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UNDERSTANDING INTRA-COMMUNITY DISPARITY IN FOOD AND NUTRITION SECURITY IN A GENERALLY FOOD INSECURE PART OF EASTERN AFRICA

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ABSTRACT

Food and nutrition insecurity continues to be one of the major development challenges in sub-Saharan Africa and other developing regions of the world. Karamoja sub-region, located in northern Uganda, is one of the poorest and most food insecure part of Eastern Africa. Previous studies have generalized the sub-region as food insecure. However, limited attention has been paid to locational differences in the food and nutrition security situation within this culturally and ecologically diverse part of the country. A cross-sectional study design was used to examine at a community level, disparity in food and nutrition security situation among communities in Kotido and Moroto districts of the Karamoja sub-region. The study investigated the status of agricultural production, dietary habits and food security situation using individual household survey, focus group discussions, key informant interviews, household food insecurity access scale (HFIAS) and food insecurity coping strategy index (CSI). Data were analyzed using descriptive statistics, analysis of variance, and correlation and regression methods, at 5 % level of significance. The results showed that irrespective of ethnic differences, majority of households (78.8%) consumed less than 3 meals 24 hours preceding the interview. Generally, agricultural production was inadequate to support household food security and less than 30% of the households had adequate calorie intake. However, calorie intake adequacy was at least three (3) times higher in Kotido than in Moroto district. Plant foods were more frequently consumed than animal-source foods. At least 57% and 73% of households in Kotido and Moroto districts, respectively, never consumed fish. Food security was generally predicted by household size, ownership of food stores, occupation of household caregivers, number of livestock (especially goats) owned by households, time taken to fetch water (related to distance to water source) and sorghum production. Whereas it is generally known that Karamoja sub-region is highly food insecure, this study has demonstrated that communities in Moroto district are worse-off than those in Kotido district. Therefore, community-level characteristics ought to be an essential baseline consideration in designing food and nutrition interventions in Karamoja, and indeed in food insecure localities in general.

Key words: Karamoja, Eastern Africa, dietary practices, coping strategies, animal source foods

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INTRODUCTION

The global effort of achieving the Millennium Development Goal of reducing the proportion of people who suffer from extreme hunger to half by 2015 is greatly challenged by the huge number of food insecure people around the globe [1]. The implication is that even if the MDG had been achieved, millions of people would remain undernourished, with the vast majority in developing countries [2]. The proportion of undernourished people in developing countries has been relatively constant for the last two decades [3], as economic growth has struggled to keep pace with increases in population.

The problem of under-nutrition continues to blight communities across the developing world. The circular links between insufficient agricultural production, under-nutrition, and poor health leading to poor life outcomes have been recognized [4]. At a global level, several approaches have been proposed to address food and nutrition insecurity, the most commonly favoured being increasing food production [5]. However, raising food production is not without its drawbacks, aside from the obvious environmental consequences of increased use of water, fertilizers, pesticides and land involved. Despite the fact that global food production has largely remained ahead of demand in the past century, about one billion of the world's population still lack sufficient food to eat and a further one billion lack adequate nutrition [6]. Problems of accessing and storing food that is produced, and, once consumed, uptake of nutrients by the body all impact food and nutrition security [7, 8] . For example, an estimated one-quarter to one-third of food produced globally gets wasted or lost along the food supply chain [8].

Food and nutrition security varies within and between countries in the same region [9]. The drivers of food and nutrition insecurity in developing countries have been broadly grouped into immediate and underlying causes. The immediate causes include restriction on food exporters, the development of bio-fuel plantations on land formerly used to produce food, and factors, such as national and local governance, that limit the resilience of people, and, therefore, their ability to recover from abrupt shortfalls in food. The underlying longer-term causes include climate change, growing population and changing dietary patterns [3, 10]. Successful interventions aimed at boosting food and nutrition security are, therefore, likely to address both immediate and more fundamental causes. The former includes improving access to food through food production and food distribution. To address the more fundamental causes, investment in agriculture and improving resilience among farmers are likely to be required [10, 11], along with the implementation of policies aimed at improving the management of natural resources, notably water, forests and soils [12].

Karamoja sub-region, north-eastern Uganda, has the highest levels of food and nutrition insecurity in the country according to recent demographic and health surveys [13] and is characterized by the lowest human development indicators [14]. Previous studies have examined food and nutrition security in Karamoja [15, 16], although none of these have focused on inter- and intra-community differences within the sub-region. Karamoja incorporates a diversity of environmental conditions along with differences in culture and socio-economic factors that are expected to affect food security [15, 17]. This

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environmental and socio-economic diversity invokes the question as to whether the factors determining food and nutrition security outcomes and coping strategies differ within the sub-region. This study sought to determine the answer to this question, thereby contributing not only to the body of knowledge concerning food and nutrition security in general, but also to the more effective design and targeting of interventions aimed at boosting resilience in one of the most economically marginal parts of eastern Africa.

MATERIALS AND METHODS

Study area and population

This study was carried out in Karamoja sub-region, Uganda (Figure 1). With a population of about 1.1 million, the sub-region covers a land area of 27,900 Km^2 and has seven administrative districts (Moroto, Nakapiripirit, Amudat, Napak, Kotido, Abim and Kaabong). Ecologically, Karamoja is semi-arid, with a unimodal rainfall regime characterized by total precipitation generally in the range of 400-800 mm per annum rising to 1000 mm in highland areas [16]. Rainfall is highly sporadic and alternate with prolonged dry spells, and there are broad differences within the sub-region, with western parts generally climatically wetter than eastern [15]. Clayey soils with very low amounts of organic matter and low agricultural productivity potential characterize many parts of Karamoja [15]. Ethnically, the sub-region is highly diverse. The current research focused on communities from four sub-counties in two districts: Nakapelimoru and Kacheri (Kotido district, dominated by Jie and Labwor people), Nadunget and Tapac (Moroto district, dominated by Matheniko and Tepeth people). These sub-counties were selected because of the diversity of cultures represented, with 273 households systematically sampled during the research.

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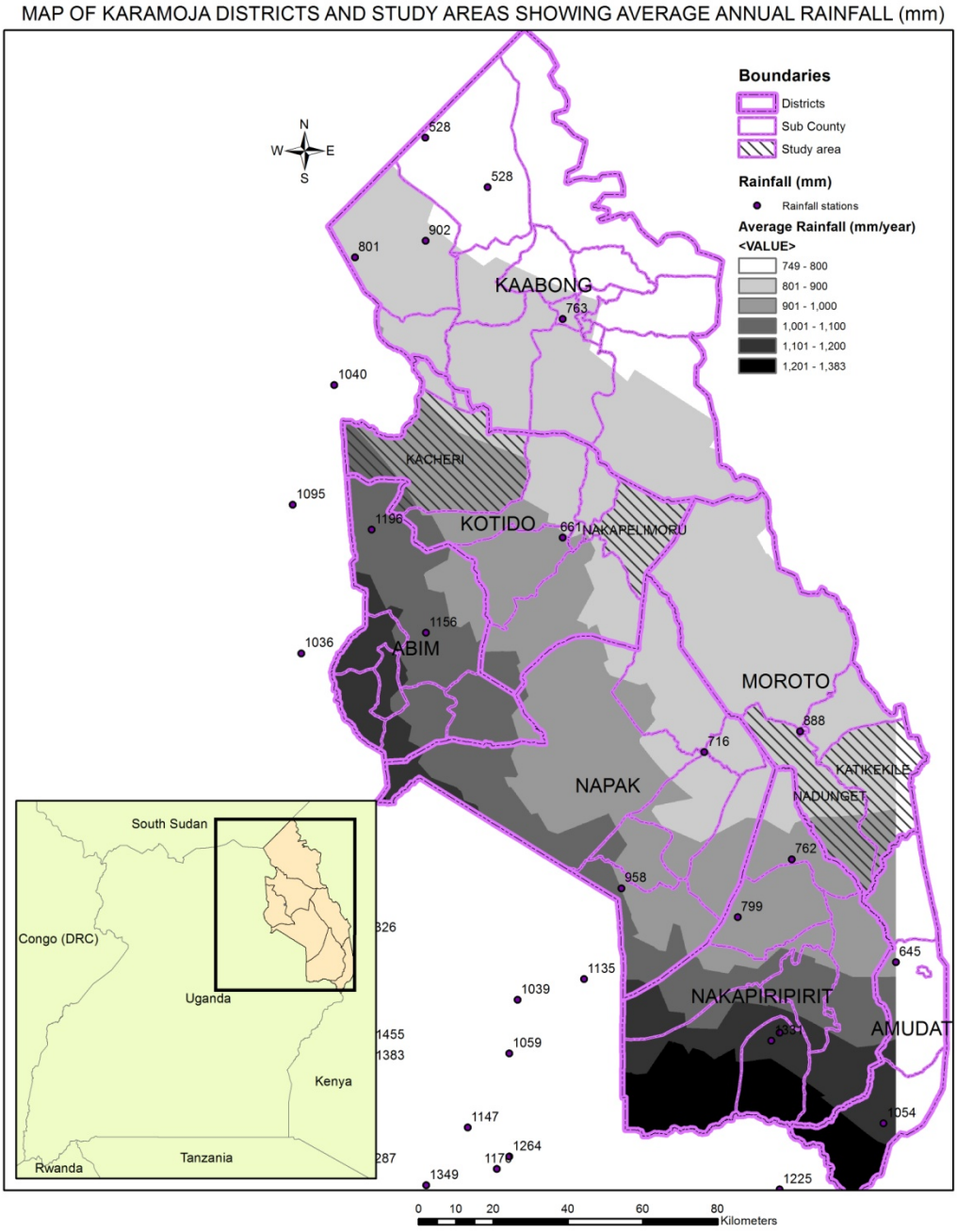

Figure 1: Map of Karamoja sub-region showing the two districts and 4 sub-counties that were studied and the average annual rainfall variability within the sub-region

Data collection

Data were collected by means of household questionnaire, key informant interviews and focus group discussions (FGD). Discussions involving two focus groups, each comprising 8 members (household caregivers and heads), generated a list of locally

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important food insecurity coping strategies. Key informants were involved in follow-up interviews to provide additional information on the situation of food and nutrition security and copying strategies within their communities. The key informants were mainly elders and leaders in the selected sub-counties and districts. They were selected based on their knowledge of the study area. Food security is a complex and multi-dimensional subject that a single indicator or tool cannot capture in its entirety [18]. As a consequence, a combination of dietary assessment methods (24-hour dietary recall and food frequency questionnaire (FFQ)) was used to assess dietary practices (food habits), along with the Household Food Insecurity Access Scale (HFIAS), a universally accepted tool for assessment of food access and availability [18]. The 24-hour dietary recall employed measures food intake in a short time of 24 hours while FFQ measures food consumption in a long period of time [19].

Assessment of dietary intake

The FFQ had a list of foods locally consumed in Karamoja sub-region. The list was developed and validated by focus group discussion in the study area prior to administration of the FFQ. Each household was asked to state how often they consume the foods listed (For example, daily, 1-3 times a week, 4-6 times a week, once a month, more than once a month). For the 24-hour recall, respondents were first asked for the number of meals they had consumed in 24 hours that preceded the survey. In the second phase, they listed all the foods that they had eaten in that period. This was followed by asking the respondents to quantify the foods by serving from the food samples provided to estimate the quantity they had eaten. The amount of each food served was weighed using a food scale to estimate the quantity eaten. The amount of calorie and nutrients in the food quantities eaten were calculated from HarvestPlus food composition table, which contains the nutritional profiles of most foods in Uganda [20]. These calories and nutrients taken by individuals were compared to the reference amounts required by them according to their age, gender and level of activity. The reference values stipulated by the Food and Nutrition Board of the National Academies (www.nap.edu) and applied by Brown *et al*. [7], were used. The comparison helped to calculate the proportion of households with adequate intake of calorie & nutrients. Those who consumed at least the recommended intake of calorie or particular nutrients were considered to have had adequate intake. Both the dietary recall and the FFQ were administered to the household main caregivers, as they know how food is gathered, prepared and served in a household.

Determination of level of food security

The level of food insecurity of households was measured using the HFIAS indicator [18]. This tool measures the access components of household food security in the past 30 days. It helps to differentiate between food secure and food insecure households in diverse cultural settings.

From the HFIAS tool, 9 questions, consisting of 3 domains (categories) were included in the household questionnaire as was recently applied by Kabunga *et al.* [21]. The first domain represented anxiety and uncertainty about household food supply; the second domain represented food quality; and the third domain food quantity intake, related to food availability. The response categories to the questions covered the frequency of occurrence of conditions being investigated, and were assigned weights ranging from 0-

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3 as described by Coates *et al.* [18]. The food insecurity score for each household was computed by summing the individual scores for the 9 questions. The HFIAS scores, therefore, range from 0, when the answer to all the 9 questions was "never" (weight 0, relating to maximum food security), to 27, when the answer to all the questions was "often" (weight 3, relating to maximum food insecurity).

To assess other determinants of food and nutrition security, a section of the household questionnaire asked questions on hypothesized determinants, such as occupation and education of household head and caregivers, size of households, household assets, food storage, agricultural production, and water, sanitation and hygiene (WASH) practices.

Assessment of food insecurity coping strategies

To assess response to food shocks by each household and disparities among different households, the Coping Strategy Index (CSI) was used, according to Maxwell *et al.* [22]. A weighted list of locally available coping strategies (for instance reduction in meal size and number), established through focus group discussions was included in the household questionnaire. Each household main caregiver was then asked how often their household had applied each of the coping strategies when faced with food insecurity shocks. The choice of caregivers as the representative for each household is based on the assumption that they know what is prepared and eaten in a household. The CSI was compiled by summing the scores (weight * frequency of application) from individual coping strategies, in accordance with Ndirangu *et al.* [23]. The weight ranged from 1 to 4, where 4 equates to the most severe coping strategies and 1 to the least severe. Coping strategies with a weight of 4 (most severe) are applied where food shortages are regarded as relatively extreme, while those with weight 1 are applied when food shortage, is least severe. The frequencies of application of the coping strategies were 7 (applied everyday), 4.5 (3-6 times a week), 1.5 (1-2 times a week), 0.5 (<1 time a week) and 0 (never applied).

Assessment of agricultural production

Following a FGD and interactions with community members, questions on crops and livestock production were included in the household questionnaire. Each household was asked how many animals in each livestock category (e.g. goats) they were rearing at the time of the survey. They were also asked to state how much produce they got from crop production in a period of 12 months that proceeded the survey. The monetary value of crop production was established by multiplying the quantities of crops produced by the local market value of the produce at the time of the survey.

Data analysis

Descriptive statistics were used to establish the number of meals taken and frequency of consumption of different foods. Cross-tabulation was used to find the proportion of households with adequate intake of calories and nutrients with respect to their locations and the age groups of those interviewed. One-way Analysis of Variance (ANOVA) and post ANOVA were used to determine the variation in agricultural production among different communities and variations in HFIAS and CSI among the four sub-counties.

Multiple linear regression was used to establish determinants that significantly predicted HFIAS. The regression was run with HFIAS score as a dependent variable and factors

that were suspected to affect food security as predicting variables. The enter method was employed after checking for multicollinearity using bivariate correlations between the predictor variables. The model produced condition index less than 30, Tolerance greater than 0.5 and the Variance Inflation Indicators (VIF) less than 10 for all the factors, showing no collinearity problems.

RESULTS

Dietary practices of households in Karamoja sub-region

Results of the dietary practices of households are presented in Tables 1-3. On average, only 21.2% of households interviewed had consumed 3 or more meals in the 24 hours that preceded the survey, although these varied across the ethnic communities studied (Table 1). Calorie and nutrient intakes varied with the age groups of household members and their locations but generally, less than half of respondents met the recommended daily allowance (RDA) for most nutrients, calories and water (Table 2).

The most frequently consumed staple food amongst respondents was found to be sorghum followed by maize, beans, and groundnuts (Table 3). Vegetables are also frequently consumed, while fruits such as mangoes and citrus were eaten rarely. Consumption of the residue from brewing local beer (for example *Kutukutu, Kwete*) which many households reported as food insecurity coping strategy, is also high in the study area, with more than 50% of households consuming it weekly. Foods sourced from animals are consumed less frequently, mainly monthly and weekly and rarely on a daily basis (Table 3).

Variation in agricultural production

Variations in the number of livestock reared at home are evident (Table 4). Generally, crop production values were low for the majority of households. However, values in the sub-counties of Nakapelimoru and Kacheri (Kotido district) were on average significantly higher ($p=0.000$) compared with sub-counties of Nadunget and Tapac (Moroto district). See Figure 2.

Table 5 presents the relationship between agricultural production and household food security level, showing community level variations. For Moroto district, only sorghum production significantly correlated with the HFIAS, while in Kotido district, both sorghum and goat production were significantly correlated with the HFIAS.

Determinants of food security and coping strategies

When the results were considered as a whole, the occupation of household main caregiver, number of goats kept by households, average time taken to fetch water, ownership of cribs (food stores), and sorghum production predicted household food security, as measured by HFIAS (Table 6). When segregated into districts, only the number of goats reared by households significantly predicted HFIAS in Kotido district (dominated by Jie and Labwor ethnic groups). For households, sampled from Moroto district (dominated by Matheniko and Tepeth people), occupation of the main caregiver, household size and average time taken to fetch water significantly predicted household food security, at 5% level of significance.

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Irrespective of the location of households, the most important coping strategies used in the sub-region are reduction in the number of meals eaten in a day, application of casual labour to earn food or income, gathering of wild foods and eating unconventional foods like local brew residue (Table 7). Differences among the ethnic groups and sub-counties in the frequencies in which the coping strategies were applied are evident. This led to a significant variation in coping strategy indices (Table 8).

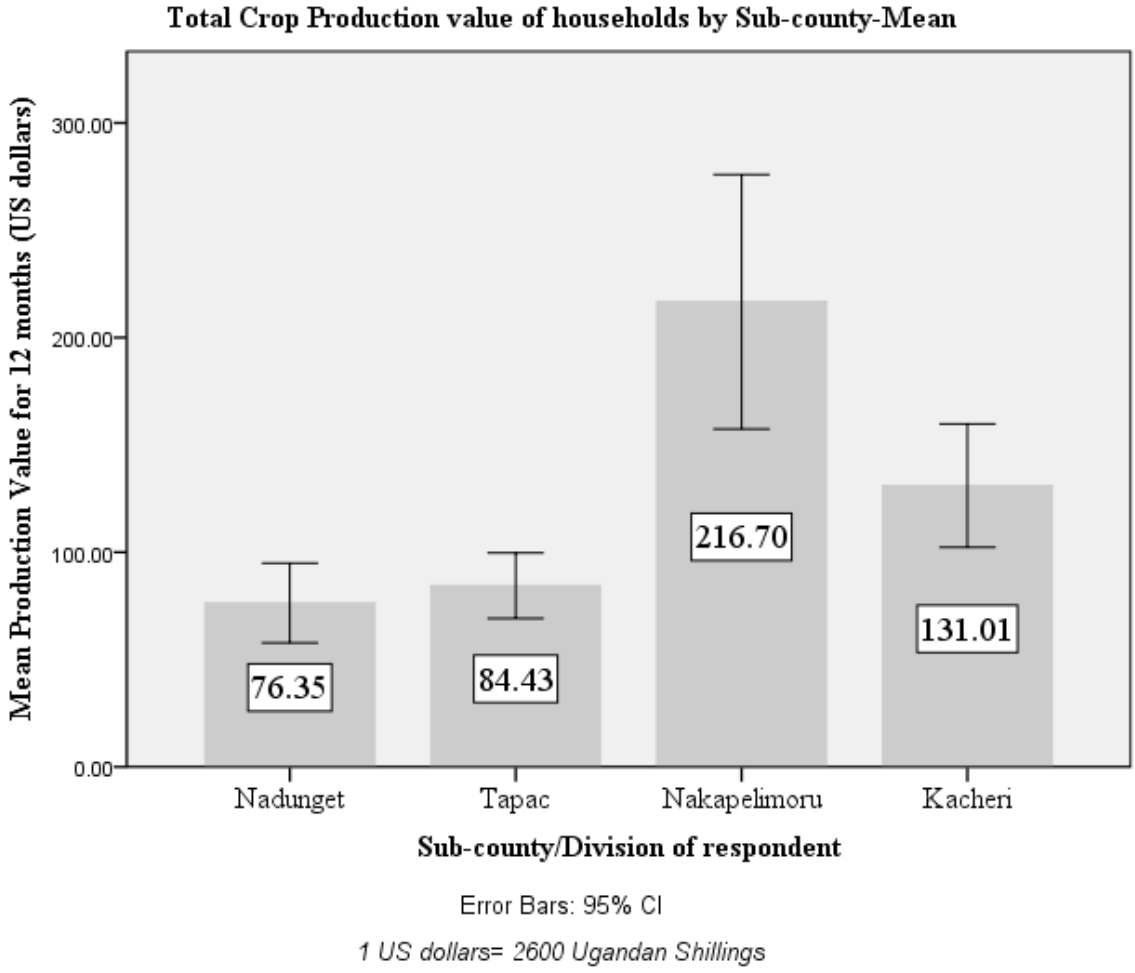

Figure 2: Household 12 month crop production value (in US dollars) segregated by sub-county (mean)

DISCUSSION

Dietary practices (food habits)

Nutritional practices and food habits normally translate directly into nutritional and health status of individuals [24]. Healthy dietary practices are based on dietary patterns over a long period and the frequent and regular consumption of small meals rather than a single, large meal in a day [25]. Meeting the dietary needs of active individuals from

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just one or even two meals a day is also difficult. In the current study, where the majority of the respondents were active farmers, reducing the frequency of meals was reported as an important food insecurity coping strategy.

For individuals to meet their nutritional requirements, it is useful to consume more frequently foods from various food groups [11]. However, this was not the case as observed in the current study. Sorghum is the leading staple crop produced in Karamoja and is the most frequently consumed food item. The local prominence of sorghum could be because it can tolerate very well the dry semi-arid climatic conditions or prolonged drought [26] that are typical of the sub-region, and because it is also used for brewing the local beer. However, sorghum contains phytate and tannins that bind some nutrients and make them unavailable for absorption [27]. As a result, consumption of large amounts of sorghum may enhance problems of nutrition insecurity locally. It would be important to investigate whether sorghum processing methods applied by communities in the sub-region can reduce tannin content in sorghum to safe levels. This is a potential subject for future research and possible area of intervention.

Beans *(Phaseolus vulgaris*) provide an important, alternative source of protein to animal sourced foods (ASFs) in the study area. The protein contents of black small beans and the "*Kanyebwa*" bean varieties (commonly eaten in Karamoja) are as high as 21.6g and 23.0g per 100g, respectively [20]. However, the bioavailability of proteins and other nutrients from plant sources such as beans is low compared to animal sourced products [28]. Results from the current study align to the 2014 World Food Programme (WFP) report which shows that 48% of the Karamoja population have poor/borderline food consumption, with low consumption of ASFs. Some barriers to consuming ASFs are known. Availability of animals is a critical restriction for majority of households. According to WFP (2015), more than half of households in Karamoja did not have any livestock. In some households, animals are present, yet the consumption of ASFs remains low. Cultural impediment to consumption of ASFs has been reported in the sub-region [29]. For those owning livestock, sale of these animals is only a coping strategy when there are food shocks. Losses to disease are another barrier to increasing access to livestock and ASFs as veterinary services and drugs to treat even the simplest animal disease are not available [30].

Results presented here, on consumption of fruits and vegetables, are consistent with those of UBOS and Macro International Inc. [31]. The current study, however, found out that most of the vegetables eaten are wild types such as wild tomatoes (*Solanum lycopersicum*) locally called *lolari* and wild *Amaranthus spp* (locally called *Akiliton)* and are generally valued locally as a means of coping with insufficient quantities of food produced through farming. Their availability is reliant not only on environmental conditions, but also on people having access to land on which they occur. The latter is increasingly problematic in parts of Karamoja, because of recent increases in the extent of enclosed land and land grabs [32].

Vegetables generally offer a wide range of benefits, including being a source of many key micronutrients and high dietary fiber, which in turn help in protecting against cardiovascular and other diet related diseases [33]. As such, different countries have

included fruits and vegetables in their national nutrition plans. For instance, in 2005, the Australian government launched the 'Go for 2+ 5' campaign which encouraged people to eat 2 portions of fruits (150g per portion) and 3 portions of vegetables (75g per portion) every day [33].

Consuming adequate levels of nutrients and calories on a daily basis, required in order to remain healthy and active, is challenging for people living in semi-arid parts of the developing world where animal-based food is costly and levels of food production are low [34]. The critically low intake of micronutrients (Calcium, Iron and Zinc) of many respondents observed in the current study could have been because of a strong reliance on plant-based foods, such as sorghum. A low intake of calcium increases the risk of osteoporosis and osteomalacia (both caused by weakening of bones), stunted growth, colon cancer, among others [7, 35]. A deficiency in zinc can heighten the risk of poor pregnancy outcomes and growth retardation, delayed sexual maturation, and slow wound healing, among others [7, 36]. According to Brown *et al*. [7], ASFs (especially milk), legumes, fruits and vegetables are key sources of zinc, iron and calcium. Milk, readily available in Karamoja sub-region, would appear to be an under-utilized source of these important micronutrients in the study area.

Agricultural production and household food security

Agriculture is an avenue to make nutritious foods available to people at risk or generate income for food purchase. This is particularly the case in sub-Saharan Africa (SSA) where over 70% of the poor live in rural areas with the majority deriving their livelihood from agriculture [37]. Increased agricultural production is thus viewed as a powerful tool in reducing rural poverty and hunger. However, food production in SSA and other developing countries is constrained by a number of factors such as low household income and poor access to external credit to increase productivity [38] as well as poor soil fertility management, making many to farm on marginal land [39]. While many farmers in Uganda are dependent on rainfall for production, the situation is worsened by the semi-arid climatic conditions of Karamoja sub-region [15]. In addition, the sub-region has a mono-modal rainfall pattern (compared to the bimodal rainfall pattern that characterizes most parts of Uganda) which permits only one planting season a year [16], further lowering food production potential of the sub-region. In the current study, higher crop and livestock production levels were associated with lower food insecurity scores. Variations in the level of production across the communities studied are likely in part a reflection of environmental differences, notably rainfall and topography. Indeed, previous studies have shown variations in climatic conditions within Karamoja sub-region and Moroto district is reported as the most drought impacted district [40]. This further supports our findings that show that production in Moroto was lower than in the Kotido district. However, aspects of agricultural production such as number of cattle reared at home, number of chickens and total crop production value were not correlated significantly with food insecurity scores. This result appears to provide confirmation that the generally semi-arid climate and relatively infertile soils that typify much of Karamoja sub-region are not conducive for agricultural production of sufficient magnitude to meet the food and nutrition needs of the local population. However, sorghum production and number of goats owned by households were found to positively influence household food security. This is likely because sorghum is relatively drought tolerant, and because goats

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are more easily liquidated (sold) to generate income to buy food during periods of shortages than cattle. However, Karamoja sub-region is known for its high number of cattle, but as pointed out by three key informants in this study, cattle are kept for prestige rather than consumption. In fact one of the key informants explained that most people in the study area only sell cattle when the animals are old and at low prices and only then in order to meet other obligations like paying school fees and buying alcohol.

Determinants of food security and coping strategies

The occupation of the main caregiver in a household could have significantly affected food security in the current study because occupation is a factor of household income. Previous studies have supported increase in household income as a key determinant of food security [41]. However, in the current study the occupation of household main caregiver (most times a woman) and not that of the household head was found to affect, significantly, food security. This points out the importance of gender in food security. The results strengthen the already known fact that women play an outstanding role in household food and nutrition security [42]. In fact, in situations where food needs are mainly met through the market pathway, women were found to spend more often a higher proportion of their income on food and nutrition related expenditures in their households than men [41].

The different aspects of WASH are known to affect various components of food security [43]. In the current study, food insecurity score increased with increase in the time taken by households to fetch water. This might be because spending time fetching water reduces the amount of time available for other duties, including producing and preparing food. This finding illustrates the relationship between water access and food insecurity in terms of food availability. This is in contrast with the classical view which looks at the dependence of food security on WASH only at the level of utilization.

Poor food storage leads to high postharvest losses and constrains food access later by households [5]. In the current study, ownership of cribs/granaries by households for drying and storage of grain foods was a significant predictor of food security. Great variability in climate conditions, with frequent, prolonged droughts characterizes Karamoja sub-region [15]. Under such conditions, in which food productivity also varies greatly both inter- and intra-annually, reliable and safe means of storing food for consumption during periods of low production are critical.

Coping strategy indices could have varied among the communities studied because households with different levels of food security are expected to cope/ respond differently.

While the determinants of food and nutrition outcomes are likely to remain the same in developing countries, example household income, education attainments, household size, gender and others, the levels of these determinants do vary between and within communities in each country or region. Nutrition programs ought to take these variations to achieve higher levels of success.

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CONCLUSION

It is clear that community level disparities exist in many aspects of food and nutrition security especially in culturally diverse settings. The dietary habits of those consulted in the research presented here are poor, as depicted by frequency of meals and calorie/nutrient intake. The implications of these poor dietary practices on their health are discussed. Agricultural production levels are highly variable in the communities studied and some components of the production appeared to confer greater levels of food security than others. Only a relatively small proportion of the variation in household food security was explained by the causal factors identified by respondents in the study. This reveals, perhaps, a poor understanding among those impacted of the causes of the relatively persistent food and nutrition insecurity. The current study did, however, reveal the important contribution to resilience played by occupation, agricultural production, food storage facilities, household size and proximity of reliable water sources, as these factors, which vary within and between the study communities, significantly predicted food security. This study provides evidence to recommend that community uniqueness be considered in designing and targeting of food and nutrition interventions.

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Table 1: Number of meals taken by households in 24 hours that preceded the survey

	Percent of households that took different number of meals in 24 hours		
Ethnic group	No meal at all	1-2 meals	3 or more meals
Jie	1.6	74.8	23.6
Labwor	0	50.0	50.0
Matheniko	0	93.9	6.1
Tepeth	3.0	68.2	28.8
Others (Acholi, Turkana)	0	62.5	37.5
Total	1.5%	77.3%	21.2%

Table 2: Proportion of households with adequate intake of calorie and nutrients segregated by age groups and district, on the basis of 24 hour dietary recall

	Percentage of households that took at least the minimum RDA								
Age group	19-30 years		31-50 years		51-70 Years		Above 70 years		
District	Kotido	Moroto	Kotido	Moroto	Kotido	Moroto	Kotido	Moroto	RDA
Calorie	20.8	7.1	25.9	3.9	12.5	0	0	0	2000-2200Kcal
Water	27.1	21.4	10.3	39.2	9.4	32.6	N/A	38.5	2.7 litre
Proteins	58.3	14.3	63.8	21.6	53.1	14	N/A	23.1	46g
Carbohyd	81.2	64.3	75.9	60.8	75.0	41.9	N/A	46.2	130g
Fiber	45.8	39.3	46.6	35.3	62.5	37.2	N/A	38.5	21-25g
Calcium	12.5	0	8.6	0	0	2.3	0	0	1000mg
Iron	41.7	10.7	43.1	13.7	84.4	51.2	N/A	46.2	8-18g
Zinc	43.8	10.7	43.1	5.9	40.6	7.0	0	0	8g

Carbohydrate: RDA, Recommended Daily Allowance: Households consuming at least the RDA for calorie and nutrients were considered to have adequate intake

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Table 3: Frequency of consumption of different foods by households segregated by household location

	Proportion of Households consuming foods											
Frequency of consumption	**Never eaten by households**		**Daily**		**1-3 times a week**		**4-6 times week**		**once a month**		**2-3 times a month**	
	Kotido district	Moroto district	Kotido	Moroto	Kotido	Moroto	Kotido	Moroto	Kotido	Moroto	Kotido	Moroto
Foods and food groups												
Cereals												
Sorghum products	0	0	**62.0**	**67.6**	20.7	22.6	14.3	6.8	1.4	1.5	0.7	1.5
Maize products	30.7	29.3	**42.8**	**51.1**	14.3	9.8	5.0	2.3	0.7	5.3	6.4	2.3
Millet products	**43.6**	**85.0**	18.5	3.1	18.6	2.3	8.6	0	4.3	9.0	6.4	2.3
Local brew residue	12.9	3.0	23.5	**51.8**	**43.6**	27.8	10.0	13.5	3.6	2.3	6.4	1.5
Legumes												
Beans	0.7	0	28.6	**48.9**	**47.1**	37.6	14.3	4.5	7.1	7.5	2.1	1.5
Groundnuts	5.0	39.1	33.5	6.8	42.9	19.5	12.1	4.5	0.7	27.8	5.7	2.3
Fruits and Vegetables												
Dark leaf vegetables	2.9	1.5	**45.7**	**56.4**	39.3	21.8	8.6	17.3	2.1	1.5	1.4	1.5
Orange coloured vegetables e.g. pumpkins	12.1	18.0	21.4	**46.6**	**40.7**	22.6	7.9	4.5	15.0	4.5	2.9	3.8
Mangoes	**60.0**	**33.1**	1.4	20.3	3.6	1.5	4.3	1.5	26.4	35.3	4.3	8.3
Oranges	**61.4**	**39.8**	4.2	12.1	5.7	15.8	1.4	2.3	17.9	26.3	9.3	3.8
Banana	**80.0**	**61.7**	0.7	0	1.4	11.3	4.3	1.5	7.1	24.1	6.4	1.5
Animal source foods												
Meat and its products	4.3	15.8	19.3	17.3	**23.6**	**27.8**	12.9	2.3	22.1	23.3	17.9	13.5
Fish	**57.9**	**73.7**	0	0.8	5.0	15.8	2.1	5.3	19.3	4.5	15.7	0
Milk and its product	8.6	18.0	**46.6**	**30.1**	25.0	25.6	12.9	4.5	5.7	11.3	1.4	10.5
Poultry e.g. chicken	**45.0**	**51.1**	1.4	2.3	2.1	9.0	1.4	1.5	39.3	27.8	10.7	8.3
Eggs	**52.1**	**44.4**	2.1	12.0	5.7	16.5	0.7	0.8	31.4	19.5	7.9	6.8
Roots and tubers												
Cassava	**45.7**	**43.6**	1.4	9.1	9.3	25.6	2.1	0.8	26.4	18.0	15.0	3.0
Sweet potatoes	**53.6**	**37.6**	1.4	5.3	8.6	28.6	5.0	4.5	23.6	19.5	7.9	4.5
Irish potatoes	**85.0**	**94.0**	0	0	1.4	0	0.7	0	6.4	4.5	6.4	1.5

The figures in bold show where and at which frequency a particular food is consumed most

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Table 4: Number of livestock (in categories) kept by households segregated by sub-county

Sub-county		Goats		Cattle		Sheep		Chicken	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Nadunget	63	2.83[a]	0.46	3.43[a]	0.67	1.29[a]	0.27	1.37[a]	0.22
Tapac	70	5.37[ab]	0.71	5.04[a]	0.80	1.66[a]	0.40	3.17[ab]	0.60
Nakapelimoru	70	16.54[c]	2.82	11.33[b]	1.92	13.29[b]	7.21	2.07[a]	0.40
Kacheri	70	11.40[bc]	2.18	10.70[b]	1.74	8.94[b]	2.29	5.03[b]	0.79

n, Number of households surveyed; SD, Standard Deviation
Values in the same columns carrying different superscripts are significantly different ($p \leq 0.05$)

Table 5: Community level variation in the relationship between household agricultural production and food security score

	Household Food Insecurity Access Scale (HFIAS)									
Production Variables	Number of goats owned		Number of cattle owned		Number of chicken		Sorghum production		Total crop production value (USD)	
Location/Division	r	P	r	p	r	p	r	p	r	P
Nadunget	0.22	0.09	0.15	0.23	-0.12	0.34	-0.25*	0.05	-0.12	0.33
Tapac	0.02	0.86	-0.07	0.58	-0.16	0.18	-0.21	0.08	-0.03	0.80
Nakapelimoru	-0.41*	0.00	-0.19	0.13	-0.21	0.09	-0.24*	0.04	-0.16	0.20
Kacheri	-0.24*	0.04	0.04	0.76	-0.05	0.66	0.04	0.72	0.66	0.59
Overall	-0.25*	0.00	-0.08	0.21	-0.11	0.07	-0.19*	0.002	-0.11	0.06

r, correlation coefficient; p, p-value of the correlation, level of significance set at $p \leq 0.05$
Values with asterisk show significant correlation at 95% level of confidence

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Table 6: Determinants of household food insecurity scores segregated by location (district) of households surveyed

Variables	Regression Coefficient (B) and standard error					
	Moroto district (n=133)		Kotido district (n=139)		Overall (n=272)	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Gender of household head	0.970	0.836	0.689	0.817	0.725	0.562
Ethnic group of respondents	-0.079	0.217	-0.058	0.346	-0.111	0.137
Size of household	1.782	0.847**	-1.242	0.705	-0.080	0.518
Education level of household	-1.327	1.355	-0.713	0.664	-0.735	0.591
Education level of household main-caregiver	-1.270	1.180	0.813	0.924	0.094	0.692
Occupation of household head	-0.023	0.226	0.178	0.173	0.139	0.134
Occupation of main caregiver	0.763	0.371**	0.338	0.201	0.375	0.174**
Quantity of sorghum produced in 12 months	-0.004	0.003	-0.002	0.001	-0.003	0.001**
Total crop production value in 12 months	-9.8E-7	0.000	-8.6E-7	0.000	-6.007E-7	0.000
Total value of non-land assets	4.8E-7	0.000	-1.5E-7	0.000	5.41E-7	0.000
Total monthly household expenditure	4.1E-6	0.000	1.02E-5	0.000	5.40E-6	0.000
Number of goats kept by households	0.099	0.083	-0.085	0.019***	-0.077	0.019***
Number of cattle kept	-0.033	0.064	0.020	0.028	0.021	0.025
Number of chicken kept	-0.160	0.105	-0.035	0.067	-0.088	0.053
Average time taken by households to fetch water	1.326	0.532**	0.370	0.435	0.816	0.327**
Ownership of cribs/food stores	1.119	0.736	1.193	0.821	1.271	0.527**
Constant	10.780	3.695	13.837	2.427	12.581	1.913
R^2	23.4		28.0		20.2	

*n, number of households studied; R^2, R square value of regression reaction, Variables with *** and ** significantly predicted HFIAS at 1% and 5%, respectively*

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Table 7: Household food insecurity weighted coping strategies for Karamoja sub-region

Coping strategy	Weight assigned
Rely on less preferred and less expensive foods	3
Borrow food or money to buy food	3
Purchase food on credit	2
Rely on help from friends/relatives	2
Limit portions at meal time	3
Limit intake to ensure children get enough	3
Reduce number of meals eaten in a day	4
Skip whole days without eating	3
Gather unusual amounts of wild foods	4
Harvest immature crops	2
Rely on casual labour for food	4
Send household members to eat elsewhere	2
Send household members to beg	2
Sell assest e.g. animals	2
Eat unconventional foods e.g. local brew residue, wild foods	4

Weights ranged from categories 2 to 4; 4, most severe coping strategies (applied when there was extreme food shock) and 2, least severe strategies

Table 8: Household food insecurity score and coping strategy index

Location	Food insecurity score		P value	Coping strategy index (CSI)		P value
District	Mean	SD		Mean	SD	
Moroto	15.4	4.2	0.76	120.9[a]	39.8	< 0.00
Kotido	14.4	4.2		96.8[b]	44.2	
Sub-county						
Nadunget	15.7	5.2	0.27	119.3[a]	47.4	< 0.00
Tapac	15.1	3.1		122.3[a]	30.9	
Nakapelimoru	14.2	4.6		94.1[b]	46.1	
Kacheri	14.8	3.8		98.1[b]	42.4	
Total	14.9	4.2		108.2	43.7	

SD, Standard Deviation. Values in the same column with different superscripts are significantly different.
Food insecurity scores ranged from 0 (most food secure households) to 27 (most food insecure)
*CSI was obtained by summing weight * frequency of application of individual coping strategy, weights ranged from 2-4 and frequencies from every day (7) to never (0)*

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