April 2011

Integrated SMART Survey
Nutrition, WASH, Food Security and Livelihoods

Kitui District

Kenya

Funded by

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Abbreviations

ALRMP	Arid Lands Resource Management Project
ASAL	Arid and Semi-Arid Lands
BSFP	Blanket Supplementary Feeding Programme
CI	Confidence Interval
CSB	Corn-Soya Blend
CTC	Community Therapeutic Care
DNOs	District Nutrition Officers
ENA	Emergency Nutrition Assessment
FFA	Food for Assets
GAM	Global Acute Malnutrition
GFD	General Food Distribution
HDDS	Household Dietary Diversity Score
IYCF	Infant and Young Child Feeding
KAP	Knowledge, Attitudes and Practices
KFSSG	Kenya Food Security Steering Group
MOH	Ministry of Health
MUAC	Middle Upper Arm Circumference
NGOs	Non-governmental Organizations
OTP	Outpatient therapeutic Programme
SC	Stabilization Centre
SFP	Supplementary Feeding Programme
SMART	Standardized Monitoring and Assessment of Relief and Transition
VCT	Voluntary Counselling and Testing
WFH	Weight for Height
WFP	World Food Programme
WHO	World Health Organization

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- UNICEF for providing financial support for the survey;
- Ministry of Health team in the Larger Kitui district, especially District Nutrition Officers from Mutomo and Kitui Districts. They provided relevant team support and vital information necessary for planning the survey;
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- District Commissioners, District Arid Lands Management Project office, District Health Planning Teams, Chiefs and Sub-chiefs from Kitui, Mutito and Mutomo districts. They all helped in mobilization, availed relevant population data, and introduced the survey team to important contacts. This both smoothed the planning and implementation of the survey;
- Village elders in Mutomo, Mutito, Ikutha and Mwitika for acting as guides to the teams in survey locations;
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- Survey drivers for timely and efficient transport and delivery.

1. Executive Summary

Research and anecdotal evidence show that Kitui is, for the most part, a food stressed district. Different studies have identified Kitui as a borderline food insecure district that easily regresses to food crisis after slight shocks. Food emergency operations have been conducted in the district since 2004.

In 2009, when the last ACF study was carried out, emergency operations had to be scaled up due to a prolonged drought that devastated both crops and livestock. The situation stabilized somewhat in 2010 hence reducing the number of beneficiaries in 2011. This trend is exemplified in the number of beneficiaries under emergency food operations: 297, 000 in 2009 and 371 00 in 2011.

Furthermore, the Kenya Food Security Steering Group (KFSSG) reports that Mutomo and Mutito Districts harvested less than 15% of anticipated crop yield while areas like Athi and Ikutha experienced total crop failure[1]. Despite reports that the prevailing nutritional status is stable cases of acute malnutrition have indicated in the marginal mixed farming livelihood zone.

The nutrition survey was implemented using the Standardized Monitoring and Assessment of Relief and Transitions (SMART) methodology in Mutomo and Mutito districts the larger Kitui. Mutomo and Mutito districts fall under the Marginal farming livelihood zone.

The specific sample areas studied were, Ikutha, Mutomo, Mwitika and Mutito.

The survey was implemented in collaboration with the Ministry of Health (MoH), Arid Lands Resources Management Project (ALRMP) and the Kenya National Bureau of Statistics (KNBS). A 4 day SMART Methodology training took place from April 13 to 16′ 2011, while data collection was carried out between April 18 and 29, 2011.

Methodology

Two-stage cluster sampling with probability proportional to size (PPS) methodology was used. Population data was obtained from chiefs, sub-chiefs and village elders.

Emergency Nutrition Assessment (ENA) for SMART software was used in determining the sample size using results of October 2009 Nutrition Survey. The survey results reported a GAM of 8.9% (7.0 – 10.9) and SAM of 1.5% (0.7 – 3). The upper limit of 10.9, precision of 3.5, a design effect of 2.0 and a 3% non-response rate were fed into ENA resulting in 609 children, (482 HH).

For mortality, a prevalence of 0.15 per 10,000/day, precision of 0.18 and design effect of 2 resulted in a sample size of 477 households (population=2964). The maximum number of households (482) was used in the sample. This was translated into 37x13 cluster design with an overall sample size of 482 households with an estimate to cover 13 households each day.

In the second stage, household selection was done using systematic random sampling. Lists of all households in respective clusters were provided by village elders. The total number of households in each village or cluster was divided by the number of households that could be visited by a team in a day (13) to determine the sampling interval.

A random number was then chosen to select the first household and the sampling interval repeatedly added to determine the remaining sample households. Respondents were primarily heads of households and their spouses.

Survey Implementation

Five survey teams, each comprising a team leader and four data collectors were constituted. The five team leaders were from the Ministry of Health (4) and KNBS (1).

[1] KFSSG Long Rain Assessment, August 2010.

A four day (13th to 16th April 2011) intensive training on SMART methodology was conducted. The field data collection took place on 18th to 29th April, 2011, covering 37 clusters and 13 households per cluster.

The anthropometric and mortality data were entered and analyzed using ENA, October 2008 version. Food Security and Water & Sanitation data entry was done in SPSS version 12.

Survey Results

A total of 678 children (351 male and 327 female) aged 6-59 months and for mortality 4,016 people from 561 households were surveyed. The mean household size and number of Under five children per household was 7.2 and 1.3 respectively. Global acute malnutrition (GAM) was 6.5% (95% CI: 4.5 – 9.3), severe acute malnutrition (SAM) was 0.9% (95% CI: 0.4-2.2) and there was one case (0.1%) of oedema.

The Crude Death Rate finding was 0.08 (0.03-0.24) per 10,000 persons per day, below the emergency threshold of 1/10,000/day.

Over half (58.7%) of the surveyed children had some form of illness in the two weeks prior to the survey an indication of a high incidence of disease. The most commonly reported illnesses included fevers, one associated with malaria (32%) and the other with cough (27.4%). Diarrheal incidents were reported at 12.4 %. Illness exacerbates a poor nutritional status which in turn reduces the body's ability to utilize nutrients.

Measles vaccination coverage was adequate at 70.1%, by card, as was coverage for vitamin A supplementation (55.5%). This coverage however is lower than the targeted 80%.

53.9% (16.2%, protected, plus 37.7%, unprotected) of households get water from shallow wells that mostly do not provide water all year round. 42.9% of the households spend more than one hour to reach a water source. The 55.3% of respondents that treat water several methods: Chemical treatment (34%), boiling (25.3%), decantation (8.4%) and filtration (1.8%). Water and sanitation practices indicated are below SPHERE standards, a potential health hazard and predisposing factor to malnutrition.

The major source of food for most purchases was reported as purchases (87.9%), followed by cultivation at 10.9%. The average number of food groups consumed based on the 12 food groups and 24 hour recall period was 4.5. Despite an astonishing 99.5% respondents reporting farming as the major economic activity, only 21.9% reported having food stocks from the previous planting season.

Table I: Summary of key Findings

Index	***Indicator***		***Results***[2]
WHO (n=678)	*Z- scores*	*Global Acute Malnutrition* W/H < -2 z and/or oedema	6.5% [4.5-9.3]
		Severe Acute Malnutrition W/H < -3 z and/or oedema	0.9% [0.4- 2.2]
NCHS (n-678)	*Z-scores*	*Global Acute Malnutrition* W/H < -2 z and/or oedema	7.4% [5.2-10.3]
		Severe Acute Malnutrition W/H < -3 z and/or oedema	0.1% [0.0-1.1]
	% Median	*Global Acute Malnutrition* W/H < 80% and/or oedema	2.9% [1.8-4.8]
		Severe Acute Malnutrition W/H < 70% and/or oedema	0.1 [0.0-1.1]

[2] Results in brackets are at 95% confidence intervals

MUAC	*Height> 65 cm*	*Global Acute Malnutrition* MUAC <12.5cm	3.9% [2.5-5.4]
		Severe Acute Malnutrition MUAC <11.5 cm	0.6% [0.0-1.2]
Total crude retrospective mortality (90 days)/10,000/ day Under five crude retrospective mortality/10,000/day			0.08 [0.03 – 0.24] 0.00 [0.00-0.61]
Measles Vaccination by card			70.1
Children who received vitamin A supplementation in past one year			55.5
Proportion of children 6-59 months of age with diarrhea in 2 weeks prior to the survey			12.4
Proportion of children 6 – 59 months with chills like malaria in 2 weeks prior to the survey			32
Proportion of children 6-59 months of age with fever or difficulty in breathing two weeks prior to the survey			27.4
Proportion of children in a treatment program (OTP/SFP)			4.6
Proportion of children who took ORS in diarrheal conditions			66.6
Proportion of children who took home made sugar solutions during diarrheal conditions.			19.9
Proportion of children who have taken drugs for intestinal worms			34
Proportion of women who took iron pills during pregnancy			68.0
Proportion of households with a family latrine within the compound			54.3
Proportion of household member with at least one mosquito net the night before the survey			67.4
Proportion of those engaged in crop farming at the time of survey			99.5
Mean household dietary diversity score			5.83

2. Background information

Kitui is presently a County comprising the former Kitui and Mwingi districts[3]. For the purposes of this study though, Kitui refers to the larger Kitui district composed of Kitui Central, Mutomo, Matinyani, Kabati, Lower Yatta, Mutitu, Chuluni, Katulani and Nzambani. Kitui is bounded by Mwingi to the north, Taita Taveta to the south, Tana River to the east, Makueni to the west and Machakos to the northwest. It is located between Longitudes 37^0 45' and 39^0 0' east and Latitudes 0^0 3.7' and 3^0 0' south in what is generally referred to as the Eastern lowlands of Kenya. Kitui covers an area of 21, 402 km^2 of which approximately 7000 km^2, 33%, is the Tsavo National Park. Most of the districts (Sub-Counties) are sparsely populated making the provision of amenities and services a challenge due to the vastness of the region. According to the 2009 National Census has a population of approximately 627, 761. Kitui Central and Matinyani Sub-Counties are relatively densely populated while Mwitika, Ikutha, and Yatta are sparsely opulated. Evidently, population density tracks agricultural potential. By livelihood zone, the district population is classified as mixed farming (69%), marginal mixed farming (28%) and formal employment/casual labour (3%).

The district's marginal climate notwithstanding, a majority of the population are classified as farmers (including pastoralists) who rely on different farm activities for a livelihood (Kenya Health and Demographic Survey, 2009). Rain fed agriculture; near absence of irrigation and the smallholder nature of most farmers (including pastoralists) have profound food security and nutritional status consequences. The district is characterized by food insufficiencies and by corollary nutritional inadequacies. Different studies classify Kitui as a borderline food insecure district that only takes slight shocks to regress into acute food crisis. Many reports, government and non-government have identified food insecurity and, by corollary, nutritional inadequacies as a major challenge in Kitui (Kenya Demographic and Health Survey, 2009). In order to cope with this and related challenges, households combine farming activities with other livelihood sources.

While about 95% of the population engages in some form of farming practices, livelihood sources for a majority of the population are eclectic, a coping strategy. Livelihood sources evident in the district can be disaggregated into the following, casual labour (35%), remittances (21%) and small and microenterprises (18%). Other sources of livelihood include formal employment (11%) and charcoal burning (9%) (Arid Land Resource Management Project, 2011). Formal employment is concentrated in Kitui town, other small towns in the district and around the district in professions like teaching and nursing. Furthermore, only about 2% of the district is classified as being agriculturally high potential. Major crops include cereals (maize, sorghum, and millet), pulses (beans, green grams, pigeon peas, and cow peas), cassava and sweet potatoes, the latter two only in small quantities. Livestock keeping is an important livelihood strategy in the district. Indigenous breeds of cows, goats, sheep and poultry are evident. Nonetheless the district is highly vulnerable to weather shocks that usually compound the challenges and ultimately reduce household living standards while increasing the levels of poverty.

A 2010 Ministry of Planning report found the incidence of absolute poverty to be about 66% and 65% in rural and urban areas respectively. Development indicators are, consequently, sub-optimal and well below the national average. Health indicators in the district show a number of challenges: life expectancy is 51 years, well below the national average, a doctor to patient ratio of 1: 16, 047, under 5 mortality rate of 98/1000 and an HIV/AIDS prevalence rate of 14% among others. Malaria is a big challenge in the district while the prevalence of HIV/AIDS is, at 14%, inordinately high. Its spread is mostly evident in Kitui and Mutomo townships as well as other towns like Mutitu, Kabati, Wikililye and Mutonguni (Government of Kenya, 2010). Kitui has 92 healthcare facilities spread across the vast region. However, the facilities are poorly equipped and understaffed and therefore do not render effective and efficient delivery of health services (Kenya Demographic and Health Survey, 2009). Given the district's large footprint and a poor infrastructure, the healthcare facilities are not readily accessible. The average distance to the nearest healthcare facility is 5km.

[3] While this report refers to Kitui district, Kitui is now a County made up of all former districts under the larger Kitui district as well as all districts under the former larger Mwingi district. The term Kitui district in this report refers to pre-August 2010 Kitui district.

With regard to education indicators, the district has approximately 600 schools around the vast area meaning that there are great distances between schools. The teacher: pupil ratio is 1: 13. Government reports indicate high school dropouts (associated with more deeper causes), early marriages and a high prevalence of child neglect evidenced by neglected children in several major towns in the district (Government of Kenya, 2009).Other important indicators include environmental: Kitui is water stressed and with a very low vegetation cover. Nonetheless, charcoal burning is prevalent, contributing to further environmental degradation, inappropriate farming methods, unprotected water catchments, a very low incidence of irrigation and water harvesting practices.

Kitui has a presence of many non-state actors including religious organizations, NGOs and CBOs that work singly or in concert to address the district's challenges. The government is represented especially by the Ministries of Education, Health and Public Health, Agriculture, Water and Irrigation and Development of Northern Kenya and other Arid Areas.

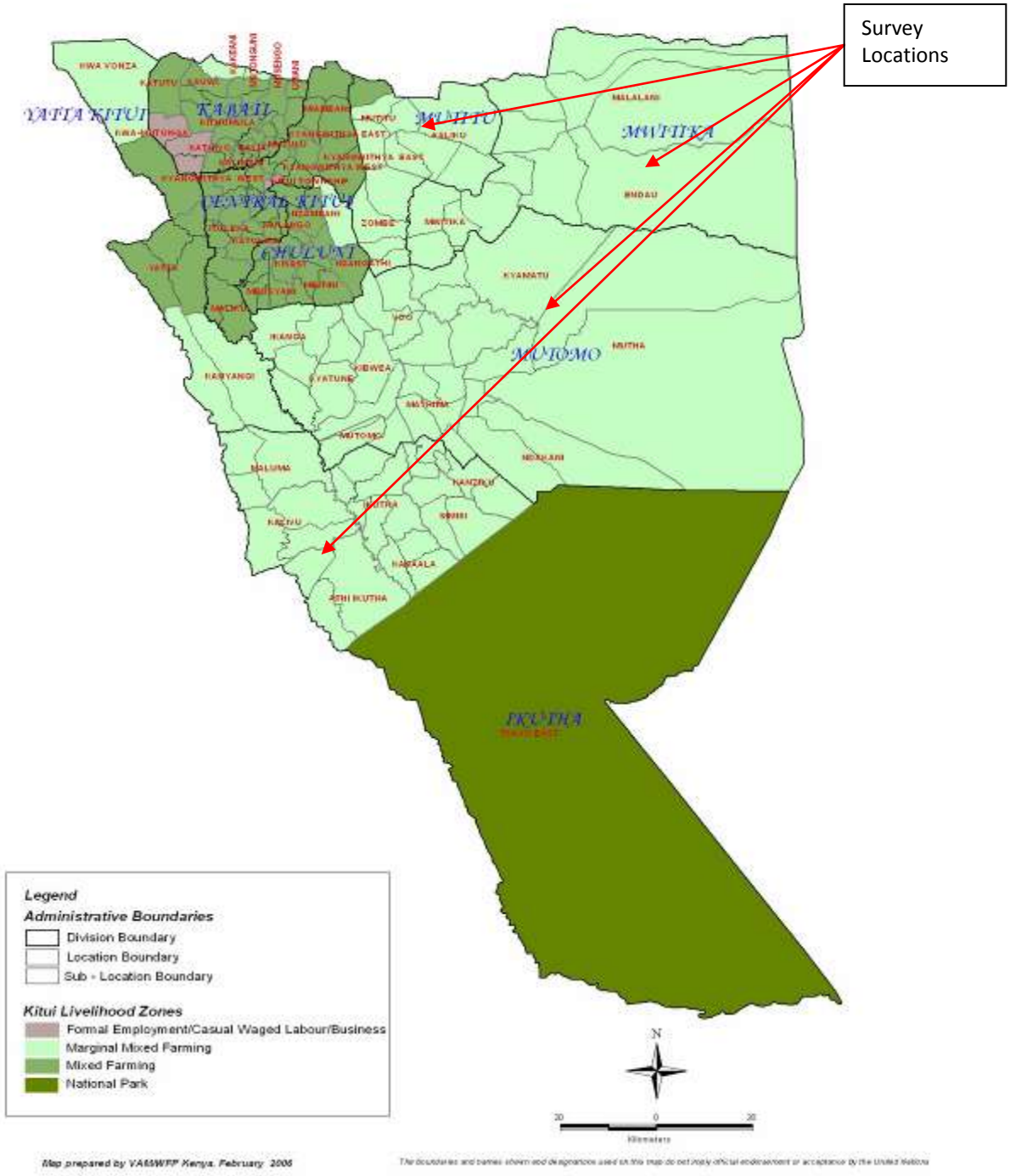
3. Survey Objectives

The overall objective of the survey was to determine the level of acute malnutrition among children aged 6-59 months and to analyze the possible factors contributing to malnutrition.

Specific objectives includ:

- Assessing the prevalence of acute malnutrition in children aged 6-59 months
- Estimating the Crude and under five mortality rates
- Determine the Infant and Young child feeding practices among children 0 – 23 months.
- Investigate household food security and food consumption patterns.
- Estimate Morbidity rates of children 6 – 59 months.
- Determine the proportion of households with access to safe water.

Figure I: Areas Surveyed in the district.



4. Methodology

4.1. Sampling

A two-stage cluster sampling design with probability proportional to size (PPS) design was employed for this survey. The Emergency Nutrition Assessment (ENA) software for

SMART was used to determine the sample size required. Village level population data were obtained from chiefs, sub-chiefs and elders in respective locations. The October 2009 Nutrition Survey was used to determine sample size which had a GAM rate of 8.9% (7.0 – 10.9 C.I) and SAM 1.5% (0.7 – 3.0 C.I). In this regard, the upper limit, 10.9 was used as highest estimated prevalence, precision of 3.5%, a design effect of 2 and a 3% non response rate giving 609 children (482 households).

For mortality, an estimated prevalence of 0.15 per 10,000/day, precision of 0.18 and design effect 1.5. The sample size was determined at 477 households and a targeted population of 2964. The maximum number of households for anthropometry (482) was used. This was translated to 37x13 cluster design with an overall sample size 482 households, as 13 was the estimated maximum number of households a team could survey in one day.

In the second stage, selection of household was done using systematic random sampling from a list of households availed by village elders. The total number of households in each village or cluster was divided by the required sample size per cluster (13) to determine the sampling interval. A random number was then chosen between 1 and the sampling interval to select the first household and the sampling interval repeatedly added to determine the remaining households. Respondents were primarily heads of households and spouses. Additional information was collected from the relevant household members.

4.2. Training and organization of survey teams

A four day intensive training held on 13th to 16th April, 2011 was done for 20 data collectors and five team leaders. The training focused on aspects of the survey implementation, objectives, household selection, MUAC, height and weight measurements and the Food Security and Livelihoods questionnaire. The five team leaders in Kitui were from the Ministry of Health (4) and KNBS (1). Five survey teams each comprising of a team leader, four data collectors were organized based on the number of clusters to be completed and households/children to be interviewed or measured per cluster. Each team did one cluster in a day (13 households).

4.3. Data Quality Assurance Processes

To ensure data quality a number of steps were taken: (i) a standardization test was carried out on the second day of training but results were unsatisfactory because participants had not taken accurate and precise measurements. Consequently a second standardization was carried out leading to desirable and expected outputs from the participants; (ii) a field test was carried out in a village that was not in the sample, adjacent to Kitui town; (iii) a local events calendar developed by the survey data collectors was used in incidences where mothers or caretakers were unable to provide an immunization card with birth dates clearly indicated; and, (iv) at the end of each day, anthropometric data was entered into ENA, plausibility check performed and feedback relayed to the respective teams.

4.4. Data Collection

The field data collection was conducted from 13th to 29th of April, 2011, covering the 37 clusters/villages and 13 households from each cluster. The following categories of data were collected using three survey instruments.

- Anthropometric data (Weight, Height, MUAC, Immunization and Disease prevalence)
- Mortality questionnaires
- Food security and livelihoods questionnaire, incorporating HINI indicators and IYCF practices.

a) Anthropometric Indicators:

Children aged 6-59 months were measured using the standard survey form (see annexes) that captures the following key variables:

- Age in months-determined from child card or with the help of a local calendar of events
- Sex- recorded as ‘m’ for male and ‘f’ for female

- Weight- Children were weighed to the nearest 100 g with a Salter Hanging Scale of 25 kg. All scales were calibrated daily by using a standard weight of 1 kg at the end of the survey exercise. In the field, it was calibrated with an empty weighing pant before each measurement.
- Height- Children were measured on a measuring board (precision of 0.1cm).Children less than 85cm were measured lying down, while those greater than or equal to 85cm were measured standing up.
- Mid-Upper Arm Circumference (MUAC) - measured in centimeters at mid-point of left upper arm to the nearest 0.1 cm with a MUAC tape.
- Bilateral oedema - assessed by the application of moderate thumb pressure for at least three seconds to both feet (upper side) simultaneously. Only children with bilateral oedema were recorded as having nutritional oedema.
- Measles vaccination- recorded for children aged 9-59 months from their vaccination cards. If no card was available at the time of the survey, the caretaker was asked if the child had been immunized against measles or not.
- Vitamin A coverage- assessed by first describing what a Vitamin A capsule looked like, then asking the mother if the child received the content of that capsule in the past. The answer was then recorded depending on how many times the child had received it in the last one year.
- Illness- assessed by asking each caretaker whether the child selected aged 6-59 months data was sick in the two weeks prior to the date of the survey. If the response was positive then the caretaker was further asked regarding the type of illnesses and the responses recorded.

b) Mortality

The data required for estimating the death rate were collected using the SMART mortality survey form and 90 days recall period. The recall period estimated from mid January (18^{th}) and the start of the survey. Each sample household regardless of having children 6-59 months of age was asked to enumerate current household members, indicate sex and age, members present at the time of the survey and at the beginning of the recall period, people joined or left during the recall period, and whether there was any birth or death in the recall period.

c) Food Security and WASH

From the same households the mortality data were collected, the WASH and food security questionnaires were administered to the head of the household and/or the spouse regardless of whether the selected household had a child 6-59 months of age. The questionnaire used to gather data on health related variables from mothers with children under five, High Impact Nutrition Indicators data, water availability and accessibility, sanitation and hygiene practices, crop and livestock production, food sources, dietary diversity, income and expenditure and coping strategies.

4.5. Data Entry and Analysis

The anthropometric and mortality data were entered and analyzed using the ENA Software, November 2008 version. The food security and WASH data entered and analyzed in SPSS. In assessing the nutritional status of children 6-59 months old, data on immediate and underlying causes of malnutrition such as disease, health seeking behavior, water and sanitation and food security and livelihood indicators were analyzed. Nutrition status is improved when individuals are healthy, have secure access to food and access to resources and livelihood options. This analytical approach provided the framework in identifying possible casual factors leading to the final outcome of malnutrition.

a) Analysis of Acute Malnutrition

Acute malnutrition rates are estimated from the weight for height (WFH) index values combined with the presence of oedema. The WFH indices are expressed in both Z-scores and percentage of the median, according to WHO 2005 and NCHS 1977 reference standards.

Z-Score

- Severe malnutrition is defined by WFH < -3 SD and/or existing bilateral oedema on the lower limbs.
- Moderate malnutrition is defined by WFH < -2 SD and >-3 SD and no oedema.
- Global acute malnutrition is defined by WFH < -2 SD and/or existing bilateral oedema.

Percentage of Median

- Severe malnutrition is defined by WFH < 70 % and/or existing bilateral oedema on the lower limbs
- Moderate malnutrition is defined by WFH < 80 % and >70 % and no oedema.
- Global acute malnutrition is defined by WFH <80% and/or existing bilateral oedema

b) Analysis of Retrospective Mortality

The Crude Death Rate is defined as the number of people in the total population who died between the start of the recall period and the time of the survey. It is calculated using the following formula.
Crude Mortality Rate (CMR) = 10,000/a*f/ (b+f/2-e/2+d/2-c/2), Where:
a = Number of recall days
b= Number of current household residents
c = Number of people who joined household
d = Number of people who left household
e = Number of births during recall
f = Number of deaths during recall period

Crude Mortality Rate (CMR):
Alert level: 1/10,000 people/day
Emergency level: 2/10,000 people/day

Under Five Mortality Rate (U5MR):
Alert level: 2/10,000 people/day
Emergency level: 4/10,000 people/day

c) Additional health information

- Illnesses of Children < 5 years and Health Seeking Behavior, Morbidity: illnesses and treatment seeking behavior and sources of health services.
- Infant and Young Child Feeding practices
- Immunization (measles) and vitamin A coverage
- Mosquito nets utilization

d) Food Security and Livelihoods

- In order to better understand the food security and livelihoods dynamics, the data collected and the analytical approaches include:
- Analysis of crop and livestock production practices and ownership structure and contribution to food security and livelihoods
- Dietary diversity score based on 12 food groups

e) WASH

- Sources of water and distance to the nearest sources, safety and quantity of water use for household consumption and its relation to nutritional outcomes
- Water treatment and hand washing practices
- Access to and utilization of latrines
- Solid waste practices

5. Results & Discussion

5.1. Socio-Demographic Characteristics

In order to situate the study, a number of socio-demographic data were collected at the household level. The mean number of people per household was 7.2 and 1.3 person and children under five respectively. In the anthropometric survey, 678 children were measured, 351 boys and 327 girls. 82% of the households are headed by males and the remaining, 18%, by females. While the highest education level for the majority of household heads is primary school (63.2%) another 18.9% have no formal education (functional illiteracy). 3.2% have non-formal education while 10% have a secondary school education. Only 4.1% of household heads interviewed have a post secondary education. Results show the area is predominantly of poor socioeconomic status. Farming (49.3%) is the major source of livelihood for household heads. Other important occupations for household heads include daily wage labor (26.9%) and formal/monthly employment (9.6%). The prominence of farming as the major livelihoods earner in Kitui underlie the importance of agriculture, and by extension, weather patterns since most farmers depend on rain fed agriculture.

Table II: Demographic characteristics

Characteristic	Description	%
Household head	Male	82
	Female	18
Occupation of household head	Livestock herding	2.3
	Farmer/own farm labour	49.3
	Employed (salaried)	9.6
	Daily/wage labour	26.9
	Trade/microenterprise	10.3
	Other	1.4

Figure II: Household head level of education

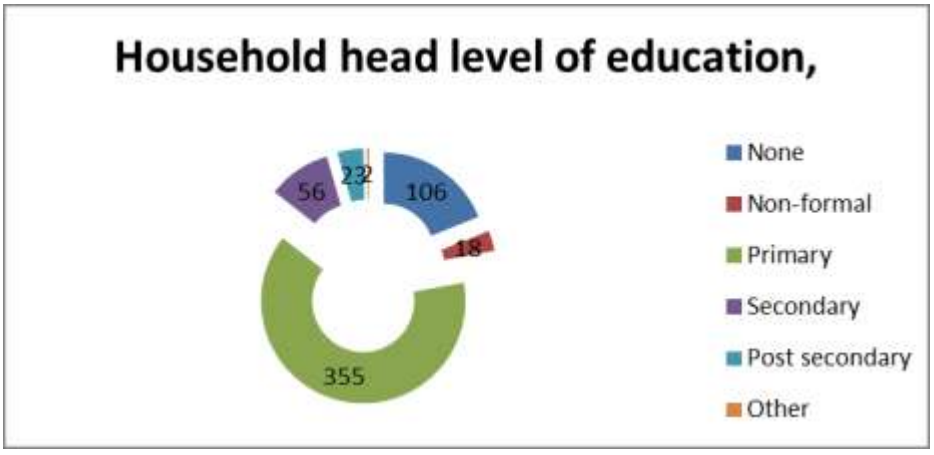


Table II shows that age distribution was within the acceptable range of the overall ratio of boys to girls (calculated by diving the total number of boys with the total number of girls) was 1.1which was within the recommended range of 0.8 – 1.2[4]

Table III: Distribution of age and sex of sample

Age	*Boys*		*Girls*		*Total*		*Ratio*
	No.	**%**	**No.**	**%**	**No.**	**%**	**Boy: girl**
6-17 months	69	52.7	62	47.3	131	19.3	1.1
18-29 months	74	50.0	74	50.0	148	21.8	1.0
30-41 months	94	56.6	72	43.4	166	24.5	1.3
42-53 months	80	45.7	95	54.3	175	25.8	0.8
54-59 months	34	58.6	24	41.4	58	8.6	1.4
Total	351	51.8	327	48.2	678	100.0	1.1

5.2. Nutritional Status

The malnutrition levels unveiled by this survey indicate rates below the emergency GAM thresholds (15.0%) and within acceptable range. The prevailing GAM and SAM rate is 6.5% and 0.9% respectively. One oedema case was reported in this study. Compared to the previous survey the nutrition situation seems to have improved. It is important to note however that the previous survey was conducted in October at a time when there was a food crisis. ALRMP results from most recent nutrition assessment by MUAC shows, the nutrition status of children below five years remained stable, with the percentage of those rated at risk of malnutrition standing at 8%. Improvement could be attributed to the intensified nutrition campaigns and the MCH programme in the district[5].

There was no significant difference between nutritional status and occupation, however significant differences were seen in education (p=0.01).

a) Prevalence of malnutrition by Z-scores

Table IV: Prevalence of acute malnutrition based on weight-for-height z-scores (and/or oedema) and by sex (WHO standards)

	All ***n = 678***	***Boys*** ***N = 351***	***Girls*** ***n = 327***
Prevalence of global malnutrition (<-2 z-score and/or oedema)	(44) 6.5 % (4.5 - 9.3.)	(26) 7.4 % (4.6 - 11.7)	(18) 5.5 % (3.2 - 9.4)
Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	(38) 5.6 % (3.8 - 8.2)	(23) 6.6 % (3.9 - 10.7)	(15) 4.6 % (2.4 - 8.5)
Prevalence of severe malnutrition (<-3 z-score and/or oedema)	(6) 0.9 % (0.4 - 2.2)	(3) 0.9 % (0.3 - 2.6)	(3) 0.9 % (0.2 - 3.9)

Table V: Prevalence of acute malnutrition based on weight-for-height z-scores (and/or oedema) and by NCHS

	All n = 678	Boys n = 351	Girls n = 327
Prevalence of global malnutrition (<-2 z-score and/or oedema)	(50) 7.4 % (5.2 - 10.3)	(26) 7.4 % (4.8 - 11.2)	(24) 7.3 % (4.6 - 11.4)
Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	(49) 7.2 % (5.2 - 10.0)	(26) 7.4 % (4.8 - 11.2)	(23) 7.0 % (4.4 - 11.1)
Prevalence of severe malnutrition (<-3 z-score and/or oedema)	(1) 0.1 % (0.0 - 1.1)	(0) 0.0 % (0.0 - 0.0)	(1) 0.3 % (0.0 - 2.2)

[4] Assessment and Treatment of Malnutrition in Emergency Situations, Claudine Prudhon, Action Contre la Faim (Action Against Hunger), 2002.
[5] Drought monitoring bulletin, March 2011, Kitui District.

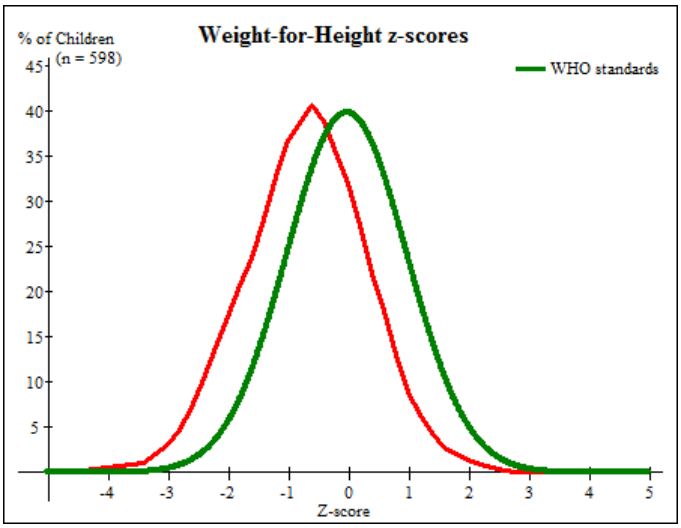
Prevalence of GAM by NCHS increased to 7.4%, whilst SAM reduced to 0.1%. One case of Oedema was confirmed in Ikutha area. WHO standards however are considered to be more representative.

Table VI: Prevalence of acute malnutrition by age based on weight-for-height z-scores and/or oedema WHO standards.

Age (mths)	Total no.	*Severe wasting (<-3 z-score)*		*Moderate wasting (>= -3 and <-2 z-score)*		*Normal (> = -2 z score)*		*Oedema*	
		No.	%	No.	%	No.	%	No.	%
6-17	131	0	0.0	5	3.8	126	96.2	0	0.0
18-29	148	0	0.0	14	9.5	134	90.5	0	0.0
30-41	166	0	0.0	14	8.4	151	91.0	1	0.6
42-53	175	0	0.0	9	5.1	166	94.9	0	0.0
54-59	58	0	0.0	7	12.1	51	87.9	0	0.0
Total	678	0	0.0	49	7.2	628	92.6	1	0.1

The sample curve shows some displacement to the left of the reference population. This is an indication of poor nutrition status of the sampled population in comparison to the reference population.

Figure III: GAM and SAM graph (WHO)



b) Prevalence of malnutrition by percentage of the median

As expected, the prevalence of acute malnutrition based on percentage of the median is lower than weight for height z-scores. In Kitui, a GAM of 2.9% and SAM of 0.1% were reported. The percentage of the median is a sensitive indicator for acute malnutrition.

Table VII: Prevalence of acute malnutrition based on the percentage of the median and/or oedema

	n = 678
Prevalence of global acute malnutrition (<80% and/or oedema)	(20) 2.9 % (1.8 - 4.8)
Prevalence of moderate acute malnutrition (<80% and >= 70%, no oedema)	(19) 2.8 % (1.7 - 4.6)
Prevalence of severe acute malnutrition (<70% and/or oedema)	(1) 0.1 % (0.0 - 1.1)

Table VIII: Prevalence of malnutrition by age, based on weight-for-height percentage of the median and oedema

Age (mths)	Total no.	*Severe wasting (<70% median)*		*Moderate wasting (>=70% and <80% median)*		*Normal (> =80% median)*		*Oedema*	
		No.	%	No.	%	No.	%	No.	%
6-17	131	0	0.0	3	2.3	128	97.7	0	0.0
18-29	148	0	0.0	7	4.7	141	95.3	0	0.0
30-41	166	0	0.0	4	2.4	161	97.0	1	0.6
42-53	175	0	0.0	2	1.1	173	98.9	0	0.0
54-59	58	0	0.0	3	5.2	55	94.8	0	0.0
Total	678	0	0.0	19	2.8	658	97.1	1	0.1

GAM and SAM by MUAC was high, background investigation in most cases revealed that is due to negligence and poor IYCF practices. The GAM and SAM in Kitui is 3.9% and 0.6% respectively.

c) Prevalence of malnutrition by MUAC

Table IXI: Prevalence of GAM and SAM by MUAC

MUAC (mm)	*>=65 - < 75 cm height*		*>=75 – < 90 cm Height*		*>=90 cm height*		*Total*	
	N	%	N	%	N	%	N	%
< 115 or oedema	2	1.9	2	0.7	0	0.0	4	0.6
>=115 MUAC<125	9	8.4	8	2.8	5	1.9	22	3.3
>=125 MUAC<135	27	25.2	49	17.4	28	10.4	104	15.8
MUAC >= 135	69	64.5	222	79.0	237	87.8	528	80.2
TOTAL	107	16.3	281	42.7	270	41.0	658	100.0

d) Prevalence of underweight

Underweight status reflects current and past nutritional experience in community. It is a good measure of both wasting and stunting, and is quite useful in child growth monitoring. As in other survey results, underweight accounted for were 34.3% with severe underweight at 4.1%.

Table X: Prevalence of underweight based on weight-for-age z-scores by sex

	All n = 677	*Boys N = 351*	*Girls N = 326*
Prevalence of underweight (<-2 z-score)	(232) 34.3 % (29.6 - 39.3)	(127) 36.2 % (30.4 - 42.4)	(105) 32.2 % (26.3 - 38.7)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	(204) 30.1 % (25.8 - 34.9)	(112) 31.9 % (26.3 - 38.1)	(92) 28.2 % (23.2 - 33.9)
Prevalence of severe underweight (<-3 z-score)	(28) 4.1 % (2.7 - 6.4)	(15) 4.3 % (2.6 - 7.0)	(13) 4.0 % (2.0 - 8.0)

Table XI: Prevalence of underweight by age based on weight-for-height z-scores and oedema

Age (mths)	Total no.	*Severe underweight (<-3 z-score)*		*Moderate underweight (>= -3 and <-2 z-score)*		*Normal (> = -2 z score)*		*Oedema*	
		No.	%	No.	%	No.	%	No.	%
6-17	131	5	3.8	27	20.6	99	75.6	0	0.0
18-29	148	8	5.4	43	29.1	97	65.5	0	0.0
30-41	165	5	3.0	54	32.7	106	64.2	1	0.6
42-53	175	8	4.6	63	36.0	104	59.4	0	0.0
54-59	58	2	3.4	17	29.3	39	67.2	0	0.0
Total	677	28	4.1	204	30.1	445	65.7	1	0.1

e) Prevalence of Stunting

Stunting is a reference of cumulative effects of long standing nutritional inadequacy. The overall stunting rates in this survey showed that 35.5% of the children in the study are stunted and of these 6.9 % are severely stunted.

Table XII: Prevalence of stunting based on height-for-age z-scores and by sex

	All n = 678	*Boys N = 351*	*Girls n = 327*
Prevalence of stunting (<-2 z-score)	(241) 35.5 % (31.8 - 39.5)	(145) 41.3 % (36.8 - 46.0)	(96) 29.4 % (24.0 - 35.4)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	(194) 28.6 % (25.1 - 32.4)	(119) 33.9 % (29.8 - 38.2)	(75) 22.9 % (18.2 - 28.5)
Prevalence of severe stunting (<-3 z-score)	(47) 6.9 % (5.2 - 9.3)	(26) 7.4 % (5.1 - 10.7)	(21) 6.4 % (3.9 - 10.5)

Table XIII: Prevalence of stunting by age based on height-for-age z-scores

Age (mths)	Total no.	*Severe stunting (<-3 z-score)*		*Moderate stunting (>= -3 and <-2 z-score)*		*Normal (> = -2 z score)*	
		No.	%	No.	%	No.	%
6-17	131	8	6.1	44	33.6	79	60.3
18-29	148	10	6.8	35	23.6	103	69.6
30-41	166	7	4.2	46	27.7	113	68.1
42-53	175	17	9.7	54	30.9	104	59.4
54-59	58	5	8.6	15	25.9	38	65.5
Total	**678**	**47**	**6.9**	**194**	**28.6**	**437**	**64.5**

Table XIVI: Mean z-scores, Design Effects and excluded subjects

Indicator	*n*	*Mean z-scores ± SD*	*Design Effect (z-score < -2)*	*z-scores not available**	*z-scores out of range*
Weight-for-Height	677	-0.83±0.82	1.42	1	0
Weight-for-Age	677	-1.62±0.87	1.76	1	0
Height-for-Age	678	-1.57±1.02	1.10	0	0

One subject was excluded in the final analysis.

5.3. Retrospective mortality

Mortality rates in the survey were low, 0.08 (0.03-0.25) and 0.0 (0.0- 0.61) for CMR and U5MR.

5.4. Morbidity status, coverage of Vitamin A and Measles Immunization

Presence of disease results in lowered immunity, mucosal damage, and exacerbates the loss of nutrients. This in turn worsens the nutritional status of an individual. There was a high incidence of illness reported in this survey (58.7%), predominantly fever with chills (32%) and fever with cough (27.4%). Diarrhea incidences were at 12.4%. Only 4.6% of the children were in a treatment program with most having received Vitamin A (63.6%) and Immunized against measles (70.1%, by card).

Table XV: Vitamin A supplementation, Measles Immunization Status, OTP/SFP and Morbidity

Characteristic	*Frequency*	*Percentage*
Measles Vaccination		
Not Immunized (Under age)	27	4.0%
Not Immunized	54	8.0%
Immunized (Card)	475	70.1%
Immunized (Mother)	122	18.0%
Vitamin A Supplementation		
Not received	247	36.4%
Received Once	370	54.6%
Received Twice	61	9.0%
Child in Treatment program*		
Not in Program	646	95.3%
OTP	25	3.7%
SFP	6	0.9%
Morbidity		
Illness in the past two weeks	398	58.7%
Diarrhoea	84	12.4%
Fever with chills	217	32.0%
Fever with cough	186	27.4%
Other Illnesses	108	15.9%
TOTAL	**678**	

*The percentage noted in Child in SFP/OTP is only the children in surveyed households that were in a treatment program. A coverage survey which is specific to areas covered by a treatment program will give more representative results.

5.5. Health seeking behavior and maternal & child care practices

a) Health seeking behaviour

Interaction between incidences of diseases and nutritional status is cyclic; therefore addressing nutrition deficiencies goes hand in hand with health interventions. Health seeking behaviour determines the wellness of an individual. Respondents sought health care from three primary sources, public clinics (70.5%), shops/kiosks (55.3%) and private clinics/pharmacies (37.4%). Discussion with health care providers in the area revealed that the most common diseases included malaria, HIV/AIDs, ARI's, Helmiths, Eye infections, Ear nose and throat illnesses, skin problems, Typhoid and amoebiasis. The most common causes of mortality included HIV/AIDs, malaria, pneumonia and diarrhoea. Most health facilities were reported to be over utilized and understaffed.

Table XVI: Health Seeking Behaviour

Characteristic	*%*
Sought assistance during child sickness	76.2
Traditional healer	1.1
From a CHW	1.2
Private clinic/pharmacy	37.4
Shop/kiosk	55.3
Public clinic	70.5
Mobile clinic	5.9
Relative/friend	1.6
Local herbs	5.5
NGO/FBO	23.8

Chi square cross tabulation test results showed significant relationship between, poor nutritional status (<-2 WHZ) and fever cough and diarrhoea ($p<0.05$). No significant relationship was seen in measles vaccination, vitamin A supplementation and fever with chills. This indicates that poor nutritional status is mainly attributed to presence of diseases.

b) Maternal and child care practices

Aside from food security and health, maternal and child care practices are a key determinant in a child's nutritional status. Colostrum was fed to at least 73.9% of the children within the first hour of birth. Proportion of non breastfeeding children were given milk was 31.7%. The frequency of feeding was almost evenly distributed from between one and three feeds per day. The mean HDDS for children 6 – 24 months was 4.5. The results show good IYCF practices, however this should be interpreted with caution, IYCF sample was drawn from overall SMART sample.

Table XVII: Maternal and children feeding practices.

Characteristic	*Percentage*
Initiation of Breastfeeding	
Immediately (First hour of birth)	73.9
More than one hour	23.2
More than one day	2.9
Continued Breastfeeding up to 2 years	
Yes	20.4
No	79.6
Frequency of feeding	
One time or less	37.9
Two times	23.3
More than three times.	38.8
Diarrhea treatment	
0RS	66.6
Homemade sugar solution	19.9
Homemade liquid	4
Others	9.6
Other Indicators	
Child taken drugs for Intestinal Worms	34
Iron pills in pregnancy	68
Under five not Breastfeeding receiving milk	32.7

High Impact Nutrition Interventions have been seen to reduce under five mortality rates. Previous researches shows that a vast majority of children are not exclusively breastfed, most pregnant women are anaemic and even

more are deficient of Vitamin A and Zinc. In Kitui, HINI indicators were commendable. Most of the mothers used ORS (66.6%) and homemade sugar solutions (19.9%) to treat diarrhea. 44.6% of the caregivers gave children deworming drugs and 89.3% of the caregivers took iron pills during their most recent pregnancy.

Table XVIII: Dietary Diversity Indicator for Children 6 – 23 Months

Food Group	*Mean*
Milk	1.36
Grains, root, tubers and porridge	1.68
Vitamin a rich foods	0.44
Other fruits and vegetables	0.27
Eggs	0.06
Meat/Poultry fish	0.07
Legumes	0.17
Foods made with oil and butter	0.46
Total	***4.50***

Only 38.8% of the children ate the recommended 3-4 meals for both breastfed and non breastfed children. There was also low consumption of vitamin A rich foods and meat products, these are supposed to be eaten daily by children of the 6-24 months age bracket.

5.6. Food Security and Livelihoods

Previous research (Kenya Food Security Steering Group, ACF, government) show that Kitui district is mostly food stressed. The stress rises in proportion to unfavourable weather to culminate into food crisis when such weather is prolonged. It has also been shown that children suffer most from malnutrition during times of food stress or crisis. Consequently, in order to assess the nutritional status as well as outlook for the district, questions on crop and livestock production, sources of food, dietary diversity and household coping strategies were addressed.

a) Crop Production

Most of the households sampled relied on crop production as a source of livelihood. Land under cultivation varies with household but the majority, 79%, farm on between 1 to 5 acres while about 19% cultivate on land above 5 acres. Crops identified span a wide continuum, from beans, maize, sorghum, peas and millet. Others are different kinds of fruits and vegetables. The value attached to the maize crop is quite evident: 98.6% of households indicated maize as a major crop as compared to 55.9% (sorghum), a more apt crop for the area. Millet (47.1%) is the third most cultivated crop. Fewer respondents cultivated fruits such as mango (18.3%) and vegetables such as cow peas leaves (26.7%). Despite the reported importance of crop production, most (87.9%) households buy their food as compared to 10.9% who reported reliance on own on-farm production. The results also show that only 21.9% of the respondents had food stock remaining from the previous planting season. Livestock (0.5%) and food aid (0.2%) are reported as insignificant as sources of food. The former can be attributed to the fact that most households keep livestock for sale to raise income for non-food related expenses like school fees, clothing, shelter or healthcare among others. The latter (food aid) maybe attributed to either food for work/asset programs or to social desirability biases.

Table XIX: Source of food

Source of food	*Percentage*
Cultivation	10.85
Livestock(livestock by products such as milk, meat etc)	0.53
Buying	87.9
Food aid	0.53
Other	0.18
Total	100

Results showed a significant association of Source of food and nutritional status, p=0.00 indicating that it played a big role in determining nutritional status.

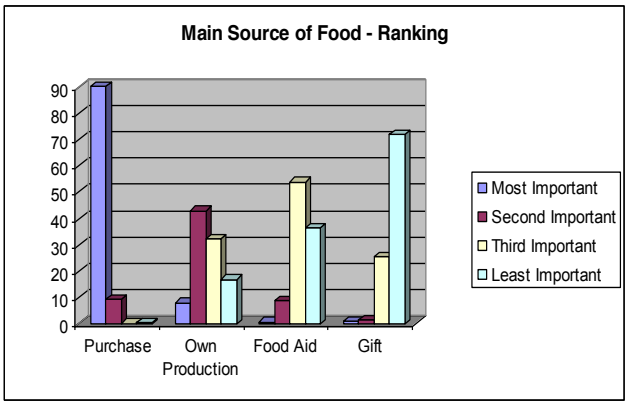
b) Coping Strategies

Coping strategies are usually indicative of food security challenges and van be used to evaluate the seriousness of food shortages or crises. Strategies that households use to cope with food challenges include skipping meals (67.6%), reducing meal portions (83.8%), eating less preferred foods (74.9%) and acquiring food on credit (72.6%). Others include borrowing money from relatives (56.4%) and selling productive assets, mostly livestock, (67.6%). Only 18.0% reported sending children to stay with relatives as a suitable coping strategy. The most important source of food was purchase at 90%. No association was observed between coping strategies and child nutrition status.

Table XX: Coping Strategy

Coping strategy	*%*
Skip Meals	67.6
Reduce size of meals	83.8
Eat less preferred foods	74.9
Purchase food on credit	72.6
Borrowed from relatives	56.4
Sent Children to eat with relatives	18
Sold off productive assets	67.6

Figure IIV: Ranking for source of food



Livestock Holding

90.2% of households keep one or several types of livestock making it a key livelihood strategy for most households. While livestock ranges from cows, goats, sheep to poultry, camels and donkeys, the most kept livestock include goats, poultry and donkeys. The former two as a saving instrument for liquidation in case a household falls into bad times and the latter for carting water and other related work at the household level. Again there was no significant association between the household which owned livestock and adequate or poor nutritional status ($p<0.05$).

Table XXI: Livestock holding

Livestock	*Sum*	*Mean*
Cattle	984	1.75
Camels	2	0
Goats	3260	5.8
Sheep	143	0.25
Chicken	4510	8.02
Donkey	557	0.99

c) Dietary Diversity

The mean Household dietary diversity score (HDDS) was 5.83, out of a possible 12. HDDS is highly correlated with caloric intake, protein adequacy, percentage of protein from animal sources and household income. Dietary diversity does not have any effect on the nutrition status ($p<0.05$).

Table XXII: Household Dietary Diversity Score

Type of food group	*N*	*Percentage*	*Mean*
Carbohydrates and starches	554.00	98.6	0.99
Roots and tubers	67.00	11.9	0.12
Vegetables	393.00	69.9	0.70
Fruits	128.00	22.8	0.23
Eggs	29.00	5.2	0.05
Meats	59.00	10.5	0.10
Fresh/dried fish	51.00	9.1	0.09
Beans and legumes	375.00	66.7	0.67
Milk and milk products	378.00	67.3	0.67
Fats and oils	314.00	55.9	0.56
Sugar or honey	494.00	87.9	0.88
Condiments	430.00	76.5	0.77
Mean HDDS			**5.83**

Table XXIII: Market Price

Item	Quantity	Price (KSH)
Maize Dry	KG	35
Maize flour	KG	50
Rice	KG	100
Wheat	KG	130
Beans	KG	115
Potatoes	KG	60
Sugar	KG	100
Millet	KG	120
Cooking oil	LT	210
Cows milk	LT	60
Goat Milk	LT	80
Beef	LT	300
Water	20 LT Jerrican	10
Bull (3 years)	1	20,000
Cow (3 years)	1	18,000
Mature Goat	1	3000
Mature sheep	1	1800

Reports indicated that there was an increase in food prices. Considering the high proportion of respondents who purchased food, it is important to look at prevailing market prices.

5.7. Water and sanitation

a) Household water source and treatment

53.9% of households get water from shallow wells that mostly do not provide water all year round. 37.7% of the shallow wells are unprotected while 16.2% are unprotected. 11.9% of households get water from earth pans/dams, 26.3% from rivers and only 5% reported having access to piped water. It is important to also note that sources of water for households are not mutually exclusive and that access to water tracks rainfall patterns, being easier during the rainy season. That more than a third, 37.7%, of households get water from shallow unprotected wells indicates water stress where mere accessibility to water is more critical than accessibility to clean and safe water. Water source has a significant effect on nutritional status (p=0.005). It is also evident that these sources do not meet the SPHERE standard of constancy (ease of access) throughout the year.

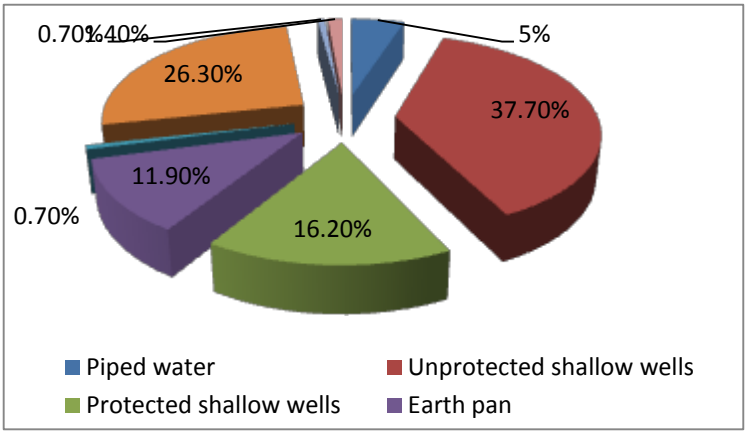


Figure V: Source of Water

b) Distance to water source

42.9% of the households spend more than one hour to reach a water source while 34.9% and 22.2% spend 15-60 minutes and less than 15 minutes respectively. As a result, only 22% of households in the sampled area have a water source within 15 minutes, the designated SPHERE standard. Distance to water source correlated with nutritional status indicating it had an effect ($p<0.05$).

Table XXIV: Distance to Water Source

Distance to water source	*%*
15 minutes or less (less than 500 m)	22.2
15 – 60 minutes (500-2000 m)	34.9
>60 minutes (> 2000m)	42.9

c) Household water treatment practices

Issues surrounding water safety were also tested with questions on household based water treatment. While more than half (55.3%) of the households treat water 44.7% do not. Chemical treatment (34.%) and boiling (25.3%) are the most preferred household water treatment practices while traditional water treatment practices (.7%) are least applied. The prevailing water treatment practices in the sample do not meet prescribed SPHERE water safety standards including, safety of source, treatment at source, treatment at the household level and post-source contamination hazards.

Table XXV: Water treatment

Characteristic	*%*
Household water treatment	55.3
Boiling	25.3
Chemical treatment	34.0
Traditional	0.7
Decantation	8.4
Filtration	1.8

d) Hand washing practices

Hand washing and use of soap key in improving sanitation. Poor sanitary habits increase the incidences of diseases such as diarrhoea, which often results in diminished nutrition status. A high proportion of the respondents wash hands, especially in instances where they were dirty (83.6%), after visiting the latrine (74.7%), before cooking (51.4%) and before breastfeeding (32.6%). Additionally, 44.4% used only water during hand washing, 36.1% used soap and 19.45 used soap only when they could afford it. Even though in many households people washed hands,

most did not do it at the right time. Use of soap was also poor. No significant differences were observed between hand washing techniques and nutrition status ($p<0.05$). SPHERE establishes a standard for at least a 250g soap to be available for a household with at least 5 members.

Table XXVI: Hand Washing Practices

Hand washing practice	***%***
Washes hands	95.2
Washes hands only when dirty	83.6
Before visiting the latrine	5.7
After visiting the latrine	74.2
Before cooking	51.4
Before eating	89.5
Before breastfeeding	32.6
After taking child to the toilet	39.7
After handling animal	53.4

e) Household solid waste and human waste management

Importance of proper waste disposal cannot be overemphasized, improper disposal mechanisms leads to exposure to pathogens and other toxins that imperil health at the individual, household and community levels. 54.3% reported using conventional pit latrines and 5.7% reported using Ventilation Improved Pit (VIP) latrines. On the other hand, about 39.9% reported open field defecation. On disposal of children's excreta, 20% reported that the child goes to the latrine, 24.9% into the garbage and 21.7% bury children excrement. With reference to availability of latrines, no significant difference was seen with regard to nutritional status ($p<0.05$). SPHERE standards state that excretion from children is more dangerous because children lack antibodies.

Table XXVII: Household disposal of solid and human waste

Method of waste disposal	***%***
Bushes	39.9
Conventional pit latrines	54.3
Ventilated Improved Pit latrines	5.7
Method of disposing child excreta	*%*
Child goes to the latrine	20
Garbage	24.9
Buried	21.7
Left in the open	13
Other	20.5

f) Household mosquito net use

67.4% of the households surveyed reported using mosquito nets. Additionally, the member of household who slept under nets per household included, children under five (19.4%), 5-18 years old (9.1%), adult females (81.5%), adult males (12.5% and everybody (43.1%). Children under five years and pregnant women are most vulnerable to Malaria. The usage of mosquito nets was low in this study. No significant relation was established between household mosquito net use and nutritional status ($p<0.05$).

6. Conclusion and Recommendations

Kitui is a food stressed district sensitive to mild shocks. Survey results show that the surveyed population was of low socio economic status, predominantly small holder farmers with low levels of education. Nutritional status of children is seen to have improved since the 2009 survey. The GAM rate is 6.5% an SAM 0.9%. Previous nutrition survey was done in October at a time of food stress. Reports show a scaling down of food aid beneficiaries in early 2011 as a result of improved conditions. This improvement could be attributed to intensified nutrition campaigns and MCH programmes in the district. Additionally data shows relatively good IYCF practices, Good practice in HINI and increased dietary diversity.

Significant relationships were established between nutrition status and education level, source of water, distance to water source, those who treated water and those who did not. A significant relationship was also established between nutritional status and source of food, and number of meals consumed by children. This is indicative that the variables had an effect on nutrition status of an individual. Nutrition status also correlated with presence of diseases.

Despite the improved nutrition situation, considering that farming as the main source of livelihood with a high number of cultivating in the previous season, very few households had food stock remaining. Additionally, purchase of food has been ranked as one of the most important food sources. The ALRMP reports show inadequate crop harvest in the marginal mixed farming livelihood zone. Given erratic weather changes and the vulnerability of the district, the situation could deteriorate.

The results also show poor access to safe water sources, long distance taken to access water sources, less than half treated water before household use and poor use of soap. Further, latrine presence and use was inadequate and poor disposal of excreta. This could contribute to increased incidences of water borne diseases and increase susceptibility to malnutrition.

A large percentage of the population reported high morbidity incidences, this information corroborated with that from health facilities. This could either worsen or lead to malnutrition as a result of reduced body defences and loss of appetite.

Following the results, the following recommendations were arrived at:

Health and Nutrition

- Although there is an improved situation, there is risk of deterioration due to poor food security. Consequently, continued sustenance and improvement of SFP, OTP, SC centres to in the district to capture all acutely malnourished children is required.
- Further strengthening of IYCF practices and continuous assessment of HINI indicators to be entrenched into the district health care structure.
- Encouraging dietary diversity through food based strategies. For example growing more fruits and vegetables and nutrition education. There was poor consumption of fruits and vegetables attributed to its unavailability.
- Morbidity was seen to be high, and statistical tests showed this to be significantly associated with nutrition status. Need to improve encourage prompt health seeking behaviour in the event of an illness. The most common disease was fever with chills like malaria.
- Nutrition education to emphasize importance of consuming vitamin A rich foods and meat products which ideally should be provided daily in a growing child's diet. Consumption of these foods was found low in this survey.

- As the survey shows low rates of malnutrition and the food security condition deteriorating, with further deterioration expected with delay of rains, another nutrition survey should be conducted in October to further analyze the situation.

Water and Sanitation

- Results show inaccessibility to safe sources of water and long distances walked to reach a water source indicate water scarcity. Construction and provision of large water containers for storage could help alleviate the problem in the short term.

- A high proportion washed hands; it was not always at the appropriate times. Additionally most treated their water before consumption. More encouragement to sustain this good practice is needed, emphasis laid on appropriate times to wash hands and best water treatment and storage techniques. This can be done through health education campaigns.

- In latrine use, although half of the respondents had access to convectional pit latrines and 39.9% used open defecation, this can highly compromise the sanitation situation and increase susceptibility to communicable disease. Again emphasis should be given on importance of latrine and proper use of latrines through health education campaigns. In the long term construction of community toilets should be considered.

Food Security/Livelihoods

- The predominant source of livelihoods is farming. More importantly, a majority of households farmed in the previous season and only 21.9% had food stock remaining from previous planting season. This is exemplified in that most homes purchased food. This could roll back the gains made thus far as there is a likelihood of further deterioration. The situation should be monitored closely to assess the need to up-scale food aid in most affected areas. In the long term, modalities to encourage income generating activities and improved accessibility to credit services should be determined.

- Additionally, ways of introducing drought tolerant crops that are also acceptable in the community can be explored. As the population is dependent mainly on rain fed agriculture, the potential for water harvesting for irrigation to help diversify crop production and improve food security should be explored.

Annex 1: SMART Survey Anthropometric Form (April 2011) 6-59 months old children

1. Identification	Data Collector_____	Team Leader_____				
1.1 Larger District	1.2 Division	1.3 Location	1.4 Sub-location	1.5 Cluster No	1.6 Team Number	1.7 Date

Child no.	HH no.	Sex (F/M)	Age in Months	Weight ##.# kg	Height ###.# cm	Weight-for-height %	Oedema (Y/N)	MUAC ##.# cm	Measles Vaccination 0= Not immunized 1= Card 2= Mothers verification	In the last one year how many times received Vitamin A	Child in any Nutrition center? 0= No 1= OTP 2= SFP	In the past two weeks did the child suffer from any sickness? 0=No 1= Yes	If yes, which sicknesses			
													Diarrhea 0= No 1= Yes	Fever with chills like malaria 0= No 1= Yes	Fever, cough, difficult breathing 0= No 1= Yes	Other (specify) 0= No 1= Yes
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

Annex II: Calendar of Events

MONTH	*Seasons*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*
JANUARY (Mwai wa Mbee)			**51**	**39**	**27**	**15**	**3**
	Harvest, New year celebrations, Schools opening						
FEBRUARY (Mwai wa keli)			**50**	**38**	**26**	**14**	**2**
	Valentine day, harvest						
MARCH (Mwai wa Katatu)			**49**	**37**	**25**	**13**	**1**
	Move to water points preparation of farmlands.						
APRIL (Mwai wa Kana)			**48**	**36**	**24**	**12**	
	Short rains						
MAY (Mwai wa Katano)		59	**47**	**35**	**23**	**11**	
	Labour day, Short rains						
JUNE (Mwai wa Thanthatu)		58	**46**	**34**	**22**	**10**	
	Madaraka day, harvesting						
JULY (Mwai wa Muonza)		**57**	**45**	**33**	**21**	**9**	
AUGUST (Mwai wa Nyanya)		**56**	**44**	**32**	**20**	**8**	
	Boys circumcision						
SEPTEMBER (Mwai wa Keenda)		**55**	**43**	**31**	**19**	**7**	
	Preparation of farm lands						
OCTOBER (Mwai wa Ikumi)		**54**	**42**	**30**	**18**	**6**	
	Moi day, Kenyatta day celebrations, Planting and long rains						
NOVEMBER (Mwai wa Ikumi na Umwe)		**53**	**41**	**29**	**17**	**5**	
	KCPE, KCSE exams, Long rains						
DECEMBER (Mwai wa Ikumi na Ili)		**52**	**40**	**28**	**16**	**4**	
	Celebrate Christmas. Long rains						

Annex III: Cluster Mortality Questionnaire

Division: _____ Location: _____ Sub location:

_____ Date: _____ Cluster number: _____Team number: _____

HH	Current HH Member		Current HH members who arrived during recall (exclude births)		Past HH members who left during recall (exclude deaths)		Births during recall	Deaths during recall	
	Total	< 5	Total	<5	Total	< 5		Total	< 5
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
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20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
Total									

Annex IV: WASH and Food Security and Livelihood Questionnaire

1. Identification	**Data Collector**_____		**Team Leader**_____				
1.1 Larger District	1.2 Division	1.3 Location	1.4 Sub-location	1.5 Cluster No	1.6 HH No	1.7 Team Number	1.8 Date

2. Household Structure		
2.1	Sex of household head 1. Male 2. Female	|____|
2.2	What is the main occupation of the household head 1. Livestock herding 2. Farmer/own farm labor 3. Employed (salaried) 4. Daily labor/Wage labor 5. Small business/Petty trade 6. Other (Specify _____	|____|
2.3	Highest educational status of the household head 1. None 2. Non formal 3. Primary Level 4. Secondary Level 5. Above Secondary 6. Other (Specify)	|____|

3. Child Health and Nutrition (Children 0-59 months of age) –the mother/caretaker should be asked for this section		
3.1	Does the household have children 0-59 months old? 0. No (if No, skip to section 4) 1. Yes	|____|
3.2	When the child is sick did you seek assistance? 0. No (If No, skip to question # 3.4) 1. Yes	|____|
3.3	If the response is yes to question # 3.2 where did you seek (More than one response possible- **Use 0 if no and 1 if yes**) 1. Traditional healer 2. Community health worker 3. Private clinic/ pharmacy 4. Shop/kiosk 5. Public clinic 6. Mobile clinic 7. Relative or friend 8. Local herbs 9. NGO/FBO	|____| |____| |____| |____| |____| |____| |____| |____| |____|
3.4	If the child had diarrhea, was he/she given any of the following to drink at any time since he/she started having the diarrhea? 1. A fluid made from a special packet called Oralite or ORS? 2. A home-made sugar-salt solution? 3. Another home-made liquid such as porridge, soup, yoghurt, coconut water, fresh fruit juice, tea, milk, or rice water? 4. Zinc 5. Others (specify)_____	|____|
3.5	Has the child taken any drug for intestinal worms in the last six months? 1. YES 2. NO	|____|

	3. Don't know
3.6	In your last pregnancy, did you take iron pills, sprinkles with iron, or iron syrup? 1. YES 2. NO 3. Don't know |____|
3.7	In the last 24 hours did the child who is < 5 years and is not breastfeeding receive milk? 0. No 1. Yes |____|
4. **Infant and young child feeding practices**	
4.1	Does the household have children 0-23 months old? 1. No **(if No, skip to section 5)** |____| 2. Yes
4.2	How long after birth did you first put the child 0-23months on the breast? (**only one response)** 1. Immediately (Less than one hour) 2. More than one hour but within 24 hours |____| 3. More than one day
4.3	At what age in MONTHS did the child (0-23M) receive food other than breast milk? (Foods includes other milk, water, fruit, juices, artificial drinks, sugar water solutions, porridge, etc.) 1. Less than 4 months 2. Between 4-6 months |____| 3. After 6 months
4.4	Is the child 0-23 months breastfeeding currently? 0. No 1. Yes
4.5	How many times did the child (0-23M) eat solid food soft foods other than liquids, yesterday, during the day or at night? **(Small snacks, small feeds such one or two bites from the mother should not be counted).** |____| 1. One time or less 2. Two times 3. More than three times
4.6	In the past 24 hours preceding the study, how many times did the child (0-23M) eat the following foods? |____| 1. Milk **(apart from breast milk, cheese, yoghurt or formula milk)** |____| 2. Grains, roots, tubers including porridge fortified baby foods |____| 3. Vitamin A rich foods **(Green leafy vegetables, orange fleshed fruits and tubers)** |____| 4. Other Fruits and vegetables |____| 5. Eggs |____| 6. Meat/Poultry/Fish |____| 7. Legumes and nuts |____| 8. Food made with oil, fat butter |____|

5. Water, Sanitation and Hygiene (WASH)/- Ask the mother/care taker	
5.1	From where did you collect water for your household TODAY? 1. Piped water system |____| 2. Unprotected shallow well 3. Protected shallow 4. Earth pan/dam 5. Roof rain catchments 6. Underground tank 7. River, flowing 8. Water trucking or seller, donkey cart or other seller 9. Other (specify)__
5.2	How long does it take to walk to the main source of water (one way in minutes) **NOW**? 1. 15 minutes or less (less than 500m) 2. Greater than 15 minutes to 1 hour (more than 500m – 2 km) |____| 3. More than one hour (more than 2 km)

5.3	What is (are) done now to the water before household members drink the water **NOW**? (**MULTIPLE RESPONSES POSSIBLE**- **Use 0 if no and 1 if yes**) 1. Nothing |____| 2. Boiling |____| 3. Chemical treatment (Alum stone, Chlorination) |____| 4. Traditional treatment |____| 5. Decantation (sitting to settle) |____| 6. Filtration (Passing through cloth) |____| 7. Other (specify_____)
5.4	When do you wash your hands? (MULTIPLE RESPONSE- **Use 0 if no and 1 if yes**) 1. Does not wash hands |____| 2. Wash hands when dirty |____| 3. Before latrine |____| 4. After latrine |____| 5. Before cooking |____| 6. Before eating |____| 7. Before breastfeeding |____| 8. After taking children to the toilet |____| 9. After handling animals |____|
5.5	If the mother washes her hands, then probe: What do you use to wash your hands? 1. Only water 2. Soap 3. Soap when I can afford it |____| 4. Ashes
5.6	Where do members of your household relieve themselves? 1. In the bushes, open defecation 2. Traditional pit latrine 3. Ventilated improved pit latrine 4. Other, specify_____ |____|
5.7	When a child relieves himself or herself, where is it the excreta disposed off? 1. Child goes to toilet 2. Thrown into garbage 3. Buried 4. Left in open 5. Other, specify_____ |____|
5.8	Does this household have a mosquito net? 0. No |____| 1. Yes (if No, skip to section 5)
5.9	If the household owns mosquito net, who slept under the mosquito net last night? (Probe- enter all responses mentioned **(Use 0 if no and 1 if yes**) 1. Children <5 years old |____| 2. Children between 5 and 18 years old. |____| 3. Adult females. |____| 4. Adult males |____| 5. Every body |____| 6. Nobody uses |____|

6. Livestock Ownership & Crop Production	
6.1	Does the household currently own livestock? 0. Yes |____| 1. No (if No, skip to question #5.5)
6.2	If yes, how many? 1. Cattle |____| 2. Camels |____| 3. Goats |____| 4. Sheep |____| 5. Chickens |____|

	6. Donkeys	|____|
6.3	For the past one month what has been the household's **main** (biggest quantity) source of food? (**Only one answer**) 1. Cultivation 2. Livestock (Livestock by products as milk, meat etc) 3. Buying 4. Food Aid 5. Wild food collection 6. Kinship 7. Other	 |____| |____| |____| |____| |____| |____| |____|
6.4	Is the household engaged in farming? **(If no skip to question 6.9)** 0. Yes 1. No	
6.5	If YES, how much land did you cultivate during the last main cropping season in ACRES?	|____ |
6.6	Which types of staple and leguminous crops were planted in the last main cropping season? 1. Maize 2. Beans 3. Sorghum 4. Sesame/simsim 5. Millet 6. Others (Specify)	 |_____| |_____| |_____| |_____| |_____| |_____|
6.7	Which types of vegetable and fruit crops were planted in the last cropping season? 1. Tomato 2. Onion 3. Sukumawiki 4. Cabbage 5. Banana 6. Pawpaw 7. Mango 8. Watermelon 9. Orange 10. Others (specify)	 |_____| |_____| |_____| |_____| |_____| |_____| |_____| |_____| |_____|
6.8	Do you still have any food stock left over from most recent planting season? 0. Yes 1. No	 |_____| |_____|
6.9	In the past 12 months, did you or your family ever cut the size of your meals or skip meals because there wasn't enough money for food or because you had run out of food stock? 0. Yes 1. No	 |_____| |_____|
6.9.1	If yes, how often did it happen? 1. Every month 2. After every three months 3. Only 1 or 2 months 4. Do not know.	 |_____| |_____| |_____| |_____|
6.9.2	Do you receive any form of food Aid from the government or NGO's 0. Yes 1. No	 |_____| |_____|
7. Dietary Diversity, Food Sources and Coping Strategies		

7.1	Did the household eat the following yesterday during the day or night? (**place a 1 beside the food if someone consumed it and zero if no one did)**	
	1. Any Ugali, pasta, rice, bread, or any food made from maize, sorghum, millet, wheat?	
	2. Any potatoes, yams, beets or other foods from roots or tubers?	|____|
	3. Any vegetables?	|____|
	4. Any fruits?	|____|
	5. Any eggs?	|____|
	6. Any meats (camel, cattle, chicken, poultry/fowl, sheep, lamb, and organ meats (heart, liver, kidney, etc)?	|____|
	7. Any fish or dried fish?	|____|
	8. Any foods made from beans, peas, lentils, or nuts?	|____|
	9. Any milk, yogurt, cheese, or other milk product?	|____|
	10. Any foods made with oil, fat, ghee, or butter?	|____|
	11. Any sugar or honey?	|____|
	12. Any other condiments (coffee, pilipili, tea)?	|____|
7.2	Rate the importance of each food source to your household food consumption in the last 30 days (Rank from most important to least important, **use codes 1= 1st or most important, 2= 2nd important, 3= 3rd important, 4= 4th or least important**	
	1. Purchase	|____|
	2. Own Production	|____|
	3. Food Aid	|____|
	4. Gift	|____|
7.3	In the last 30 days has household members done any one of the following? **(Use 1 if done and 0 if not done)**	
	1. Skip meals (excluding Ramadan)	|____|
	2. Reduce the size of meals	|____|
	3. Eat less preferred foods (e.g. wild foods etc.)	|____|
	4. Purchase food on credit from local vendors	|____|
	5. Borrow money from relatives	|____|
	6. Send children to eat with relatives	|____|
	7. Sell off productive assets (selling livestock, farming tools, donkey cart etc.)	|____|
	8. Other (specify)	|____|

Annex V: Anthropometric data plausibility check (WHO)

Standard/Reference used for z-score calculation: WHO standards 2006

(If it is not mentioned, flagged data is included in the evaluation. Some parts of this plausibility report are more for advanced users and can be skipped for a standard evaluation)

Overall data quality

Criteria	Flags*	Unit	Good	Accept	Poor	Unacceptable	**Score**
Missing/Flagged data	Incl	%	0-2.5	>2.5-5.0	>5.0-10	>10	
(% of in-range subjects)			0	5	10	20	**0** (0.0 %)
Overall Sex ratio	Incl	p	>0.1	>0.05	>0.001	<0.000	
(Significant chi square)			0	2	4	10	**0** (p=0.357)
Overall Age distrib	Incl	p	>0.1	>0.05	>0.001	<0.000	
(Significant chi square)			0	2	4	10	**4** (p=0.005)
Dig pref score - weight	Incl	#	0-5	5-10	10-20	> 20	
			0	2	4	10	**0** (5)
Dig pref score - height	Incl	#	0-5	5-10	10-20	> 20	
			0	2	4	10	**2** (6)
Standard Dev WHZ	Excl	SD	<1.1	<1.15	<1.20	>1.20	
			0	2	6	20	**0** (0.92)
Skewness WHZ	Excl	#	<±1.0	<±2.0	<±3.0	>±3.0	
			0	1	3	5	**0** (-0.01)
Kurtosis WHZ	Excl	#	<±1.0	<±2.0	<±3.0	>±3.0	
			0	1	3	5	**0** (0.11)
Poisson dist WHZ-2	Excl	p	>0.05	>0.01	>0.001	<0.000	
			0	1	3	5	**3** (p=0.007)
Timing	Excl	Not determined yet					
			0	1	3	5	
OVERALL SCORE WHZ =			0-5	5-10	10-15	>15	**9** %

At the moment the overall score of this survey is 9 %, this is acceptable.

There were no duplicate entries detected.

Anthropometric Indices likely to be in error (-3 to 3 for WHZ, -3 to 3 for HAZ, -3 to 3 for WAZ, from observed mean - chosen in Options panel - these values will be flagged and should be excluded from analysis):

Line=346/ID=346:	HAZ (2.090), Height may be incorrect
Line=454/ID=454:	WAZ (2.009), Age may be incorrect
Line=500/ID=500:	HAZ (1.545), Height may be incorrect
Line=617/ID=617:	WAZ (1.776), Weight may be incorrect
Line=643/ID=643:	HAZ (4.510), Height may be incorrect

Percentage of values flagged with SMART flags:WHZ: 0.0 %, HAZ: 0.4 %, WAZ: 0.3 %

Age distribution

Month 6 : ################## Month 8 : #######
Month 7 : ######### Month 9 : ############

Month 10 : ##########
Month 11 : #########
Month 12 : ##########
Month 13 : ##########
Month 14 : ##########
Month 15 : ##########
Month 16 : ########
Month 17 : ##########
Month 18 : ##########
Month 19 : ##########
Month 20 : #########
Month 21 : ##########
Month 22 : ##########
Month 23 : ##########
Month 24 : ##########
Month 25 : ##########
Month 26 : ##########
Month 27 : ##########
Month 28 : #########
Month 29 : ##########
Month 30 : ##########
Month 31 : ##########
Month 32 : ##########
Month 33 : ########
Month 34 : #########
Month 35 : ##########
Month 36 : ##########
Month 37 : ##########
Month 38 : #######
Month 39 : ########
Month 40 : ##########
Month 41 : ##########
Month 42 : ##########
Month 43 : ##########
Month 44 : ##########
Month 45 : ##########
Month 46 : ##########
Month 47 : ##########
Month 48 : ##########
Month 49 : ##########
Month 50 : #########
Month 51 : ########
Month 52 : #########
Month 53 : ##########
Month 54 : #####
Month 55 : ##########
Month 56 : ########
Month 57 : ########
Month 58 : ##########
Month 59 : ######

Age ratio of 6-29 months to 30-59 months: 0.70 (The value should be around 1.0).

Statistical Evaluation of Sex and Age Ratios (using Chi squared Statistic)

Age cat.	mo.	Boys	Girls	Total	Ratio Boys/Girls
6 to 17	12	69/81.4 (0.8)	62/75.9 (0.8)	131/157.3 (0.8)	1.11
18 to 29	12	74/79.4 (0.9)	74/74.0 (1.0)	148/153.4 (1.0)	1.00
30 to 41	12	94/77.0 (1.2)	72/71.7 (1.0)	166/148.7 (1.1)	1.31
42 to 53	12	80/75.7 (1.1)	95/70.6 (1.3)	175/146.3 (1.2)	0.84
54 to 59	6	34/37.5 (0.9)	24/34.9 (0.7)	58/72.4 (0.8)	1.42
6 to 59	54	351/339.0 (1.0)	327/339.0 (1.0)		1.07

The data are expressed as observed number/expected number (Ratio of obs/expect)

Overall sex ratio: p = 0.357 (boys and girls equally represented)
Overall age distribution: p = 0.005 (significant difference)
Overall age distribution for boys: p = 0.159 (as expected)
Overall age distribution for girls: p = 0.006 (significant difference)
Overall sex/age distribution: p = 0.000 (significant difference)

Digit preference Weight

Digit .0 : ##################################
Digit .1 : ######################################
Digit .2 : ##################################
Digit .3 : ########################
Digit .4 : ##
Digit .5 : ##################################
Digit .6 : ####################################
Digit .7 : ############################
Digit .8 : ##################################
Digit .9 : ####################################

Digit Preference Score: **5** (0-5 good, 5-10 acceptable, 10-20 poor and > 20 unacceptable)

Digit preference Height

Digit .0 : ##
Digit .1 : ####################################
Digit .2 : ##
Digit .3 : ####################################
Digit .4 : ####################################
Digit .5 : ##################################
Digit .6 : ######################################
Digit .7 : ##################################
Digit .8 : ####################
Digit .9 : ##########################

Digit Preference Score: **6** (0-5 good, 5-10 acceptable, 10-20 poor and > 20 unacceptable)

Evaluation of Standard deviation, Normal distribution, Skewness and Kurtosis using the 3 exclusion (Flag) procedures

	No exclusion	Exclusion from Reference Mean (EPI Info 6 flags)	Exclusion from Observed Mean (SMART flags)
WHZ			
Standard Deviation SD:	0.92	0.92	0.92
(The SD should be between 0.8 and 1.2)			
Prevalence (< -2)			
observed:			
calculated with current SD:			
calculated with a SD of 1:			
HAZ			
Standard Deviation SD:	1.05	1.05	1.01
(The SD should be between 0.8 and 1.2)			
Prevalence (< -2)			
observed:	43.2%	43.2%	43.4%
calculated with current SD:	41.6%	41.6%	42.0%
calculated with a SD of 1:	41.2%	41.2%	41.9%
WAZ			
Standard Deviation SD:	0.94	0.94	0.92
(The SD should be between 0.8 and 1.2)			
Prevalence (< -2)			
observed:			
calculated with current SD:			
calculated with a SD of 1:			
Results for Shapiro-Wilk test for normally (Gaussian) distributed data:			
WHZ	p= 0.838	p= 0.838	p= 0.838
HAZ	p= 0.000	p= 0.000	p= 0.096
WAZ	p= 0.453	p= 0.453	p= 0.562

(If $p < 0.05$ then the data are not normally distributed. If $p > 0.05$ you can consider the data normally distributed)

Skewness			
WHZ	-0.01	-0.01	-0.01
HAZ	0.53	0.53	0.17
WAZ	0.13	0.13	0.03

If the value is:
-below minus 2 there is a relative excess of wasted/stunted/underweight subjects in the sample
-between minus 2 and minus 1, there may be a relative excess of wasted/stunted/underweight subjects in the sample.
-between minus 1 and plus 1, the distribution can be considered as symmetrical.
-between 1 and 2, there may be an excess of obese/tall/overweight subjects in the sample.
-above 2, there is an excess of obese/tall/overweight subjects in the sample

Kurtosis			
WHZ	0.11	0.11	0.11
HAZ	1.87	1.87	0.07
WAZ	0.18	0.18	-0.09

(Kurtosis characterizes the relative peakedness or flatness compared with the normal distribution, positive kurtosis

indicates a relatively peaked distribution, negative kurtosis indicates a relatively flat distribution)
If the value is:
-above 2 it indicates a problem. There might have been a problem with data collection or sampling.
-between 1 and 2, the data may be affected with a problem.
-less than an absolute value of 1 the distribution can be considered as normal.

Test if cases are randomly distributed or aggregated over the clusters by calculation of the Index of Dispersion (ID) and comparison with the Poisson distribution for:

WHZ < -2: ID=1.62 (p=0.007)
WHZ < -3: ID=1.31 (p=0.083)
Oedema: ID=1.00 (p=0.471)
GAM: ID=1.70 (p=0.003)
SAM: ID=1.22 (p=0.153)
HAZ < -2: ID=0.99 (p=0.494)
HAZ < -3: ID=0.97 (p=0.525)
WAZ < -2: ID=1.55 (p=0.013)
WAZ < -3: ID=1.41 (p=0.040)

Subjects with SMART flags are excluded from this analysis.

The Index of Dispersion (ID) indicates the degree to which the cases are aggregated into certain clusters (the degree to which there are "pockets"). If the ID is less than 1 and $p < 0.05$ it indicates that the cases are UNIFORMLY distributed among the clusters. If the p value is higher than 0.05 the cases appear to be randomly distributed among the clusters, if p is less than 0.05 the cases are aggregated into certain cluster (there appear to be pockets of cases). If this is the case for Oedema but not for WHZ then aggregation of GAM and SAM cases is due to inclusion of oedematous cases in GAM and SAM estimates.

Are the data of the same quality at the beginning and the end of the clusters?
Evaluation of the SD for WHZ depending upon the order the cases are measured within each cluster (if one cluster per day is measured then this will be related to the time of the day the measurement is made).

Time point — SD for WHZ

0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
01: 0.84 (n=43, f=0) ##
02: 0.87 (n=43, f=0) ###
03: 0.77 (n=43, f=0)
04: 1.09 (n=42, f=0) ############
05: 1.08 (n=43, f=0) ############
06: 0.81 (n=43, f=0)
07: 1.00 (n=42, f=0) ########
08: 0.84 (n=42, f=0) ##
09: 0.96 (n=42, f=0) #######
10: 0.92 (n=40, f=0) #####
11: 0.97 (n=40, f=0) #######
12: 0.90 (n=37, f=0) ####
13: 0.92 (n=34, f=0) #####
14: 0.84 (n=31, f=0) ##
15: 1.03 (n=28, f=0) ##########
16: 0.92 (n=25, f=0) #####
17: 0.86 (n=22, f=0) OO
18: 0.77 (n=17, f=0)

19: 0.89 (n=08, f=0) ~~~~
20: 1.04 (n=06, f=0) ~~~~~~~~~~
21: 0.69 (n=03, f=0)
22: 0.68 (n=02, f=0)

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)

Analysis by Team

Team	**1**	**2**	**3**	**4**	**5**	
Percentage of values flagged with SMART flags:						
WHZ:	0.0	0.0	0.0	0.7	0.0	
HAZ:	0.8	0.0	0.0	0.7	0.6	
WAZ:	0.8	0.6	0.0	0.7	0.0	
Age ratio of 6-29 months to 30-59 months:						
	0.59	0.80	0.58	0.68	0.79	
Sex ratio (male/female):						
	1.02	1.07	1.26	0.96	1.14	
Digit preference Weight (%):						
.0 :	12	7	11	10	10	
.1 :	10	13	8	10	13	
.2 :	13	10	5	9	9	
.3 :	8	7	13	5	5	
.4 :	12	15	17	12	8	
.5 :	7	13	7	12	8	
.6 :	12	10	11	8	13	
.7 :	7	7	12	10	6	
.8 :	9	6	8	12	14	
.9 :	7	12	8	13	12	
DPS:	8	9	10	7	10	Digit preference score (0-5 good, 5-10 acceptable, 10-20 poor and > 20 unacceptable)
Digit preference Height (%):						
.0 :	11	12	11	17	10	
.1 :	12	14	11	7	11	
.2 :	14	12	9	15	8	
.3 :	8	13	12	10	11	
.4 :	10	12	14	6	11	
.5 :	7	5	8	12	14	
.6 :	12	8	13	12	12	
.7 :	10	10	7	10	9	
.8 :	6	9	5	4	6	
.9 :	11	5	11	7	7	
DPS:	7	10	8	13	7	Digit preference score (0-5 good, 5-10 acceptable, 10-20 poor and > 20 unacceptable)
Standard deviation of WHZ:						
SD	0.90	0.94	0.79	0.92	0.99	
Prevalence (< -2) observed:						
%						
Prevalence (< -2) calculated with current SD:						
%						

Prevalence (< -2) calculated with a SD of 1:
%
Standard deviation of HAZ:
SD 1.02 0.92 1.05 1.17 1.06
observed:
% 57.9 47.4 38.6 37.0
calculated with current SD:
% 51.8 42.9 38.8 36.2
calculated with a SD of 1:
% 51.9 42.6 37.0 35.4

Statistical evaluation of sex and age ratios (using Chi squared statistic) for:

Team 1:

Age cat.	mo.	boys	girls	total	ratio boys/girls
6 to 17	12	11/14.2 (0.8)	9/13.9 (0.6)	20/28.1 (0.7)	1.22
18 to 29	12	13/13.8 (0.9)	12/13.6 (0.9)	25/27.4 (0.9)	1.08
30 to 41	12	20/13.4 (1.5)	15/13.2 (1.1)	35/26.5 (1.3)	1.33
42 to 53	12	12/13.2 (0.9)	17/12.9 (1.3)	29/26.1 (1.1)	0.71
54 to 59	6	5/6.5 (0.8)	7/6.4 (1.1)	12/12.9 (0.9)	0.71
6 to 59	54	61/60.5 (1.0)	60/60.5 (1.0)		1.02

The data are expressed as observed number/expected number (ratio of obs/expect)

Overall sex ratio: p = 0.928 (boys and girls equally represented)
Overall age distribution: p = 0.230 (as expected)
Overall age distribution for boys: p = 0.344 (as expected)
Overall age distribution for girls: p = 0.477 (as expected)
Overall sex/age distribution: p = 0.091 (as expected)

Team 2:

Age cat.	mo.	boys	girls	total	ratio boys/girls
6 to 17	12	18/18.6 (1.0)	17/17.4 (1.0)	35/36.0 (1.0)	1.06
18 to 29	12	20/18.1 (1.1)	14/17.0 (0.8)	34/35.1 (1.0)	1.43
30 to 41	12	22/17.5 (1.3)	16/16.4 (1.0)	38/34.0 (1.1)	1.38
42 to 53	12	12/17.3 (0.7)	25/16.2 (1.5)	37/33.4 (1.1)	0.48
54 to 59	6	8/8.5 (0.9)	3/8.0 (0.4)	11/16.5 (0.7)	2.67
6 to 59	54	80/77.5 (1.0)	75/77.5 (1.0)		1.07

The data are expressed as observed number/expected number (ratio of obs/expect)

Overall sex ratio: p = 0.688 (boys and girls equally represented)
Overall age distribution: p = 0.597 (as expected)
Overall age distribution for boys: p = 0.560 (as expected)
Overall age distribution for girls: p = 0.076 (as expected)
Overall sex/age distribution: p = 0.022 (significant difference)

Team 3:

Age cat.	mo.	boys	girls	total	ratio boys/girls

6 to 17	12	6/12.3 (0.5)	4/9.7 (0.4)	10/22.0 (0.5)	1.50
18 to 29	12	14/12.0 (1.2)	11/9.5 (1.2)	25/21.5 (1.2)	1.27
30 to 41	12	10/11.6 (0.9)	8/9.2 (0.9)	18/20.8 (0.9)	1.25
42 to 53	12	16/11.4 (1.4)	17/9.1 (1.9)	33/20.5 (1.6)	0.94
54 to 59	6	7/5.7 (1.2)	2/4.5 (0.4)	9/10.1 (0.9)	3.50
6 to 59	54	53/47.5 (1.1)	42/47.5 (0.9)		1.26

The data are expressed as observed number/expected number (ratio of obs/expect)

Overall sex ratio: p = 0.259 (boys and girls equally represented)
Overall age distribution: p = 0.004 (significant difference)
Overall age distribution for boys: p = 0.205 (as expected)
Overall age distribution for girls: p = 0.017 (significant difference)
Overall sex/age distribution: p = 0.001 (significant difference)

Team 4:

Age cat.	mo.	boys	girls	total	ratio boys/girls
6 to 17	12	11/17.4 (0.6)	16/18.1 (0.9)	27/35.5 (0.8)	0.69
18 to 29	12	11/17.0 (0.6)	24/17.6 (1.4)	35/34.6 (1.0)	0.46
30 to 41	12	22/16.4 (1.3)	14/17.1 (0.8)	36/33.5 (1.1)	1.57
42 to 53	12	23/16.2 (1.4)	18/16.8 (1.1)	41/33.0 (1.2)	1.28
54 to 59	6	8/8.0 (1.0)	6/8.3 (0.7)	14/16.3 (0.9)	1.33
6 to 59	54	75/76.5 (1.0)	78/76.5 (1.0)		0.96

The data are expressed as observed number/expected number (ratio of obs/expect)

Overall sex ratio: p = 0.808 (boys and girls equally represented)
Overall age distribution: p = 0.345 (as expected)
Overall age distribution for boys: p = 0.056 (as expected)
Overall age distribution for girls: p = 0.430 (as expected)
Overall sex/age distribution: p = 0.011 (significant difference)

Team 5:

Age cat.	mo.	boys	girls	total	ratio boys/girls
6 to 17	12	23/19.0 (1.2)	16/16.7 (1.0)	39/35.7 (1.1)	1.44
18 to 29	12	16/18.5 (0.9)	13/16.3 (0.8)	29/34.8 (0.8)	1.23
30 to 41	12	20/18.0 (1.1)	19/15.8 (1.2)	39/33.8 (1.2)	1.05
42 to 53	12	17/17.7 (1.0)	18/15.5 (1.2)	35/33.2 (1.1)	0.94
54 to 59	6	6/8.8 (0.7)	6/7.7 (0.8)	12/16.4 (0.7)	1.00
6 to 59	54	82/77.0 (1.1)	72/77.0 (0.9)		1.14

The data are expressed as observed number/expected number (ratio of obs/expect)

Overall sex ratio: p = 0.420 (boys and girls equally represented)
Overall age distribution: p = 0.496 (as expected)
Overall age distribution for boys: p = 0.681 (as expected)
Overall age distribution for girls: p = 0.716 (as expected)

Overall sex/age distribution: p = 0.280 (as expected)

Evaluation of the SD for WHZ depending upon the order the cases are measured within each cluster (if one cluster per day is measured then this will be related to the time of the day the measurement is made).

Team: 1

```
Time                              SD for WHZ
point          0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
01: 0.88 (n=08, f=0)  ###
02: 0.70 (n=08, f=0)
03: 0.71 (n=08, f=0)
04: 1.35 (n=08, f=0)  ########################
05: 1.18 (n=08, f=0)  ################
06: 0.94 (n=08, f=0)  ######
07: 0.55 (n=08, f=0)
08: 0.94 (n=08, f=0)  ######
09: 0.56 (n=08, f=0)
10: 1.05 (n=08, f=0)  ###########
11: 0.76 (n=08, f=0)
12: 0.58 (n=06, f=0)
13: 0.73 (n=06, f=0)
14: 0.53 (n=05, f=0)
15: 1.19 (n=03, f=0)  OOOOOOOOOOOOOOO
16: 0.48 (n=03, f=0)
17: 0.63 (n=03, f=0)
18: 0.82 (n=03, f=0)  O
19: 0.04 (n=02, f=0)
```

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)

Team: 2

```
Time                              SD for WHZ
point          0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
01: 1.24 (n=08, f=0)  ###################
02: 0.68 (n=08, f=0)
03: 0.74 (n=08, f=0)
04: 0.98 (n=08, f=0)  #######
05: 0.66 (n=08, f=0)
06: 0.88 (n=08, f=0)  ###
07: 1.27 (n=08, f=0)  ####################
08: 0.85 (n=08, f=0)  ##
09: 1.12 (n=08, f=0)  ##############
10: 0.49 (n=08, f=0)
11: 1.38 (n=08, f=0)  ########################
12: 0.86 (n=08, f=0)  ###
13: 0.78 (n=08, f=0)
14: 0.64 (n=08, f=0)
15: 1.04 (n=08, f=0)  ##########
16: 0.93 (n=08, f=0)  #####
17: 1.00 (n=08, f=0)  ########
18: 0.94 (n=08, f=0)  ######
```

19: 0.67 (n=04, f=0)
20: 0.64 (n=04, f=0)

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)

Team: 3

Time SD for WHZ
point 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
01: 0.51 (n=08, f=0)
02: 1.11 (n=08, f=0) ##############
03: 0.51 (n=08, f=0)
04: 0.79 (n=08, f=0)
05: 1.20 (n=08, f=0) ##################
06: 0.74 (n=08, f=0)
07: 0.65 (n=07, f=0)
08: 0.74 (n=07, f=0)
09: 1.01 (n=07, f=0) #########
10: 0.68 (n=06, f=0)
11: 0.35 (n=06, f=0)
12: 0.53 (n=06, f=0)
13: 0.51 (n=03, f=0)
14: 0.49 (n=02, f=0)
15: 0.82 (n=02, f=0) ~

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)

Team: 4

Time SD for WHZ
point 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3
01: 0.91 (n=10, f=0) #####
02: 0.55 (n=10, f=0)
03: 1.03 (n=10, f=0) ##########
04: 0.91 (n=09, f=0) #####
05: 1.39 (n=10, f=0) ########################
06: 0.66 (n=10, f=0)
07: 0.79 (n=10, f=0)
08: 0.69 (n=10, f=0)
09: 0.74 (n=09, f=0)
10: 1.15 (n=09, f=0) ################
11: 0.81 (n=09, f=0)
12: 0.92 (n=08, f=0) #####
13: 1.06 (n=08, f=0) ############
14: 0.94 (n=08, f=0) ######
15: 1.21 (n=07, f=0) ##################
16: 0.99 (n=06, f=0) OOOOOOOO
17: 0.96 (n=05, f=0) OOOOOOO
18: 0.28 (n=03, f=0)

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)

Team: 5

Time SD for WHZ

point 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 2.1 2.2 2.3

01: 0.67 (n=10, f=0)
02: 0.83 (n=09, f=0) #
03: 0.86 (n=09, f=0) ###
04: 1.27 (n=09, f=0) ####################
05: 0.81 (n=09, f=0)
06: 0.81 (n=09, f=0)
07: 1.34 (n=09, f=0) ########################
08: 1.02 (n=09, f=0) #########
09: 1.23 (n=09, f=0) ##################
10: 0.89 (n=09, f=0) ####
11: 1.23 (n=09, f=0) ##################
12: 1.09 (n=09, f=0) ############
13: 0.97 (n=09, f=0) #######
14: 1.17 (n=08, f=0) ################
15: 0.69 (n=08, f=0)
16: 1.16 (n=07, f=0) ###############
17: 0.64 (n=06, f=0)
18: 0.74 (n=03, f=0)

(When n is much less than the average number of subjects per cluster different symbols are used: 0 for n < 80% and ~ for n < 40%; The numbers marked "f" are the numbers of SMART flags found in the different time points)