not have access to home gardens. Of the 5.6% that grow vegetables, 86% grow vegetables only during the wet season. However, almost 25% of households reported growing vegetables on either rain-fed or irrigated land outside of their home gardens. Only 17.6% sells their produce, the majority either keep it for home consumption (55.9%) or a combination of sale and own consumption (26.5%). Only 12% of households reported having access to fruit trees.[33]

[27] Ibid.
[28] GIZ (2016). *Nutrition Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*
[29] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[30] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[31] GIZ (2016). *Nutrition Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*
[32] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[33] GIZ (2016). *Nutrition Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*

2.7. Household characteristics in the central pastoral livelihood zone

Table 2 is a summary of the key characteristics of households in the central pastoral livelihood zone. Wealth in the central pastoral livelihood zone is mostly determined by the size of the herd. A larger holding of livestock allows a head of the household to maintain multiple wives and an overall larger household. Most of the population in the livelihood zone is classified as very poor (35%) or poor (30%). The average household size is different across wealth groups, with an average of 8 individuals for a poor or very poor household, 11 individuals for a middle household, and 13 for a better-off household.[34]

Table 2. Summary of the household characteristics in the central pastoral livelihood zone.

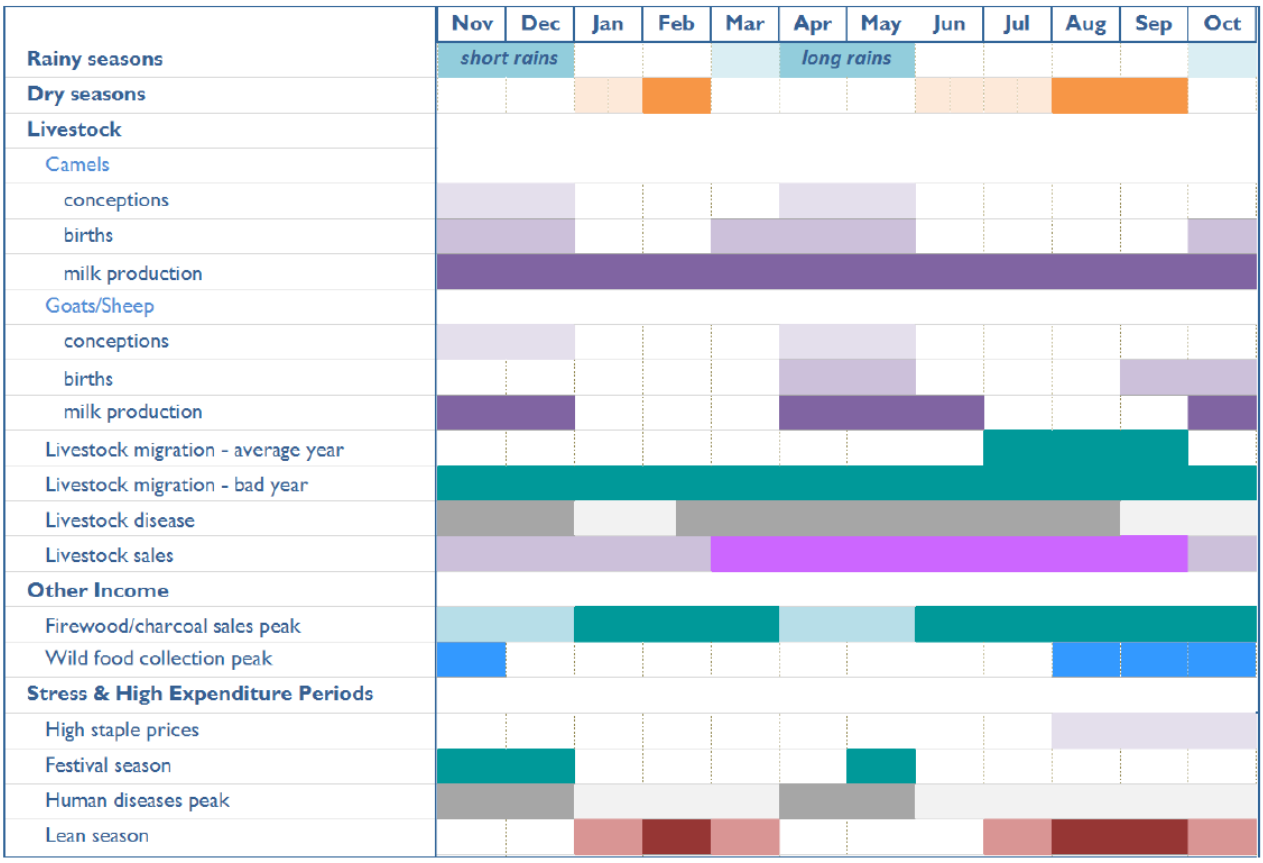
Wealth Group	Percentage of households	Percentage of the population	Household size	Number of wives	Livestock holdings
Very Poor	35%	30%	6-10 (8)	1	10-20 goats, 5-15 sheep
Poor	30%	26%	6-10 (8)	1	0-3 camels, 15-25 goats, 5-15 sheep
Middle	23%	27%	9-13 (11)	1-2	5-15 camels, 30-80 goats, 20-50 sheep
Better Off	12%	17%	10-15 (13)	2-3	15-25 camels, 50-150 goats, 40-80 sheep

2.8. Seasons in the central pastoral livelihood zone

Seasonality in the central pastoral zone is determined by rainfall, which in turn affects livestock productivity and movements. The long rains normally occur between March and May, and the short rains are from October to December, and are respectively referred to as *Akiporo* and *Akicheres*. The long rains are followed by a period of dry pasture until the end of July. Once the pasture has been exhausted, the animals are moved to grazing areas for the duration of the dry season. The rainy seasons see a peak in the levels of milk production; during this period, households decrease the amount of staple food purchased and sell off livestock. The 'hunger' season coincides with the dry season, during which time milk production is at its lowest.[35]

[34] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[35] Ibid.

Figure 2. A seasonal calendar for central pastoral livelihood zone developed as part of the Household Economy Analysis (HEA). [36]



[36] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*

3. Methods

3.1. The Cost of the Diet method and software

The Cost of the Diet (CotD) is a method and software developed by Save the Children to estimate the amount and combination of local foods that are needed to provide individuals or a family with foods that meet their average needs for energy and their recommended intakes of protein, fat and micronutrients (Deptford *et al*., 2017). The Cost of the Diet software selects a variety of foods that would enable a family to meet their nutrient requirements.

3.1.1. Energy only diet (EO)

An energy only diet is a diet that meets only the average energy requirements of a family at the lowest cost. An energy only diet will likely not meet all the micronutrient requirements and it is therefore not recommended. However, it is useful to exemplify how a diet that only meets energy is likely to lead to micronutrient deficiencies. Furthermore, it is useful to identify the cheapest sources of energy available for purchase (based on Kcal per 100g) and to estimate the cost of meeting the nutrient requirements of a family.

3.1.2. Micronutrient nutritious diet (NUT)

A micronutrient nutritious diet (also more simply referred to as a nutritious diet) is a diet that meets the recommended intakes for energy, protein, fat and micronutrients (nine vitamins and four minerals) at the lowest cost. The diet does not reflect people's typical dietary habits, but it is useful to illustrate the following:

- The difference in the foods selected and their cost when compared with a diet that takes into account typical dietary habits (in the FHAB diet, see below).
- The extra cost of meeting specifications for micronutrients compared with a diet that only meets average energy needs.
- The remarkably small number of foods needed to meet a nutritious diet, although often included in very large quantities.

3.1.3. Food habits nutritious diet (FHAB)

A food habits nutritious diet is a diet that meets the recommended intakes for energy, protein, fat and micronutrients (nine vitamins and four minerals) for the specified family or individual at the lowest cost, whilst applying a minimum and maximum number of times a week that the foods can be included in the diet. The minimum and maximum constraints are based on dietary habits questionnaire as part of a focus group discussion. The food habits nutritious diet is useful to illustrate the extra cost of meeting average energy and recommended nutrient when taking into account typical dietary habits and preferences, such as the main staple food consumed and frequency of consumption of other particular foods.

The Cost of the Diet software can also be used to:

- Estimate the minimum cost of a diet for specified families/households of multiple individuals;
- Identify seasonal shortfalls in nutrient intake;
- Take into account seasonal variations in food prices when costing the diet;
- Develop models of current or potential interventions.

The details of the parameters used and the limitations of the Cost of the Diet software and method can be found in Appendix 1.

3.2. Location

Due to limited time and resources available to conduct the assessment, one livelihood zone had to be chosen out of the six. The central pastoral livelihood zone was chosen as the area covers five of Turkana's administrative units (Turkana West, Turkana Central, Turkana North, Turkana South and Loima). The data was collected at the peak of the dry season (*Akamu*), in late March, during an ongoing drought and concurrent to the onset of an emergency response across areas of Turkana County.

Market prices and dietary habits data were collected in the villages of Nasiger, Kalobeyei, Lorugum, Lochwaa, Lomil and Kanakurudio. Additional markets were selected to collect market price data: Kapua, Kakwanyang, Makutano and Lolupe (see Appendix 2). These villages were selected using a Centric Systematic Area Sampling (Cost of the Diet, 2014) and using knowledge of local staff. The selected villages were discussed and agreed upon by Save the Children and Ministry of Health staff to ensure that these were representative of the overall livelihood zone.

3.3. Data collection

The sections below describe in detail the data collection of market prices and dietary habits for the purpose of conducting the cost of the diet analysis (see Annexes 1 and 2 for data collection tools).

3.3.1. Market survey

Market surveys were conducted in ten markets across the central pastoral livelihood zone (see Appendix 2). A list of all the food items available in the region was developed following discussion with local data collectors and staff prior to collecting data. A pilot market survey was then conducted in Lodwar, where the team had a chance to familiarize with the data collection sheets and equipment. The names of the foods found during the pilot were used to update and finalize the food list that was used to collect data during the survey.

The food list was entered into the software by selecting food items from a database of food composition tables embedded in the CotD software (Cost of the Diet, 2014). Where possible, food items were selected from the Kenyan food composition table. Alternatively, food items from

the closest regions to Kenya were selected instead. Information on the foods composition of wild and new varieties of foods were collated from a published papers and online resources.[37]

The prices of foods across four seasons were recorded for each food item found during the survey. For the purpose of the assessment, retrospective price data were collected to cover a one year period, from April 2016 to March 2017, to estimate the cost of the diet across the year. Information on seasons and periods of the year was taken from the HEA livelihoods profiles in the Turkana report (FEG, 2016) and the year was divided as such:

- Season 1: Dry season (*Akamu*)– January 2017 – March 2017
- Season 2: Short rains *(Akicheres)* – December 2016 – October 2016
- Season 3: Dry season – September 2016 – July 2016
- Season 4: Long rains *(Akiporo)* – June 2016 – April 2016

Market traders were asked current prices of the smallest unit of all food items sold at the point of trade. The traders were also asked to recall the price of each item during each season. The weight and price of the smallest unit sold was recorded (based on the assumption that this is the unit the poor are likely to afford and purchase).

Three samples of each food were chosen and weighed on the electronic scales (Tanita KD-400, ±1g). Where possible, four set of prices for each food item were collected (therefore a total of 12 weights per food). Market traders were asked about seasonality and price trends as well as any changes in availability of produce over the previous twelve months. Data collected were then entered into the software, where the seasonal and annual average prices per 100g of each food item were calculated.

3.3.2. Interviews and focus group discussions of typical food consumption

As mentioned in *section 3.1.3*., a food habits nutritious diet is calculated by applying minimum and maximum constraints that are derived from dietary habits interview. In order to do so, the software requires the number of times a food is consumed in a week (referred to as minimum and maximum constraints). For example, if the minimum and maximum constraints for cowpeas is set between 0 and 7, the software has the ability to include it in the diet up to seven times a week, or once a day, for each individual in the family.

Therefore, the weekly frequency needs to be determined for each food found in the market. In order to gather these data, a total of six villages were visited (see Appendix 2), whereby eight women and mothers of children under five years of age were asked to participate. These women were identified by the village leaders based upon the wealth groups defined in the Household Economy Analysis (HEA).[38] Of the eight women, the village leaders were asked to select two

[37] Maundu, P. M. (1999); Polidoria, *et al.* (2008); Aboshora, W. *et al.* (2014).
[38] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*

women from each wealth groups. The sessions lasted between two to three hours, and took place in shaded and safe areas nearby the town centre. There were two parts to the sessions:

1. *Food Frequency Questionnaire* – the frequency of consumption of 74 food items was used to record individual answers;
2. *Semi structured focus group discussions* – group discussions around food habits, preferences, taboos, beliefs and access to markets and home grown food.

Figure 3. A focus group discussion conducted in Kanakurdio, Turkana North.

The frequency questionnaires were carried out on an individual basis and the frequency of consumption for each food item on the printed food list was recorded. The respondents were given four frequency options: never, rarely (once a month or special occasions), often (1-4 times a week) or usually (more than five times a week). The responses were given a numerical score: 'never' was awarded 0 points, 'rarely' 0.5 point, 'often' 1 point and 'usually' 2 points. The total for each food item from all 8 respondents was then calculated. This meant that each item could receive a minimum total score of 0 and maximum of 16. A total score of 0 to 1 points was translated into a maximum constraint of 0; 1 to 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).

Although eight women in each village took part in the individual interviews, in two of the villages the groups expanded during the focus group discussions, as the field visits raised considerable interest among locals. As the number of women exceeded 12 women, the core group of women that had been interviewed were separated and two concurrent focus groups conducted to allow for discussions to be led appropriately. Therefore a total of eight focus group discussions were conducted.

3.4. Specification of a typical household

Information on typical household size was taken from the HEA baseline.[39] The table below is a summary of the four wealth groups identified in the HEA. For the purpose of this analysis, a household of 8 individuals (a man, a woman and 6 children) was used, representing the average number of individuals in poor and very poor households. Estimates of household income for this typical household are based on an energy requirement of 8 x 2,100 kcals, or 16,800 kcal in total; thus, the Cost of the Diet method identifies a family of the same individuals that require as close to 16,800 kcal as possible. This typical HEA/Cost of the Diet family consists of:

- *Child (either sex) 12-23 months (907 kcal)*
- *Child (either sex) 6-7 years (1,501 kcal)*
- *Child (either sex) 8-9 years (1,764 kcal)*
- *Child (either sex) 10-11 years (2,078 kcal)*
- *Child (either sex) 12-13 years (2,412 kcal)*
- *Child (either sex) 14-15 years (2,720 kcal)*
- *Man, 30-59 years, 50 kg, moderately active (2,750 kcal)*
- *Woman, 30-59 years, 45kg, moderately active (lactation, 7-12 months) (2,760 kcal)*

The total energy requirement of this family is 16,892 kcal/ day.

In order to estimate a cost for middle and better-off households to inform the affordability analysis (see section 3.5 below), the composition of a typical household of 11 and 13 were also calculated. The specifications can be found in Appendix 3.

3.5. Estimating affordability of the diets

A crucial part of a Cost of the Diet analysis is its ability to estimate the extent to which a nutritious diet (as calculated) can be afforded by households in the study area. The income and expenditure figures of all four wealth groups reported in the HEA report[40] were used and are summarized in Table 3. The additional cash value of livestock products (camel milk, goat milk, sheep milk, shoat meat and camel meat) available for household consumption has been added to the total income, in order to account for their contribution to the diet and therefore reduce the overall cost.

[39] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[40] *Ibid.*

Table 3. Average household size and total estimated income and expenditure (in Kenyan Shillings) for the four wealth groups identified in the Household Economy Analysis (FEG, 2016).

	Very Poor	***Poor***	***Middle***	***Better off***
Average household size	8	8	11	13
Average annual Income	117,400	144,700	220,000	302,230
Additional income from monetized livestock products*	34,400	50,050	150,650	279,875
Total income	151,600	194,750	370,650	582,105
Non-Food Expenditure	20,101	35,240	61,677	122,950

4. Results

Across the ten markets surveyed in the central pastoral zone, the team collected price and weight data for a total of 74 food items. Of these, 15 were grains and grain-based products, 2 tubers, 7 varieties of legumes, 8 animal products (meat and eggs), 2 fish based foods (processed), 5 dairy products, 10 vegetables and vegetable products, 11 fruits and fruit products, 4 types of oils and fats and 10 other miscellaneous items (including salt, sugar and tea). A list of all foods and prices per 100g can be found in Appendix 4.

4.1. Food availability and markets

Markets consisted mostly of small shops clustered around the village centres. The lack of fresh produce was evident across the livelihood zone; fresh fruit and vegetables were seldom encountered and in small quantity. Figure 4 (below) pictures a trader's shop displaying the limited number of foods being sold. The lack of fresh produce was exacerbated due to the survey being led at the end of the dry season and already scarce rainfall during the previous short rains (*Akicheres*). As such, there was little or no fresh milk (cow, camel or goat) across the zone; this has a considerably restrictive effect on the analysis as no retrospective weight or price data for these foods could be collected. Similarly, the team encountered difficulties in collecting price data for fresh meat. The main challenge arose as traders often were not willing to cut the meat unless it was purchased after. A further challenge was the general lack of meat available for weighing: the most common was goat meat followed by donkey meat and live chickens. As the analysis focuses on a pastoral zone, the limited data on meat and dairy products was a limitation to the study.

In some villages, locals reported paying up to 3,000 KES for a motorbike roundtrip to Lodwar to purchase goods. The high transport cost limits what is transported back to the villages and inflates the prices of goods sold locally. The hot weather and the bad road conditions also mean that fresh foods perish quickly. The repair of the dilapidated A1 road (Lodwar to Kitale) has been planned and is due to commence in the next few months. The completion of the new A1 road could potentially have a major impact on the availability and prices of foods across the central pastoral zone, as well as wider Turkana County.

Based on the latest HEA[41], food aid distributions in the livelihood zone were infrequent in the area and made a small contribution to overall food needs, and mostly from school feeding. Data gathered during the HEA survey for the central pastoral zone found that on average very poor households received 40 kg of grain a year; poor households received 20kg (FEG, 2016). The amount works out to approximately 110g and 55g per day, per household (of 8), for the respective wealth groups. Given the trivial amount, food aid was not considered as part of the main analysis. [42]

[41] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[42] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*

Figure 4. A photo of a local shop in Kalobeyei, Turkana West.

4.2. Typical food consumption habits and food taboos

Results from individual interviews and focus group discussions confirmed that maize and beans are the staple foods, also due to their relatively constant prices across the seasons and low prices. Onions, vegetable oil, salt and sugar are also very commonly consumed (0 to 14 minimum and maximum constraints). Meat was also mentioned as a staple food during focus group discussions; however, during the individual interviews it transpired that meat is seldom consumed. Although this is a pastoralist zone, respondents revealed that the animals that are kept are slaughtered only occasionally or on special occasions. Other foods that prominently feature in the local diet are split peas, cowpeas and tea. Milk is also generally consumed, although there is a lack of fresh milk during the dry season, exacerbated by the current drought. Wild foods were also part of the questionnaire; according to the dietary habits results (see Appendix 5), some wild fruits were eaten, but up to once a day, such as ng'akalaleo (*ziziphus mauritiana*); however, the majority of wild food identified and included in the questionnaire were not eaten by locals and, consequently, a minimum and maximum weekly constraint of 0 to 0 applied automatically.

Focus group discussions also revealed that dietary habits change during the rainy season, as meat and milk are more available and therefore consumed more frequently. Milk is especially important as it is readily available during the rainy season, also mixed with maize flour and cooked together. Due to the higher availability of food during the rainy season compared to the dry season, portion sizes are larger during this time, as well as an increase in diversity of foods in the diet. At the time of the survey (dry season) households were consuming two meals per day (breakfast and supper), although the first meal of the day often consisted of "strong tea" (black tea without milk) alone. During the rainy seasons, when food is more abundant, they eat up to three meals a day. It was reported that the frequency of meals was the same across all age groups.

Women reported purchasing most of their food from the market. During the dry season most households reported visiting the market once a day. However, in the rainy season, during which time milk is readily available, households visit markets less frequently, as food is bought in bulk and more meat, milk and, although rarely, home grown produce is more available. The frequency with which households visited the market also varied depending on distance of households to the market. Women were also asked if there were any foods that they would consume but cannot be afforded; among these: wheat flour, millet, spaghetti, rice, cabbage, kale, sugar, milk, mangoes, oranges, bananas, meat, fish and potatoes. Discussions also revealed that, at times, foods such as sorghum, maize and Corn Soy Blend (CSB) are consumed, in small quantities and raw, as a snack.

As part of the typical dietary habits, taboos around foods were discussed. All communities mentioned a variety of taboos concerning a number of foods and for different individuals (children, women of reproductive age). However, these varied across the clans. The following were the most commonly mentioned food taboos:

- Only consume milk from your own clan, as this would cause negative consequences on health;
- Children:
    - The head of the goat is not eaten by children, as it causes cognitive impairment; normally it is reserved for the head of the household or adult males;
    - Children do not eat blood, as it will cause diarrhoea;
    - Children are not supposed to eat the tongue of animals, as it inhibits speech development;
- Pregnant women and women of reproductive age
    - If the head of the animal is eaten by a pregnant woman, the child will be born with sores on its head;
    - Pregnant women cannot eat offal (internal organs, such as liver, kidneys, intestines and heart), as the child will have stomach issues;
    - Pregnant women should not eat millet, as it will lead to miscarriage;
    - WRA should also not eat millet, as it will cause fertility issues;
    - Pregnant women should not eat intestines, as it will either lead to miscarriage, foetus malformations or the child could disappear mysteriously.
    - WRA should also not eat intestines, as they might become barren.

Among the foods given to children, the mothers mentioned maize flour (ugali or porridge), rice, milk (fresh and powdered), bananas, potatoes, kidney beans, ujimix (porridge mix) and tea. Mothers reported feeding these foods regularly to their children as they are readily available and affordable, easily prepared, easily chewed (soft) and digested, and generally considered “light meals”.

4.3. The cost of the diet

Table 4 is a summary of the cost of all diets calculated by the software. The analysis revealed that all requirements could be met in all diets (EO, NUT and FHAB) using locally available foods, despite the lack of diversity of foods across the livelihood zone. The analysis found that a nutritious diet is almost double (1.95 times) the cost of an energy only diet, reflecting the high cost of meeting fat, protein and micronutrient requirements compared to only meeting energy requirements. The cost of the food habits nutritious diet is twice (1.97 times) the cost of the nutritious diet and almost four times (3.85 times) the cost of the energy only diet. The inflated cost of the food habits nutritious diet shows that dietary habits can in fact lead to an increase in the overall cost of the diet, as these may be restricting certain foods from being included in the diet.

Table 4. Summary of the lowest cost of the diet for an HEA/CotD family of 8 in Kenyan Shillings.

Type of diet	Family size	Average daily cost of diet	Annual cost of diet	Requirements met?
Energy only (EO)	8	294	107,338	Yes (energy requirements only)
Nutritious (NUT)	8	574	209,682	Yes (energy and nutrient requirements)
Food habits nutritious (FHAB)	8	1,132	413,299	Yes (energy and nutrient requirements)

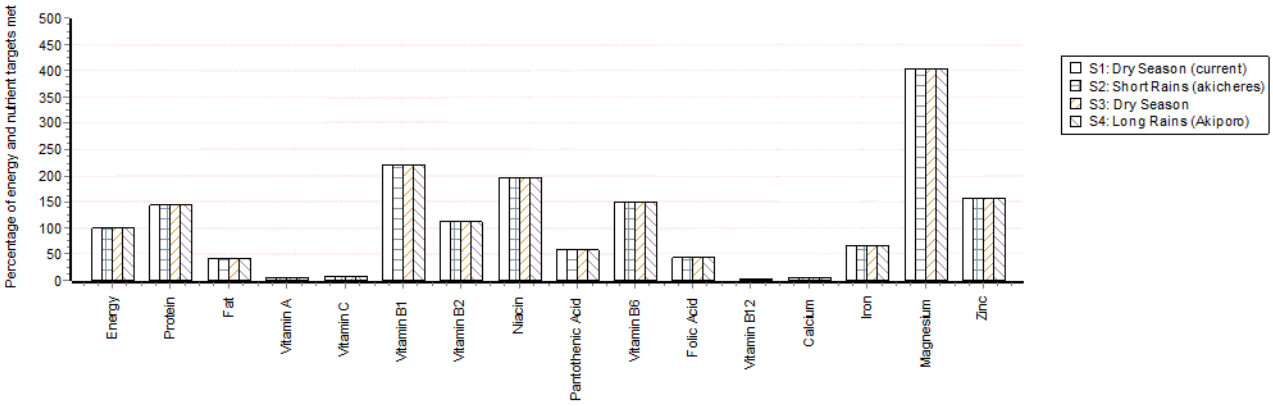
4.3.1. Energy only diet (EO)

The daily cost of an energy only diet (a diet that meets the energy requirements of a family of 8) has been estimated between 250 (long rains season) and 317 (current dry season) Kenyan Shillings across four seasons, and varies according to seasonal food availability and price variation. The dry season (from January to March 2017) was the most expensive season, reflecting the poor availability of food and the inflated price possibly as an effect of the ongoing drought. The annual average cost was estimated at 107,338 Kenyan Shillings. The diet includes 3 food items: maize flour, wholegrain maize and breastmilk (for the child 12-23 months). Almost three quarters of the energy are sourced from maize flour (65.2%), representing the cheapest source of calories on the market, followed by wholegrain maize (34.8%) and breastmilk (2.0%). A detailed breakdown of the annual diet calculated by the software can be found in Appendix 6, which shows the weight and cost of the food items included and the percentage contribution of each to energy, protein, fat, vitamin and mineral requirements. Breastmilk requirement for the child 12-23 months has been accounted for in the diet by including 532g of breastmilk (daily) to the child's diet at a zero cost. The mother's additional energy required during lactation has also

been accounted for and an additional 460 kcal added to the woman's daily energy requirements, thus included in the overall estimated cost.

Figure 5 shows the percentage of nutrient requirements (other than energy) that are met in the diet. The results show that, in an energy only diet, the requirements for fat, vitamin A, vitamin C, vitamin B12, folic acid, calcium and iron were not met. The results also show that the protein requirements have been met by almost 150%, as the large quantities of maize included provided sufficient protein to meet and exceed the requirements. However, maize protein is deficient in lysine and tryptophan, thus, such diet would not provide adequate amounts of essential amino acids.[43] Thus, such a diet would not sufficiently provide the adequate nutrients for an adult nor for a child, preventing adequate growth and development.

Figure 5. The percentage of energy and target nutrient intakes met in an energy only diet for an average family of 8, by season, in the Central Pastoral Livelihood Zone.



4.3.2. Micronutrient nutritious diet (NUT)

The minimum cost of a nutritious diet that meets the daily requirements for micro- and macronutrients of a standard family was estimated between 528 (long rains season) and 594 (dry season, July to September) Kenyan Shillings and at an average annual cost of 209,682 Kenyan Shillings. The nutritious diet included a total of 15 food items from 8 different food groups and mainly consisted of maize flour (both fortified and non-fortified), legumes (split peas, lentils, kidney beans and moth beans), Swiss chard (locally referred to as spinach), *sujaa* (*solanum nigrum L.*), *omena* (small, dried fish), millet, vegetable fat, margarine, donkey meat and avocado (see Appendix 7). The biggest contributors to energy were maize flour (26.4%), vegetable fat (16.3%), split peas (15.5%), lentils (10.4%) and moth beans (10.0%). The largest contribution to the overall cost were *omena* (16.5%), maize flour (13.5%), vegetable fat (10.8%), and beans (9.5% split peas, 9.1 moth beans and 8.4 lentils).

[43] FAO (1992). *Maize in Human Nutrition.*

The core of the diet and key contributors to meeting micronutrient requirements were maize flour and beans (split peas, moth beans, lentils and kidney beans). The software included 450kg of maize flour (non-fortified) a year, contributing to meeting the requirements of niacin (34.7%), vitamin B2 (28.7%), and vitamin B6 (26.2%), vitamin B1 (24.3%), zinc (22.7%), iron (17.3%) and protein (13.5%). A sum of the contribution of legumes to the percentage on nutrients met highlights their significance in the diet, as these provide 79% of folic acid, 61% of protein, 60% of vitamin B1, 57% of zinc, 52% of iron, 51% of vitamin B6, 40% of vitamin B2, 31% of niacin and 19% of calcium requirements. Important sources of micronutrients were also *sujaa* and Swiss chard, which provided 50% and 40% of vitamin A requirements respectively, as well as 25% and 59% of vitamin C and 24% and 13% of calcium. *Omena* contributed to meeting almost all of the vitamin B12 requirements for a family (96.8%). Vegetable fat contributed to 70% of the family's total fat intake requirements across the year.

Figure 6 shows the percentage of nutrient requirements met (by season) for the whole family. All nutrient requirements were met by 100% or above across all four seasons. The analysis and further sensitivity tests revealed that iron and calcium were the biggest drivers of cost, followed by vitamin B12, vitamin A and vitamin C. Figure 7 shows the results of the sensitivity analysis that was carried out in order to identify the micronutrients that are contributing the most to the cost of the diet.

The model shows that as the micronutrient requirement increases, the cost of the diet also increases, thus highlighting the cost implications of meeting nutrient requirements compared to a diet that only meets energy specifications. Reducing the requirements for all micronutrients had the biggest impact on the cost. However, reducing the requirements for iron had the biggest impact on cost as a single micronutrient. Reducing the requirements for calcium also led to a decrease in cost, although the change was not as evident. Vitamin A and vitamin B12 had marginal effects on cost reduction when lowering the percentiles. Other micronutrients not featured in the analysis did not have a significant effect on the cost of the diet.

Figure 6. The percentage of target energy and nutrient intakes met in a nutritious diet for an average family of 8, by season, in the Central Pastoral Livelihood Zone.

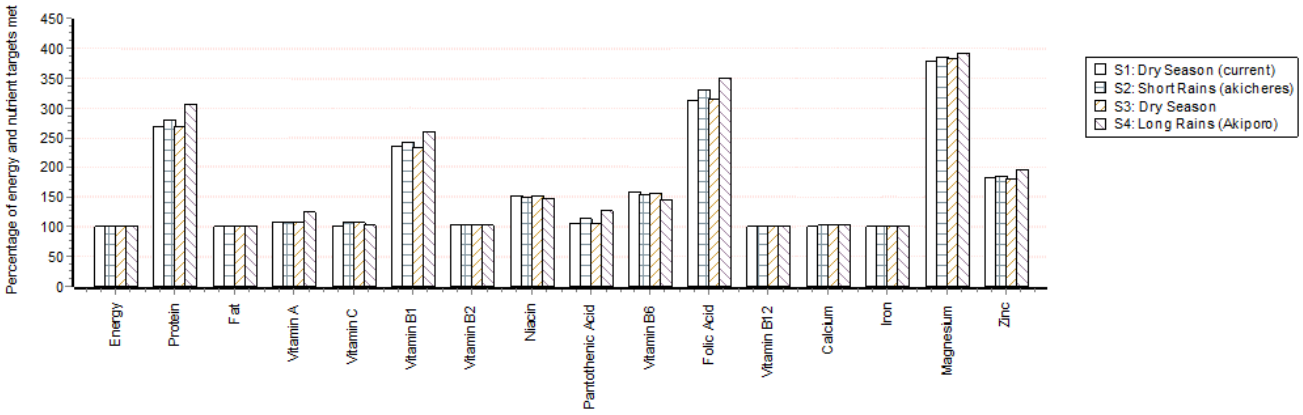
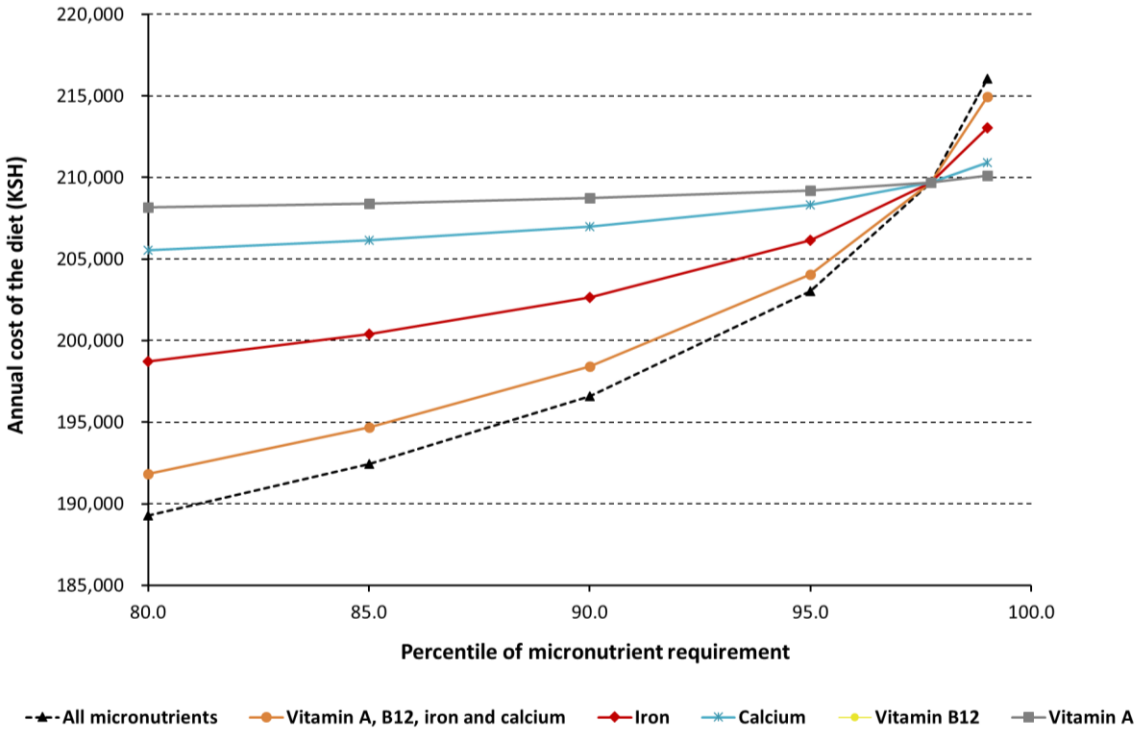


Figure 7. A sensitivity analysis using percentiles of micronutrient intake of key micronutrients and a combination of micronutrients between the 80th and 99th percentile. Changes in iron requirements resulted in the largest degree of change compared to other single micronutrients.



4.3.3. Food habits nutritious diet (FHAB)

As explained in section 3.1.3., the FHAB diet is equivalent to a micronutrient nutritious diet, although constrained by minimum and maximum weekly frequency constraints that are applied to the diet in order to model a diet closer to the one consumed in the central pastoral livelihood zone (see Appendix 5). The cost of the FHAB diet was estimated at an average annual cost of 413,299 Kenyan Shillings. Figure 8 shows the daily cost of the NUT diet and the extra cost of the FHAB diet by individual. The graph illustrates the extra cost of meeting a nutritious diet influenced by dietary habits. It also reveals that the highest cost of the diet was for a child (either sex) 14 to 15 years of age, just above the cost of the lactating woman.

Figure 8. Individual daily cost of the nutritious diet and extra cost of a food habits nutritious diet (Kenyan Shillings).

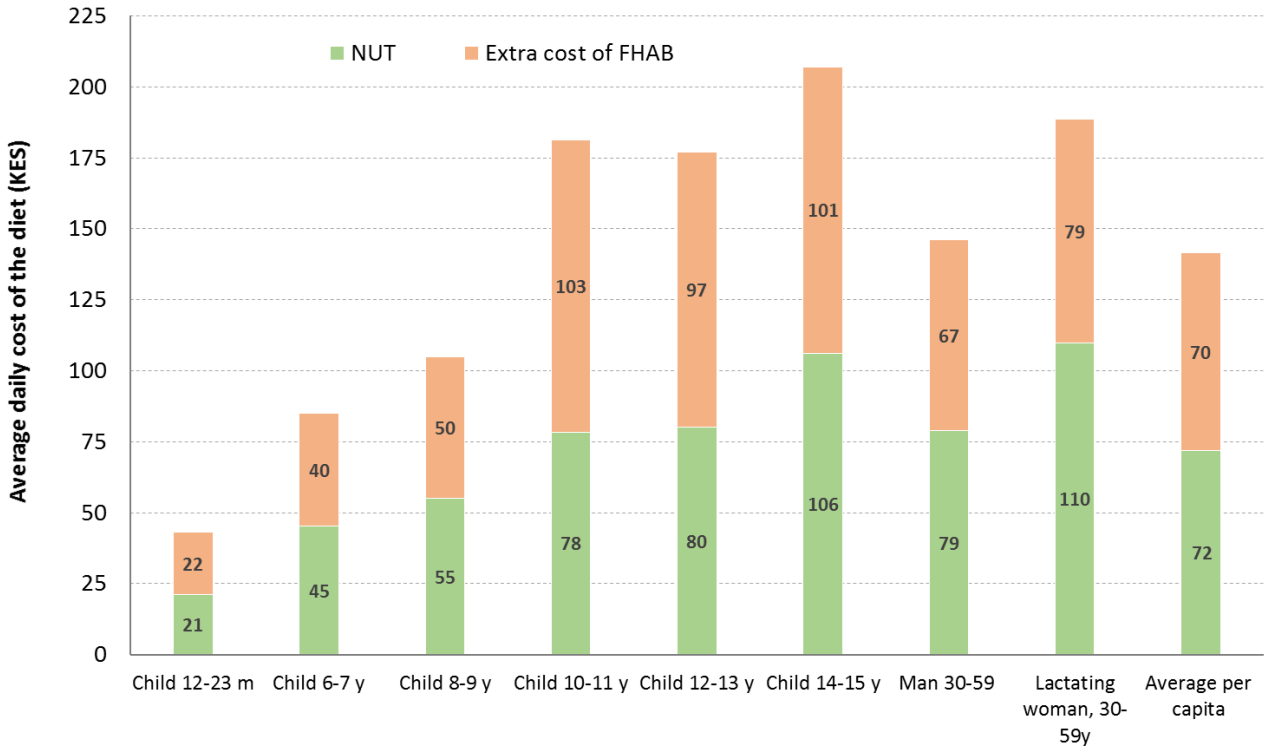
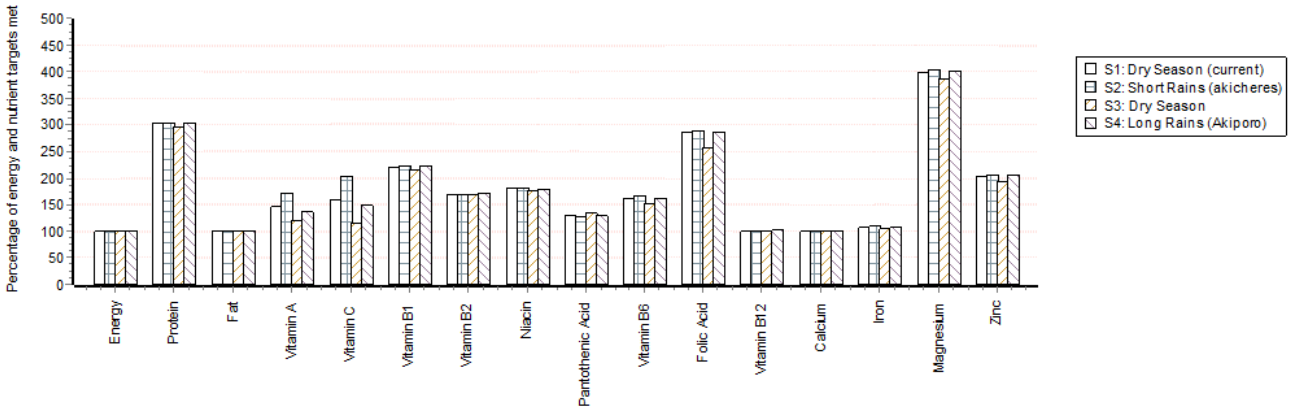


Figure 9 shows the percentage of nutrient requirements met by the FHAB diet, whereby all the nutrient specifications could be met for all individuals.

The FHAB diet included a total of 17 foods and 9 food groups, a marginal increase from the 15 food items included in the NUT diet. Table 4 is a summary of the annual diet, which shows the percentage of the requirements for energy, fat, protein, vitamins and minerals met by individual food items and the total percentage of nutrient requirements met for the family of 8.

Figure 9. The percentage of energy and target nutrient intakes met in a FHAB diet for an average family of 8, by season, in the Central Pastoral Livelihood Zone.



The biggest contributors to cost were milk (UHT, powdered and goat), which represented over half of the total cost of the diet over the year (56.4%), followed by kale (8.3%), maize flour (6.8%) and kidney beans (6.8%). In terms of energy, the biggest contributors were maize flour (26.5%), kidney beans (12.7%), moth beans (8.4%), split peas (8.3%), vegetable fat (8.1%), milk powder (7.7%), sorghum flour (6.8%), UHT milk (6.3%) and lentils (6.3%). Generally, the biggest contributors to the diet were maize flour, UHT milk and kidney beans, which were also the food items included in larger quantities by the software. In terms of food groups, dairy products included in the FHAB diet met most of the nutrient requirements. The specifications for calcium, met mostly by *omena* in the NUT diet, were here met by dairy (29.5% powdered milk, 24.1% UHT milk and 13.1% goat milk). Over 90% of vitamin B12 specifications were met by the three dairy products included. Iron specifications were met by legumes (50.6%), donkey meat (18.5%) and maize flour (16.4%); kidney beans were the single biggest contributor to iron, meeting 18.6% of specifications. Vegetable fat was the biggest contributor to meeting fat requirements (34.9%), although milk products also largely contributed (38.5%). Donkey meat was included in the diet, however, similarly to the NUT diet, only in small quantities (94kg a year, equivalent to just under 1kg of meat per person per month). Large quantities of kale also contributed to over half of the family's requirements of vitamin A (56.2%) and vitamin C (79%).

Table 5. The edible weight and cost of the foods selected for the family for the whole year for a FHAB 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
(Bean, kidney, dried, raw)	240	8.2	28 292	6.8	12.7	18.6	1.9	0.0	3.8	15.0	6.9	20.2	13.9	28.6	0.0	6.2	18.6	17.3
(Bean, moth, mature, raw)	150	5.1	15 932	3.9	8.4	11.9	1.5	0.1	3.2	12.8	2.6	6.0	10.2	34.7	0.0	8.0	16.9	7.4
Breast milk	194	6.6	0	0.0	2.0	0.7	4.7	4.0	4.1	0.6	1.3	1.2	0.3	0.6	3.2	1.9	0.0	0.6
(Donkey, flesh)	44	1.5	9 591	2.3	0.8	3.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	4.2
(Donkey, leg, with bone)	50	1.7	9 896	2.4	0.9	3.9	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	9.8	4.7
(Egg, chicken, CotD)	34	1.1	12 916	3.1	0.8	1.4	2.1	2.6	0.0	0.3	3.2	1.2	0.7	0.5	6.1	0.6	2.0	0.9
(Kale, raw or cooked)	365	12.4	34 444	8.3	1.9	2.4	0.9	56.2	79.3	2.8	4.9	4.6	9.5	1.7	0.0	9.4	3.4	1.9
(Lentil, dried, raw)	113	3.8	9 162	2.2	5.4	9.9	1.3	0.1	0.0	10.1	5.0	3.7	14.3	11.8	0.0	2.4	8.2	11.3
(Maize, dried, raw)	3	0.1	181	0.0	0.2	0.1	0.1	0.0	0.0	0.2	0.1	0.2	0.2	0.0	0.0	0.0	0.1	0.1
(Maize, flour, dry)	452	15.4	28 145	6.8	26.5	12.6	10.0	0.0	0.0	26.8	17.4	29.2	25.2	4.0	0.0	1.0	16.4	20.9
(Milk, cow, powdered, whole)	97	3.3	84 109	20.4	7.7	8.0	17.4	16.5	3.6	4.4	23.6	8.8	8.0	1.5	48.2	29.5	1.7	7.5
(Milk, cow, UHT)	588	20.0	103 967	25.2	6.3	6.5	14.2	13.5	3.1	3.6	19.3	7.2	6.6	1.3	39.4	24.1	1.4	6.1
(Milk, goat, fresh)	274	9.3	44 479	10.8	3.1	3.4	6.9	6.4	1.5	2.1	7.4	4.0	2.6	0.1	3.2	13.1	0.7	2.1
(Peas, split, mature, raw)	150	5.1	11 455	2.8	8.3	12.7	1.1	0.4	1.4	16.6	6.2	6.2	4.9	14.7	0.0	2.9	6.9	11.6
(Salt, iodized)	3	0.1	149	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(Sorghum, grain or flour, CotD)	126	4.3	9 417	2.3	6.8	4.3	1.9	0.2	0.0	4.8	2.0	7.5	3.7	0.5	0.0	0.8	5.2	3.2
Vegetable fat	57	1.9	11 165	2.7	8.1	0.0	34.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2 941	100	413 299	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	301	100	143	157	221	170	180	161	280	100	100	107	203

The percentage of target met is an average of the % nutrient requirements met over the year.

4.3.3.1. Seasonal fluctuations in the FHAB diet

Figure 10 shows the seasonal fluctuations in daily cost of the food habits nutritious diet across the reference year. The cost of the diet was lowest during long rains season (*Akiporo*), at an average daily cost of 998 Kenyan Shillings (long rains season); the highest cost was estimated at 1,207 Kenyan Shillings during the dry season, from January to March 2017.

Figure 10. The cost of the food habits nutritious diet by season of the year for a standard family of 8 in the Central Pastoral Livelihood Zone (Kenyan Shillings).

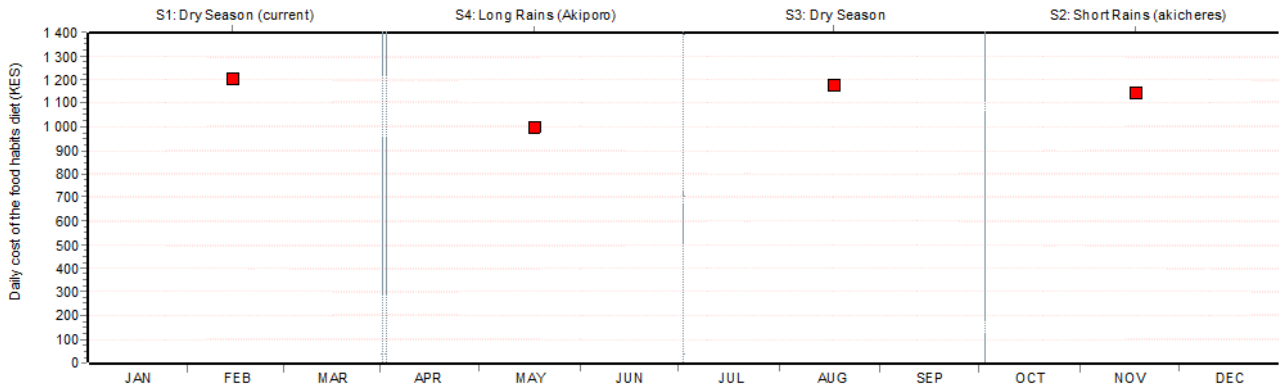
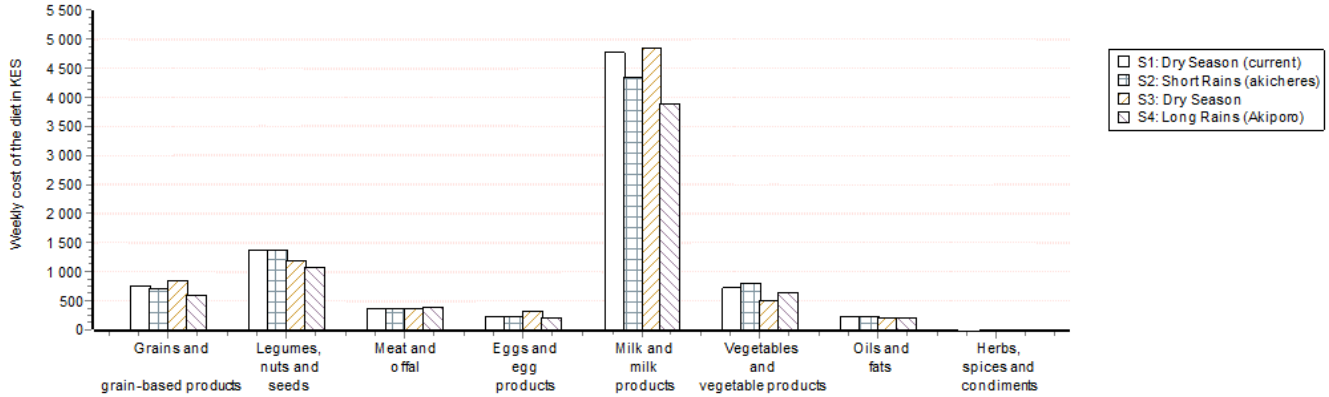


Figure 11 shows the average weekly cost of the diet by food group selected by the software. The largest expenditure was dairy products, followed by legumes, grains, vegetables, meat, eggs and oils. The graph also shows seasonal variation in cost. The cost of dairy products was lowest during the rainy months, with approximately a 10% decrease in cost from the dry season to the rainy season. A similar cost variation is displayed by grains, as the price drops in the rainy season and increase during the dry season.

Figure 11. The average weekly cost of food groups selected by the cost of the diet software for a FHAB diet for a family of 8 in the Central Pastoral Livelihood Zone (Kenyan Shillings).

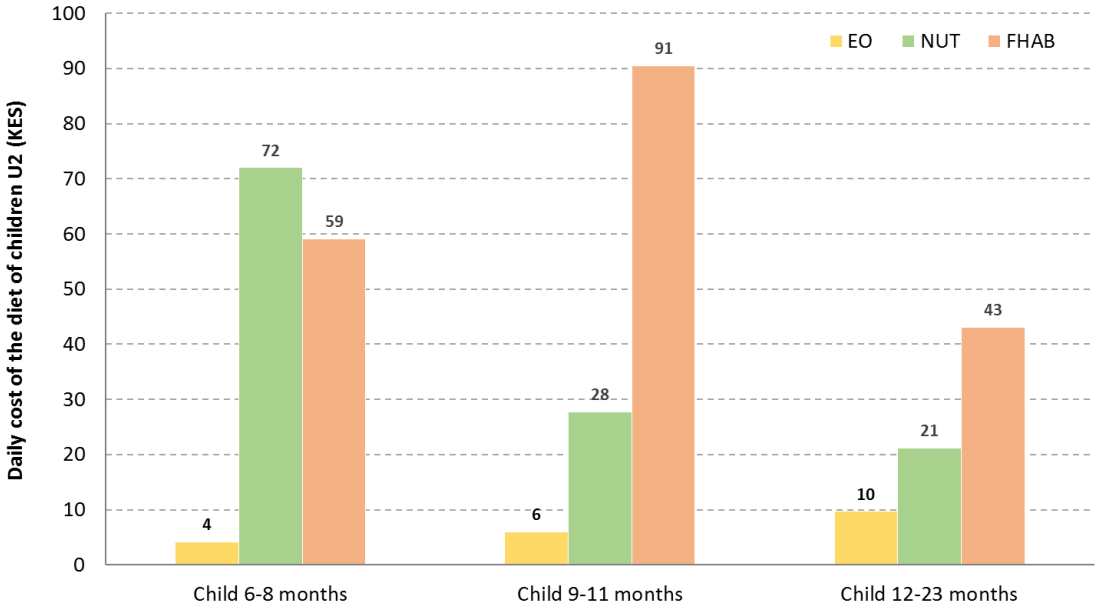


4.3.4. Cost of the diet for children 6-23 months

Figure 12 shows the cost of the diet for children under 2 years (except children 0 to 5 months based on the assumption that they are exclusively breastfed). The graph illustrates how the cost of the diet is surprisingly higher in children aged 6 to 8 months and 9 to 11 months than in children aged 12 to 23 months. This was likely due to the higher iron requirements in children aged 6 to 11 months compared to 12 to 23 months, as iron was identified as the main limiting nutrient in the sensitivity analysis (Figure 7).

Figure 12 is a summary of the percentage of nutrient requirements met by the FHAB diet for children belonging to the following age groups: 6 to 8 months, 9 to 11 months and 12 to 23 months. The analysis revealed that the iron requirements for children aged 6 to 8 and 9 to 11 could not be met across all four seasons. Similarly, in the nutritious diet, the iron requirements could not be met for the 6 to 8 month child, although they were met by 100% for the child aged 9 to 11.

Figure 12. Daily cost of an energy only, nutritious and food habits diet for children aged 6 to 8 months, 9 to 11 months and 12 to 23 months in the Central Pastoral Livelihood Zone (Kenyan Shillings).[44]



The inability of the software to meet the iron requirements may also have been impacted by young children reduced capacity of food intake and need for a more nutrient dense diet. First of all, the energy requirement of a 6 to 8 months child is lower than a child 12-23 months. Secondly, a larger proportion of a young child's energy requirement is met by breastmilk. Figure 13 shows

[44] The cost of the NUT diet is higher than the cost of the FHAB diet for the child 6 to 8 months as the nutrient requirements cannot be met. Thus, in a diet unconstrained by food habits, the software adds as many nutrient rich foods as it can to attempt to meet the nutrient requirements for this individual, even if it results driving up the cost.

the percentage of energy requirements met by each food group. Based on standard portion sizes used in the analysis[45], breastmilk provides 63% of the energy requirement of a child aged 6 to 8 months; 52% of a child aged 9 to 11 months; and 38% of a child aged 12 to 23 months. Breastmilk also provided a large proportion of nutrients for children across all three age groups (see Appendices 8-10 for diet details), highlighting the importance of continued breastfeeding.

[45] Cost of the Diet (2014). *A method and software to calculate the lowest cost of meeting recommended nutrient intakes using local foods.*

Figure 13. The percentage of energy and target nutrient intakes met in a FHAB diet for children aged 6 to 8, 9 to 11 and 12 to 23 months in the Central Pastoral Livelihood Zone.

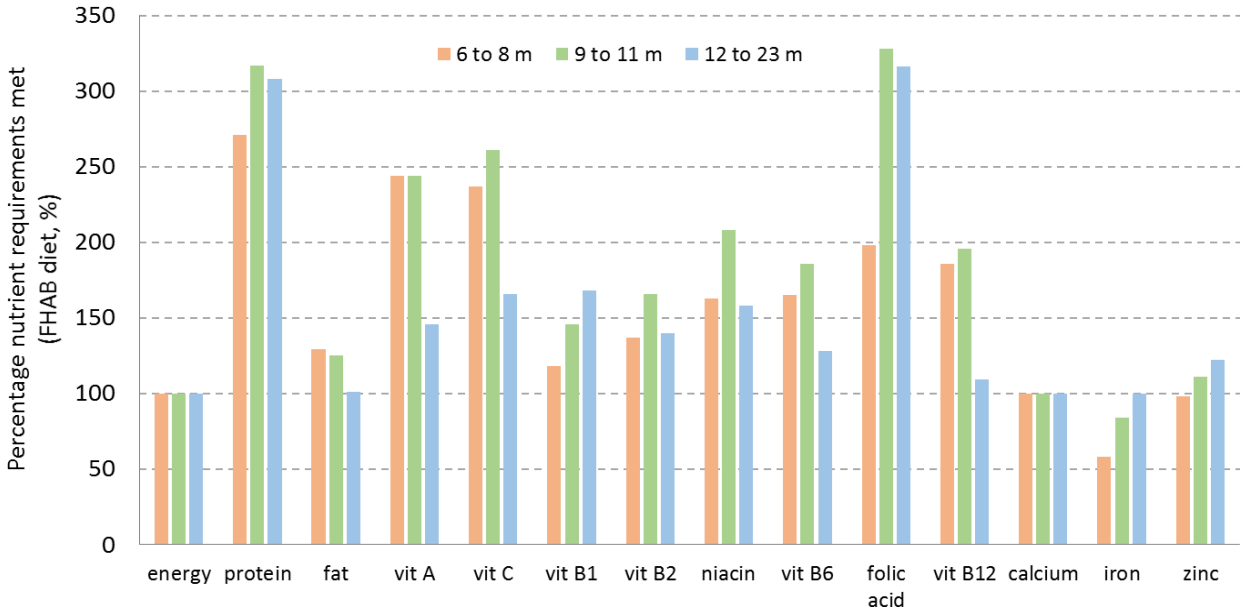
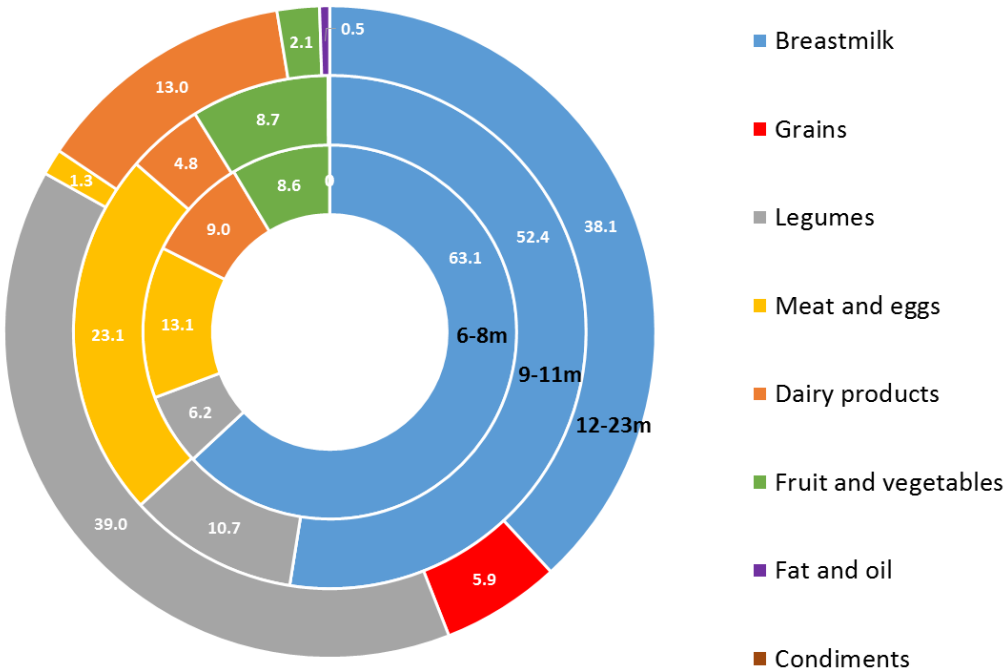


Figure 14. Percentage of energy (kcal) met by each food group for a child 6-8 months (inner circle), a child 9-11 months, and a child 12-23 months (outer circle).



4.3.4.1. Modelling the impact of iron supplements in the diet of children under 2 years

As the software was not able to meet the requirements of iron for children aged 6 to 11 months, a "what if" model was developed to show the potential impact of iron supplementation (in the form of Sprinkles, with 30mg of Ferrous Fumarate) on the cost and composition of the diet. Two types of micronutrient powders were added to the diet: Sprinkles™ (SuppleFer), which contains 30mg of iron per 1g sachet; and locally produced Vitamin & Mineral Powder supplement, which contains 10mg of iron per 1g sachet (see Appendix 11).[46] Three scenarios were modelled:

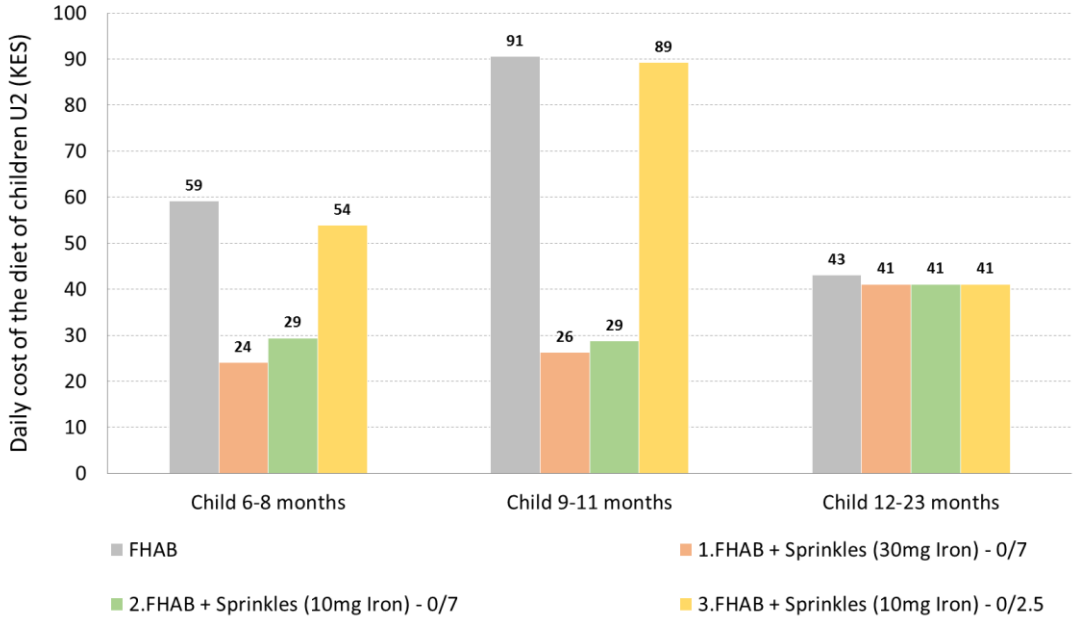
1. A food habits nutritious diet (FHAB) with the addition of Sprinkles™, constrained to a maximum of 7 portions per week per child (equal to 7g or 7 x 1g sachets per *week*);
2. A food habits nutritious diet (FHAB) with the addition of Vitamin & Mineral Powder supplement, constrained to a maximum of 7 portions per week, per child (equal to 7g or 7 x 1g sachets per *week*);
3. A food habits nutritious diet (FHAB) with the addition of Vitamin & Mineral Powder, constrained to a maximum of 2.5 portions per week, per child (equal to 2.5g per week or 2.5 sachets per week = 10 x 1g sachets per *month*, which amounts to the number of sachets currently given to children aged 6 – 23 months in Kenya as part of high impact nutrition interventions).

Figure 15 illustrates the results of the model. The results show that the largest price reduction was seen in the child aged 9 to 11 months, although a dramatic cost reduction was also seen in the child aged 6 to 8 months. For the 12 to 23 months child, the introduction of Sprinkles to the diet had little effect on the cost (from 43 to 41 KES per day). Of the 7 grams of Sprinkles™ made available, the software selected 2 grams weekly for both 6 to 8 and 9 to 11 months aged children. For the child aged 12 to 23 months, the software only selected 1 gram per week. All micronutrient requirements could then be met by the software. In the second scenario, the software selected 7 portions of Vitamin and Mineral Powder supplement for both 6 to 8 and 9 to 11 months aged children. Only 2 grams weekly of micronutrient powder were selected for a child 12 to 23 months. Once again, all micronutrient requirements for all three children could be met. The third scenario that was modelled showed that including 2.5 sachets a week (which is equal to 10 sachets a month) in the diet led to a small reduction in cost: a reduction of 5 KES a day for a child 6 to 8 months and 2 KES for children aged 9 to 11 and 12 to 23 months. Additionally, the iron requirements for the child 9 to 11 and 6 to 8 months were not met, despite the 2.5 grams of vitamin and mineral powder. This may indicate that the current number of sachets distributed

[46] N.B.: The information on the nutrient composition of these two micronutrient powders, as specified on the respective packaging, was added to the software under "new foods". However, different iron bioavailability factors were applied to the supplements: for Sprinkles™, a 7% absorption factors was applied as the sachets contain ferrous fumarate; for the Vitamin & Mineral powders, no such specifications are included, therefore a 5% absorption factor was assumed and thus applied.

may not be sufficient to cover the recommended intake of iron for children aged 6 to 11 months. Thus, the analysis further points to iron as the problem nutrient in the diets of infants.

Figure 15. A "what if?" analysis showing the difference in daily cost of the FHAB diet with and without the addition of Sprinkles supplements.



Further to the introduction of these micronutrient powders, the impact of introducing these at different costs was explored. The minimum and maximum constraint were set between 0 to 7, to allow up to 1 sachet a week of micronutrient supplements to be included in the diet. Figure 16 and 17 show the impact of introducing Sprinkles™ and Vitamin and Mineral Powder supplement to the diet at a cost between 0 KES (free) to 100 KES per sachet. Figure 16 shows the modelling results using Sprinkles™, revealing that even at a cost of 100 KES per sachet, the overall cost of the diet of all three children was reduced, particularly for the child aged 9 to 11 months. Figure 17 shows the modelling results using the Vitamin & Mineral Powder supplement. A similar trend can be observed in the children aged 9 to 11 and 12 to 23 months. However, in the 6 to 8 months aged child, there is a sharp increase in cost of the diet when the price for the micronutrient supplement is set at a cost of 100 KES. A decrease in overall cost of the FHAB diet can only be observed when the (arbitrary) price of the sachet was set at 25 KES. Nonetheless, although the price did increase drastically, the iron requirements could be met.

Figure 16. Modelling the effect of introducing Sprinkles™ at different costs and for free to the overall cost of the FHAB diet for children 6 to 8 months, 9 to 11 months and 12 to 23 months.

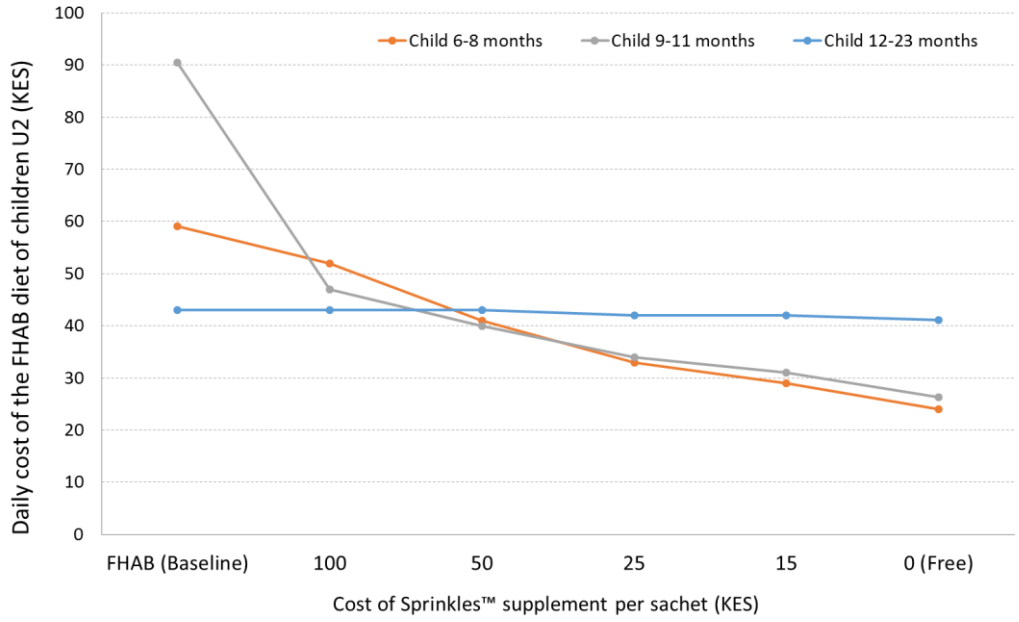
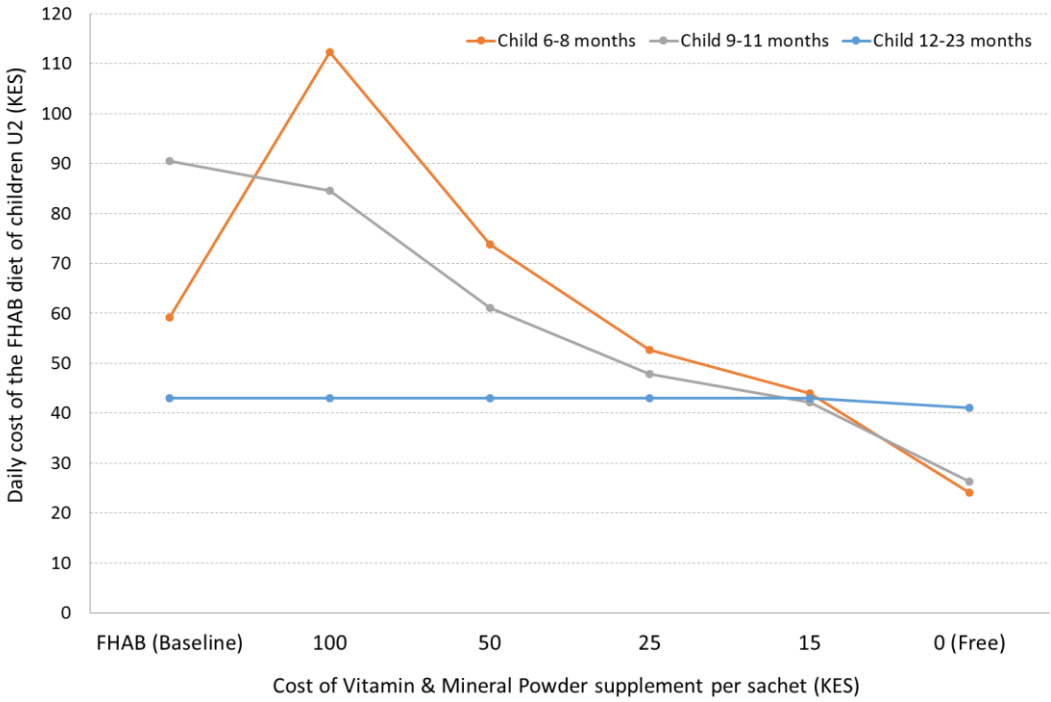


Figure 17. Modelling the effect of introducing Vitamin & Mineral Powder supplement at different costs and for free to the overall cost of the FHAB diet for children 6 to 8 months, 9 to 11 months and 12 to 23 months.

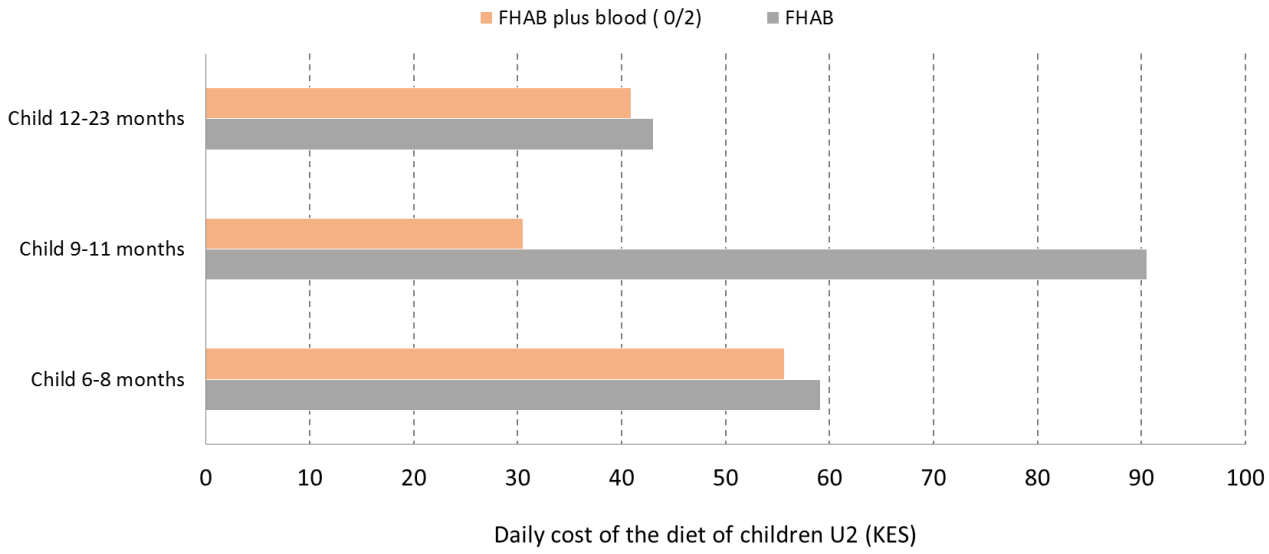


4.3.4.2. Modelling the impact of coagulated blood in the diet of children under 2 years

As discussed in section 4.3.4.1 (above), the software was not able to meet the requirements of iron for children aged 6 to 11 months. Therefore, a further model was developed to show the potential impact of coagulated goat blood (a highly iron-rich food – approximately 40mg of iron per 100g of blood) could have on the cost and composition of the diet, as an alternative to micronutrient supplements. Figure 18 shows the results of the analysis, which reveal a reduction of 60 KES in the daily cost of the FHAB diet for a child aged 9 to 11 months, therefore almost two thirds of the total cost. For a child 6 to 8 months, there was a minimal reduction in cost, from 59 KES to 56 KES a day. For a child 12 to 23 months, the cost of the diet was reduced from 43 KES to 41 KES.

The introduction of coagulated blood into the diet of children under two led to a lower overall reduction in the cost of the FHAB diet compared to a potential introduction of multiple micronutrient powders. Nonetheless, the high availability of goats, and therefore goat blood, in the central pastoral livelihood zone means that households could already have access to this rich source of iron and, supposedly, for free. The software included 8 grams of coagulated blood in the daily diet of the child aged 12 to 23 months, and 6 grams in the daily diets of the children aged 6 to 8 months and 9 to 11 months, therefore only small quantities would be sufficient to provide 50% or more of their recommended iron requirements. Nonetheless, the acceptability of blood consumption amongst children under two years would have to be further explored.

Figure 18. A "what if?" analysis showing the impact on the cost of the FHAB diet in children under two years when adding coagulated blood to the diet (KES).



4.4. The affordability of diets

Based on annual income and expenditure figures identified during the HEA for poor, very poor, middle and better-off wealth groups, an affordability analysis was carried out to assess the ability of typical households to afford a diet that meets all their nutrient requirement specifications. The analysis also takes into account essential non-food expenditure, such as healthcare, schooling and clothes. The analysis also took into consideration livestock products consumed from own production and added the equivalent cash value to the available income. Furthermore, the average typical household size differs across wealth groups, which was taken into account by recalculating the cost of the diet according to the wealth group specific household size. Table 6 provides a summary of the cost of each diet, average household size and affordability (as % of income) by wealth group.

Figure 19 shows the results from the analysis (also summarized in Table 6). The affordability gap is evident across all wealth groups. The energy only diet alone represents between 55% and 71% of the income of the poor and very poor, respectively. The affordability gap for each wealth group, expressed as a percentage of income, were as follows: very poor = 186% (equivalent to 281,976 KES); poor = 130% (equivalent to 253,175 KES); middle = 77% (equivalent to 285,401 KES); better-off = 37% (equivalent to 215,379 KES). Although the affordability gap expressed as a percentage of income is greatest among the very poor, when expressed in Kenyan Shillings it reveals that middle wealth group households have the biggest income gap (approximately 23% of the population[47]), followed by the very poor, poor and better-off.

Although the affordability gap significantly changes in magnitude across wealth groups, the analysis revealed that households in the central pastoral livelihood zone are not able to afford a food habits nutritious diet. If dietary habits are not taken into account, the middle and better-off wealth groups would potentially be able to afford a nutritious diet.

Table 6. Affordability of an energy only, nutritious and food habits nutritious diet, expressed as a percentage of the annual income for typical household in the Central Pastoral Livelihood Zone (Kenyan Shillings).

Wealth Group	Annual income	Annual cost of energy only diet	% income of energy only diet	Annual cost of nutritious diet	% extra cost of nutritious diet	Annual cost of food habits nutritious diet	% extra cost of food habits nutritious diet	Annual non-food expenditure	% NFE for wealth group	Number of individuals in family
Very Poor	151,600	107,338	70.8	209,682	67.5	413,299	134.3	20,101	13.3	8
Poor	194,750	107,338	55.1	209,682	52.6	413,299	104.6	35,240	18.1	8
Middle	370,650	148,591	40.1	298,498	40.4	593,461	79.6	61,677	16.6	11
Better off	582,105	176,739	30.4	351,665	30.1	677,329	55.9	122,950	21.1	13

[47] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*

Figure 19. The affordability of an energy only, nutritious and food habits nutritious diet for the Central Pastoral Livelihood zone expressed as percentage of household income across four wealth groups.

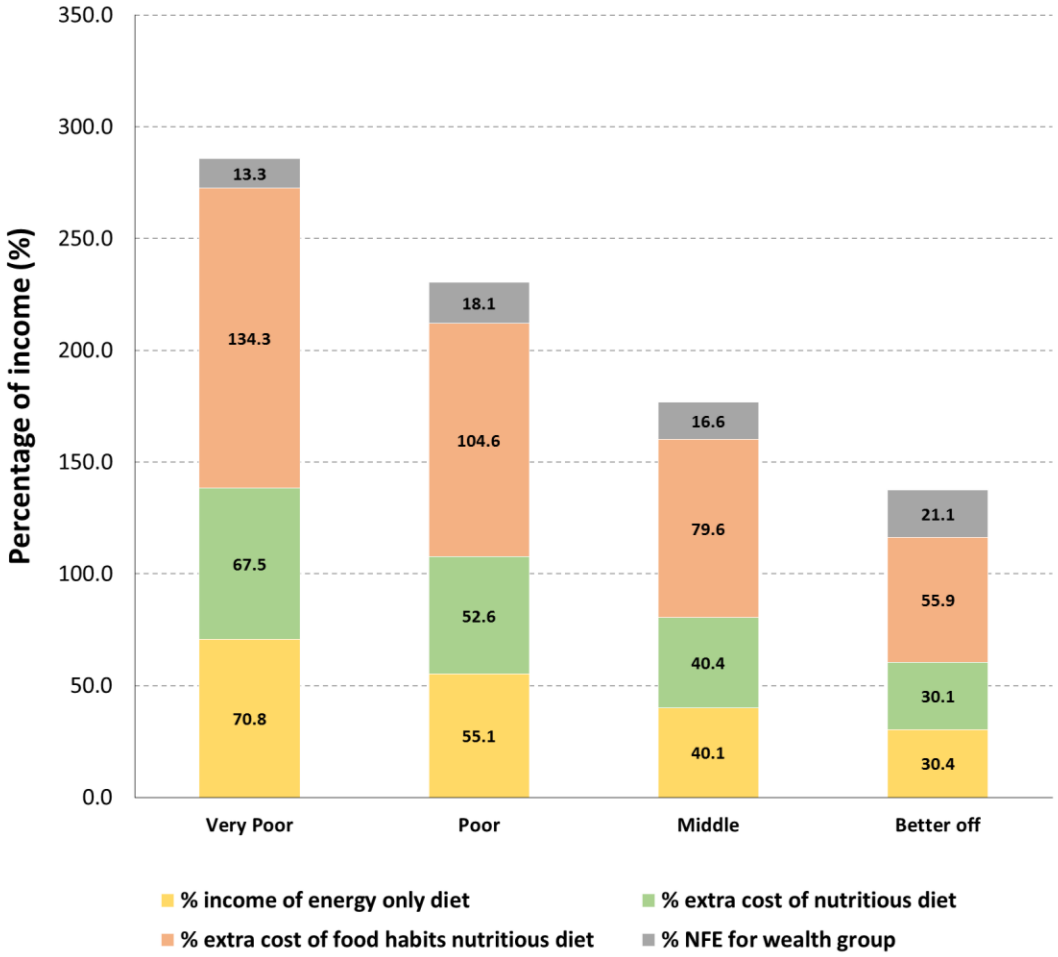


Figure 20 summarizes the changes in income gap when accounting for the effect of potential cash transfer interventions. Three cash transfer amounts were modelled:

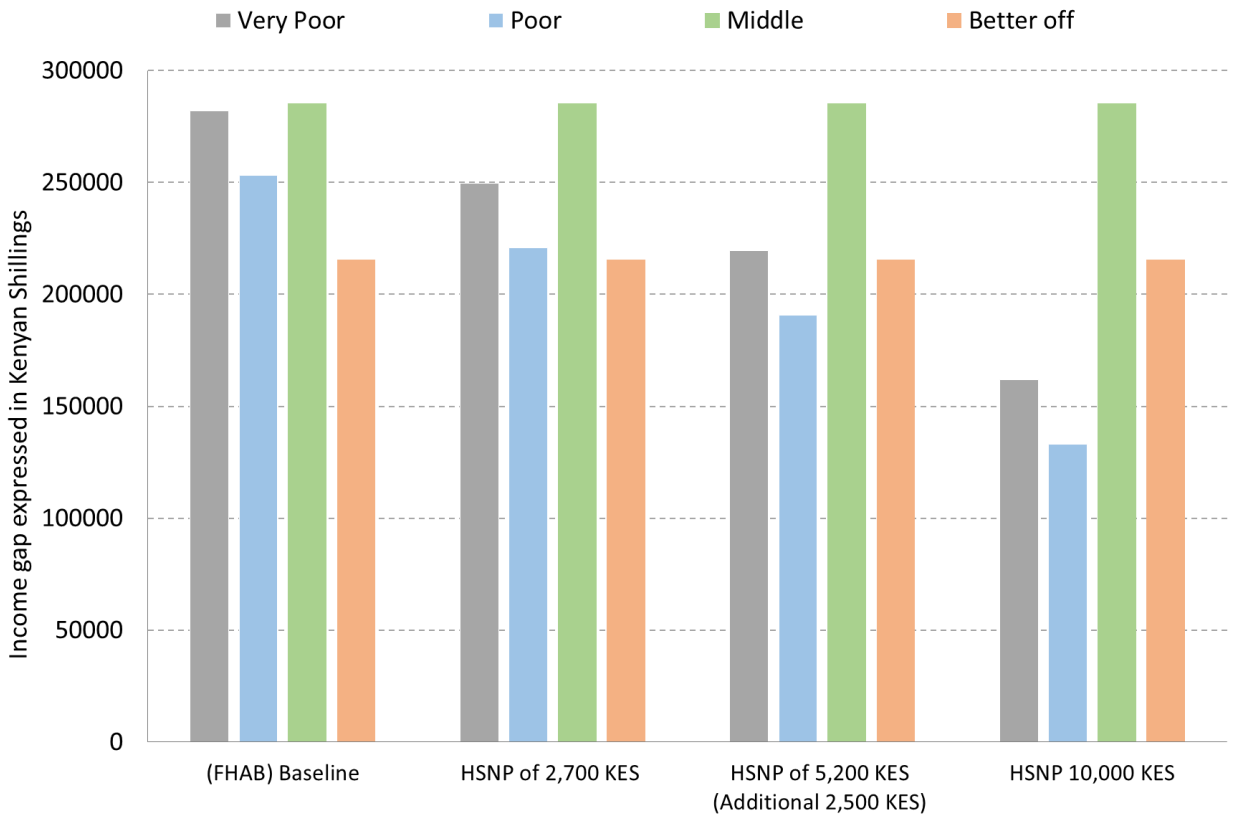
1. A monthly cash transfer of 2,700 KES monthly for poor and very poor wealth households, as currently in place;
2. A monthly cash transfer of an additional 2,500 KES, for a total sum of 5,200 KES for poor and very poor households;
3. A monthly cash transfer of a total of 10,000 KES for poor and very poor households.

The results for model 1 revealed that the cash transfer would see a reduction in the affordability gap of -50% and -30%, shrinking the deficit to 136% (250,240 KES) and 97% (220,336 KES) for the very poor and poor wealth groups, respectively. Model 2, therefore a monthly cash transfer of 5,200 KES, would shrink the deficit to 103% (220,420 KES) and 74% (190,291 KES) for the very

poor and poor wealth groups, respectively. Model 3, therefore a monthly cash transfer of 10,000 KES, would shrink the deficit to 60% (162,960 KES) and 43% (188,850 KES) for the very poor and poor wealth groups, respectively. Although it is a considerable reduction, these households would still not be able to access a nutritious diet.

Figure 20 also shows that by targeting very poor and poor households only, the middle and better-off households ultimately will have a greater income gap compared to the poor and very poor groups. Middle wealth group households especially are especially vulnerable as, although they have higher overall income and greater livestock holdings, the average household size is overall larger (11) than poor and very poor households (8), therefore the cost of the diet is also higher.

Figure 20. The affordability gap across the four wealth groups (in Kenyan Shillings) in the central pastoral livelihood zone and the potential impact of cash transfer interventions on the affordability gap.



4.5. Modelling the impact of dairy consumption

The cost of the diet standard analysis presented in the report (section 4.3) accounted for milk production by 'monetizing' the value of milk and adding the total value to the total income. Nonetheless, a "what if" analysis was carried out to assess the impact of adding milk directly on the diet by including the amounts produced by households (shown in table 7) across all wealth groups, as specified in the HEA.[48] Based on the information provided by the HEA, Camel milk was made available throughout the year; goat and sheep milk combined (here referred to as *shoat milk*) was made available only during the rainy seasons.

Table 7. The amount of camel, goat and sheep (shoat) milk consumed across four wealth groups according to the Household Economy Analysis.[49]

	Wealth group			
	Very Poor	**Poor**	**Middle**	**Better-off**
Camel milk consumed (L)	0	240	1440	1620
Shoat milk consumed (L)	630	730	1607.5	2655

Figure 21 illustrates the results of the analysis and show a reduction in cost across all wealth groups. Unsurprisingly, the combination of shoat and camel milk led to the largest reduction in cost, except for the very poor who typically only have access to shoat milk only. The largest reduction in the overall annual cost of the diet was seen in the better-off group, at 32%, equivalent to 218,934 KES reduction. For the middle wealth group, the introduction of the milk saw a reduction in annual cost of 31%, equivalent to 183,128 KES. The introduction of the specific amounts of milk to the diets of the poor and very poor wealth groups also led to a reduction in annual cost of the diet, although lower compared to the middle and better-off group: 18% for the poor, equivalent to a reduction in annual cost of 73,219 KES; and 10% for the very poor, equivalent to 42,753 KES reduction in annual cost.

The affordability of the diet was estimated again based on the newly calculated cost of the FHAB diet. As illustrated in figure 22, affordability of the diets improves across all wealth groups, reducing the gap to 264, 176 KES for the very poor group, 219,890 KES for the poor group, 223,875 KES for the middle group and 168,553 KES for the better off group. Thus, the impact of milk in terms of overall cost of the diet reduction exceeded the equivalent cash amount from the monetization of milk.

The results of the analysis highlight the importance of milk in the diets of the pastoral communities of Turkana, as milk largely contributes to meeting both macronutrient and micronutrient recommended intakes, and especially for calcium, vitamin A, vitamin B2, protein and fat.

[48] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[49] *Ibid.*

Figure 21. The results of the "what if" model analysis illustrating the effect of dairy on the cost of the FHAB diet of typical households across all four wealth groups (Kenyan Shillings).

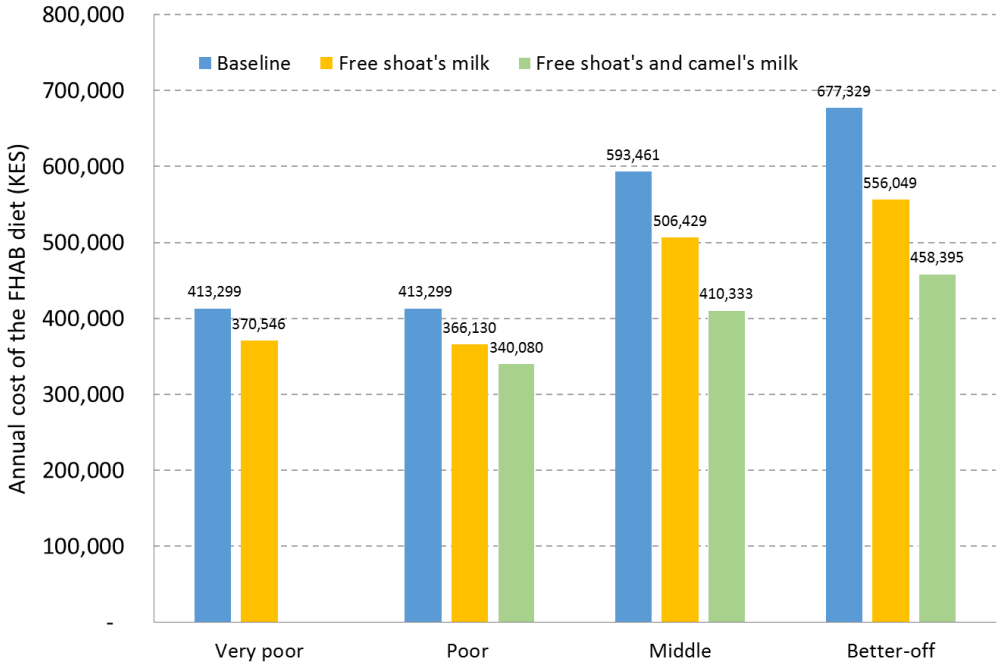
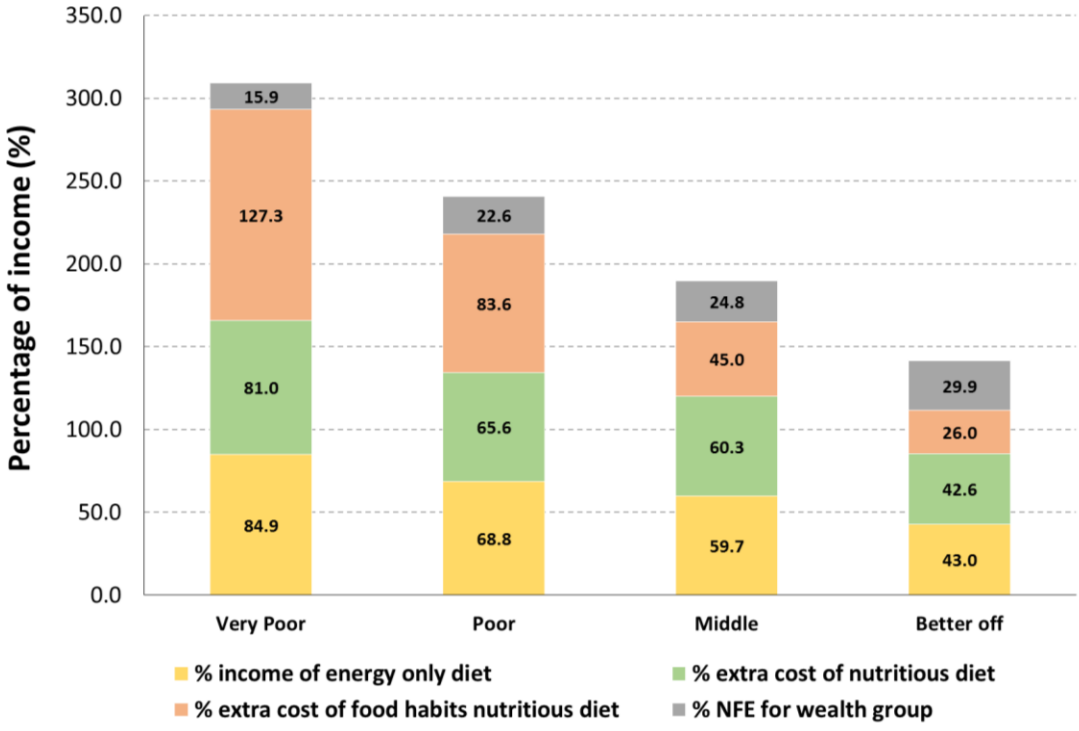


Figure 22. Recalculated affordability analysis after the introduction of milk, illustrating the cost of an energy only, nutritious and food habits nutritious diet for the Central Pastoral Livelihood zone expressed as percentage of household income across four wealth groups.



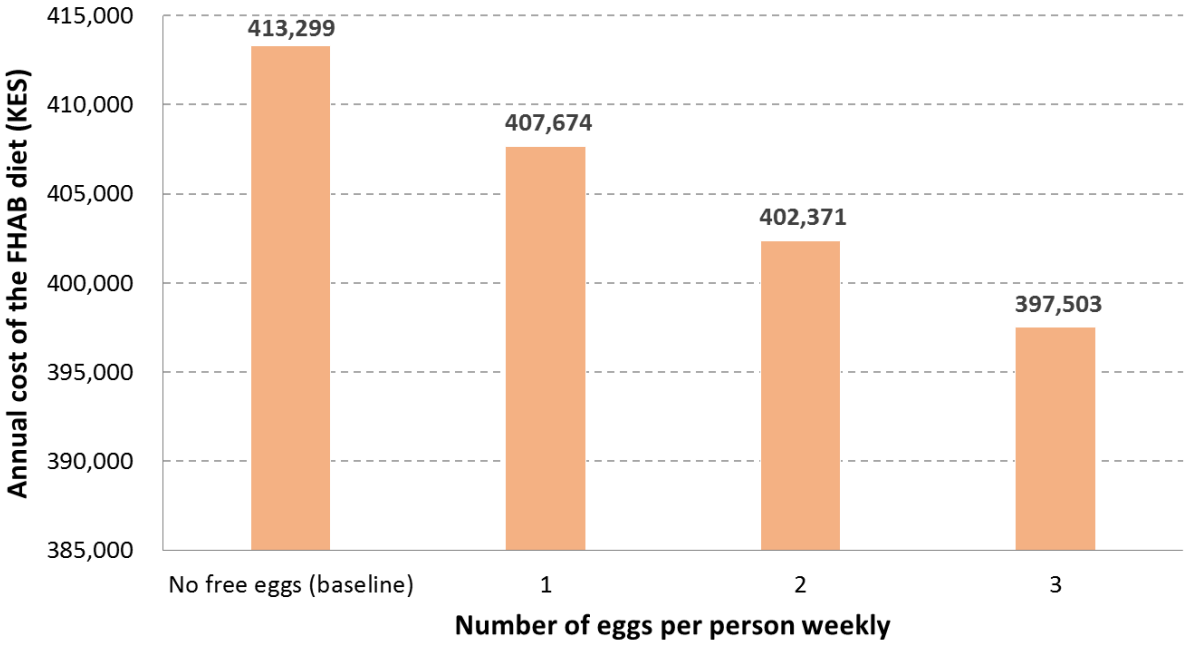
4.6. Modelling the impact of chicken rearing

As a potential intervention to reduce the cost of the diet and increase the affordability of, and therefore, access to, a nutritious diet in the central pastoral zone, the potential impact of a chicken rearing intervention was modelled. Thus, the effect of introducing between 1 and 3 eggs a week at no cost into the FHAB diet for each household member was assessed.

Based on FAO guidelines[50] and a production of 180 eggs a year per hen (range between 180 – 200 eggs): between 2 and 3 (2.3) hens would be needed to produce 1 egg per household member, per week; between 4 and 5 (4.6) hens would be needed to produce 2 eggs per household member, per week; and between 6 and 7 (6.9) hens would be needed to produce 3 eggs per household member, per week. Dire environmental conditions should be considered (such as lack of water and feed) as these will likely impact egg production, although the use of local hens would potentially increase the chances of adaptation.

Figure 23 illustrates the results of the analysis, which showed that one weekly egg per individual led to a 1.4%, or 5,625 KES, reduction in the annual cost of the FHAB diet; two weekly eggs per individual led to a 2.6%, or 10,928 KES, reduction; and three weekly eggs per individual led to a 3.8%, or 15,796 KES, reduction.

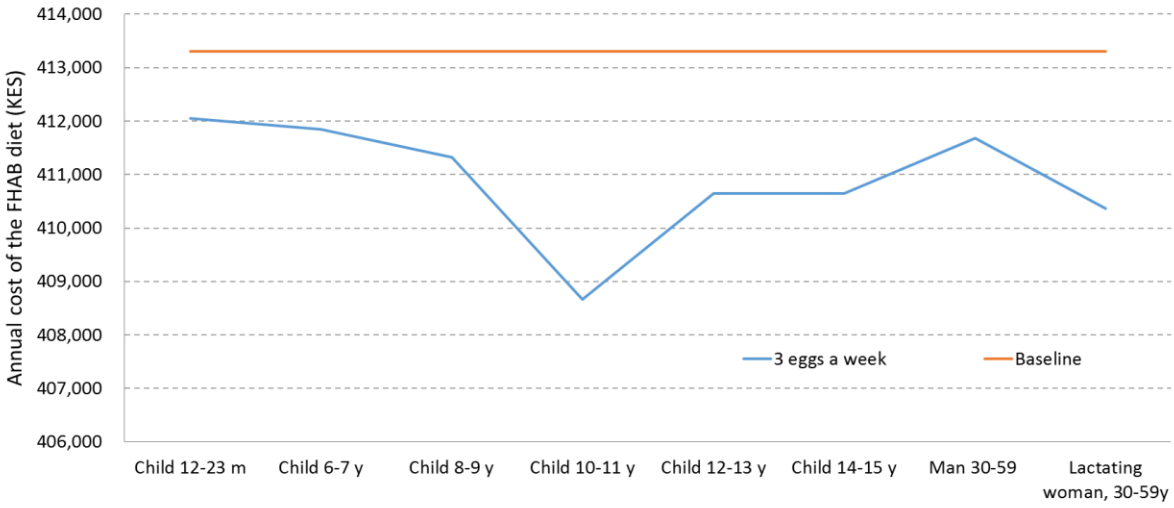
Figure 23. The effect of introducing between one and three eggs per individual, per week, on the cost of the FHAB diet (Kenyan Shillings).



[50] FAO (2010). *Egg Marketing - A Guide for the Production and Sale of Eggs.*

The impact of introducing three eggs per week for each individual in the household was analyzed at an individual level. Therefore, three eggs were added to the diet of one member of the household at a time, in order to show the degree of change in the annual cost of the FHAB diet for the whole household. Results, illustrated in figure 24, showed that the biggest cost reduction was seen once the eggs were introduced in the diet of the child 10 to 11 years of age, followed by the lactating woman, adolescent children (12 to 13 and 14 to 15 years), man and younger and infant children (12 to 23 months and 6 to 7 years).

Figure 24. The impact of introducing three free eggs a week on the annual cost of the household diet, by individual (Kenyan Shillings).



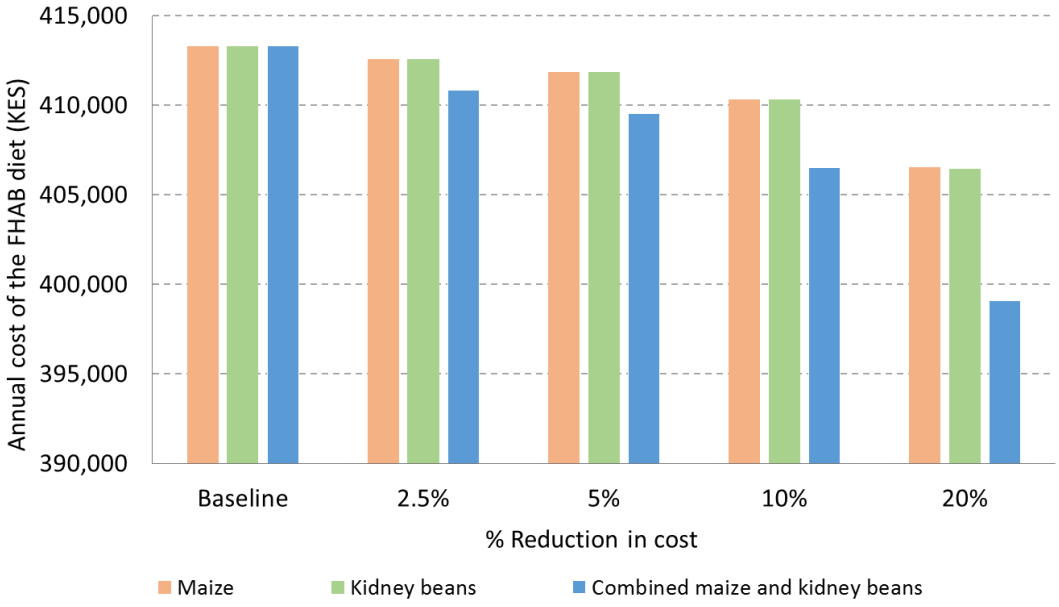
4.7. Modelling potential subsidization of maize and legumes

A "what if" scenario of the potential impact of a maize and beans subsidy was modelled. The reduction in prices of maize and kidney beans was modelled at -2.5%, -5%, -10% and -20%. The impact of the subsidisation of each commodity was assessed independently of each other as well as combined.

Figure 25 shows the results of the analysis, which revealed a modest reduction in cost of the diet. The potential maize subsidy led to a reduction in the cost of the diet between 0.2% and 1.6% (2.5% to 20% subsidy). Similarly, the modelled kidney beans subsidy led to a reduction in the cost between 0.2% and 1.7%. Therefore, the largest reduction in the cost of the FHAB diet was estimated at 6,847 KES based on a 20% reduction in kidney beans prices across the year. A combined reduction in the prices of beans and maize was also modelled, which resulted in an overall 3.4% reduction in cost of the FHAB diet, equivalent to a reduction of 12,195 KES a year.

Therefore, subsidized prices of kidney beans and maize at the modelled rates would have modest effects on the reduction in the cost of the diet and, consequently, limited impact on bridging the current affordability gap.

Figure 25. The annual cost of the FHAB diet against the percentage reduction in the prices of maize and kidney beans, illustrating the effect of potential subsidization of maize and beans (Kenyan Shillings).



4.8. Modelling the impact of wild foods

According to the Household Economy Analysis[51], the most consumed wild foods in the central pastoral livelihood zone were doum palm or *hyphaene compressa* (*eng'ol* in Turkana), *ziziphus mauritania* (*ng'akalaleo*) and *salvadora persica* (*esekhon*). The nutritional composition and images of these wild fruits can be found in *Appendix 12*.

Approximately half (53.3%) of households in Turkana have access to wild fruits.[52] According to the HEA, these contribute to a significant proportion of energy requirements; approximately, 15% for very poor households and 11% for poor households. According to Maundu, P. M. (1999), all three species grow in Turkana County. Of the three species of wild fruits, *ng'akalaleo (ziziphus mauritania*) is amongst the species of wild plants rated highly for domestication. In terms of seasonal availability, *eng'ol* is available throughout the year, but mainly from July to November; *ng'akalaleo* is available between September and October; *esekhon* is available between June and July.

A scenario was modelled to illustrate the impact that these foods or a combination of these foods can have on the diet. The impact was modelled on both an energy only diet and a micronutrient nutritious diet, applying minimum and maximum constraint of 0 to 7, a standard portion size of 30g, and at a zero cost. Figure 26 and 27 illustrate the results of the analysis and show a significant reduction in cost (between -8% and -14%). The most significant reduction in cost was seen with *eng'ol*, as this was also the most nutrient dense of the three, followed by *ng'akalaleo* and *esekhon*. The same model was run in a nutritious diet (Figure 27). A significant price reduction was also observed in the nutritious diet; however, the biggest reduction was seen after introducing *esekhon* (-18%), followed by *eng'ol* (-14%) and *ngakalaleo* (-5%).

[51] Food Economy Group (2016). *Livelihood Profiles Baseline Update: Six Livelihood Zones in Turkana County.*
[52] GIZ (2016). *Nutrition Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*

Figure 26. The effect of introducing doum palm (*eng'ol* in Turkana), *ziziphus mauritania* (*ng'akalaleo*) and *salvadora persica* (*esekhon*) to an energy only diet to model the impact on the annual cost of the diet (Kenyan Shillings).

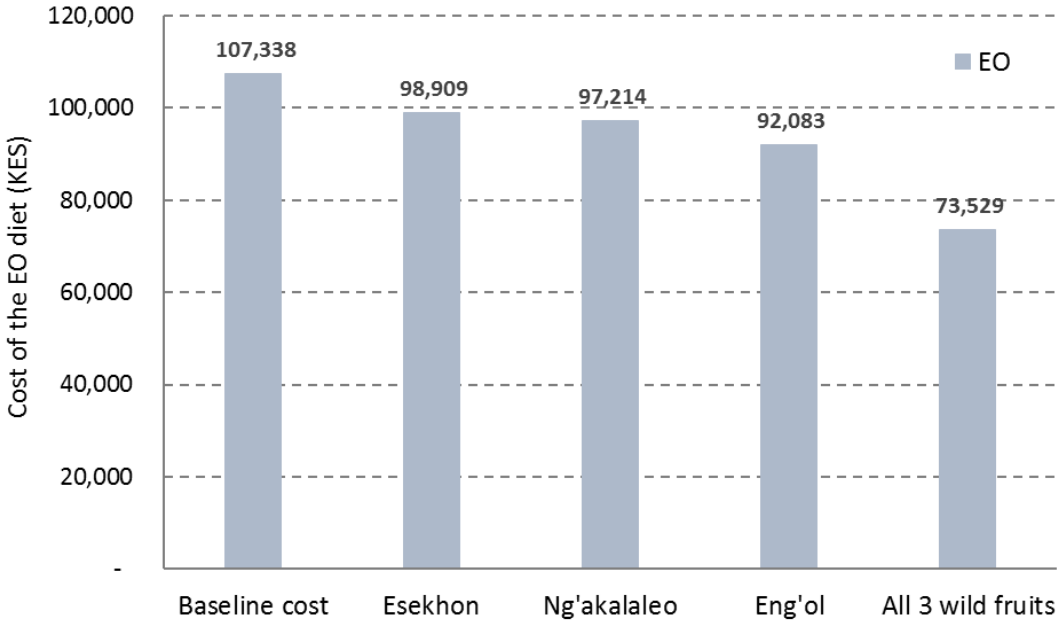
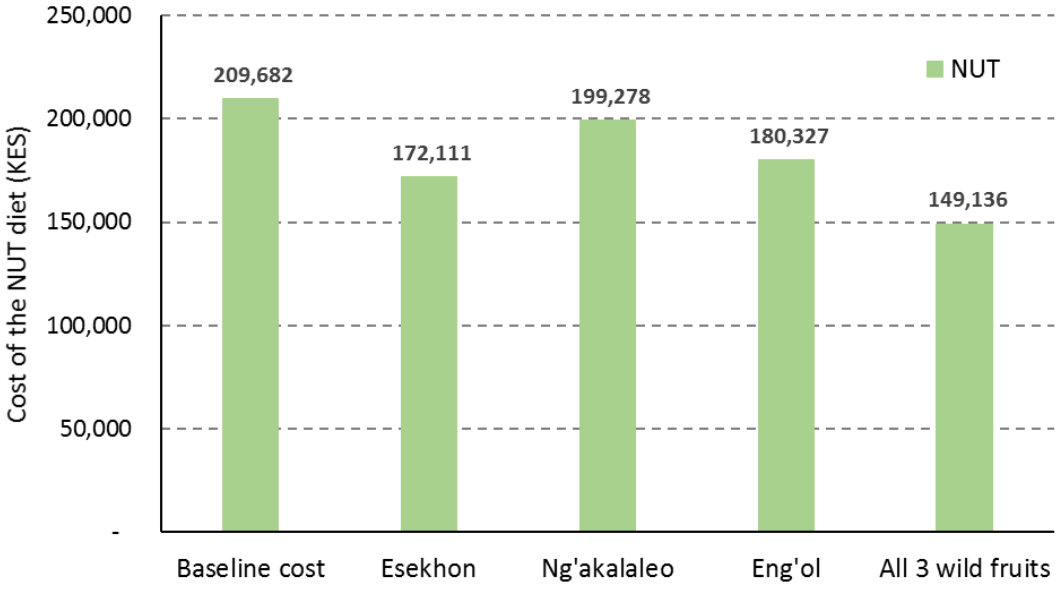


Figure 27. The effect of introducing doum palm (*eng'ol* in Turkana), *ziziphus mauritania* (*ng'akalaleo*) and *salvadora persica* (*esekhon*) to an energy only diet to model the impact on the annual cost of the diet (Kenyan Shillings).



5. Discussion

Findings from the Cost of the Diet analysis revealed that all nutrient requirements could be met in all diets (EO, NUT and FHAB) using locally available foods. A nutritious diet was approximately twice the cost of an energy only diet, reflecting the high cost of meeting fat, protein and micronutrient requirements compared to only meeting energy requirements. The cost of the food habits nutritious diet was approximately double the cost of the nutritious diet. The inflated cost of the food habits nutritious diet shows that dietary habits can in fact lead to an increase in the overall cost of the diet, as these may be restricting certain foods from being included in the diet.

The FHAB diet calculated by the software met the energy, protein fat, micronutrient and mineral requirements of all individuals based on 15 food items included in the diet. The diet mostly consisted of maize, beans and milk, with also important contributions from kale and vegetable fat. Milk was especially important in providing group B vitamins, vitamin A, calcium and protein. Legumes made a crucial contribution to the diet, meeting over half of a standard family's requirements for protein and iron. Maize provided over a quarter of energy requirements and significant proportion of the B vitamins in the diet. Although fortified maize flour was also available, the software identified non-fortified maize flour as a more cost effective food item to include in the diet. The inclusion of large volumes of kale provided over 50% of the requirements of vitamin A and over 70% of vitamin C requirements. These are the cheapest sources of nutrients that the software identified from the pool of locally available foods. A sensitivity analysis revealed that iron and, to a lesser extent, calcium, are the limiting nutrients, thus, being the micronutrients contributing the most to driving up the cost of the diet.

Although nutrient requirements could be met for the standard household across all diets, the lack of fresh fruit and vegetables in the livelihood zone still raises concerns. The results from the market survey showed that only a limited number of foods could be found in markets around the central pastoral zone. Furthermore, only small quantities of certain fresh produce, such as kale, spinach, avocados and bananas, could be found in the locations surveyed. For this reason, although a nutritious diet could be calculated, households may not always have physical access to these foods as a nutritious diet would require. This is corroborated by the high prevalence of food insecurity in Turkana where 89% of households currently classify as severely food insecure.[53]

The lack of access to water in the area also means that households are unable to grow fresh produce (only 6% were able to grow vegetables), increasing households' dependence on what is available and affordable for purchase in markets.[54] A third of Turkana residents queue between 30 and 60 minutes to fill water containers.[55] Fetching water also represents a burden for mothers, needing to carry 20 litre jerricans on top of other duties (such as caring for the children and

[53] GIZ (2016). *Nutrition Baseline Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*
[54] *Ibid.*
[55] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.

fetching firewood). Limited water access also has clear repercussions on hygiene and sanitation. In Turkana, only 29.5% of households used the daily minimum required 15 litres of water per person, necessary for washing, drinking and cooking. Moreover, only 10.2% of households washed their hands at four critical times during the day. The lack of water access and limited use increases the risk of diarrheal diseases and other infections, which further compound the risk of malnutrition especially for children. The prevalence of diarrhea in children 6 to 23 months has also increased from 12% in 2016 to 17% in 2017.[56] Given the current drought, the situation is likely to be further exacerbated.

The results from the diet analysis of children between 6 and 23 months revealed that iron could not be met in the diets of children 6 to 8 months and 9 to 11 months. These age groups have higher requirements in iron and coincide with a rapid growth phase (KDHS, 2014). A review of the literature also revealed a low consumption of iron rich foods in children 6 to 11 months, especially in breastfed children, and only 20% of children in Turkana are consuming a minimum acceptable diet (accounting for both frequency and diversity).[57] Furthermore, the coverage of vitamin A supplementation for children under the age of five years in Turkana County is below the acceptable level of coverage of 80%.[58] A lack of iron and vitamin A during this critical period of child development could have negative and irreversible consequences on child health and growth. The low intake of iron and low coverage of vitamin A supplementation could be key contributing factors in the high rates of malnutrition in the zone.

The situation could be further exacerbated by the lack of diversity in mother's diets, as dietary diversity indicators revealed that 88% of women of reproductive age are consuming less than the minimum of five food groups to ensure adequate nutrient intake.[59] Inadequate nutrient intake before and during pregnancy, and during lactation can have negative repercussions on both mothers and children. It is therefore crucial that the coverage and compliance of iron and folic acid supplementation in WRAs (90 days of IFAS during the last pregnancy), currently at 55%, is further encouraged.[60]

An analysis of the impact of multiple micronutrient powders revealed that supplementing the diets of children with as little as two sachets a week could dramatically decrease the overall cost of the diet for a child and enable children 6 to 8 and 9 to 11 months to meet their iron requirements. The analysis also revealed that commonly eaten wild foods can play an important factor in lowering the cost of the diet and meeting some of the nutrient requirements of the household. More information on seasonal availability and quantities consumed to construct a more detailed analysis is needed; nonetheless, these foods could play a crucial role in the central

[56] Turkana County Government (2016). *Turkana SMART Nutrition Survey*. Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[57] GIZ (2016). *Nutrition Baseline Survey Kenya. For the Global Programme Food and Nutrition Security, Enhanced Resilience.*
[58] Turkana County Government (2017). *Turkana SMART Nutrition Survey*.
[59] *Ibid.*
[60] *Ibid.*

pastoral livelihood zone, especially given the large affordability gap across the wealth groups. Furthermore, some species, such as *ng'akalaleo (ziziphus mauritania*), could be grown more widely given potential for domestication.

The results from the affordability analysis revealed that there is currently an affordability gap (expressed as a percentage of income): 37% for better-off households, 77% for middle households, 130% for poor households, and 186% for very poor households). Although the affordability gap significantly changes in magnitude across wealth groups, the analysis reveals that households in the central pastoral livelihood zone are not able to afford a food habits nutritious diet. Additionally, when modelled into the analysis, the monthly 2,700 KES cash transfer sum led to a reduction of the deficit, however, an affordability gap of 136% and 97% for the very poor and poor wealth groups remained. The inability to afford a nutritious diet could be a key contributing factor to the high rates of malnutrition in the area, as households are not able to access the foods necessary to meet an adequate diet.

The lack of households' purchasing power may in turn affect the demand of fresh and more diverse food products on the market. As discussed in the previous sections, the arid conditions in Turkana combined with the lack of infrastructure for transportation of fresh fruit and vegetable across the county limit the access to an adequate diet further. Furthermore, harsh weather conditions mean that preserving fresh produce is a challenge and nutrient losses are likely to occur due to unsuitable storage conditions. As households are heavily dependent on market purchases, the prospective reconstruction of the A1 road could, therefore, have considerable repercussions on increasing access to nutritious food in the zone and across Turkana.

Data collection was carried out at the very end of the dry season, which may have exacerbated the results and the lack of fresh foods available throughout the year. Furthermore, the current situation is different to the reference year of HEA[61] due to the ongoing drought, as the two rainy seasons during the reference year had been rated as average by the pastoral community (FEG, 2016). Therefore, the results may not be reflective of the cost of the diet during non-drought years.

[61] HEA reference year for the pastoral zones as between 2015 and 2016, starting from March/April.

6. Conclusions and recommendations

- **Poor infrastructure in Turkana is a barrier to gaining physical access to the foods.** The software was able to calculate a nutritious and food habits nutritious diet that met all the requirements of a standard household, meaning that there is sufficient diversity of foods in the region. However, the frequency with which these foods are available to households and the quantity with which these can be found in the markets is likely to be an obstacle to achieving a nutritious diet. The repairs of the A1 road (Lodwar to Kitale) will have a considerable impact on the households living in the central pastoral livelihood zone, as well as the wider county. Better roads will also allow for more efficient transportation of fresh produce and, possibly, decrease the extent of food degradation and nutrient depletion due to heat and travel conditions.

- **Inadequate diet and consequent poor nutritional status likely to be a heavily driven by financial factors due to a considerable affordability gap.** The analysis found that between 215,000 KES and 285,000 KES are needed to close the affordability gap and enable households to purchase a nutritious diet. The highest affordability gap was, surprisingly, identified for the middle wealth group, driven by the larger typical household size. Although these results may have generally been exacerbated by the current drought, and therefore are not necessarily reflective of a normal year (affordability gap may be narrower during non-drought years).
    - Very poor: 186% = **281,976 KES**
    - Poor: 130% = **253,175 KES**
    - Middle: 77% = **285,401 KES**
    - Better-off: 37%= **215,379 KES**

- **Current cash transfer of 2,700 KES for very poor and poor household is not sufficient to close the affordability gap, although reduces the deficit by 50% and 33% in each group, respectively.** Increasing the cash transfer for these groups to 10,000 KES a month would increase affordability, but would not be sufficient in closing the affordability gap. Based on the affordability analysis, the following monthly cash transfers would be needed to close the affordability gap:
    - Very poor: **21,000 KES/ month**
    - Poor: **18,500 KES/ month**
    - Middle: **24,000 KES/ month**
    - Better-off: **18,000 KES/ month**

- **Interventions to increase cash income to be considered to close the affordability gap.** Current cash income and available livestock products are not sufficient for a family to access a nutritious diet. Avenues should be explored to allow households to increase their means to access nutritious foods, such as food for work or vouchers. Current food distribution is inconsistent and not sufficient to make a meaningful impact, but further

food assistance should also be considered given the large affordability gap and generally hostile conditions across the central pastoral livelihood zone.

- **Livelihoods interventions, such as supplying households with chickens for increased egg consumption could decrease the cost of the diet, and therefore improve affordability.** The analysis showed a reduction in overall cost of the diet for very poor and poor households (from 413,299KES to 397,503KES a year) and could contribute to narrowing the affordability gap by 8 to 11%:

- **Subsidization of maize and beans (between 2.5% and 20% reduction in cost) showed limited impact on the reduction of the overall cost of the diet – between 0.17% - 1.66%.** However, if subsidy was available on a range of foods, it could potentially results in increased affordability. In combination with vouchers and/or other means to increase access to nutritious foods, it could lead to a meaningful impact. Nonetheless, food subsidies alone are unlikely to make a meaningful impact due to the considerable income deficit.

- **Milk consumption is crucial for households living in the central pastoral zone.** The analysis showed how milk (camel, goat, and sheep) can contribute greatly to meeting a nutritious diet and its contribution outweighs its cash value. A recalculated affordability gap shows a narrower gap when milk consumption is added to the diet:
  - Very poor **= 264,176 KES**
  - Poor = **219,890 KES**
  - Middle = **223,875 KES**
  - Better-off = **168,553 KES**
- **Given the importance of dairy in meeting key nutrient requirements, the current drought is likely to have gravely impacted the diets of households living in the central pastoral livelihood zone, as this will have decreased the production of milk.**

- **Reducing the risk of iron deficiency in children between 6 and 11 months through the promotion of iron rich foods (coagulated blood) and/or home fortification (multiple micronutrient powders).** Given the concerning results of the analysis that revealed that iron requirements for children 6 to 11 months could not be met, and based on the results of the modelling around the cost reducing potential of coagulated blood and/or multiple micronutrient powders, such interventions should be considered to ensure adequate iron intake to aid healthy growth and development. The analysis revealed that as little as 6g of coagulated blood a day in a child's diet could drastically lower the cost of the diet (FHAB). As a pastoral community, there is potentially widespread access to this food, especially given the small quantities required for consumption. The analysis also revealed that multiple micronutrient powders also had a meaningful impact on the reduction of the cost of the diet. Nonetheless, the acceptability of coagulated blood and micronutrient sprinkles should be investigated prior to implementing these recommendation. Increasing the availability of iron rich foods in the livelihood zone could be an alternative

avenue to using supplements; however, growing opportunities are very limited in the zone due to extremely arid conditions.

- **Reinforce messages on complementary feeding.** The analysis identified a vulnerability in children under two, as there are not sufficient iron rich foods in the area; additionally, majority of children do not receive adequate complementary feeding. Messaging around appropriate feeding practices should therefore be reinforced alongside interventions to increase availability of iron rich foods. Legumes played a significant role in meeting the nutrient requirements and an increase in consumption should be promoted.

- **Legumes and kale played a significant role in meeting the nutrient requirements and increased consumption should be promoted across all age groups.** Legumes made significant contributions in the diet (90% folic acid, 55% vitamin B1, 53% protein, 51% iron, 48% zinc, 43% vitamin B6, 36% niacin), therefore provide cheap access to nutrients. Additionally, kale was identified as an important source of vitamin A and vitamin C. Households could therefore be encouraged to consume more legumes and kale, favouring larger portions of these and avoiding excessively large portions of grain (e.g. maize meal). This is especially important in young children. Households are currently consuming these and promoting an increase in consumption of these could be beneficial and potentially easily integrated in the current diet in larger amounts.

- **Promotion of kale, legumes and coagulated blood should be coupled with a sensitization on how to prepare these foods**. For example, how to economize on fuel, rid them of anti-nutrients and phytates, which hinder absorption of nutrients, help digestion and, thus, maximize the nutritional value by, for example, sprouting of legumes. The households with children 6 to 23 months should also be supported to prepare nutritious recipes using locally available foods at their disposal including various food combinations.

- **Pulses (dried legumes) are especially important in the livelihood zone, as these are easier to transport than fresh food products, have a long shelf life and are widely consumed and accepted.** Stocking up on these products ahead of the lean seasons could improve affordability and increase access to nutrients.

- **Drying foods, such as vegetables and meat, could be used as a method to increase availability of food during the dry season, during which prices are highest.** Drying foods could be a means for household to preserve foods during seasons of (relative) abundance and prepare for the lean (dry) seasons, using methods such as solar drying. Nonetheless, potential storing solutions should be investigated further. Transportation of dried goods could potentially be more economical and efficient, and may increase availability of key nutrients at a low cost across the zone.

- **Wild foods play an important role in the diet of households in the central pastoral zone.** However, this study does not fully capture the extent to which these foods contribute to the diet in reality. Furthermore, nutrient composition data for all of the wild foods

available in the livelihood zone could not be found, so information was limited to a number of wild foods. Furthermore, more detailed information on seasonality and availability and acceptability of these foods should be gathered to allow for a more accurate analysis of the impact of these foods in terms of nutrient value and diet cost reduction.

- **Investigate the potential of using traditional drying and preservation techniques.** Drying foods, including meat, vegetable and fruits, could be a means for household to preserve foods during seasons of abundance and prepare for lean (dry) seasons. Transportation of dried goods could potentially be more economical and efficient, and may increase availability of key nutrients at a low cost across the zone.

- **A further investigation into availability and prices of foods during the rainy season is recommended.** This study could not fully capture the availability of foods during the rainy season and, more generally, seasonal fluctuations, as the data was gathered in the height of the dry season, when food availability was at its lowest, and in the midst of the drought. Further data gathered during a period during which food is more abundant would give a more integral analysis of availability.

- **Increase the capacity for households to store water and use of innovative solutions.** Although there is a general scarcity of water across Turkana County, increased safe water storage solutions could aid safe environments. Furthermore, innovative solutions, such as rolling water barrel could help decrease mother's workload.

- **Ensure results are fed back to the communities visited.** Upon visiting communities, residents voiced their discontent with previous surveys conducted in the areas, as no feedback process ever took place. Given their active collaboration and interest in the matter, it is recommended that the communities visited be informed of the results of the survey through the appropriate media (e.g. inform the village chief or elders). As only 10 communities were involved, the process would require very limited resources and ensure future collaboration with the communities who had kindly collaborated.

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Appendices

Appendix 1.

i. Recommended intakes 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).

A diet selected by the Cost of Diet software which meets all of the requirements described above is called a 'nutritious' diet.

ii. The limitations of the Cost of the Diet software and method

It is useful to understand the limitations of the cost of the diet method before applying any analysis.

The software can identify a 'diet' that provides the recommended amounts of energy and micronutrients from a relatively small number of foods, but they would need to be eaten every day at every meal, which is unrealistic.

Because the actual requirements for micronutrients of any given individual cannot be known, the RNIs are set at two standard deviations above the average, to minimise the risk of deficiency. This means that when the mixture of foods selected by the Cost of the Diet software meets the RNIs of a family by 100%, the nutritional needs of 97% of all individuals will be exceeded. The result is that greater quantities of food are selected and at a higher cost than is necessary to meet the actual nutritional requirements of most individuals.

The needs for a number of nutrients are not taken into account by the software including iodine, vitamin D, essential amino acids and essential fatty acids. Iodine is not included because the

amount in foods depends on the soil on which plants are grown or animals are reared, so no data are provided in food tables. Vitamin D is not included because requirements can be met by making vitamin D in skin exposed to ultra-violet light. And most food tables do not provide data on essential amino acids or fatty acids.

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Appendix 2. A list of the villages and markets surveyed, date of visit and type of data gathered.

Name of village	Constituency	Data gathered	Date of visit
1. Nasiger	Loima	Market prices; dietary habits	14/03/2017
2. Kalobeyei	Turkana West	Market prices; dietary habits	15/03/2017
3. Lorugum	Loima	Market prices; dietary habits	16/03/2017
4. Lochwaa	Turkana South	Market prices; dietary habits	17/03/2017
5. Lomil	Loima	Market prices; dietary habits	18/03/2017
6. Kanakurdio	Turkana North	Market prices; dietary habits	19/03/2017
7. Kapua	Turkana Central	Market prices	20/03/2017
8. Kakwanyang	Turkana Central	Market prices	20/03/2017
9. Makutano	Turkana West	Market prices	21/03/2017
10. Lomil	Turkana West	Market prices	21/03/2017

Appendix 3. Specifications of composition of standard households used for the Cost of the Diet analysis and affordability analysis.

	Household size		
Individuals in the standard family (energy requirement)	8	11	13
Child (either sex) 12-23 months (907 kcal)	X	X	X
Child (either sex) 3-4 years (1,156 kcal)			X
Child (either sex) 4-5 years (1,241 kcal)		X	X
Child (either sex) 6-7 years (1,501 kcal)	X	X	X
Child (either sex) 8-9 years (1,764 kcal)	X	X	X
Child (either sex) 10-11 years (2,078 kcal)	X	X	X
Child (either sex) 12-13 years (2,412 kcal)	X	X	X
Child (either sex) 14-15 years (2,720 kcal)	X	X	X
Child (either sex) 16-17 years (2,503 kcal)		X	X
Man, 30-59 years, 50 kg, moderately active (2,750 kcal)	X	X	X
Woman, 30-59 years, 45kg, moderately active (lactation, 7-12 months) (2,760 kcal)	X	X	X
Woman, 30-59 years, 50kg, moderately active (lactation, 7-12 months) (2,860 kcal)			X
Woman, 30-59 years, 50kg, moderately active (2,400 kcal)			X
Woman, 30-59 years, 60kg, light active (2,150 kcal)		X	

Appendix 4. A list of the foods found in the assessment area and average cost per 100g for all three seasons and the annual average (KES) based on the data gathered through market surveys across the Central Pastoral Livelihood Zone.

	Average Price Per 100g				
	1. Dry Season	***2. Short Rains***	***3. Dry Season***	***4. Long Rains***	**Annual Average**
Grains and grain-based products					
(Maize, dried, raw)	7.37	6.93	7.34	5.63	6.82
(Maize, flour, dry)	6.74	6.41	6.45	5.39	6.25
(Maize, flour, fortified, local)	9.44	9.27	9.57	8.31	9.15
(Maize, yellow, on the cob, raw)	8.03	8.03	8.03	8.03	8.03
(Ujimix sour porridge, maize and millet mix)	12.93	12.93	12.60	12.60	12.77
(Millet, finger)	9.49	9.49	9.49	9.49	9.49
(Millet, flour)	13.40	13.22	13.40	12.23	13.06
(Bread, wheat, white for toasting)	17.65	16.57	17.65	15.49	16.84
(Pasta)	14.15	14.15	13.87	13.16	13.83
(Rice, raw)	10.66	10.23	10.59	9.43	10.23
(Sorghum, grain or flour, CotD)	7.95	7.95	7.21	7.21	7.58
(Spaghetti, dry, unenriched)	13.67	13.22	14.39	12.89	13.54
(Wheat, flour, all purpose, 72% extract)	10.26	10.26	9.54	9.39	9.86
(Wheat, flour, fortified, local)	14.59	14.44	14.46	13.28	14.19
(Wheat, flour, wholegrain)	8.48	8.48	8.48	8.48	8.48
Roots and tubers					
(Beet root, red, raw)	6.77	6.77	6.77	5.42	6.43
(Potato, english, raw)	5.47	5.57	5.48	4.54	5.32
Legumes, nuts and seeds					
(Bean, baked, canned)	20.62	20.62	20.62	20.62	20.62
(Bean, kidney, dried, raw)	13.08	12.58	12.69	9.09	11.87
(Bean, moth, mature, raw)	10.61	10.61	10.61	10.61	10.61
(Groundnut, shelled, dried, raw)	41.90	41.90	41.90	41.90	41.90
(Lentil, dried, raw)	7.31	8.95	8.95	7.31	8.13
(Peanut, roasted, shelled)	66.67	66.67	66.67	66.67	66.67
(Peas, split, mature, raw)	8.65	8.02	8.65	5.19	7.70
Meat and offal					
(Beef, meat, cured, corned, canned)	62.50	62.50	62.50	62.50	62.50
(Chicken)	57.14	57.14	57.14	57.14	57.14
(Donkey, flesh)	21.57	21.57	21.57	21.57	21.57
(Donkey, leg, with bone)	13.64	13.64	13.64	13.64	13.64
(Donkey, liver and kidney)	12.35	12.35	12.35	12.35	12.35
(Goat, intestines and stomach, raw)	56.64	56.64	56.64	56.64	56.64
(Goat, raw)	42.02	40.08	42.02	42.02	41.53

Fish, seafood, amphibians and invertebrates					
(Tuna, canned, Omaar)	81.52	81.52	81.52	73.37	79.48
Omena (Fish, small, dried, fresh water)	72.03	72.03	72.03	72.03	72.03
Eggs and egg products					
(Egg, chicken, CotD)	34.84	34.84	34.84	33.55	34.52
Milk and milk products					
(Milk, cow, powdered, whole)	93.21	83.45	96.47	72.65	86.56
(Milk, cow, UHT)	18.77	18.48	18.22	15.23	17.67
(Milk, goat, fresh)	18.52	18.52	14.81	14.81	16.66
(Milk, powder, fortified)	86.99	80.63	80.63	74.51	80.82
(Milk, sheep, fresh, whole)	182.07	182.07	182.07	182.07	182.07
Vegetables and vegetable products					
(Cabbage, green or white, raw)	8.09	7.61	7.93	7.26	7.72
(Carrot, raw)	11.06	11.06	11.06	11.06	11.06
(Kale, raw or cooked)	9.92	8.20	10.75	9.81	9.70
Naivasha Dry (Mixed vegetables, dry)	48.00	48.00	48.00	48.00	48.00
(Onion, raw)	19.95	19.95	19.95	18.67	19.63
(Onion, spring or scallion, raw)	16.08	15.74	16.08	12.79	15.21
(Peas, cooked or canned)	23.81	23.81	35.71	23.81	26.79
(Pepper, sweet, green, raw)	19.77	19.77	19.77	19.77	19.77
Spinach (Chard, swiss)	6.03	6.03	6.03	6.03	6.03
(Sujaa (local))	10.95	10.95	10.95	10.95	10.95
Fruit and fruit products					
(Avocado)	7.93	6.62	6.59	4.63	6.44
(Banana, large, ripe)	11.79	11.79	11.79	11.79	11.79
(Banana, unripe)	5.71	5.71	5.71	5.71	5.71
(Date)	71.68	71.68	25.60	25.60	48.64
(Eng'ol (local))	10.90	10.90	10.90	10.90	10.90
(Mango, orange flesh)	7.84	7.84	6.87	5.15	6.92
(Ng'apedur (local))	44.77	44.77	44.77	44.77	44.77
(Orange)	11.25	11.25	9.88	8.52	10.22
(Pear)	9.46	9.46	9.46	9.46	9.46
(Pineapple, canned in juice)	50.00	50.00	50.00	50.00	50.00
(Tomato, CotD)	14.71	12.60	14.68	11.76	13.42
Oils and fats					
(Margarine, fortified)	30.00	30.00	34.00	26.00	30.00
(Oil, palm, red)	162.92	146.07	157.30	134.83	150.28
(Oil, vegetable)	26.59	26.52	26.69	25.50	26.33
(Fat, vegetable, cowboy, kapra or kimbo)	20.56	20.00	20.53	17.94	19.76
Sugars and confectionary					

(Sugar, brown, CotD)	21.56	21.28	22.80	19.70	21.35
(Sugar, white, CotD)	21.37	18.22	22.21	20.12	20.48
(Sugarcane)	4.22	4.22	4.22	4.22	4.22
Herbs, spices and condiments					
Ail, cru (Garlic, raw)	78.98	78.98	78.98	52.66	72.40
(Tomato paste, concentrated)	30.45	30.45	31.20	28.55	30.16
(Lemon)	18.47	18.47	18.47	18.47	18.47
(Salt, iodized)	4.94	4.94	4.98	4.83	4.92
Beverages					
(Tea, leaf, dry)	66.67	66.67	66.67	66.67	66.67
Supplements and infant foods					
(Corn Soya Blend (WFP))	9.89	9.89	9.89	9.89	9.89
(Glucose, mr energy)	50.00	50.00	50.00	50.00	50.00

Appendix 5. Dietary habits interview results summarized as minimum and maximum weekly constraints applied in the food habits nutritious diet (FHAB).

	Percentage of interview respondents				Minimum and maximum weekly food frequency constraints	
	Usually (5 days + per week)	Often (1-4 days per week)	Rarely (Once a year, once a month etc.)	Never	Min	Max
Grains and grain-based products						
Maize, dried, raw	66.67	29.17	4.17	0.00	0	14
Maize, flour, dry	45.83	47.92	4.17	2.08	0	14
Maize, flour, fortified, local	0.00	22.92	27.08	50.00	0	7
Maize, yellow, on the cob, raw	0.00	2.08	4.17	93.75	0	0
Millet, finger	0.00	2.08	8.33	89.58	0	0
Millet, flour	2.08	4.17	16.67	77.08	0	0
Pasta	0.00	14.58	50.00	35.42	0	7
Rice, raw	2.08	62.50	22.92	12.50	0	7
Sorghum, flour	4.17	10.42	27.08	58.33	0	7
Sorghum, grain or flour, CotD	2.08	16.67	27.08	54.17	0	7
Spaghetti, dry, unenriched	2.08	27.08	31.25	39.58	0	7
Ujimix sour porridge, maize and millet mix	0.00	0.00	0.00	0.00	0	0
Wheat, flour, all purpose, 72% extract	6.25	10.42	41.67	41.67	0	7
Wheat, flour, fortified, local	0.00	14.58	25.00	60.42	0	7
Wheat, flour, wholegrain	0.00	2.08	10.42	87.50	0	0
Bread, wheat, white for toasting	0.00	0.00	0.00	0.00	0	0
Roots and tubers						
Egilae	2.08	4.17	16.67	77.08	0	0
Potato, english, raw	4.17	54.17	29.17	12.50	0	7
Potato, red, raw	4.17	22.92	22.92	50.00	0	7
Legumes, nuts and seeds						
Bean, baked, canned	0.00	0.00	0.00	0.00	0	0
Bean, kidney, dried, raw	52.08	29.17	4.17	14.58	0	14
Bean, kidney, green, raw	0.00	0.00	2.08	97.92	0	0
Bean, moth, mature, raw	0.00	0.00	0.00	0.00	0	0
Bean, mung, raw	0.00	0.00	12.50	87.50	0	0
Cowpea, green, uncooked	0.00	14.58	29.17	56.25	0	7
Cowpea, white, dried, raw	0.00	2.08	27.08	70.83	0	0
Groundnut, shelled, dried, raw	0.00	10.42	6.25	83.33	0	0
Lentil, dried, raw	0.00	16.67	27.08	56.25	0	7
Peanut, roasted, shelled	0.00	0.00	0.00	0.00	0	0
Peas, split, mature, raw	0.00	33.33	31.25	35.42	0	7

Meat and offal						
Beef, liver, raw	0.00	2.08	31.25	66.67	0	0
Beef, medium fat, raw	0.00	0.00	35.42	64.58	0	0
Camel, raw, meat	0.00	16.67	54.17	29.17	0	7
Chicken	0.00	0.00	0.00	0.00	0	0
Chicken, raw	0.00	8.33	56.25	35.42	0	7
Donkey, flesh	0.00	0.00	0.00	0.00	0	0
Donkey, leg, with bone	0.00	0.00	0.00	0.00	0	0
Donkey, liver and kidney	0.00	0.00	0.00	0.00	0	0
Goat, intestines and stomach, raw	8.33	52.08	25.00	14.58	0	7
Goat, raw	12.50	66.67	18.75	2.08	0	7
Beef, meat, cured, corned, canned	0.00	0.00	0.00	0.00	0	0
Tuna, canned, Omaar	0.00	0.00	0.00	33.33	0	0
Fish, small, dried, fresh water	0.00	8.33	25.00	66.67	0	0
Eggs and egg products						
Egg, chicken, CotD	4.17	22.92	45.83	27.08	0	7
Milk and milk products						
Edodo (local powdered milk)	6.25	2.08	31.25	60.42	0	7
Milk, camel, raw	0.00	4.17	37.50	58.33	0	0
Milk, cow, fresh, non fortified	4.17	4.17	29.17	62.50	0	7
Milk, cow, powdered, whole	27.08	20.83	8.33	43.75	0	7
Milk, cow, UHT	10.42	33.33	20.83	35.42	0	7
Milk, goat, fresh	6.25	8.33	54.17	31.25	0	7
Milk, powder, fortified	22.92	22.92	16.67	37.50	0	7
Milk, sheep, fresh, whole	0.00	4.17	31.25	64.58	0	0
Sour milk	2.08	6.25	45.83	45.83	0	7
Vegetables and vegetable products						
Cabbage, green or white, raw	12.50	45.83	29.17	12.50	0	7
Carrot, raw	2.08	16.67	27.08	54.17	0	7
Dodoo (local)	0.00	0.00	20.83	79.17	0	0
Eosin alkeny (local)	2.08	0.00	14.58	83.33	0	0
Kale, raw or cooked	16.67	45.83	22.92	14.58	0	7
Leaf, cowpea, raw	8.33	22.92	12.50	56.25	0	7
Mrere (local)	4.17	6.25	18.75	70.83	0	0
Onion, raw	41.67	37.50	12.50	8.33	0	14
Onion, spring or scallion, raw	20.83	22.92	27.08	29.17	0	7
Peas, cooked or canned	0.00	0.00	0.00	0.00	0	0
Sagaa (local)	0.00	0.00	6.25	93.75	0	0
Sujaa (local)	0.00	0.00	12.50	87.50	0	0
Terere (local)	0.00	0.00	10.42	89.58	0	0
Mixed vegetables, dry	0.00	0.00	0.00	0.00	0	0
Pepper, sweet, green, raw	0.00	0.00	0.00	33.33	0	0

Chard, swiss	0.00	8.33	18.75	72.92	0	0
Fruit and fruit products						
Avocado	0.00	8.33	52.08	39.58	0	7
Banana, large, ripe	4.17	25.00	56.25	14.58	0	7
Banana, unripe	0.00	6.25	31.25	62.50	0	0
Date	0.00	2.08	0.00	97.92	0	0
Edung (local)	0.00	2.08	39.58	58.33	0	0
Eng'ol (local)	0.00	10.42	22.92	66.67	0	0
Eng'omo (local)	0.00	2.08	31.25	66.67	0	0
Mango, orange flesh	2.08	33.33	47.92	16.67	0	7
Ng'akalaleo (local)	0.00	2.08	54.17	43.75	0	7
Orange	0.00	29.17	35.42	35.42	0	7
Orange, juice	0.00	6.25	16.67	77.08	0	0
Pear	0.00	0.00	0.00	0.00	0	0
Pineapple, canned in juice	0.00	0.00	0.00	0.00	0	0
Tomato, CotD	27.08	37.50	16.67	18.75	0	7
Ng'apedur (local)	0.00	2.08	31.25	66.67	0	0
Oils and fats						
Fat, animal	2.08	8.33	35.42	54.17	0	7
Margarine, fortified	2.08	4.17	12.50	81.25	0	0
Oil, corn	14.58	0.00	8.33	77.08	0	7
Oil, palm, red	2.08	4.17	2.08	91.67	0	0
Oil, vegetable	72.92	22.92	2.08	2.08	0	14
Fat, vegetable, cowboy, kapra or kimbo	39.58	35.42	6.25	18.75	0	14
Sugars and confectionary						
Sugar, brown, CotD	58.33	35.42	0.00	6.25	0	14
Sugar, white, CotD	47.92	27.08	4.17	20.83	0	14
Herbs, spices and condiments						
Salt, iodized	93.75	2.08	0.00	4.17	0	14
Beverages						
Tea, leaf, dry	0.00	0.00	0.00	0.00	0	0

Appendix 6. The edible weight and cost of the foods selected for the family for the whole year for an **energy only (EO)** 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
Breast milk	194	10.4	0	0.0	2.0	1.5	11.2	100.0	100.0	0.6	2.0	1.1	0.4	3.8	100.0	35.2	0.0	0.8
(Maize, dried, raw)	548	29.4	37 336	34.8	32.2	32.3	29.2	0.0	0.0	32.6	32.2	32.5	32.7	31.6	0.0	21.3	32.8	32.6
(Maize, flour, dry)	1121	60.2	70 002	65.2	65.8	66.2	59.6	0.0	0.0	66.8	65.8	66.4	66.9	64.6	0.0	43.5	67.2	66.7
Total	1 862	100	107 338	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	143	42	6	6	220	112	197	150	43	3	5	65	158

The percentage of target met is an average of the % nutrient requirements met over the year.

Appendix 7. The edible weight and cost of the foods selected for the family for the whole year for a **nutritious diet (NUT)** 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
(Avocado)	4	0.2	263	0.1	0.1	0.0	0.4	0.0	0.3	0.0	0.2	0.1	0.2	0.1	0.0	0.0	0.0	0.1
(Bean, kidney, dried, raw)	1	0.1	113	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1
(Bean, moth, mature, raw)	180	8.1	19 070	9.1	10.0	15.3	1.8	0.2	5.8	14.0	5.2	8.5	12.7	35.6	0.0	9.4	21.4	9.7
Breast milk	194	8.8	0	0.0	2.0	0.8	4.7	5.2	6.2	0.6	2.2	1.4	0.3	0.5	3.2	1.9	0.0	0.7
(Donkey, leg, with bone)	55	2.5	10 949	5.2	1.0	4.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	11.5	5.7
(Lentil, dried, raw)	215	9.8	17 529	8.4	10.4	20.3	2.4	0.3	0.0	17.6	15.8	8.4	28.4	19.4	0.0	4.6	16.5	23.5
(Maize, flour, dry)	450	20.4	28 268	13.5	26.4	13.5	10.0	0.0	0.0	24.3	28.7	34.7	26.2	3.4	0.0	0.9	17.3	22.7
(Maize, flour, fortified)	105	4.8	9 644	4.6	6.3	2.8	1.1	0.0	0.0	8.0	12.7	8.8	3.7	6.7	0.0	0.1	5.0	1.9
(Margarine, fortified)	5	0.2	1 317	0.6	0.6	0.0	2.4	2.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
(Millet, finger)	127	5.8	12 057	5.8	6.8	3.1	1.0	0.2	0.0	4.7	5.7	5.1	5.7	0.4	0.0	12.2	3.8	4.3
Omena (Fish, small, dried, fresh water)	48	2.2	34 553	16.5	2.6	10.4	2.8	0.0	0.0	0.7	4.1	15.6	3.8	0.4	96.8	28.4	6.6	7.0
(Peas, split, mature, raw)	281	12.7	20 024	9.5	15.5	25.5	2.0	1.1	4.0	28.2	19.2	13.7	9.5	23.5	0.0	5.4	13.6	23.6
Spinach (Chard, swiss)	273	12.4	16 433	7.8	0.9	1.1	0.3	40.3	58.9	1.9	6.1	3.4	9.5	9.8	0.0	13.0	2.4	0.8
(Sujaa (local))	154	7.0	16 915	8.1	1.0	2.5	0.0	50.6	24.7	0.0	0.0	0.0	0.0	0.0	0.0	23.8	1.7	0.0
Vegetable fat	114	5.2	22 547	10.8	16.3	0.0	70.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2 207	100	209 682	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	281	100	111	104	243	103	151	155	326	100	102	101	187

The percentage of target met is an average of the % nutrient requirements met over the year.

Appendix 8. The edible weight and cost of the foods selected for the **1 x Child (either sex) 6-8 months** for the whole year for a **FHAB 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
(Bean, kidney, dried, raw)	< 1	0.1	54	0.3	0.6	1.0	0.0	0.0	0.1	1.5	0.3	1.1	0.8	2.7	0.0	0.2	0.9	0.9
Breast milk	232	69.9	0	0.0	63.1	24.1	75.3	32.5	35.7	37.7	40.5	42.3	12.0	34.1	47.2	44.4	0.0	18.9
(Carrot, raw)	15	4.6	1 880	8.7	2.2	1.4	0.3	30.3	4.1	6.5	3.6	4.3	19.0	8.2	0.0	3.6	2.7	2.6
(Donkey, flesh)	6	1.8	1 291	6.0	2.9	13.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.1	14.9
(Donkey, leg, with bone)	6	1.8	1 183	5.5	2.9	13.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	29.1	14.9
(Goat, intestines and stomach, raw)	7	2.3	4 238	19.6	3.8	8.3	5.1	0.0	0.0	2.3	2.6	11.0	6.2	0.4	13.2	0.1	7.6	9.1
(Goat, raw)	4	1.4	2 520	11.7	3.5	7.7	4.7	0.0	0.0	2.1	2.5	10.3	5.7	0.3	12.3	0.1	6.9	8.8
(Kale, raw or cooked)	28	8.6	2 745	12.7	3.8	5.3	0.9	29.5	44.9	11.0	9.9	10.6	22.0	6.4	0.0	14.0	6.5	3.9
(Lentil, dried, raw)	4	1.4	365	1.7	5.6	11.3	0.7	0.0	0.0	20.5	5.2	4.3	16.9	23.0	0.0	1.9	8.0	11.9
(Milk, cow, powdered, whole)	4	1.2	3 376	15.6	8.0	9.2	9.4	4.5	1.1	9.1	24.6	10.5	9.5	3.0	24.3	22.8	1.6	8.0
(Milk, cow, UHT)	4	1.1	633	2.9	1.0	1.1	1.2	0.6	0.1	1.1	3.0	1.3	1.2	0.4	3.0	2.8	0.2	1.0
(Onion, spring or scallion, raw)	19	5.9	3 280	15.2	2.6	3.5	0.3	2.7	14.1	8.3	7.8	4.3	6.6	21.6	0.0	9.6	7.4	5.2
(Salt, iodized)	< 1	0.1	14	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Total	331	100	21 581	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	271	129	244	237	118	137	163	165	198	186	100	58	98

The percentage of target met is an average of the % nutrient requirements met over the year.

Appendix 9. The edible weight and cost of the foods selected for the **1 x Child (either sex) 9-11 months** for the whole year for a **FHAB 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
(Bean, moth, mature, raw)	7	1.8	701	2.1	8.6	11.5	0.8	0.0	0.9	23.3	2.5	6.1	11.9	44.7	0.0	6.8	12.5	7.7
Breast milk	213	59.2	0	0.0	52.4	17.0	64.9	29.8	29.7	28.0	30.7	30.3	9.7	18.9	41.1	40.8	0.0	15.4
(Carrot, raw)	12	3.2	1 445	4.4	1.5	0.8	0.3	23.3	2.8	4.1	2.3	2.6	13.0	3.8	0.0	2.8	1.4	1.8
(Chicken)	5	1.4	4 233	12.8	2.5	4.8	3.5	0.3	0.0	1.2	2.2	8.2	2.9	0.1	1.1	0.2	3.0	2.4
(Donkey, flesh)	7	1.8	1 425	4.3	2.9	11.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.9	14.6
(Donkey, leg, with bone)	7	1.8	1 306	4.0	2.9	11.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	21.9	14.6
(Egg, chicken, CotD)	13	3.7	5 068	15.3	7.5	12.3	10.6	6.8	0.0	5.6	26.9	11.2	7.6	5.9	28.4	4.4	13.6	8.6
(Goat, intestines and stomach, raw)	8	2.3	4 672	14.1	3.8	7.0	5.2	0.0	0.0	2.1	2.4	9.5	6.1	0.3	13.8	0.1	5.8	9.0
(Goat, raw)	5	1.4	2 786	8.4	3.5	6.6	4.9	0.0	0.0	1.9	2.2	8.9	5.6	0.2	13.0	0.1	5.2	8.7
(Kale, raw or cooked)	31	8.7	3 035	9.2	3.8	4.5	1.0	32.6	45.0	9.8	9.0	9.1	21.6	4.3	0.0	15.5	4.9	3.8
(Lentil, dried, raw)	2	0.5	154	0.5	2.1	3.7	0.3	0.0	0.0	7.0	1.8	1.4	6.3	5.8	0.0	0.8	2.3	4.5
(Milk, goat, fresh)	18	5.1	3 075	9.3	4.8	5.1	5.9	2.9	0.6	5.8	10.6	6.3	4.5	0.2	2.6	16.9	0.8	3.3
(Onion, spring or scallion, raw)	21	6.0	3 619	11.0	2.6	3.0	0.3	3.0	14.1	7.4	7.1	3.7	6.4	14.3	0.0	10.6	5.6	5.0
(Salt, iodized)	< 1	0.1	18	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
(Tomato paste, concentrated)	< 1	0.1	99	0.3	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.3	0.3	0.0	0.0	0.1	0.2	0.1
(Tomato, CotD)	10	2.8	1 404	4.2	0.8	0.7	0.2	1.2	6.5	3.7	2.0	2.3	3.9	1.5	0.0	0.3	0.9	0.6
Total	359	100	33 040	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	317	125	244	261	146	166	208	186	328	196	100	84	111

The percentage of target met is an average of the % nutrient requirements met over the year.

Appendix 10. The edible weight and cost of the foods selected for the **1 x Child (either sex) 12-23 months** for the whole year for a **FHAB 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 target met for each nutrient, averaged across the seasons in the Central Pastoral Livelihood Zone.

Food List	Quantity (Kg)	% quantity	Cost (KES)	% cost	% energy	% protein	% fat	% vit A	% vit C	% vit B1	% vit B2	% niacin	% vit B6	% folic acid	% vit B12	% calcium	% iron	% zinc
(Bean, kidney, dried, raw)	17	5.6	1 965	12.5	16.3	24.4	1.9	0.0	2.7	22.1	9.8	28.3	22.1	32.0	0.0	6.5	29.4	25.3
(Bean, moth, mature, raw)	8	2.8	879	5.6	8.6	12.5	1.2	0.1	1.8	15.1	3.0	6.7	13.0	31.1	0.0	6.8	21.2	8.7
Breast milk	194	65.5	0	0.0	38.1	13.4	67.7	45.6	42.8	13.3	26.7	24.3	7.8	9.6	52.7	29.8	0.0	12.7
(Donkey, leg, with bone)	4	1.3	757	4.8	1.3	5.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	17.2	7.7
(Kale, raw or cooked)	21	7.2	1 963	12.5	2.1	2.7	0.8	37.3	48.4	3.5	5.9	5.5	12.9	1.6	0.0	8.5	4.6	2.3
(Lentil, dried, raw)	6	2.1	505	3.2	5.6	10.3	1.0	0.1	0.0	11.9	5.6	4.1	18.1	10.6	0.0	2.1	10.3	13.2
(Maize, flour, dry)	1	0.4	70	0.4	1.4	0.7	0.4	0.0	0.0	1.6	1.0	1.7	1.7	0.2	0.0	0.0	1.1	1.3
(Milk, cow, powdered, whole)	5	1.7	4 375	27.8	7.5	7.9	13.2	9.7	2.0	5.0	25.2	9.4	9.6	1.3	42.2	23.8	2.0	8.4
(Milk, goat, fresh)	26	8.9	4 166	26.5	5.5	6.2	9.6	6.9	1.4	4.3	14.4	7.8	5.6	0.2	5.1	19.3	1.5	4.3
(Peas, split, mature, raw)	8	2.8	632	4.0	8.5	13.3	0.9	0.3	0.8	19.6	7.0	6.9	6.2	13.1	0.0	2.5	8.7	13.6
(Salt, iodized)	< 1	0.1	22	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
(Sorghum, grain or flour, CotD)	4	1.5	344	2.2	4.5	2.9	1.0	0.1	0.0	3.6	1.5	5.4	3.0	0.3	0.0	0.4	4.2	2.4
Vegetable fat (Fat, vegetable, cowboy, kapra or kimbo)	< 1	0.1	38	0.2	0.5	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	297	100	15 715	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% target met					100	308	101	146	166	168	140	158	128	316	109	100	100	122

The percentage of target met is an average of the % nutrient requirements met over the year.

Appendix 11. Specifications of micronutrient powders used in the model in section 4.3.4.1.

a. A picture of the packaging of micronutrient powders currently used in some parts of Kenya as part of high impact nutrition interventions.

b. A picture of Sprinkles™ packaging.

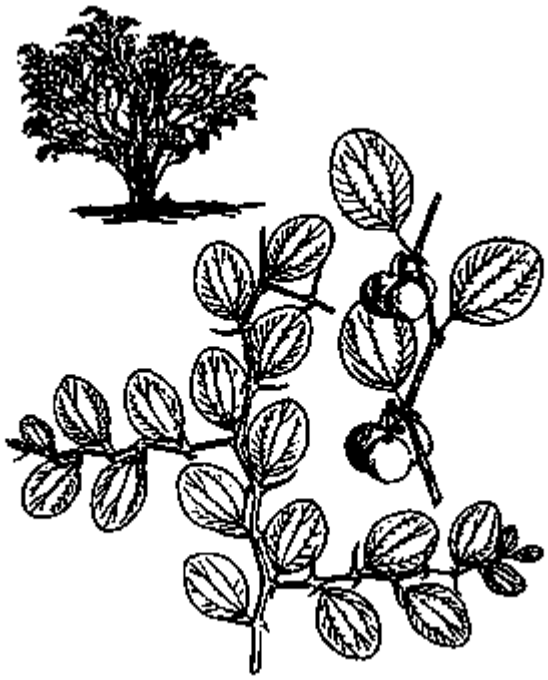
Appendix 12. Specifications of micronutrient powders used in the model.

Appendix 12a. Summary of nutritional information per 100g for ng'akalaleo, esekhon and eng'ol.

	Local name	**ng'akalaleo**	**esekhon**	**eng'ol**
	Latin Name	*Ziziphus mauritiana*	*salvadora persica*	*hyphaene compressa*
Nutritional information per 100g	Energy (kcal)	240.2	200.0	361.9
	Protein (g)	3.7	14.8	2.4
	Fat (g)	0.1	5.3	0.4
	Vitamin C (mg)	35.0	0.0	0.0
	Vitamin B1 (mg)	0.0	0.0	9.2
	Vitamin B2 (mg)	0.0	0.0	6.9
	Niacin (mg)	2.1	0.0	3.6
	Iron (mg)	3.1	300.0	12.2
	Calcium (mg)	170.0	875.0	284.0
	Magnesium (mg)	0.0	125.0	94.9
	Zinc (mg)	-	-	6.7

Appendix 12b. A photo of the *hyphaene compressa* fruit taken in the field during data collection.

Appendix 12c. An image of *salvadora persica*, taken from Maundu, P. M. (1999).



Appendix 12c. An image of *ziziphus mauritiana*, taken from Maundu, P. M. (1999).