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Innovating pro-poor Strategies to safeguard Food Security using Technology and Knowledge Transfer

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Analysing and enhancing food quality and consumption practices; minimizing quality losses related to food processing

Christine Lambert & Hans Konrad Biesalski
Institute of Biological Chemistry and Nutrition
University of Hohenheim, Stuttgart, Germany

Hadijah Mbwana & Joyce Kinabo
Department of Food Science and Technology, SOKOINE University of
Agriculture, Morogoro, Tanzania

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Analysing and enhancing food quality and consumption practices; minimizing quality losses related to food processing

Introduction

According to the Global Hunger Index 2014 the severity of hunger in Tanzania is serious, although the food insecurity decreases in the last 14 years (von Grebmer, 2014). Poor nutritional status is a consequence of an unbalanced diet and/or infectious diseases affecting the individual requirement and/or the utilisation of the food. Numerous environmental and socioeconomic factors, like income, education and gender are underlying causes for the development of malnutrition and poor health (Ali, 2005; Kinabo, 2003; Mahgoub, 2006; Masibo, 2013). The Tanzania Demographic and Health Survey (TDHS, 2010) reported that approximately 42% of children below five years of age are stunted as a result of chronic under nutrition (National Bureau of Statistics & ICF Macro, 2010). The most vulnerable groups of people to malnutrition are children below the age of five years and women of the reproductive age. Low dietary intakes, especially for non-energy nutrients, are due to inequitable distribution of food within the household, improper food storage and preparation, dietary taboos as well as infectious diseases and inadequate care (Goudet, 2011). The high portion of staple foods and the very low portion of animal products in diets of rural, poor Tanzanians increases the risk for an unbalanced diet. High phytate content in staple foods reduces the bioavailability of many minerals. In combination with a low intake of these minerals (e.g. iron, zinc, calcium) the risk of iron and zinc deficiency is very high (Moore, 2012). Additional factors that may contribute to undernutrition among women include the demanding nutritional requirements of pregnancy and lactation.

This report focuses on nutrition quality and factors influencing malnutrition – like nutrition and home gardening knowledge and income. Agro-climatic conditions differ in Dodoma and Morogoro region, which affects agricultural production, food availability and income, dependent on the season (Kinabo, 2003; Meena, 2008). Dependent on the Tanzanian region, eating pattern is affected by these parameters in variable degree and nutritional status reflects the physical consequences (National Bureau of Statistics & ICF Macro, 2010).

The results of the nutrition survey and the household survey (wave I) concerning food security and nutrition will be used to assess the impact of the UPS 'Nutrition education' and 'Kitchen gardens' on (1) nutrition knowledge, (2) implementation of kitchen gardening, (3) nutrition quality and (4) anthropometric/health data.



Methods

Design of Nutrition survey (baseline)

The cross sectional study was conducted from January to May 2015 in four TransSEC CSS villages. Two of them have been in the sub humid Morogoro region and two in the semi arid Dodoma region. The two regions have sufficiently diverse environmental and socio-economic conditions for investigating causative factors for food and nutrition insecurity thus allowing for the transfer of results to other regions in Tanzania. In Morogoro region, Kilosa district was selected and Changarawe and Ilakala villages represented the sub humid climate. In Kilosa, the food systems are more varied mainly relying on sorghum, maize, legumes, rice, and horticulture and livestock (Mnenwa & Maliti, 2010). Morogoro region receives two rainfall seasons with an average of 600-800mm per annum. In Dodoma region, Chamwino district was selected and Ilolo and Idifu villages represented the semi-arid climate.

A cluster sampling method was used to select 351 households. In the selected households participants were the mother/caregiver-child pair. Household heads and spouses were informed of purpose, objectives and activities of the study. The household representatives were required to sign the form or apply a thumb print (in ink) to consent to participating in the study. The study population comprised all children aged between 6-59 months and their care givers in the sampled households. The respondent was the mother/ woman or any other person responsible for food preparation and serving in the household.

Permission and ethical clearance were obtained from National Institute for Medical Research (NIMR) Ethical Committee.

Data Collection of Nutrition survey (baseline)

Interviewer administered questionnaire was used to collect demographic and socioeconomic information. Mothers/caregivers' knowledge in nutrition and kitchen gardening was also assessed in the selected households. The age of the children were obtained from their parents and verified from their clinic cards where available. The height (in cm) and weight (in kg) of 351 children and their caregivers in the sampled households were measured. The weight was measured to the nearest 0.01 kg or 10 g using a SECA electronic bathroom scale for children below two years or who could not stand on their own, their weight was measured using a SECA scale with a tare facility. Both children and their caregivers were in minimal clothing and without footwear when measurements were taken. Height was measured using a stadiometer. The measurements were taken while the subject was standing without shoes, on a horizontal flat plane attached to the base of the stadiometer with heels together; and stretched upwards to a full extent and the head in the Frankfurt plane. Recumbent length was measured on children below the age of 24 months.

Data analysis of Nutrition survey (baseline)

The SPSS software version 17 (SPSS Inc., Chicago, IL, USA) computer programme was used to analyze the collected data. All categorical variables were described by using the frequencies and percentages. ENA for SMART 2011 (www.nutrisurvey.de/ena2011/) was used to classify the study children into categories of nutritional status by converting the anthropometric measurements into z-scores of weight for age (WAZ), height for age (HAZ) and weight for height (WHZ), and compared with the WHO guidelines and standards (2006), which were also used to define stunting, underweight, wasting in children. For women, the indicator used to assess nutritional status was body mass index (BMI). This indicator is the most frequently used standardized indicator of thinness (wasting) to assess the progressive loss of body energy in developing countries. Descriptive statistics were computed wherever necessary. The net effects of each independent variable were estimated by the logistic



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regression multivariate analysis while controlling other factors. Odds ratio was used to determine the chance (increased or decreased) of malnutrition of independent variables while controlling for effects of other variables in the models. Significance was considered when P value ≤ 0.05 .

Design and data collection of Household survey wave I (baseline)

Methods of the Household survey were described in TransSEC deliverable 3.2.1: Household survey wave I: baseline.

Data analysis of Household survey wave I (baseline)

Statistical analysis was performed using IBM SPSS Statistics Version 22. Twenty eight households were excluded from the original cleaned data set due to unreliable low food intake (consumption of cereals and tubers less than 2 days per week or no consumption of pulses in a week).

Calculation of the two indicators Household insecurity access scale (HFIAS) and Household hunger scale was modified, due to different requested periods: the original HFIAS/HHS has been designed for a period of 4 weeks, whereas a period of 7 days was asked in the TransSEC Household survey wave I (Coates, 2007; Deitchler, 2011). Therefore, the transformation was done by multiplying the days with the factor 4.



Results of Nutrition survey (baseline)

Socio-demographic information

Eighty eight percent (88%) of households were headed by males and married 81%. Household size ranged between 2-5 persons (51%) and between 6-8 (43%) persons. Other demographics of the households and respondents are indicated in Table 1. Regarding the child population, 56% were male and 45% were females. The distribution of age of the children is presented in Figure 1.

Table 1: Demographic characteristics of households (n=351)

Characteristics	n	%
Village of origin		
Changarawe	101	28.8
Ilakala	100	28.5
Ilolo	50	14.2
Idifu	100	28.5
Sex of household head		
Male	309	88
Female	42	12
Marital status of household head		
Married-monogamous	251	71.5
Married-polygamous	34	9.7
Widowed	25	7.1
Divorced	18	5.2
Single	10	2.8
cohabitation	13	3.7
Level of literacy of caregiver/mother		
Not able to read or write	141	40.2
Can read and write to some extent	73	20.8
Can read and write	137	39
Occupation of respondent		
Farmer	335	95.4
Employed formal sector	1	0.3
Self employed/other	6	1.7
Other	9	2.6
Total number of people living in the household		
2 to 5	177	50.5
6 to 8	150	42.7
9 to 13	24	6.8
Education level of respondent		
No education	137	39
Primary education	199	56.7
Secondary education	12	3.5
Adult Education	3	0.8

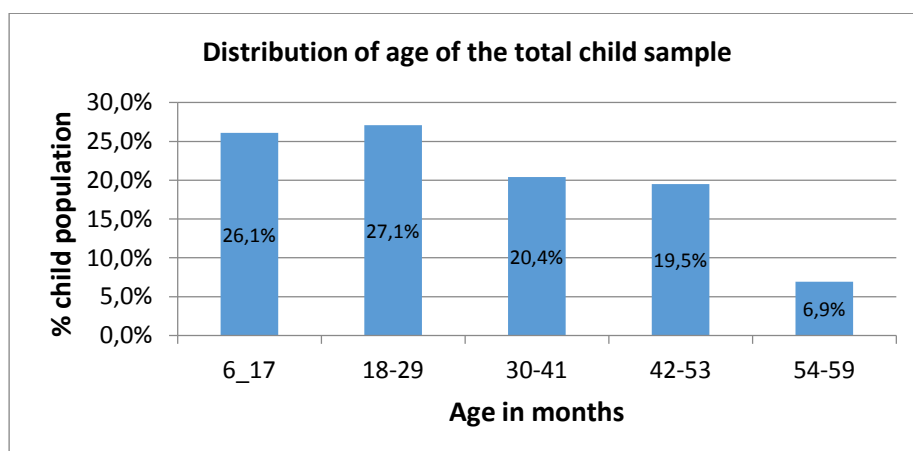


Figure 1: Age distribution of children

Home Gardening

About 60% of the caregivers indicated that they are forced to consume particular foods in a meal because of the availability factor. About 74% of the caregivers had never heard about pocket/bag/sack vegetable gardening. A high proportion of women (84%) was aware that children aged 6-59 months should be fed fruits and vegetables in addition to their diets. Further results regarding questions asked on kitchen gardening are indicated on Table 2.

Table 2: Mothers' responses on kitchen gardening knowledge and practices

Question asked	n	%
Factors influencing consumption of different foods in a meal		
Availability	209	59.5
Appearance	29	8.3
Good for health	32	9.1
Accessibility	21	6.0
Preparation time	4	1.1
taste	33	9.4
Cost	17	4.8
Amount of food	6	1.7
Do you know any fruits and vegetables that grow in this village		
Yes	336	95.7
No	15	4.3
If yes, do you grow these vegetables and fruits		
Yes	175	49.9
No	161	45.9
Not applicable	15	4.3



Mention types of fruits and vegetables that you grow		
Pawpaw	13	3.7
Mangoes	25	7.1
Oranges	15	4.3
Ripe banana	4	1.1
Pineapple	1	0.3
Pumpkin fruits	1	0.3
Not applicable	292	83.2
Mention types of vegetables that you grow		
Amaranths	34	9.7
Sweet potato leaves	47	13.4
Pumpkin leaves	41	11.7
Chinese cabbage	26	7.4
Cow pea leaves	31	8.8
Cassava leaves	3	0.9
Not applicable	169	48.1
Can children 2-5 years be given fruits and vegetables		
Yes	294	83.8
No	27	7.7
Do not know	30	8.6
Do you know bag/pocket gardening		
Yes	92	26.2
No	259	73.8
Have you ever cultivated vegetables in a bag/pocket garden		
Yes	28	7.9
No	241	68.7
Not applicable	82	23.4

Nutritional knowledge

Results indicate further that 90% of the caregivers had never received any kind of nutrition education and 86% did not know anything about food groups (Table 3 and Table 4).

Table 3: Mothers'/ caregivers' nutritional knowledge

Question asked	n	%
Have you received any training about nutrition before		
Yes	34	9.7
No	317	90.3
How often should children 2-5 years be fed		
Once	10	2.8
Twice	54	15.4
Thrice	239	68.1
More than three times	34	9.8
Do not know	14	3.9



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How often should children 2-5 years be fed	n	%
Once	10	2.8
Twice	55	15.7
Thrice	242	68.9
More than three times	34	9.7
Do not know	10	2.8
How many servings of fruits and vegetables a day are advised for people to eat		
One	101	28.8
Two	122	34.8
Three	79	22.5
Four	4	1.1
Five	4	1.1
Do not know	41	11.7
Which one is a good way of eating healthy		
Eat many different kinds of food	81	23.1
Eat some foods more than other foods	22	6.3
eat certain kinds of foods in moderate or small amounts	39	11.1
Do not know	209	59.5
What is a balanced diet		
a diet rich in protein	15	4.3
a diet poor in fat	8	2.3
a diet without carbohydrates	12	3.4
a diet containing all nutrients in proper quantities	50	14.2
Do not know	266	75.8
Do you know foods that increase intake of fibre		
Yes-with correct example	16	4.6
Yes -with wrong or no example	21	6.0
No	314	89.5
How can you recognize that someone is not having enough food		
lack of energy	76	21.7
Becomes ill easily or seriously ill	35	10.0
Loss of weight/ thinness	51	14.5
growth faltering	16	4.6
Do not know	173	49.3



Table 4: Mothers'/ caregivers' nutritional knowledge-continued

Question asked	n	%
To whom do you seek advice and opinion about whether your baby is growing well or not		
Health centre ask a health professional	246	70
Go to relative-mother, grand mother	36	10.3
Do not know	69	19.7
Do you know any kinds of food groups		
Yes	51	14.5
No	300	85.5
Name some food groups you know		
Cereals	25	7.1
Roots, tubers, plantain	2	.6
Oils and fat	2	.6
Not applicable	300	85.5
Do not know	22	6.3
Can you list examples of foods in each food group		
Maize	21	6.0
Tea	3	0.9
Not applicable	327	93.1
What is the reason why green leafy vegetables and orange fruits are healthy foods		
They are rich in protein	26	7.4
They are rich in vitamin A	51	14.5
They are rich in iron	33	9.4
They are rich in many nutrients	45	12.8
Do not know	196	55.8

Knowledge on iron deficiency anaemia

As shown in Table 5, when asked to mention any foods rich in iron, about 45% of caregivers/mothers mentioned dark green vegetables and about 48% of the mothers/caregivers did not know any food rich in iron, but when they were asked if they knew any foods that when taken with food helps the body to absorb and use iron, 81% said no and 95% did not know any foods that decrease iron absorption.

Table 5: Mothers'/ caregivers knowledge on iron deficiency anaemia (n=351)

Question asked	n	%
Have you ever heard about iron deficiency anemia		
Yes	289	82.3
No	62	17.7



Can you tell me how you can recognize someone who has anemia	N	%
Less energy/ weakness	63	17.9
Paleness/pallor	144	41.0
Spoon nails/ bent nails	12	3.4
More likely to become sick-less immunity to infections	15	4.3
Do not know	117	33.3
What do you think causes iron deficiency anemia		
Lack of iron in the diet	77	21.9
Inability to absorb iron	2	0.6
Blood loss	16	4.6
Other-lack of appetite	2	0.6
Does not know	254	72.4
Can you list examples of foods rich in iron		
Organ meat	4	1.1
Flesh meat	7	2.0
Dark green leafy vegetables	157	44.7
Beans	8	2.3
Insects e.g. grasshoppers	4	1.1
Fish and sea foods	2	0.6
Does not know	169	48.1
Do you know foods that when taken during meals help the body to absorb and use iron		
Yes	67	19.1
No	284	80.9
What are the foods that increase iron absorption		
Vitamin C rich foods eg. citrus fruits, tomatoes and leafy vegetables	52	14.8
Not applicable	284	80.9
Does not know	15	4.3
Do you know foods that when taken during meals decrease iron absorption		
Yes	16	4.6
No	335	95.4
What are the foods that decrease iron absorption		
Coffee	1	0.3
Not applicable	335	95.4
Does not know	15	4.3
Has child 6-59 months used iron tablets in the last six months		
Yes	32	9.1
No	319	90.9
Have mother used iron tablets in the last six months		
Yes	44	12.5
No	307	87.5
Has child 6-59 months ever used ant-helminthes drugs		
Yes	161	45.9
No	190	54.1



Iodine fortification

About 49% of the participating households consumed salt that is not iodized; the reason for using this type of salt is because it is cheaper (29%) and easily accessible (52%) compared to the iodized salt (Table 6).

Table 6: Use of iodized salt

Question asked	n	%
May I see the salt used to cook the main meal eaten by HH members		
Iodized	167	47.6
Not iodized	173	49.3
No salt at home	11	3.1
Reasons for using this kind of salt		
Cost	102	29.1
Accessibility	183	52.1
Good for health	20	5.7
No reason	46	13.1

Breastfeeding practices

Majority (99%) of the mothers had ever breastfed their children and fed the colostrum (96%) but 39% exclusively breastfed for less than three months. Further results are shown in Table 7.

Table 7: Caregivers knowledge and practices of breastfeeding

Question asked	n	%
Did you ever breastfeed the youngest child 5-59 months		
Yes	347	98.9
No	4	1.1
Did you feed colostrum to this child		
Yes	336	95.7
No	15	4.3
Who offered support/advice to help start breastfeeding		
Health professional	263	74.9
Relative, family member, neighbour	84	23.9
Not applicable	4	1.1
How many months old was child exclusively breastfed		
Less than 1 month	17	4.8
One to three months	138	39.3
Four to five	56	16.0
Six months	135	38.5
More than six months	1	0.3
Not applicable	4	1.1



Question asked	n	%
Reasons for not exclusively breastfeed		
Breast milk was not enough	118	33.6
Mother busy with other activities	120	34.2
Cultural norms	109	31.1
Not applicable	4	1.1

Food consumption

Dietary diversity

A scale of twelve food groups was used in assessing the dietary diversity of subjects (Similar foods were combined to form one group). Using information collected from the house hold dietary diversity questionnaire, the dietary diversity scores for individuals were derived using the FAO guidelines for measuring household and individual dietary diversity (FAO, 2007). All households consumed cereals in the immediate 24 hours preceding the survey. Also households in villages in Morogoro seem to consume more vegetables (88% and 74% for Changarawe and Ilakala respectively) compared to villages in Dodoma region (36% and 44% for Ilolo and Idifu respectively) (Table 8).

Table 8: Consumption of various food groups among villages

Food groups	Morogoro		Dodoma	
	Changarawe (n=101) %	Ilakala (n=100) %	Ilolo (n=50) %	Idifu (=100) %
Cereals	100	100	100	100
Vegetables, Vitamin A Rich & other Vegetables and Tubers	88	74	36	44
White tubers and roots	11	7	6	7
Vitamin A rich & other fruits	78	11	6	4
Flesh & Organ meat (iron-rich)	5	2	6	4
Eggs	2	2	0	2
Fish	10	8	4	12
Legumes, nuts and seeds	25	38	34	19
Milk and milk products	3	4	6	4
Oils and fats	92	97	44	46
Sweets	96	94	82	84
Spices, condiments, beverages	98	98	96	91



The dietary diversity was assessed based on the number of food groups consumed over the immediate past 24 hours. One point was awarded to each food group consumed over the reference period, and the sums of all points were calculated for the dietary diversity score for each individual (Table 9). Furthermore, Dietary Diversity tertiles were derived from the 12 food groups into; low, medium and high dietary diversity tertiles. A high proportion of the households fell into the medium dietary diversity tertile. Comparing households in Morogoro and Dodoma, a high proportion of households in Changarawe (48%) and Ilakala (40%) were in the medium dietary diversity of five compared to households in Ilolo (32%) and Idifu (29%).

Table 9: Household Diversity Scores in the four villages

Dietary diversity scores	Morogoro		Dodoma	
	Changarawe %	Ilakala %	Ilolo %	Idifu %
2	1.0		4.0	8.0
3	2.0	3.0	24.0	20.0
4	7.9	12.0	30.0	33.0
5	47.5	40.0	32.0	29.0
6	31.7	38.0	10.0	6.0
7	8.9	6.0		4.0
8	1.0	1.0		

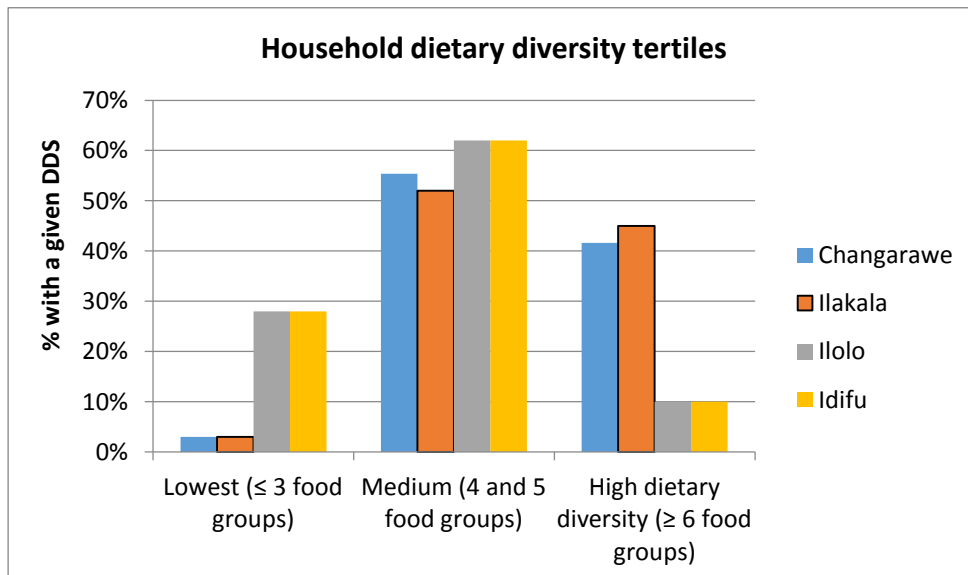


Figure 2: Dietary diversity tertiles



Food frequency (Consumption of foods from the ten food groups)

The main foods that are available in the case study sites and which dictate consumption patterns are presented in Table 10 and Table 11 under the ten food groups namely, cereals, roots, tubers, plantain, legumes, nuts and seeds, meat, poultry, fish, eggs, milk and milk products, oils and fat, vegetables, fruits and beverages. As shown in Table 10, the main staples consumed were maize, sorghum and wheat. Majority (84%) of respondents indicated that they consumed maize on a daily basis; however, in Dodoma 42% and 40% were consuming pearl millet and bulrush millet respectively. The roots, tubers and plantain foods were represented by sweet potatoes and plantain bananas. The consumption of nuts and legumes for specific sites in the two study regions are presented in Table 10.

Table 10: Frequency of consumption of cereals, roots, tubers and plantain, legumes, nuts and seeds in Morogoro and Dodoma study villages

Food item	% Response									
	Morogoro (n=202), Dodoma (n=149)									
	Daily		Weekly		Monthly		Rare		Never	
	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma
Cereals										
Maize	84.2	18.1	14.7	12.8	0.0	8.1	0.5	34.2	0.5	26.8
Sorghum	5.0	28.2	5.0	12.1	4.5	3.4	51.5	31.5	34.2	24.8
pearl millet	8.9	41.6	6.4	8.7	4.5	4.0	38.6	23.5	41.6	22.1
Bulrush millet	1.5	40.3	3.0	2.7	4.5	1.3	36.6	14.1	54.5	41.6
Wheat	9.9	8.1	74.8	36.2	8.4	3.4	6.4	26.8	0.5	25.5
Rice	27.2	2.0	52.5	38.9	3.5	20.1	12.9	28.9	4.0	10.1
Roots, tubers, plantain										
Cassava	9.4	0.7	52.0	17.4	11.4	12.1	24.3	33.6	3.0	36.2
Sweet potatoes	6.9	1.3	33.7	9.4	15.3	12.8	39.6	42.3	4.5	34.2
Round potatoes	6.4	2.0	28.2	18.8	11.9	8.7	45.5	36.9	7.9	33.6
Yams	5	2.7	8.9	4.7	5.9	0.7	40.6	22.8	39.6	69.1
Green bananas	12.4	0.7	58.4	9.4	12.4	7.4	11.9	32.9	5.0	49.7
Legumes										
Beans	11.9	4.0	82.2	65.8	4.5	18.8	1.5	9.4	0.0	2.0
Peas (Njegere)	4.5	0.7	25.7	4.7	6.4	0.9	38.6	30.2	24.8	63.8
Cowpeas (kunde)	5.0	2.0	36.6	36.2	30.2	19.5	25.7	33.6	2.5	8.7
Pigeon peas (mbaazi)	5.0	3.4	27.7	12.1	15.3	2.0	42.6	45	9.4	37.6
Green grams (choroko)	5.9	1.3	27.2	9.4	6.9	4.7	34.7	42.3	25.2	42.3
Chickpeas (dengu)	1.5	2.0	1.0	3.4	1.5	0.7	36.1	23.5	59.9	70.5
Soybeans (soya)	4.0	4.0	44.6	18.8	16.8	12.1	23.3	26.8	11.4	38.3
Bambara nuts (Njugumawe)	3.5	6.0	11.9	39.6	7.9	14.8	46.0	30.2	30.7	9.4
Lablab bean (fiwi)	4.0	3.4	26.2	16.1	17.3	14.1	32.2	42.3	20.3	24.2
Nuts and seeds										
Groundnuts	5.9	34.2	31.2	28.2	15.8	6.7	29.7	26.2	17.3	4.7
Coconut	12.4	6.7	62.9	34.2	10.9	3.4	9.9	24.8	4.0	30.9
Cashew nut	0.0	0.0	4.5	2.7	4.5	1.3	47.0	36.2	44.1	59.7
Oils and fat										
Sunflower oil	26.2	33.6	10.4	10.7	3.5	1.3	46.0	47.0	13.9	7.4
Red palm oil	3.5	5.4	5.4	1.3	2.5	2.7	26.7	36.2	61.9	54.4
Korie oil	50.0	32.9	13.9	14.8	3.5	2.7	21.8	24.8	10.9	24.8
Ground nut oil	1.5	2.7	1.0	0.0	0.5	0.0	18.3	24.2	78.7	73.2



Beef and sardines were the main source of animal protein for the respondents but were consumed weekly in most of the households. Other sources of animal protein included goat meat and fish. Milk and eggs were less frequently consumed (Table 11).

Table 11: Frequency consumption of Meat, poultry, fish, eggs, Milk and milk products

Food item	% Response									
	Morogoro (n=202), Dodoma (n=)									
	Daily		Weekly		Monthly		Rare		Never	
	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma
Meat, poultry, fish, eggs										
Cow-beef	5.4	4.7	45.0	50.3	26.0	19.5	12.4	17.8	10.9	8.1
Liver	1.0	0.0	6.4	9.4	9.4	9.4	57.9	47.0	25.2	34.2
Other organ meats	0.0	0.0	2.0	4.7	9.4	8.1	60.9	50.3	27.7	36.9
Goat	0.5	0.0	16.8	23.5	13.9	17.4	50.5	48.3	18.3	10.7
Sheep-lamb	0.0	0.0	1.0	0.0	2.0	6.0	43.6	43.0	53.5	51.0
Pork	0.0	0.0	0.0	14.8	2.0	10.7	35.1	37.6	62.9	36.9
Wild game meat	0.5	0.0	0.0	0.0	5.9	2.7	48.5	37.6	45.0	59.7
Poultry-chicken/duck	1.5	0.0	7.4	6.7	44.6	29.5	31.7	55.0	14.9	8.7
Eggs	2.0	2.0	17.3	16.8	19.3	12.8	52.0	59.1	9.4	9.4
Fresh-water fish	5.9	2.7	60.4	43.0	16.3	8.7	9.9	31.5	7.4	14.1
Sea fish	0.0	0.0	0.0	1.3	0.0	1.3	27.2	44.3	72.8	53.0
Dried fish	2.5	1.3	26.2	22.8	11.9	10.1	42.1	41.6	17.3	24.2
Sardines	5.4	2.0	61.4	67.1	5.0	9.4	6.9	4.0	21.3	0.7
Milk and milk products										
Cow's milk (whole)	11.4	5.4	31.7	27.5	9.9	6.7	30.2	38.3	16.8	22.1
Goat's milk (whole)	0.0	0.0	2.0	2.7	0.5	1.3	25.2	30.9	72.3	65.1
Yoghurt	1.5	0.0	10.4	9.4	13.4	17.7	38.1	38.3	36.6	34.9
Beverages										
Water	84.7	88.6	8.4	2.7	0.0	0.0	4.5	5.4	2.5	3.4
All soda drinks	5.9	6.7	28.7	16.8	21.8	16.8	32.7	47.7	10.9	12.1
Coffee	5.9	8.1	0.0	0.0	0.5	0.0	18.3	23.5	75.2	68.5
Tea	62.9	35.6	21.3	28.2	3.5	6.0	8.4	23.5	4.0	6.7
Juice	6.4	5.4	40.1	31.5	15.3	6.0	30.7	39.6	7.4	17.4
Local brew	2.0	7.4	4.0	7.4	1.5	7.4	18.8	17.4	73.8	60.4

The major fruits found in the area include oranges, mangoes, pineapples, pawpaw, watermelon, and banana. Fruit consumption was found to be very low in all the villages. With respect to vegetables, Indigenous vegetables such as mchungu, chiwandagulu and chipali were found to be consumed on a daily basis by the majority of respondents at 71% and 59% for Morogoro and Dodoma respectively. Similarly, mlenda, cow pea leaves and amaranth were important vegetables daily and weekly by majority of the households (Table 12).



Table 12: Frequency of consumption of vegetables and fruits

Food item	% Response									
	Morogoro (n=202), Dodoma (n=)									
	Daily		Weekly		Monthly		Rare		Never	
	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma	Morogoro	Dodoma
Vegetables										
Cabbage	3.5	0.0	17.8	16.1	22.3	27.5	34.2	31.5	22.3	24.8
Amaranth leaves	11.9	19.5	68.8	54.4	8.9	8.1	7.9	17.4	2.5	0.7
Sweet potato leaves	6.9	6.7	81.7	55	4.5	9.4	5.4	22.8	1.5	6.0
Cassava leaves	2.5	3.4	73.3	57.7	14.9	16.1	7.4	20.1	1.5	2.7
Pumpkin leaves	5.9	4.7	56.4	46.3	19.3	17.4	16.3	29.5	2.0	2.0
Carrots	4.5	2.7	32.2	14.8	7.9	5.4	40.1	43.0	15.3	34.2
Pumpkin fruit	8.4	2.0	10.4	4.0	16.8	12.1	52	55.7	12.4	26.2
Spinach	4.0	0.7	22.8	14.1	10.4	10.7	45.5	43.0	17.3	31.5
Chinese cabbage	1.5	0.0	24.8	30.2	12.9	20.1	41.6	28.9	19.3	20.8
African eggplant	1.5	0.0	31.2	18.1	7.9	2.7	46.5	47.0	12.9	32.2
Safwe- Cowpea leaves	8.4	12.8	52.5	47.7	19.3	14.1	16.8	14.1	3.0	10.1
<i>Mlanda</i>	9.9	20.8	70.8	65.1	6.4	2.0	9.4	6.0	3.5	6.0
Other indigenous veges	71.3	59.1	17.3	28.2	1.0	2.0	8.9	7.4	1.5	3.4
Fruits										
Citrus e.g oranges	5.4	2.7	33.2	18.8	12.4	8.7	39.1	45.0	9.9	24.8
Mangoes	8.4	10.1	29.2	34.2	11.9	11.4	47.0	40.3	3.5	4.0
Water melon	3.0	0.0	17.3	9.4	20.3	13.4	44.6	53.7	14.9	23.5
Bananas	6.4	6.0	49.5	25.5	16.8	16.8	23.8	40.6	3.5	10.7
Pineapple	2.5	0.0	10.9	1.3	11.4	5.4	59.4	58.4	15.8	31.5
Papaya	3.5	3.4	46.0	38.9	16.8	17.4	28.7	35.6	5.0	4.7
Avocado	3.5	2.7	15.3	4.7	2.0	0.0	52.0	45.0	27.2	47.7
baobab	5.9	12.1	13.9	17.4	10.4	16.1	44.6	43.0	25.2	11.4
Other indigenous fruits	9.4	12.1	4.0	2.7	2.0	2.7	22.8	28.2	61.9	54.4

Nutritional status

Nutritional status of children

The anthropometric results reported in this paper are based on WHO standards (2006). Acute under nutrition is defined as below -2 Z scores and severe acute under nutrition is defined as below -3 Z scores.

The overall prevalence of stunting based on HAZ for the total sample was 41%, and severe stunting was 16%. The prevalence of underweight and wasting based on WAZ and WHZ was 15% and 3% respectively. In Dodoma region, the prevalence of stunting based on HAZ was 57% and 52% in Idifu and Ilolo respectively (Figure 2). In Morogoro region, the prevalence of stunting based on HAZ was 29% and 30% for Ilakala and Changarawe respectively. The prevalence of moderate and severe stunting for specific villages is indicated on Figure 3.



Table 13: Prevalence of under nutrition based on Z scores

Under nutrition status	All child population n = 348
Prevalence of stunting (height-for-age z-scores) (<-2 z-score)	40.5 % (9.7 - 81.3 95% C.I.)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	24.7 % (9.7 - 50.0 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	15.8 % (2.9 - 54.1 95% C.I.)
Prevalence of underweight (weight-for-age z-scores) (<-2 z-score)	14.7 % (10.3 - 20.5 95% C.I.)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	12.1 % (9.8 - 14.7 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	2.6 % (0.9 - 7.1 95% C.I.)
Prevalence of wasting (weight-for-height z-scores) (<-2 z-score)	2.9 % (0.5 - 14.1 95% C.I.)
Prevalence of moderate wasting (<-2 z-score and >=-3 z-score)	2.6 % (0.5 - 13.4 95% C.I.)
Prevalence of severe wasting (<-3 z-score)	0.3 % (0.0 - 9.4 95% C.I.)

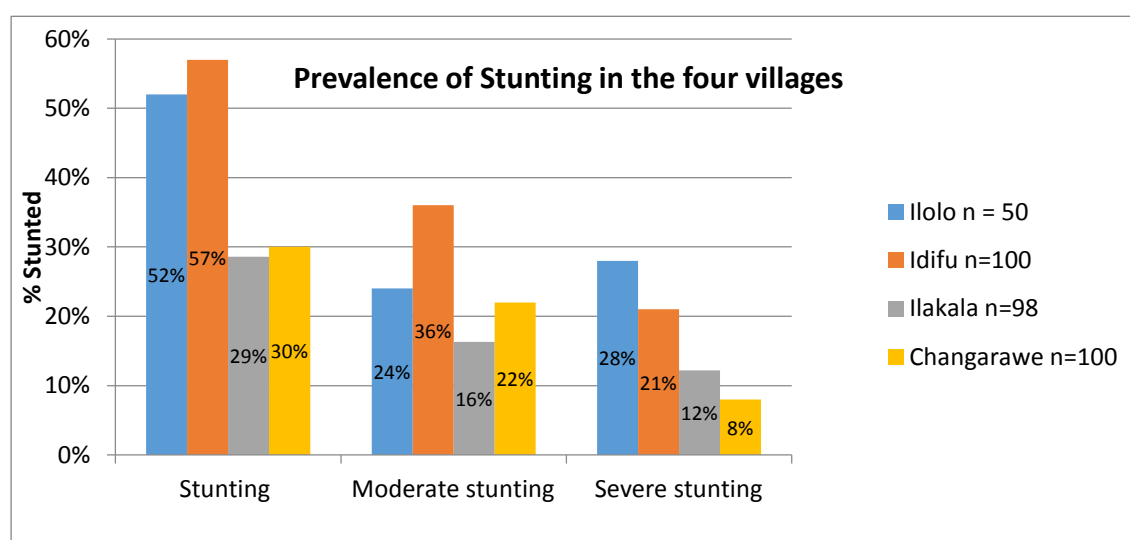


Figure 3: Prevalence of child stunting in Ilolo, Idifu, Changarawe and Ilakala villages



Table 14: Prevalence of wasting and underweight in children in Iloilo, Idifu, Changarawe and Ilakala villages

Status	Dodoma		Morogoro	
	Iloilo n = 50	Idifu n=100	Ilakala n=98	Changarawe n=100
Underweight (W/A) (<-2 z-score)	20.0%	14.0%	12.2%	15.0%
Moderate underweight (<-2 z-score and ≥-3 z-score)	18.0%	10.0%	10.2%	13.0%
Severe underweight (<-3 z-score)	2.0%	4.0%	2.0%	2.0%
Wasting (W/H) (<-2 z-score)	0.0%	2.0%	5.1%	3.0%
Moderate wasting (<-2 z-score and ≥-3 z-score)	0.0%	2.0%	4.1%	3.0%
Severe wasting (<-3 z-score)	0.0%	0.0%	1.0%	0.0%

When comparing the child growth in these villages with the WHO standard growth of the reference population, children in the study villages seem to lag behind in growth (Figure 4). About 16% of children in this population are severely stunted as opposed to their counterparts in the reference population.

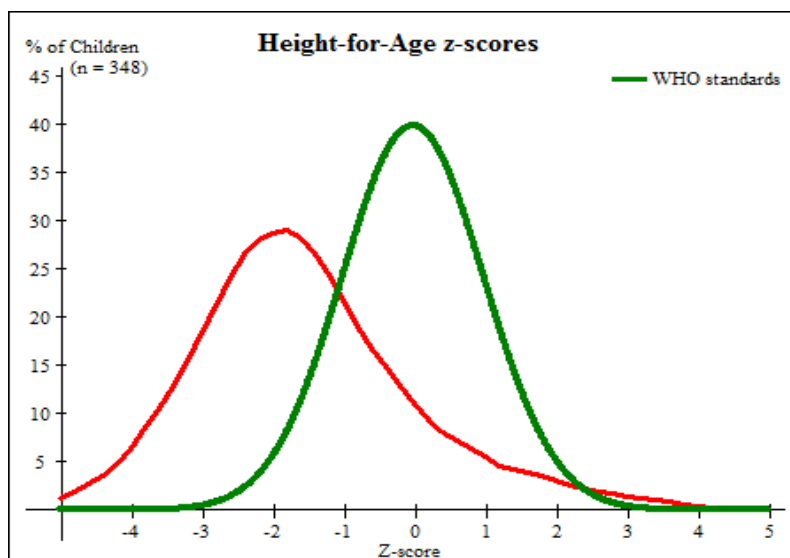


Figure 4: Comparison of child stunting with WHO standards



Nutritional status of mothers/caregivers

The overall Nutritional status of women and caregivers was such that 9% of them had BMI below 18.5, 23% were overweight and 6% obese (Table 15).

Table 15: Prevalence of wasting and underweight in children in Iloilo, Idifu, Changarawe and Ilakala villages

Nutritional status	BMI	Percentage
Underweight	< 18.50	9.1 %
Normal	18.50-24.99	62.4 %
Overweight	25.00- 29.99	22.5 %
Obese	≥ 30.00	6.0 %



Results of Household survey wave I

In contrast to the Nutrition survey, household survey wave I assessed seasonal variation of nutrition quality and food security, as well as economic access to food. Therefore, Food consumption score (FCS), Household food insecurity access scale (HFIAS), Household hunger scale (HHS) and Coping strategy index (CSI) were calculated in relation to season and region. Income as limiting factor was also partially related to these indicators.

Food consumption score

Food Consumption Score (FCS) is used to measure the diversity and frequency of food consumed within a 7-d recall period. Derived from the Food and Nutrition Technical Assistance Dietary Diversity Score, the higher the score, the better the diet and the more food secure is the household (WFP, 2008). Cut-off-values are used to transform the score in three categories: acceptable food consumption, borderline food consumption and poor food consumption.

According to FCS classification only half of the households showed acceptable food consumption in planting and pre-harvest season. In post-harvest season three quarter were found in this category (Table 16). Great regional differences were measured between Morogoro and Dodoma region (Table 17, Figure 5) and within the case study villages in Dodoma (Table 19). Over 20% of the households in Dodoma showed poor food consumption in planting and pre-harvest season. This applies only to 4-6% of households in Morogoro. In addition, Food consumption scores in villages in Dodoma varied more widely than in Morogoro.

Table 16: Food Consumption Score classification per season

Food consumption	Planting season		Pre-harvest season		Post-harvest season		Annual average	
	N	%	N	%	N	%	N	%
acceptable	485	55.7	467	53.6	670	76.9	545	63.2
borderline	275	31.6	289	33.2	165	18.9	268	31.1
poor	111	12.7	115	13.2	36	4.1	50	5.8



Table 17: Food Consumption Score classification per season and region

Food Consumption	Region	Planting season		Pre-harvest season		Post-harvest season	
		N	%*	N	%*	N	%*
acceptable	Total	485	55.7	467	53.6	670	76.9
	Morogoro	334	75.1	326	73.3	367	82.5
	Dodoma	151	35.4	141	33.1	303	71.1
borderline	Total	275	31.6	289	33.2	165	18.9
	Morogoro	91	20.4	92	20.7	63	14.2
	Dodoma	184	43.2	197	46.2	102	23.9
poor	Total	111	12.7	115	13.2	36	4.1
	Morogoro	20	4.5	27	6.1	15	3.4
	Dodoma	91	21.4	88	20.7	21	4.9

* Percentage of households in a region, that belong to the different food consumption categories during the indicated season

Table 18: Food Consumption Score classification per season in the CSS villages in Morogoro region

Season	Village	Acceptable food consumption		Borderline food consumption		Poor food consumption	
		N	%	N	%	N	%
Planting season	Changarawe	111	76,0%	25	17,1%	10	6,8%
	Ilakala	112	75,2%	31	20,8%	6	4,0%
	Nyali	111	74,0%	35	23,3%	4	2,7%
Pre-harvest season	Changarawe	106	72,6%	26	17,8%	14	9,6%
	Ilakala	110	73,8%	31	20,8%	8	5,4%
	Nyali	110	73,3%	35	23,3%	5	3,3%
Post-harvest season	Changarawe	116	79,5%	21	14,4%	9	6,2%
	Ilakala	125	83,9%	19	12,8%	5	3,4%
	Nyali	126	84,0%	23	15,3%	1	0,7%



Table 19: Food Consumption Score classification per season in the CSS villages in Dodoma region

Season	Village	Acceptable food consumption		Borderline food consumption		Poor food consumption	
		N	%	N	%	N	%
Planting season	Idifu	43	30,7%	55	39,3%	42	30,0%
	Ilolo	59	42,1%	55	39,3%	26	18,6%
	Ndebwe	49	33,6%	74	50,7%	23	15,8%
Pre-harvest season	Idifu	33	23,6%	80	57,1%	27	19,3%
	Ilolo	62	44,3%	46	32,9%	32	22,9%
	Ndebwe	46	31,5%	71	48,6%	29	19,9%
Post-harvest season	Idifu	90	64,3%	41	29,3%	9	6,4%
	Ilolo	103	73,6%	30	21,4%	7	5,0%
	Ndebwe	110	75,3%	31	21,2%	5	3,4%

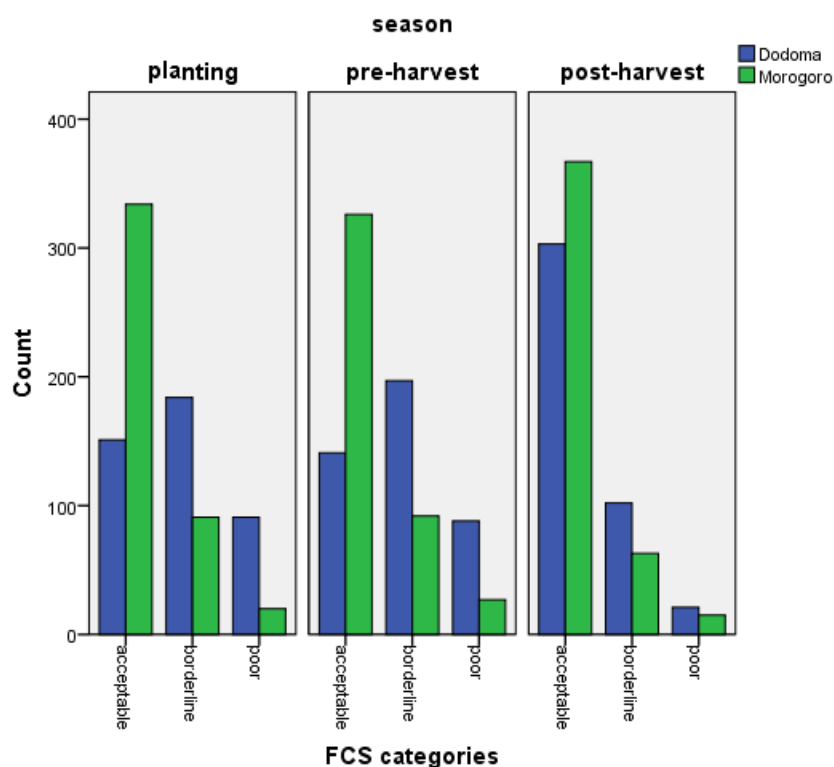


Figure 5: Number of households in the three Food Consumption Score (FCS) categories per season and region: poor food consumption < 21.5; borderline food consumption 21.5-34.9, acceptable food consumption \geq 35.



Limited access to nutritious foods, due to low income, is widely distributed in the case study site. In Dodoma region, the median income per capita is 10.04 PPP USD versus 16.99 PPP USD in Morogoro region. 86% of households in Dodoma region have an income per capita that is lower than the poverty line of 30.45 PPP USD, whereas this applies to 70% of household in Morogoro region (Figure 6A). The comparison of regional food consumption scores within the same income quartile clearly shows lower nutrition quality in Dodoma (Figure 6B). In the highest income quartile 82% of households in Morogoro had an acceptable food consumption in planting season but this applied only to 52% in Dodoma (Figure 7).

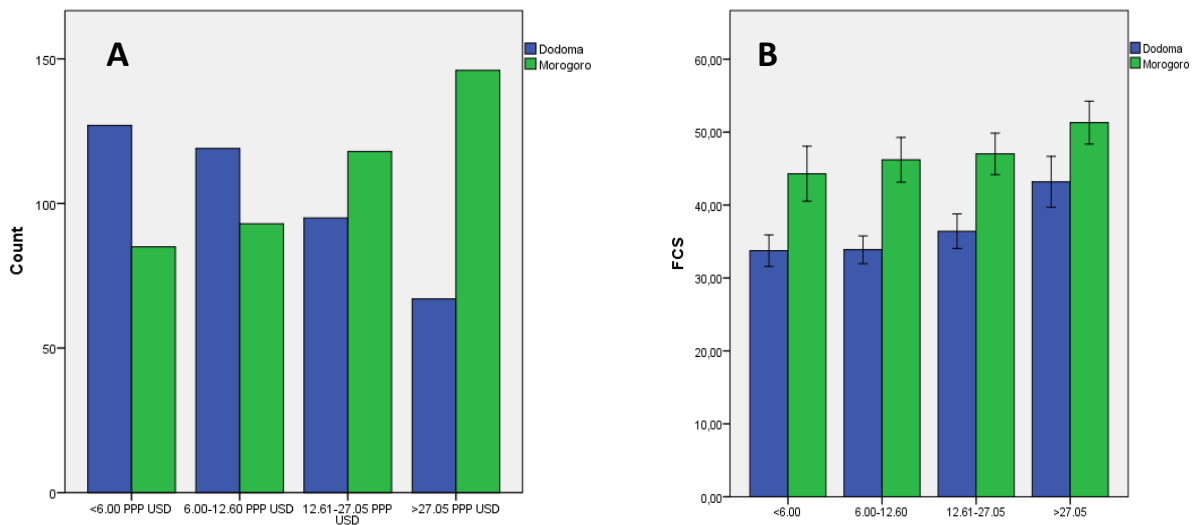


Figure 6: Number of households in income quartiles (PPP USD per capita) in Dodoma and Morogoro region (A). Average annual Food Consumption Score (FCS) per income quartile in both regions (B). Data represent mean +/- SD.

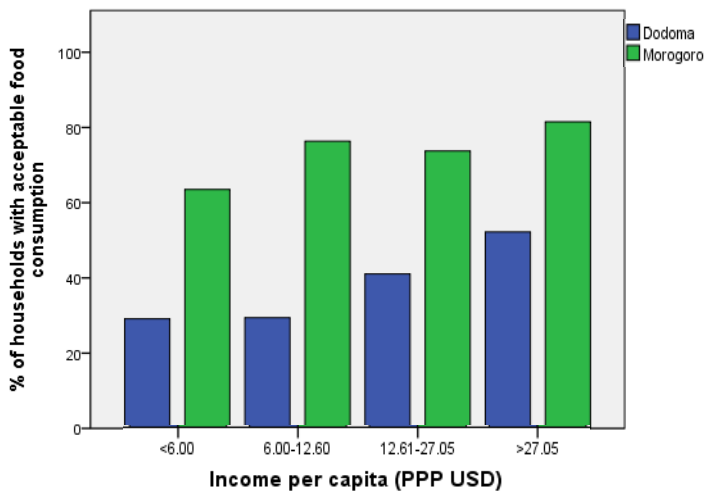


Figure 7: Percentage of households with acceptable food consumption (according to FCS classification) in planting season related to income quartile



Animal based products were eaten rarely. 41.5% of the households in Dodoma and 25.4% in Morogoro never ate meat, fish or eggs in planting season. 53.1% respectively 62.0% ate these foods only once or twice a week (Figure 8). Here again, consumption of these animal products increased with income, but only to a frequency up to 5 days a week.

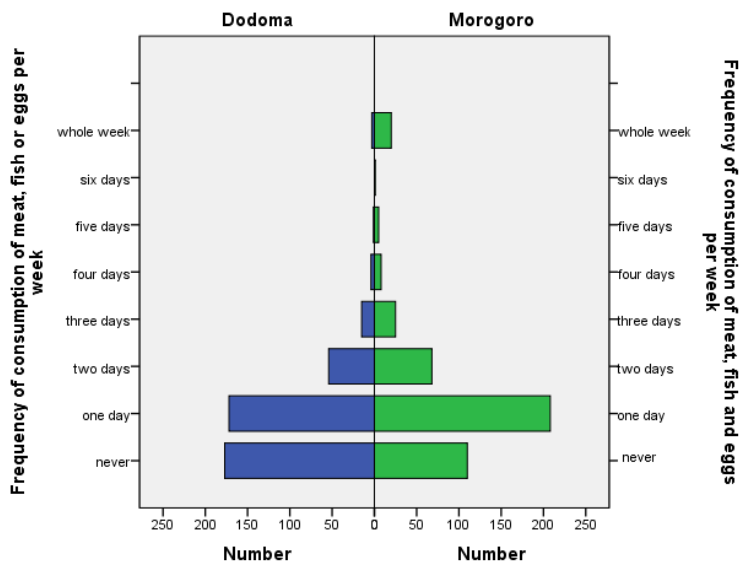


Figure 8: Consumption of meat, fish or eggs in days per week in planting season

Household hunger scale

Household hunger scale addresses the experience of severe food insecurity with three questions concerning the absence of food in the household:

- In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?
- In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?
- In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?

The frequency of hunger experience was determined by HHS and categorized into three hunger classes. In addition to the results of the Food consumption score, households in Dodoma suffered more frequently from hunger than in Morogoro. Half of the households in Dodoma had moderate to severe hunger in planting and pre-harvest season, whereas this was the case only for 20% in Morogoro (Table 20). In planting time, severe hunger seemed to be a great burden in Dodoma (26%), but this is not the case for Morogoro. Especially the village Ndebwe in Dodoma reported severe hunger, which affected 2 of 5 households in planting season (Table 22).



Table 20: Number and percentage of households in the three different HHS categories in planting, pre-harvest and post-harvest season

HHS	Morogoro						Dodoma						Both regions					
	Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Little to no hunger	354	79.7	370	83.3	403	90.8	208	48.8	222	52.1	377	88.9	562	64.6	592	68.0	780	89.9
Moderate hunger	79	17.8	64	14.4	33	7.4	109	25.6	132	31.0	24	5.7	188	21.6	196	22.5	57	6.6
Severe hunger	11	2.5	10	2.3	8	1.8	109	25.6	72	16.9	23	5.4	120	13.8	82	9.4	31	3.6

Table 21: Number and percentage of households in the three different HHS categories in planting, pre-harvest and post-harvest season in Morogoro region

HHS	Changarawe						Ilakala						Nyali					
	Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Little to no hunger	112	77.2	120	82.8	132	91.0	117	78.5	121	81.2	136	91.3	125	83.3	129	86.0	135	90.0
Moderate hunger	28	19.3	18	12.4	11	7.6	27	18.1	25	16.8	8	5.4	24	16.0	21	14.0	14	9.3
Severe hunger	5	3.4	7	4.8	2	1.4	5	3.4	3	2.0	5	3.4	1	0.7	0	0	1	0.7

Table 22: Number and percentage of households in the three different HHS categories in planting, pre-harvest and post-harvest season in Dodoma region

HHS	Idifu						Ilolo						Ndebwe					
	Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season		Planting season		Pre-harvest season		Post-harvest season	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Little to no hunger	74	52.9	75	53.6	128	92.1	79	56.4	88	62.9	138	99.3	55	37.7	59	40.0	111	76.0
Moderate hunger	38	27.1	48	34.3	7	5.0	37	26.4	41	29.3	1	0.7	34	23.3	43	25.9	16	11.0
Severe hunger	28	20.0	17	12.1	4	2.9	24	17.1	11	7.9	0	0	57	39.0	44	30.1	19	13.0

Household food insecurity access scale

A more detailed analysis of the food security situation is provided by the Household food insecurity access scale, which includes nine questions about food availability in the household. Nearly three quarter of the households in Dodoma were food insecure in planting and pre-harvest season and only one third in Morogoro (Table 23, Figure 9). In addition to the HHS results, the percentage of food insecure households was highest in Ndebwe (80%, Table 25).



Table 23: Number and percentage of households in the four different HFIAS categories in planting, pre-harvest and post-harvest season

Season	Region	Food secure		mildly food insecure		moderately food insecure		food insecure	
		N	%	N	%	N	%	N	%
Planting season	Morogoro	124	27,9%	17	3,8%	151	34,0%	152	34,2%
	Dodoma	37	8,7%	6	1,4%	72	16,9%	311	73,0%
	both regions	161	18,5%	23	2,6%	223	25,6%	463	53,2%
Pre-harvest season	Morogoro	158	35,6%	19	4,3%	123	27,7%	144	32,4%
	Dodoma	36	8,5%	12	2,8%	80	18,8%	298	70,0%
	both regions	194	22,3%	31	3,6%	203	23,3%	442	50,8%
Post-harvest season	Morogoro	272	61,3%	25	5,6%	77	17,3%	70	15,8%
	Dodoma	270	63,5%	21	4,9%	55	12,9%	79	18,6%
	both regions	542	62,4%	46	5,3%	132	15,2%	149	17,1%

Table 24: Number and percentage of households in the four different HFIAS categories per season and village in Morogoro region

Season	Village	Food secure		mildly food insecure		moderately food insecure		food insecure	
		N	%	N	%	N	%	N	%
Planting season	Changarawe	53	36,6%	4	2,8%	38	26,2%	50	34,5%
	Ilakala	31	20,8%	6	4,0%	53	35,6%	59	39,6%
	Nyali	40	26,7%	7	4,7%	60	40,0%	43	28,7%
Pre-harvest season	Changarawe	62	42,8%	7	4,8%	28	19,3%	48	33,1%
	Ilakala	43	28,9%	5	3,4%	41	27,5%	60	40,3%
	Nyali	53	35,3%	7	4,7%	54	36,0%	36	24,0%
Post-harvest season	Changarawe	93	64,1%	10	6,9%	20	13,8%	22	15,2%
	Ilakala	84	56,4%	8	5,4%	32	21,5%	25	16,8%
	Nyali	95	63,3%	7	4,7%	25	16,7%	23	15,3%



Table 25: Number and percentage of households in the four different HFIAS categories per season and village in Dodoma region

Season	Village	Food secure		mildly food insecure		moderately food insecure		food insecure	
		N	%	N	%	N	%	N	%
Planting season	Idifu	15	10,7%	2	1,4%	23	16,4%	100	71,4%
	Iloilo	12	8,6%	3	2,1%	32	22,9%	93	66,4%
	Ndebwe	10	6,8%	1	0,7%	17	11,6%	118	80,8%
Pre-harvest season	Idifu	15	10,7%	4	2,9%	25	17,9%	96	68,6%
	Iloilo	15	10,7%	4	2,9%	35	25,0%	86	61,4%
	Ndebwe	6	4,1%	4	2,7%	20	13,7%	116	79,5%
Post-harvest season	Idifu	96	68,6%	6	4,3%	16	11,4%	22	15,7%
	Iloilo	95	68,3%	5	3,6%	29	20,9%	10	7,2%
	Ndebwe	79	54,1%	10	6,8%	10	6,8%	47	32,2%

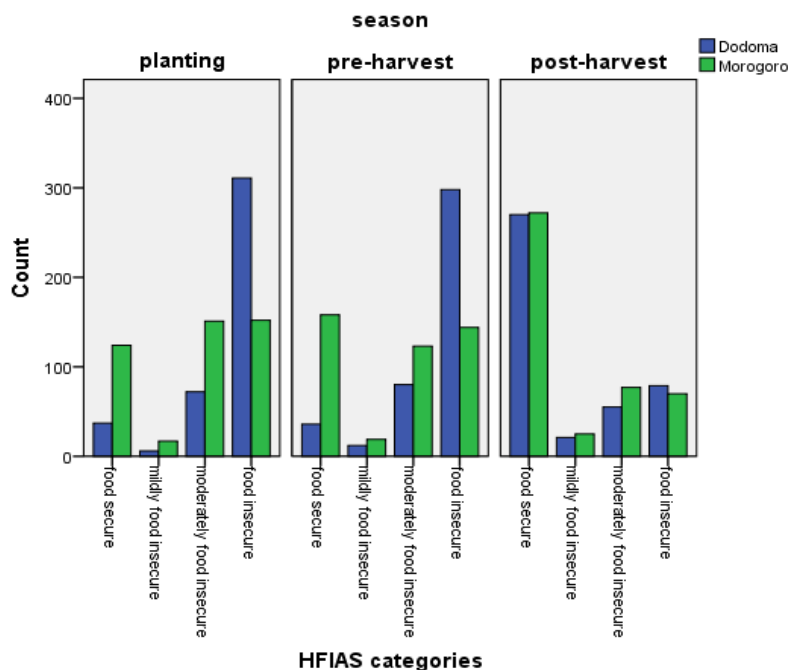


Figure 9: Number of households in the four different HFIAS categories per season and region

Within both regions, HFIAS sum correlates significantly with the income quartile. But HFIAS sum was significantly lower in Dodoma than Morogoro. HFIAS sum of the highest income quartile in Dodoma was comparable to the lowest quartile in Morogoro (Figure 10). Therefore, better earning opportunities will probably decrease food insecurity in Dodoma, but will not overcome it.

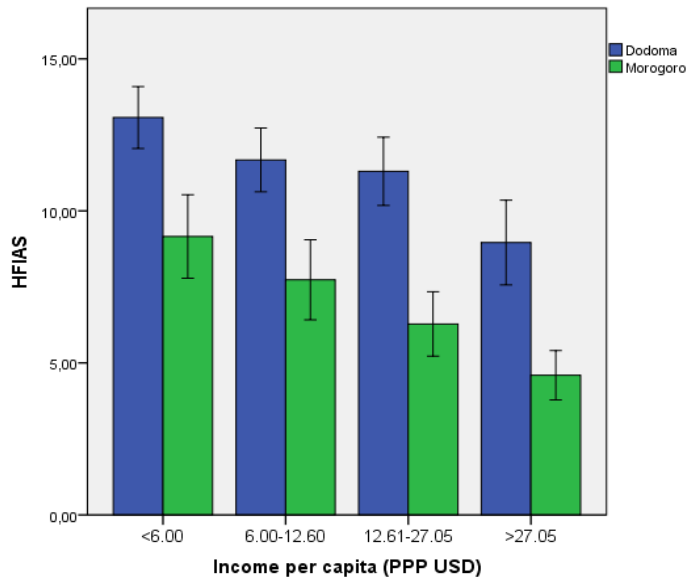


Figure 10: HFIAS sum per income quartile in Dodoma and Morogoro region.
Data represent mean +/- SD.

Coping strategy index

Coping strategy index (CSI) measures behavioral responses to food insecurity: the things that people do when they cannot access enough food.

(Maxwell, 2008). For example, in planting season 40% of households in Dodoma reduced meal size, dietary diversity and the number of meals in at least four days a week. This also applies to 10-23% of the households in Morogoro. Options, that do not decrease food quality like gathering wild food or hunting were carried out less frequent. The fact, that one household out of 8 in Dodoma consumed seed stock that was hold for the next season (Table 26) had a negative impact on future food security.

Concordant to the variations of the HHS and HFIAS results in villages in Dodoma region , CSI results of Ndebwe was highest in all seasons, followed by Idifu and Ilolo (Table 28).



Table 26: Number and percentage of households answering the questions of the Coping Strategy Index (CSI) with “four days a week” or more often. Data represent answers related to planting season.

How many days a week...	Morogoro (N=444)		Dodoma (N=426)		Total (N=870)	
	N	%	N	%	N	%
... you were not able to eat the kinds of food you preferred?	100	22.5	179	42.1	279	32.1
... you ate a limited variety of foods?	102	23.3	173	40.6	275	31.6
... you ate a smaller meal than you felt you needed?	48	10.8	163	38.3	211	24.3
...you ate fewer meals in a day?	41	9.2	163	38.3	204	23.4
...you went a whole day and night without eating?	8	1.8	44	10.3	52	6.0
...you borrowed food or relied on help from a friend or relative?	13	2.9	41	9.6	54	6.2
...you purchased food on credit?	22	5.0	48	11.3	70	8.0
...you gathered wild food or hunted?	3	0.7	19	4.5	22	2.5
...you harvested immature crops?	7	1.6	16	3.8	23	2.6
...you consumed seed stock held for the next season?	11	2.5	53	12.4	64	7.3
...you sent household members to eat elsewhere?	3	0.7	16	3.8	19	2.2
...you sent household members to beg?	5	1.1	8	1.9	13	1.5
...you restricted consumption by adults in order for small children to eat?	8	1.8	50	11.7	58	6.7

Table 27: Coping Strategy Index per season in Morogoro and Dodoma region

Season	Morogoro		Dodoma		Total	
	N	Mean	N	Mean	N	Mean
Planting	444	21,2	426	48,2	870	34,4
Pre-harvest	444	17,1	426	43,6	870	30,0
Post-harvest	444	11,6	426	10,9	870	11,3

Table 28: Coping Strategy Index per season in villages in Morogoro region

Season	Changarawe		Ilakala		Nyali	
	N	Mean	N	Mean	N	Mean
Planting	145	19.2	149	24.1	150	20.1
Pre-harvest	145	16.5	149	20.4	150	14.4
Post-harvest	145	10.7	149	12.5	150	11.6



Table 29: Coping Strategy Index per season in villages in Dodoma region

Season	Idifu		Ilolo		Ndebwe	
	N	Mean	N	Mean	N	Mean
Planting	140	45.6	140	35.4	146	63.0
Pre-harvest	140	44.0	140	30.7	146	55.6
Post-harvest	140	8.5	140	4.3	146	19.6



Discussion

Nutrition quality and nutrition security is low in Morogoro and Dodoma region because of an unbalanced diet and seasonal variations in food availability. In Dodoma, the situation is more alarming, mainly due to the semi-arid climate. Nutrition in both regions is dominated by high amounts of cereals, which provide insufficient amounts of minerals and vitamins. Additionally, high phytate content of cereals reduces bioavailability of minerals like iron, zinc and calcium. On the other hand, low intake of animal products and fruits (-> vitamin c) further diminishes the bioavailability of these elements. Especially hem iron in meat is absorbed efficiently. Beyond that, some amino acids and peptides of animal products increase the bioavailability of non-hem-iron as well. Therefore, poor food composition of the diet, caused by low availability and insufficient intake of (micro) nutrients due to low income and poor nutritional knowledge, is probably the main reason for the bad nutritional status. Nutrient losses due to inadequate processing techniques like long-lasting cooking or boiling in water for a long time lower food quality furthermore.

Especially in Dodoma area, the availability of vegetables is dependent on rainfalls, this is also the case for meat: 61% of the variation in cattle numbers in Dodoma is associated with differences in the amount of rainfall received and only 39% could be accounted of other factors (Meena, 2008).

Results of nutritional status of children demonstrate great differences between the two regions: in Morogoro 29% of the children below 5 years of age were stunted, whereas in Dodoma 54% suffer from stunting. A comparison with the results of the Tanzania Demographic and Health Survey in the year 2010 clearly indicate, that the high stunting rates in Dodoma did not change (TDHS: 56%). But Morogoro showed a significant decrease by 15 per cent (TDHS: 44%) (National Bureau of Statistics & ICF Macro, 2010).

In 2004, iodized salt coverage at household level was over 90% in Kilosa and Dodoma region according to the Tanzania national survey on iodine deficiency (Assey, 2009). In contrast, only half of the households used iodized salt in the present study. This indicates a higher risk of iodine deficiency, which affects health negatively, especially in children and pregnant women/fetus. Semba et al. showed, that child malnutrition and child mortality in rural areas of Indonesia is 50-60% higher in households using no or not adequately iodized salt compared to households, which did use adequately iodized salt (Semba, 2008). The role of iodized salt in a healthy diet and its sale should be propagated on different levels: awareness of iodine deficiency should be increased in the population, and availability of iodized salt should be enhanced. Price support for iodized by the government could be a further option.

Generally caregivers' knowledge on the importance and matters related to kitchen gardening was very limited. This implies that this population is at higher risk of increased food insecurity and micronutrient deficiencies because they do not utilize the great potential of kitchen gardens for improving household food security and alleviating micronutrient deficiencies (Marsh, 1996). Any breastfeeding was very high in this population with almost all mothers having breastfed for some time. This could be because in Tanzania breastfeeding is like a culture where women are aware that they have to do so. Regarding colostrums feeding, previous studies in Tanzania reported high prevalence of pre-lacteal feeding and discarding of colostrum (Shirima et al., 2000; Shirima et al., 2001; Nkala & Msuya, 2011). However, this study indicates most mothers fed the first milk to their children. This positive result could be explained by the positive breastfeeding culture of the Tanzanian women.



Negative effects of early introduction of solid foods continue to be an important concern for the health of the infants in this study sample where only 39% were exclusively breastfed for six months. The results of this study are in line with findings from the TDHS (NBS & ICF Macro, 2010), which identified that most babies in Tanzania are not exclusively breastfed for the first six months of life. The lack of knowledge about the recommended age for introduction of solid food in our sample may account for the large number of women who did not breastfeed exclusively for six months. Similar results were reported by Shirima et al., showing a median age of 2.0 and 2.5 months for introduction of solid foods in rural and urban areas of Morogoro (Shirima, 2000). Nutrition training to both women and men on breastfeeding topics could be a sustainable solution to this problem.

Poor nutritional knowledge and little own vegetable production in kitchen or pocket gardens are additional factors that deteriorates nutritional quality in Dodoma and Morogoro. The implementation of nutrition education and practical trainings in cultivating vegetables/fruits in many Tanzanian schools are positive steps to improve the situation. But this knowledge has not yet got hold of most household heads. Hossain and Akter could show, that especially leafy vegetables, which are rich in pro-vitamin A and iron, are very suitable for sack-gardening (Hossain and Akter, 2011). This may result in higher dietary diversity and a better nutritional status (Cabalda, 2011).

In Dodoma region, the median income per capita is 41% lower compared to Morogoro region. Therefore, the economic access to food in Dodoma is lower, resulting in increase food insecurity and hunger. In addition, availability of food is limited in this region. The comparison of food consumption (Dietary Diversity, FCS, HFIAS) in relation to income classes clearly show, that households in Dodoma experienced greater food insecurity than households in Morogoro region with equivalent income. Consequently, a high income in Dodoma does not enable the households to buy food for a healthy, diverse diet in the same extent as in Morogoro. Lower food availability in Dodoma is probably the main cause for this result. Poorer nutritional knowledge in Dodoma due to a lower educational level (primary education in Dodoma 48%, in Morogoro 63%) may also contribute to this phenomenon. The semi-arid climate in Dodoma additionally diminishes the possibility to collect indigenous vegetables or fruits to increase dietary diversity and therefore nutrient intake.

High seasonal variations in food consumption pattern and food availability were documented in this study. The rural study case regions, with mainly small scale farmers as study population, account for these results. A recently published survey in Kilosa district determined also seasonal differences in food security between rain and harvest season, but the results did not vary to the same extent (Ntwenya, 2015). In contrast, urban or peri-urban Tanzanian regions did not show such high seasonal variations (Mazengo, 1997).



References

- Ali, S. S., Karim, N., Billoo, A. G., & Haider, S. S. (2005). Association of literacy of mothers with malnutrition among children under three years of age in rural area of district Malir, Karachi. *Journal of the Pakistan Medical Association*, 55(12), 550–553.
- Assey, V.D., Peterson, S., Kimboka, S., Ngemera, D., Mgoba, C., Ruhiye, D.M., Ndossi, G.D., Greiner, T., Tylleskar, T. (2009) Tanzania national survey on iodine deficiency: Impact after twelve years of salt iodation. *BMC Public Health* 9 doi:10.1186/1471-2458-9-319.
- Cabalda, A.B., Rayco-Solon, P., Solon, J.A. and Solon, F.S. (2011) Home gardening is associated with Filipino preschool children's dietary diversity. *J Am Diet Assoc.* 111(5):711-5. doi: 10.1016/j.jada.2011.02.005.
- Coates, J., Swindale, A. and P. Bilinsky (2007). Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Version 3: Food and Nutrition Technical Assistance Project, Academy for Educational Development, Washington, D.C. URL:http://www.fao.org/fileadmin/user_upload/eufao-fsi4dm/doc-training/hfias.pdf (20.07.2015)
- Deitchler, M., Ballard, T., Swindale, A., Coates, J. (2011). Introducing a simple measure of household hunger for cross cultural use. Technical Note 12 "Food and Nutrition Technical Assistance II, AED, Washington, D.C. URL: http://www.fao.org/fileadmin/user_upload/wa_workshop/docs/HH_Hunger_Scale.pdf (20.07.2015)
- FAO (2011). Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organization of the United Nations, Rome, Italy.
- Goudet, S. M., Faiz, S., Bogin, B. a., & Griffiths, P. L. (2011). Pregnant women's and community health workers' perceptions of root causes of malnutrition among infants and young children in the slums of Dhaka, Bangladesh. *American Journal of Public Health*, 101(7), 1225–1233. doi:10.2105/AJPH.2010.300090
- Hossain, S. T. and Akter, S. (2011). Organic sack garden ensuring nutrition and improve the food security on small scale households. In Proc. the 17th IFOAM Organic World Congress. Gyeonggi Province, Republic of Korea (Vol. 26).
- Kinabo J., Kamukama, E., & Bukuku, U. (2003). Seasonal variation in physical activity patterns, energy expenditure and nutritional status of women in a rural village in Tanzania. *South African Journal of Clinical Nutrition*, 16(3), 96-102.
- Mahgoub SEO, Nnyepi M, Bandeke, T. (2006). Factors Affecting Prevalence of Malnutrition among Children under Three Years of Age in Botswana. *Afr J Food Agr Nutr Dev*, 6(1), 1–15.
- Mamiro, P. S., Kolsteren, P., Roberfroid, D., Tatala, S., Opsomer, A. S., & Van Camp, J. H. (2005). Feeding practices and factors contributing to wasting, stunting, and iron-deficiency anaemia among 3-23-month old children in Kilosa district, rural Tanzania. *Journal of Health, Population, and Nutrition*, 23(3), 222–30.
- Marsh, R. (1996). Household Gardening and Food Security: A Critical Review of the Literature. Nutrition Programmes Service, Food and Nutrition Division, FAO, Rome.



Masibo, P. K. (2013). Trends and Determinants of Malnutrition among Children Age 0-59 Months in Kenya (KDHS 1993, 1998, 2003 and 2008-09) [WP89], (February).

Maxwell, D. and R. Caldwell (2008). The Coping strategy index – Field Methods Manual. Second Edition. CARE and WFP, Nairobi. URL: http://home.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp211058.pdf (20.07.2015)

Mazengo, M. C., Simell, O., Lukmanji, Z., Shirima, R. and Karveti, R. L. (1997). Food consumption in rural and urban Tanzania. *Acta Tropica*, 68(3), 313–26.

Meena, H. E., Lugenja, M. S., Ntikha, O. a, & Hermes, M. (2008). Analyses of Technological and Policy Options for Adaptation to Consequences of Climate Change Overview of Agro-Ecological Zones Adaptation: The Case Of Crops And Livestock, (March). URL: http://www.nlcip.net/fileadmin/NCAP/Countries/Tanzania/032135.070212.TAN.CON-02.Output13.agroecological_zones.pdf (20.07.15)

Moore, L.L., Singer, R.M., Quresh, M.M., Bradlee, L.M. and Daniels R S. (2012). Food group intake and micronutrient adequacy in adolescent girls. *Nutrients*, 4: 1692–1708. doi: 10.3390/nu4111692

National Bureau of Statistics & ICF Macro. (2010). Tanzania demographic and health survey 2009–10. Dar es Salaam, Tanzania: National Bureau of Statistics & ICF Macro. URL: <http://www.nbs.go.tz/takwimu/references/2010TDHS.pdf> (20.07.2015)

Nkala, T. E., & Msuya, S. E. (2011). Prevalence and predictors of exclusive breastfeeding among women in Kigoma region, Western Tanzania: A community based cross sectional study. *International Breastfeeding Journal*, 6, 17.

Ntwenya, J.E., Kinabo, J., Msuya, J., Mamiro, P., Majili, Z.S. (2015). Dietary patterns and household food insecurity in rural populations of kilosa district, Tanzania. *PLoS One*. 21;10(5):e0126038. doi: 10.1371/journal.pone.0126038. eCollection 2015.

Semba, R. D., De Pee, S., Hess, S. Y., Sun, K., Sari, M., & Bloem, M. W. (2008). Child malnutrition and mortality among families not utilizing adequately iodized salt in Indonesia. *American Journal of Clinical Nutrition*, 87(2), 438–444.

Shirima, R., Greiner, T., Kylberg, E., & Gebre-Medhin, M. (2000). Exclusive breast-feeding is rarely practised in rural and urban Morogoro, Tanzania. *Public Health Nutrition*, 4(2), 147-154.

Shirima, R., Gebre-Medhin, M., & Greiner T. (2001). Information and socio-economic factors associated with early breastfeeding practices in rural and urban Morogoro, Tanzania. *Acta Paediatrica*, 90(8), 936-942.

SWFP (2008). Technical Guidance Sheet - Food Consumption Analysis: Calculation and Use of the Food Consumption Score in Food Security Analysis WFP FAO, Rome. URL: http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp197216.pdf (20.07.2015)

von Grebmer, K., Saltzman, A., Birol E., Wiesmann, D., Prasai, N., Yin, S., Yohannes, Y., Menon, P., Thompson, J., Sonntag, A. (2014). 2014 Global Hunger Index: The Challenge of Hidden Hunger. Bonn, Washington, D.C., and Dublin: Welthungerhilfe, International Food Policy Research Institute, and Concern Worldwide. <http://dx.doi.org/10.2499/9780896299580>