Farm Households Food Production and Households' Food Security Status: A Case of Kahama District, Tanzania

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Abstract

Food is an important basic human need for survival, growth, and good health. Most rural households in Tanzania, Kahama district inclusive produce the food they consume. Despite this reality, a number of households in the district suffer from food insecurity. However, there are inequalities across the district's ecological zones and administrative divisions. Therefore, the paper aims at determining how farming households in Kahama District cope with food insecurity. Specifically, the paper determines food security status based on Dietary Energy Consumed (DEC) per Adult Equivalent (AE) per day, identifies households' food insecurity coping strategies and examines factors influencing food production and supply. The paper uses data collected through a survey of 150 randomly selected farm households in Msalala and Isagehe divisions. In addition, some qualitative information on crop production, food security situation and households' food insecurity coping strategies was collected through focus group discussions (FDGs) conducted in the surveyed villages. Generally, observations based on the 24 hours recall and household income expenditure survey (HIES) indicate that food insecurity existed among households in the study areas based on the recommended average DEC/AE, of 2200 kcal and 2100 kcal respectively. Binary regression analysis results show that five predictors were significantly ($P \leq 0.05$) associated with surveyed households' food security/insecurity. Multiple regression analysis results further show that, total annual income, the amount of maize and paddy produced, household size, the number of plots owned, and the number of cattle owned significantly influenced the surveyed households' food production and supply. Observations further show that most households rely on less preferred foods as a food insecurity copying strategy. The paper concludes that food insecurity existed among farming households in the study area. It is therefore recommended that, farming households adopt drought resistant food crops, diversify into off-farm income generating activities and that village extension officers (VEO's) and community development officers (CDO's) play a more active role to enable households achieve food security.

Key Words: Farm household, production and food security

Introduction

Food is an important basic human need for survival, growth, and good health. Freedom from hunger is the most fundamental human right that can be attained if an individual is food secure. Despite this reality, the number of people suffering from food insecurity globally is high, estimated at 925 million (FAO, 2010). According to FAO, developing countries, account for 98% of the World's under-nourished, and a third of these reside in sub-Saharan Africa (SSA). Graaf *et al.* (2007) argue that though some of the SSA countries do report adequate food supplies at the national level at times, this does not necessarily guarantee food security at the household level. Generally, food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life (FAO *et al.,* 2013). On average, about 70% to 80% of Africans live in rural areas and many face

seasonal food shortages. In addition, most of Africa's food insecure households are also the poorest (Brummet *et al.,* 2011; Bukusuba *et al.,* 2007).

Most rural households facing food insecurity have different strategies to cope with food insecurity. However, some strategies seem to be inadequate to meet household's food needs. According to Maxwell *et al.* (2008) some of the strategies adopted are just norms as they do not contribute to improving food security among the population, for example, eating of less preferred foods. Shariff and Khor (2008) have pointed out that several food coping strategies are associated with food insecurity, and they are mostly acceptable to vulnerable households in different cultures for example skipping meals.

Although Tanzania is not femine-prone, national production aggregates may conceal significant variations in food security among regions and districts. Seasonal variations may also be pronounced depending on rainfall. (URT, 2009a). On average Tanzania produces about 95% of her food requirements. In some years, the country's food self-sufficiency, as measured by the Self Sufficiency Ratio (SSR), is over 100. A Survey carried out by the Food Security Information Team (FSIT) in 2008 in Tanzania, identified a total of twenty districts in ten regions as food insecure; these are Shinyanga, Arusha, Kilimanjaro, Lindi, Manyara, Mara, Mwanza, Mtwara, Singida, and Tabora (URT, 2009a). According to URT (2009b), the percentage of people with food poverty based on poverty head count index increased from 16.6 % in 2007 to 17.4 % in 2008-09.

Kahama District in Shinyanga Region does enjoy a boom of food production in some years, especially during seasons of adequate rainfall, which leads to good harvest. However, there are inequalities across ecological zones, and administrative divisions, particularly in Isagehe and Msalala Divisions. The two divisions have been more frequently affected by incidences of food insecurity than has been the case in other areas in the district (KDP, 2011). Despite the high frequency of food insecurity in these two divisions, it is still possible to find households with food surplus side by side with food insecure households. This is happening despite the two groups sharing common climatic and weather conditions, similar soil types and topography (KDP, 2011). Therefore, the paper aims at determining the food security status of farming households in Kahama District.

Problem Statement and Justification Tanzania's food self-sufficiency has ranged from 88 to 112 percent over the past 8 years FSD (2012). However, some localized food deficits are rampant. In addition, FSD argues that Tanzania's low agricultural productivity poses a significant challenge to poverty reduction and food security. Kahama district faces regular food insecurity; in addition, it is among those districts with high incidences of food insecurity in Tanzania. For example in the period 2011 - 2012 the district had about 23 083 food insecure households with more than half (14 637) residing in Isagehe and Msalala Divisions (DAO, 2011). Generally, about 85% of the residents in Kahama district are engaged in agricultural production, with farm sizes varying from 0.4 to 20 ha per household. Surprisingly, the district reported the food shortages despite being part of the districts receiving inputs support from the National Agricultural Input Voucher System (NAIVS) since 2008. Availability of inputs through NAIVs was expected to increase productivity and hence reduce food insecurity in the district. However, between 2009 and 2012, the district remained in need of food aid from the government and other development partners. Generally, food aid in tonnes for the above period was 856 (2009), 666 (2010), 768 (2011) 1108.8, (2012), and 713 (2013). In the year 2009 the amount of food received from NFRA was 125 tons of maize, 19 tons of beans, and nine tons of vegetable cooking oil. In 2010, the district received 200 tons of food from Bulyanhulu Gold Mine.

Although Kahama district faces regular food shortages, food security/insecurity varies across the district on basis of ecological zones and administrative divisions. According to information from KDC (Kahama District Council) office, in 2009-10 Kahama district received 857 tons of maize as relief food from NFRA (National Food Reserve Agency).

Furthermore, between 2011 and 2012 the amount of food assistance from the NFRA and other development partners reached 4140 tons, this was mostly distributed to the above-mentioned divisions. Despite of the above, information on the severity of food insecurity among farming households in Isagehe and Msalala divisions is scanty or not readily available. In addition, the effectiveness of their copping strategies is also unknown. This paper therefore aims at providing an understanding of the intensity of food insecurity and how farm households in Kahama district cope with the situation. Moreover, empirical information presented in relation to households' food insecurity and their coping strategies could enhance the understanding of various stakeholders, policy makers, and development practitioners interested in rural households' food security. This is particularly important as Tanzania and her development partners aim to achieve goal number one of the Millennium Development Goals (MDGs) i.e. that of eradicating extreme poverty and hunger come 2015.

Objectivies and research questions

The overall objective of the current paper is to assess farming households' food production and households' food security status in Kahama District, Tanzania. Specifically, the paper aims at; (i) examining factors influencing food production and supply among farming households in Kahama district, (ii) to determine farming households food security status (iii) to identify the surveyed households' food insecurity coping strategies. In addition to the above, the paper also tries to answer the following questions; what is the intensity of food insecurity among farming households in the study area? What are the most popular food insecurity coping strategies adopted by farmers within the study area and what challenges are associated with food production and supply among farming households in the study area?

Conceptual framework for food security and coping strategies

A household's food security can be influenced by a variety of factors. These include; household characteristics (household head's age, sex, education level, marital status household size and farming experience) (Kayunze, 2000; Idrisa *et al.,* 2007; Babatunde *et al.,* 2007; Basukuba, 2007; Dauda, 2010: Obayelu 2010; Kuwornu *et al.,* 2012). Farming characteristics such as farm size, farm labour, investment in agriculture, households' use of improved seeds and fertilizers, a household's access to extension services and amount of grains produced and stored by households (FAO, 1997; SAA, 2006; FAO *et al.,* 2013; Adenyi and Ojo, 2013), market characteristics (availability and price of food

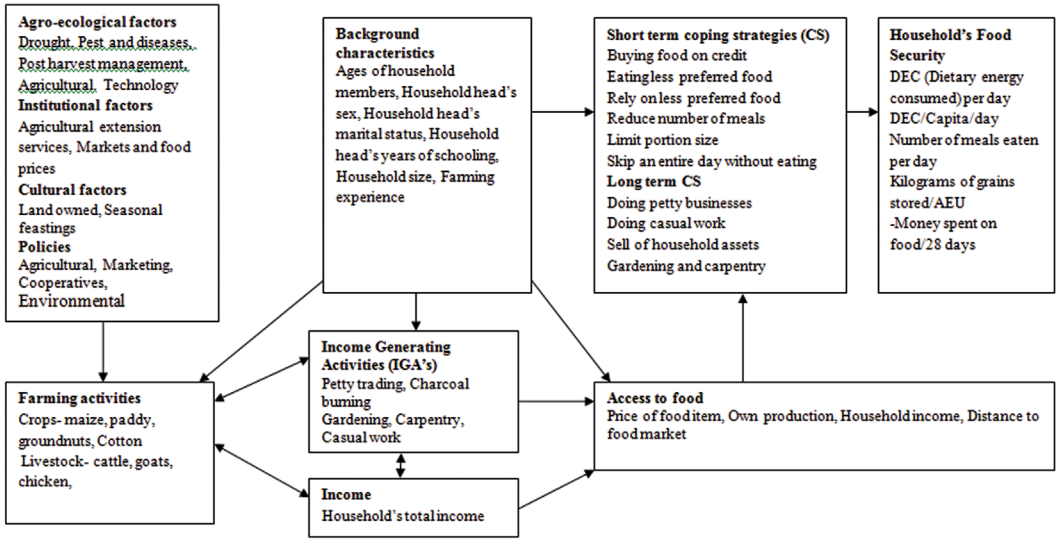

Figure 1: Conceptual Framework for Food Security/Insecurity and Coping Strategies

stuff, distance to food markets, stability of food supplies) (FAO, 1997; FAO *et al.,* 2013).

The paper's conceptual framework (Fig.1) is based on the above revelations and on Sen's 1981 entitlement to food concept. The entitlement approach to hunger discusses the ability of people to command food through the legal means available in the society. The dependent variable (food security) is influenced by various variables, these include; household's background characteristics, involvement in income generating activities and its food insecurity copping strategies which are important in ensuring food security. Literature (Babatunde *et al.,* 2008; Amaza *et al.,* 2009) shows that sex of a household's head can influence its food security. According to Babatunde *et al.* male-headed households (MHHs) possess more resources than female-headed households (FHHs) as a result, FHHs are more vulnerable to food insecurity than MHHs. In addition, literature (Obayelu, 2010) marital status can affect a household's food security status. For example, Obayelu reports that in the North Central Nigeria a slightly larger percentage of married household heads were reported to be food secure compared to the single (unmarried) class.

Agriculture in most of Sub Saharan Africa is labour intensive, therefore large sized rural households are expected to be more able to easily supply the labour required for their crop production. According to Basukuba (2007), household size is normally seen as equivalent to family labour endowment. Moreover, in situations where hired labour is costly to monitor, households with a greater endowment of labour are not only placed to farm their land more intensively but also to conduct critical operations at the right time than is the case with households that are dependent on hired labour. Therefore, larger households have more potential of obtaining higher yields and hence being more food secure than smaller households.

Education level of household heads is another important background variable that can affect a household's agricultural production and food security in general. Households with more educated members and other forms of human capital stand a better chance of accessing non-farm income and/or credit. According to Idrisa *et al.* (2007), an increase of one's education is likely to increase ones related skills and, hence, the ability to acquire new skills. In addition, education is also associated with production of higher quality crops and greater participation in non-farm activities all of which could enhance a household's food security status.

Literature (Amaza *et al.,* 2006) also shows that a household's farming experience plays an important role in determining both the productivity and the production levels. However, the effect of farming experience on productivity and production may be positive or negative. Generally, it would appear that up to a certain number of years, farming experience would have a positive effect; after a span of time, the effect may become negative. The negative effect may be derived from aging or reluctance to change from old and familiar farming practices and techniques to modern and improved farming practices. A study by Kuwornu *et al.* (2012) shows that an experienced farmer is expected to have more insight and ability to diversify his or her production and minimize risk of food shortage.

A study covering the northwest of Iran by Rahim *et al.* (2011), observed that severity of household food insecurity increased with increasing distance from the city. Rahim *et al.* further observed that it decreased with increasing centres' that provide food, residential infrastructure, family size and the presence of both parents in comparison to the presence of single parent at home. Agro-ecological factors, (drought, pest and diseases, postharvest management) can also influence a household's food security (Bahiigwa, 1999). According to Bahiigwa, the three main causes of household food insecurity in Uganda have been inadequate rainfall, pests and diseases and excessive rain. According to literature (institutional factors, (agricultural extension services, markets, and food prices) do also influence a household's food security. For example, FAO (1999) argue that an effective marketing system is important in terms of ensuring availability of food in different regions of a country.

Literature also shows that food security is determined by various socio-economic, natural and political factors. According to Rose et al. (1998), Mano *et al.* (2003) and Makombe *et al.* (2011) as cited by Oni and Fashogbon (2013) these include; income, availability of infrastructure, availability of extension services, government policies on trade, agricultural land area under cultivation, and social safety net. Others as reported in literature (Olayemi, 1998; Amaza *et al,* 2007; Ayantoye *et al,* 2005; Oni *et al,* 2011) as cited by Oni and Fashogbon (2013) include; stability of access, household economic status, household income variability, degree of producer and consumer price variability, food storage, inventory, and access to social capital.

Methodology

Description of the Study Area

Kahama District where the study was conducted is found in the Northwest of Tanzania, South of Lake Victoria. As shown in (Fig. 2). The area was selected because no studies (that the authors are aware of) on food security and coping strategies have been conducted. In addition, the need for food aid has been increasing since 2009-12. Kahama District is administratively divided into 2 councils with 5 divisions, which have been subdivided further into 55 wards and a total of 232 villages and 97 streets. Major crops grown include paddy, cotton, tobacco, maize, legumes, sorghum, cassava, groundnuts, millet, beans and sweet potatoes. Fruit trees commonly found include mangoes, lemons, oranges, bananas, guava, and papaya. With the exception of mangos, the others are grown around homesteads, cashew nut trees are found in a few places in the district (KDP, 2011).

Research Design

A cross-sectional research design was used to collect data used for the current paper. Based on the nature of the study and absence of longitudinal data the above design was the best suited. Moreover, literature (Babbie, 1990; Bailey, 1998) shows that a cross-sectional design can provide information that is useful for descriptive purposes as well as for determination of relationship between and among variables. Further to the above, a cross sectional research design is cost effective and allows inclusion of participants or groups of people from whom a comparison can be made (Matthews and Ross, 2010). Data collection was undertaken for about two months, in the months of November and December 2012.

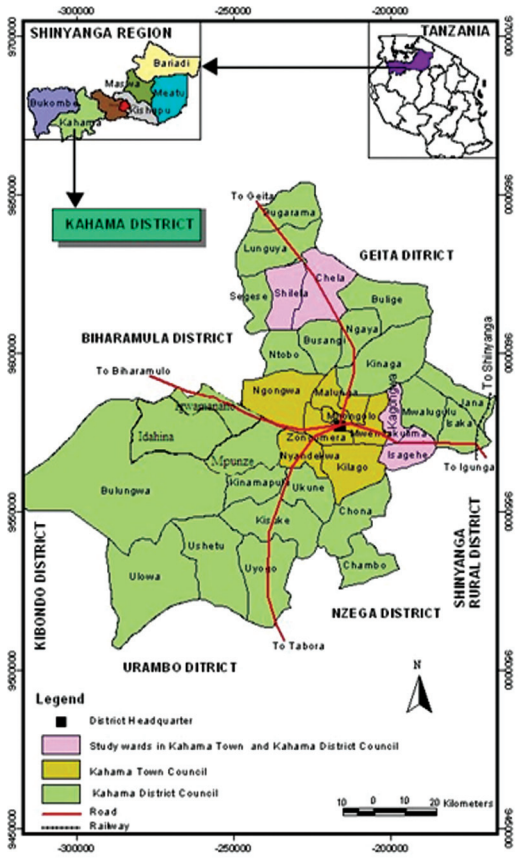

Figure 2: Map of Kahama District showing the study area

Study Population, Sampling Frame and Sample Size

The population for the study comprised all farming households in in Isagehe and Msalala Divisions, Kahama district. A sample of 150 farm households was selected from a total of 3796-farm households from eight villages from the above-mentioned divisions to represent the total population at a confidence level of 95% and level of precision of 8%; this was thought to be optimum. The unit of analysis for the study was the household, with the assumption that the household is where one can get most of information with regard to the study objectives.

The sample size was calculated using the following formula:-

$$N = Z^2 pq / d^2 \quad (1)$$

Where N = sample size, z = statistical certainty desired, p = estimated prevalence rate of food insecurity and q = 1 – p (proportion without the attribute of interest), and d = degree of precision. The desired precision (d) was set at 8 percent (0.08) and statistical certainty was set at 95 percent (z = 1.96). Because the general prevalence rate of the key variable (households' food insecurity) was not known, the value of p was set at 50% (0.5) to maximize the impact of this variable on the sample size. Thus, the resulting sample size was:-

$$n = \frac{(1.96 \times 1.96) \times 0.5 \times (1 - 0.5)}{0.08 \times 0.08} = 150 \quad (2)$$

However, 150 farm households were earmarked for the study. Nonetheless, only 137 were included in this papers analysis due to a lack of adequate data for the HIES (Household Income Expenditure Survey).

Sampling procedure

As pointed out earlier the two divisions of Isagehe and Msalala were purposive sampled due to their frequent need of government's assistance in relation to food supplies in comparison to the other divisions of Kahama district. Thereafter, two wards were selected from each of the above-mentioned divisions; this was followed by a random selection of two villages from each ward hence, the 8 villages were involved in the study. Households included in the study were selected from the eight villages through stratified random sampling as shown in Table 1.

Data types, sources and methods of collection

This paper uses both primary and secondary data collected from the study areas. The primary data collected included socio-economic characteristics of respondents as well as crop production practices and food supply, food consumption and expenditures, and food insecurity coping strategies; information on food insecurity was collected using a nine-item household food insecurity access scale (HFIAS), and 24 hours recall period. In addition, households' income and expenditure was recorded for 30 days . Further to the above, questions on food insecurity copping strategies were developed during the FGDs. Generally, key informants interviews (KIs) and focus group discussion (FGDs) were also conducted to supplement information collected through the questionnaires. The FDGs and KIs involved village leaders, village executive officers, influential people, sub village leaders and agricultural extension workers. In total eight FGDs, were conducted. Secondary information was also collected from Kahama District Offices to show the trend and amount of food aid received in the district.

For the purpose of food security analysis, food composition tables and recommended dietary energy intake were used to determine amount of dietary energy consumed (DEC) based on adult equivalent i.e. a household member's sex and age. The above was done as per the Food and

Table 1: Sample selection

Villages	Number households (N)	Households selected	Households actually involved in the study
Malito	371	15	13
Shilela	247	10	10
Jomu	407	16	16
Mhandu	522	21	15
Kidunyashi	362	14	14
Mpera	539	21	20
Gembe	277	11	11
Kishima	1071	42	38
Total	3796	150	137

Agriculture Organization's recommendations' (FAO, 2007). In Tanzania, DEC per adult per day below the minimum of 2200 kilocalories indicates food insecurity (URT, 2002).

Data Analysis

Primary data were analysed using Statistical Package for Social Sciences (SPSS) computer software whereby descriptive statistics, multiple linear and binary logistic regression analyses were conducted to answer the specific objectives. The descriptive statistics determined include, means, standard deviation, percentages, and frequency of distribution. To address specific objective one, a multiple linear regression was used whereas for objective two a binary logistic regression analysis was employed to indicate the likelihood of the independent variables being associated with a household's food security or insecurity. Since determination of households' food security status per adult equivalents (AEU) gives a better understanding than determining the same using total number of household members. The surveyed households AEU (Adult Equivalent Unit) was determined using information in Appendix I.

The multiple linear regression model

As mentioned above a MLR was used to address specific objective one. However, before running the model, collinearity and multicollinearity diagnostics were done to check for linear association between independent/explanatory variables and correlation among the independent/ explanatory variables respectively. A natural log transformation of skewed data was done before running the regression analysis to make them have a normal distribution. According to Pallant (2007), multiple linear regression (MLR) does not require the distribution of data that are skewed for both dependent and independent variables. The MLR was run to quantify the combined effect of the factors contributing to food production and supply as independent variables as well as to gauge the role of each variable in explaining the variances in the dependent variable (food security). The MLR model used is as specified below;

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \ldots \beta_9 X_9 + e \qquad (3)$$

Whereby Y = The dependent variable was amount of grains available per year measured in kilogram's.

X1 = Household head's sex; X2 = Number of plots owned; X3 = Total annual income; X4 = Amount of maize produced; X5 = Amount of paddy produced; X6 = Number of cattle kept; X7 = household size; X8 = years of farming; X9 = A household's practice of long-term coping strategies; a= Intercept (constant) term; e = Random error term; β1... βn=Standardized partial regression coefficients for independent variables.

The binary logistic regression model

The model for the binary logistic regression, which was used in determining factors, associated with a household's likelihood of being food secure is as specified below-

$$Model\ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_{14} X_{14} + e \qquad (4)$$

Where;

Y = Households food security status (1 = Food secure, 0 = Food insecure (measured by DEC)) β0 = Constant X_1 = Marital status respondent. (1= Married; 2 Otherwise) X_2 = Education of house members (Measured in years of schooling) X_3 = Household size (number of members) X_4 = access to agricultural extension services (1= Yes; 2=No) X_5= the use of ox plough in cultivation (1= Yes; 2= No) X_6= the use of organic or inorganic fertilizers (1 = Yes; 2=No) X_7= the use of improved seeds (1 = Yes; 2=No) X_8 = the use of herbicides/ insecticides (1 = Yes; 2=No) X_9 = the costs of food items. Measured in TAS (Tanzanian shillings) X_{10} = Reliance on less preferred foods (1 = Yes; 2=No) X_{11}= Borrowing food from relatives (1 = Yes; 2=No) X_{12} = Purchasing food on credit (1 = Yes 2=No) X_{13} = Consumption of seed stock (1 = Yes; 2=No) X_{14} = Reducing number of meals eaten in a day (1 = Yes; 2=No) e = Error term

Determination of household food insecurity access scale (HFIAS)

The HFIAS consists of two types of related questions. The first question type is called an occurrence question. There are nine occurrence questions that ask whether a specific condition associated with the experience of food, insecurity

ever occurred during the previous seven days). Each severity question is followed by a frequency-of-occurrence question, which asks how often a reported condition occurred during the previous four weeks. Each occurrence question consists of the stem (timeframe for recall), the body of the question (refers to a specific behaviour or attitude), and two response options (0 = no, 1 = yes). Each HFIAS frequency-of-occurrence question asks the respondent how often the condition reported in the previous occurrence question happened in the previous four weeks. There are three response options representing a range of frequencies (1 = rarely, 2 = sometimes, 3 = often) Food and Nutrition Technical Assistance (FANTA) Project (Swindale and Ohri-Vachaspati (2005).

The HFIAS indicator categorizes households into four levels of household food insecurity (access): food secure, mild, moderately and severely food insecure. Households are categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or experience those conditions more frequently. According to FANTA (Swindale, and Ohri-Vachaspati, 2005) a food secure household experiences none of the food insecurity (access) conditions, or just experiences worry, but rarely with a score of less or equal to ten. A mild food insecure (access) household worries about not having enough food sometimes or often, and/or is unable to eat preferred foods, and/or eats a more monotonous diet than desired and/or some foods considered undesirable, but only rarely. A moderately food insecure household sacrifices quality more frequently, by eating a monotonous diet or size of meals or number of meals, rarely or sometimes. A severely food insecure household has graduated to cutting back on meal size or number of meals often, and/or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely. In other words, any household that experiences one of these three conditions even once in the last seven days is considered severely food insecure; its score is between twenty three and twenty seven (according to the FANTA project) (Swindale and Ohri-Vachaspati, 2005).

Determination of households' dietary energy consumed (DEC). DEC/adult equivalent (AE)/ day is calculated based on all food items consumed within 24 hours. The Tanzania Food Composition Tables Lukmanji and Hertzmark (2008) were used for the calculation. According to the Tables, 1 kg of white maize flour contains 3620 kcal and 1 kg of rice contains 3580 kcal. Therefore, the amounts of maize eaten were multiplied by 3620 while those of rice eaten were multiplied by 3580 to get the amounts of kcal consumed in maize and rice respectively.

DEC obtained for all food items was added to get the amount of kcal consumed per day. DEC per capita is calculated based on grains consumed only. This procedure has been used by other researchers in determination of DEC. According to Ashimogo (1995) and Kayunze (2008), cereals have been reported to supply 80% of DEC, other foodstuff supply the remaining 20%. Therefore, when calculating DEC based on grains one has to inflate the resulting figure by multiplying it by 100/80 to cater for energy from other foodstuffs. DEC amounts obtained in that way were divided by household sizes to get DEC per capita (Kayunze, 2008). Thereafter, the above was then divided by surveyed households' calculated AE. In this case, a household is said to be food insecure if it consumed less than 2200 kcal per adult equivalent per day.

Results and Discussion

Surveyed farm households food security status

As pointed out earlier (methodology section) a number of ways were used to determine the surveyed households' food security status, these include; number of meals per day, household Income and Expenditure Survey (HIES) for 30 days, DEC/AE/day and DEC per capita per day from 24 hrs recall data and amount of grains stored by the specific households. Results (Table 2) show that adults in more than half (59.9%) of the households consume at least three meals; whereas about two fifths (40.1%) consume less than three meals. And among children under-five year old, about (90.4%) of the households reported children ate four to five meals or more in 24 hours and very few (9.6%) households reported to have children who eat less than three meals in 24 hours. These results are consistent

with those from the household budget survey which show that between 2001/01 and 2007 there has been a fall in the proportion of those consuming two meals per day (55.8% to 49.8%) and an increase in the proportion of those consuming three meals a day (42.8% to 48.9%). According to URT (2009a), most households usually consume two or three meals per day; however, in the urban areas three meals is a norm.

On basis of DEC results, Table 2 shows that more than half (59.9%) of the households are food insecure as the amount of kcals consumed is less than 2 200 kcals per AEU per day. These results imply that more than half of the respondents were food insecure. In Tanzania, households are food secure if they consume at least 2200 kcal per AEU per day (URT, 1999). Based on the study area's main staples (maize and rice) about three quarters (75.2%) of the households were food insecure since the amounts of DEC were less than 2100 kcal per capita per day. Based on the HIES data the minimum and maximum amounts of kilocalories consumed in the study area were 670 and 4469 kcal respectively, the mean amount consumed per day was 1759 kcal, thus suggesting that on average households were food insecure. This might be attributed to higher consumption of non-grain energy foodstuffs; especially sweet potatoes and cassava which were not included in the analysis although the foodstuffs are consumed in the area especially between September and December where the majority of the households consumed 'mapalage' (local name for boiled and dried sweet potatoes) and 'mbute' (fermented and dried cassava).

Observations from the study (Table 2) further show that just over half (51.8%) of the surveyed households were food insecure. According to URT (1999) as cited by Kayunze *et al.* (2009) for a household to be food secure, it needs to store at least 270 kg of grains per AEU per year. Table 2 further shows that in relation to monetary food poverty, more than four fifths (87.6%) of the households were food secure. A household was said to be food insecure based on monetary term if it had spent less than 24 196 Tshs (Tanzanian Shillings) per capita per 28 days. Based on the

Table 2: Food security determination based on various method (n =137)

Characteristic	Categories		Frequency	Percent
Number of meals per day	Adults	< 3	51	40.1
		3	75	59.2
		> 3	1	0.7
	Children*	< 3	8	9.6
		4 - 5	75	90.4
		> 5	0	0
DEC per AEU per day	Food secure	Takes ≥ 2 200kcal	56	40.1
	Food insecure	Takes ≤ 2 200kcal	81	59.9
DEC per capita	Food secure	Takes ≥ 2 100kcal	34	24.8
	Food insecure	Takes ≤ 2 100kcal	103	75.2
Grains stored/available per AEU/year	Food secure	≥ 270 Kg of grains	66	48.2
	Food insecure	≤ 270 Kg of grains	71	51.8
Monetary food poverty per AEU/28 days	Food secure	≥ 24 196 Tshs	120	87.6
	Food insecure	≤ 24 196 Tshs	17	12.4
Food security based HFIAS	Food Secure		29	22.6
	Mild food Insecurity		48	38
	Moderate food insecurity		31	24.8
	Severely food insecure		19	14.6

*As regards meals taken by children the question was only applicable to 83 households (i.e. n = 83)

costs of food items consumed by all households, the incidence of food secure households was 87.6% while that of food insecure which was 12.4%. The minimum and maximum costs were 2559 and 194 063 TAS per capita per 28 days respectively. Using this indicator, most of the households are food secure as compared to other indicators above. However, based on analysis of the HFIAS data (Table 2) over a fifth (22.6%) of the households are food secure. The study observations show the importance of using more than one method in determining households' food security.

Multiple linear regression (MLR) results on factors influencing a household's food production and supply

To determine the factors influencing farm households' production/supply of grains (food), households' socio-economic characteristics were regressed on the total grain available per year for consumption at the household level. Table 3 presents factors affecting food production and supply at the household level. The regression model provides a best fit (P= 0.001) and the ten independent variables accounted for R2 0.543 (adjusted R^2 = 0.50). MLR results (Table 3) show that six variables; total annual income, the amount of maize and paddy produced, household size, the number of plots owned, and the number of cattle owned in the household to significantly ($p \leq 0.05$) influence a household's food production and supply in the study area.

Total amount of food produced by households from own farms was measured (estimated) in kilograms. Generally, a household's own food production increases the amount of food supply within the household. The amount of major food crops produced by households was found to be positively and significantly related to amount of grain available to a household: standardized regression coefficient for maize and paddy were 0.59 and 0.32 respectively and both were significant at the P = 0.001 level. The positive sign of the variable indicates that the higher the output levels of household, the greater the food produced and the more likely it is for the food to be supplied and available at the household level. The above observation was as expected. According to RAWG (2011), the agricultural sector is the main source of employment and livelihood for about 75 % of Tanzania's population. Therefore, agriculture is an important economic sector in terms of food production, employment generation, production of raw materials for industries and foreign exchange earnings.

Table 3: Multiple linear regression results of factors that influence a household's supply of grains (food)

Model	Un standardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	5.016	0.328		15.279	0.000
Sex of the household head	-0.174	0.166	-0.072ns	-1.048	0.297
Number of plots owned	0.113	0.049	0.161**	2.318	0.022
Total annual income	0.031	0.013	0.163**	2.338	0.021
Amount of maize produced	0.000	0.000	0.316*	3.231	0.002
Amount of paddy produced	0.000	0.000	0.587*	6.090	0.000
Number of cattle kept	-0.018	0.004	-0.437*	-4.452	0.000
Dependence on rain	0.084	0.060	0.099ns	1.408	0.162
Household size	-0.097	0.022	-0.337*	-4.450	0.000
Years of farming	0.009	0.006	0.128	1.634	0.105
Household's use of food insecurity CS	0.196	0.106	0.131	1.858	0.066

Y = Total grain available per year (Kg) R = 0.737; R squared = 0.543; Adjusted R square 0.50; F. statistics 11.99; n =137 *** significant at 1%** significant at 5%** and *significant at 10% NB: CS= Coping strategies

Household size (total number of individuals in a household) negatively and significantly ($p \leq 0.05$) influenced food production and supply, implying that the larger household, the less the food produced hence supply to household. The results (Table 2) are in contrast with the results in the previous findings as presented under factors contributing to food insecurity. However, these findings are in conformity with the results in the study by Idrisa *et al.* (2008) who observed that the larger the household size, the greater the responsibilities, especially, in a situation where many of the household members do not generate any income but only depend on the household head, and that households that are food secure were the small-sized ones with low dependency ratio.

Years of farming and engagement in long-term coping strategies (LCS) were positively and slightly significantly ($P \leq 0.10$) associated with a household's production/supply of grains (food). The result suggests that an increase in the years of farming and engagement in LCS activities are positively related to food production and supply. Similar findings are reported in previous studies for example Kowornu (2012), points out that farming experience refers to the number of years the household head has engaged him/herself in farming. In addition, all things being equal, an experienced household head is expected to have more insights and ability to diversify his or her production to minimize risk of food shortage. An experienced farmer is also expected to have adequate knowledge in pest and disease management as well as good knowledge of the weather and therefore he/she is expected to have higher levels of food production and supply. According to Amaza (2006), farming experience on productivity and production can affect agricultural production either positively or negatively. Moreover, Obasi *et al.* (2013) point out that agricultural productivity can be higher for farmers with higher educational level and many years of farming experience. Generally, it would appear that up to a certain number of years, farming experience would have a positive effect; after a span of time, the effect may become negative. In addition, an experienced farmer is more likely to have adequate knowledge on pest, disease management and weather. Nonetheless, Doss *et al.,* (2003) argue that at times younger farmers are more open to new technologies compared to older ones, whose accumulated experience acts as an obstacle to adoption of new technologies compared to the younger who have less experience. In such a scenario, experience could affect production negatively.

A household's total annual income was ositively and significantly ($p=0.005$) associated with grain production and supply, this had a standardized regression coefficient of 0.16 (Table 3). This implies that households with more income have better access to food production and supply. According to Urassa (2010), a household's income can be very crucial in determining how households may invest in new technologies, these could then enable households to increase their food productivity and supply and presumably its food security. In addition, Rweyemamu and Kimaro (2006) have also reported on the importance of income in agricultural productivity.

Results from the regression analysis showed that livestock keeping was negatively related to grain/food production and supply with a standardized regression coefficient of -0.44 which was significant at $p = 0.000$. This implies that an increase in number of livestock led to a decrease in a household's food production and supply, and access to more quantity and quality foods. However, this is surprising, generally it is expected that, households keeping cattle are more food secure relative to those not. In addition, cross tabulation results showed that households owning cattle were slightly more food secure than their counterparts. Moreover, a study by Kapunda (1994) showed that livestock play a significant role to farmers as not only an indicator of wealth, means of paying dowry or a source of cash income, but also as a source of food security especially during times of crop failure. Indeed the keeping of livestock in Tanzania seems to improve further food security situation. Bogale and Shimelis (2009) points out that total number of livestock (mostly cows and goats) can make a difference in relation to households' food security.

Dependence on rainfall and lack of irrigation had a positive but insignificant relationship

with food production and supply. This is an unexpected result because during the FGDs it was revealed that drought was among the factors responsible for food insecurity in the study area. Nevertheless, the positive correlation might be a result of the fact that some households were producing enough food for their families and surplus for sale. In addition, households with low production had to cope with shortage through doing various activities to ensure food is available for their members. According to Kangalawe (2012) and URT (2006), climatic and environmental changes have resulted into declining agricultural productivity.

Results of the binary logistic regression analysis

A binary logistic regression analysis was used to address specific objective 2. According to the results presented in Table 4 only two predictors were significantly ($p = 0.001$) associated with a household's food security status on basis of DEC/ day, these are, household size and eating of less preferred foods. Four predictors were significant ($p = 0.05$) and these are, a household's use of organic or inorganic fertilizers, costs of food items, purchasing food on credit and borrowing foods from relatives. In addition, three were slightly significant ($p = 0.1$). These are, a household head's level education, source of agricultural extension services and reducing number of meals taken by households. According to literature (Urassa, 2010; Dauda, 2010) a household head's education is believed to increase the likelihood of using improved technologies in agricultural production and hence agricultural productivity. However, the logistic regression results (Table 4) shows that education was negatively associated with food security ($p = 0.082$). The study's observation seems to mirror what was reported by Bogale and Shimelis (2009) from their Ethiopian study that, education of household head was not statistically significant in determining household food insecurity. According to Table 2, the majority (81%) of the household heads had primary education. According to Dauda, (ibid) education is widely believed to be a key determinant of food security. In addition, a study by Swift (1989) indicates that very few households with at least one formal educated member starve because of food insecurity. A study by Amaza *et al.* (2009) further reported that the higher the educational level of a household head, the more the food security status of the family.

Results in Table 4 further show that household size had a negative effect, suggesting that large households are more likely to be food insecure as compared to small and medium households (- 440; $p = 0.001$). These results are in line with Neo-Malthusian theory that population has a negative influence on food security. For example a study by Amaza *et al.* (2009) found that households with large sizes had higher probabilities of being food insecure than those with smaller sizes, and vice versa. This is obvious because the larger the household size, the greater the responsibilities, especially, in a situation where many of the household members do not generate any income but only depend on the household head or a few able bodied individuals. Amaza *et al* (ibid) further argue that, the significance of household size in agriculture is linked to availability of labour for farm production, total area cultivated for different crops, amount of farm produce retained for domestic consumption and the marketable surplus. However, some previous researches in Tanzania for example, Kayunze (2000) has shown a positive relationship between household size and food security. Also, a study by Basukuba (2007) reveals that large numbers of people in the household are normally seen as equivalent to family labour and therefore, a large household has the potential of obtaining sufficient labour which is capable of producing more food and therefore become food secure. Nonetheless, Basukuba's argument is true in absence of under-employment of the available labour force. Based on the above, a household's food security can both be affected by its size and composition.

The binary regression results (Table 4) as expected show that use of inorganic/organic fertilizers was positively and significantly (1,622; $P = 0.043$) associated with a household's food security. The reason might be, in the sample only a few of the households used appropriate technologies and to a small extent eg. use of plough in cultivation, use organic fertilizers, and use improved seeds (Appendix II). According

Table 4: Binary regression results on factors associated with surveyed households' food security based on DEC per capita

Indicators entered in the model	Beta	Standard error	P- value	Expected β
Marital status of household head	1.254ns	0.796	0.115	3.504
Education level household head	-0.184*	0.106	0.082	0.832
Household size	-0.555***	0.152	0.000	0.574
Source of agricultural extension services	1.194*	0.668	0.074	3.301
Use of ox plough in cultivation	-0.497ns	0.756	0.510	0.608
Use of improved seeds	0.271ns	0.595	0.648	1.312
Use of organic or inorganic fertilizers	1.622**	0.802	0.043	5.065
Use of herbicides/insecticides	0.956ns	0.697	0.170	2.600
Expenditure on food items	0.000**	0.000	0.005	1.000
Rely on less preferred foods	-3.340***	0.940	0.000	0.035
Borrowing food from relatives	1.917**	0.811	0.018	6.797
Purchasing food on credit	-1.332**	0.677	0.049	0.264
Consumption of seed stock	0.121ns	0.694	0.862	1.129
Reduce number of meals eaten in a day	1.212*	0.660	0.066	3.359
Constant	-2.221	2.147	0.301	0.109

χ^2=54.664; P=0.005; n=137; ns= not significant: *** significant at 1%** significant at 5%** and *significant at 10%

to Baltzer and Hansen (2011), agricultural input intensity is very low in Tanzania; farmers use on average 8 kg/ha of fertilizers below SSA average which is 9 kg/ha, and only 5.7% of rice farmers and 0.7% of maize farmers use improved seed varieties together with fertilizers.

The results from the binary regression analysis also show that out of the four coping strategies entered in the model, three were significantly associated with food security. Relying on less preferred food was one of the predictors that were negative and significant (-3.340; P = 0.000), implying that households which experience food insecurity adopt this strategy frequently in order to sustain their lives (ration for survival). The majority (83.2%) of the respondents practiced the strategy whereby the less preferred food mentioned were *matobolwa/mapalage* and cassava. This results support the concept of using coping strategies as an indicator of food insecurity. According to the concept, households with more than eight months of food self-sufficiency may be able to manage the overall calorie requirements by adopting a combination of coping strategies. However, these strategies are repercussion on food security.

Borrowing food from friends or relatives was positive and significantly (1.971; P = 0.018); associated with a household's food security. This seems to suggest that borrowing food contributes to a household's food security as households, which borrow food from friends and relatives are able to meet their DEC requirements. During the FGDs, it was revealed that borrowing of grains from friends and relatives is among the ways food deficient households get their food. In addition, some meet their food needs through informal loans from local traders and property owners. Nonetheless, the borrower has to repay the grain (maize/paddy) loan with interest usually after the next harvest. For example, one bag of maize would attract three bags after harvesting and two bags of paddy would attract five bags. The above results are in line with the institutional theory and food security. Institutional elements are important for food security. Institutions regularize life, support values, produce and protect interests, and can help mitigate food insecurity at the household level. The practice of households borrowing or giving one another

food is also common culture/practice among the people in Kahama District. However, the tendency of the borrower having to pay twice or thrice the amount borrowed may result into the borrowing households being trapped in a viscous circle of food insecurity presumably even under years of good crop harvests.

Purchasing food on credit was negatively associated with food insecurity; (lower caloric intake); the association was statistically significant at 5% level (-1.332; P = 0.049); this implies that a households ability to buy or get food on credit helps to reduce a households food shortfalls. However, the negative association suggests that households accessing food on credit may have to reduce their total intake hence leading to the low daily caloric intake.

Lastly, results from the binary regression analysis show that expenditure on food was one of the variables significantly (p = 0.001) associated with a household's food security. Generally, households with more income are expected to be more food secure than poor ones. The results conform with the entitlement theory and food security by Sen (1981) which says that people do not usually starve because of an insufficient supply of food at the local, national, or international level, but because they have insufficient resources, including money ('entitlements') to acquire it. These results also correspond with the results in a study by Pauw and Thurlow (2011) which reported that there is a relationship between calorie intake and income: income improves food security by increasing consumer ability to purchase more or better quality foods.

Surveyed farm households' food insecurity coping strategies (CS)

Food insecurity coping strategies mentioned by farming households in the study area are presented in Table 5. According to the results the used strategies in order of importance include; involvement in petty trade, working as casual labourers (casual work), selling of livestock, charcoal making, gardening, and carpentry. The standardized regression coefficient for coping strategies is 0.13, this was slightly significant ($p \leq 0.1$) and positively associated with a households supply of grains (food) available to a household (Table 3). The positive regression coefficient implies that CS and food production and supply are positively related. An increase in the engagement into CS might lead to an increase of the supply of food. According the available literature (Chhetri and Maharjan, 2006: Hadley et al., 2007: Maxwell et al., 2008) households adopt both short and long term coping strategies in order to ensure food availability and supply at the household level.

Results from the study (Table 5) show that more than three quarters (75.9%) of the households reported to have been relying on less preferred foods at least more than once per week as a means of dealing with food shortages. Under half (48.2%) reported to have been borrowing food from friends/relatives to improve their food availability. Observations from FGDs show that borrowing food from various informal sources was common in all villages; this condition is locally referred to as *'fogonho'* (Borrowing food or money from informal sources). About two-fifths (41.6%) reported to have been purchasing food on credit at least more than once per week and over two fifths (43%) of the respondents reported to have been reducing the size of meals. About a fifth (21%) of the households reported to have consumed seed stocks at least once in a week. However, consumption of seed stock has a serious consequence on crop production as lack of seeds during planting periods might lead to low agricultural productivity and hence food insecurity.

Table 5 also shows that about two thirds (62.8%) of the respondents reported to be reducing the number of meals at least once in a week. The food insecurity coping strategies reported above are similar to those observed in other studies (Chhetri and Maharjan, 2006; Norhasmah, 2010; Kuwornu *et al.* 2012). For example, Chhetri and Maharjan (2006) have reported that during food crisis, affected households adopt strategies such as, finding additional food or income generating activities or migrate to ensure food availability. According to Kuwornu et al., eating less preferred and less expensive food is the immediate strategy normally adopted by households faced with food shortage. However,

as food insecurity gets worse other more severe strategies such as reduction of the quantity of food consumed and skipping meals for the entire day are then used. Apart from the above-mentioned coping strategies, households do also adopt other long-term strategies as shown in Table 5. Based on the results it is worth noting that, working, as a casual labourer is a widely adopted livelihood strategy in the study villages, particularly among resource poor households.

Table 5: Farm household food insecurity coping strategies (n=137)

Characteristic	Categories	Frequency	Percent
Short term coping strategies	Rely on less preferred foods	104	75.9
	Borrow food from friend/relative	66	48.2
	Purchase food on credit	57	41.6
	Consume seed stock for next season	29	21.2
	Limit portion size at mealtimes	59	43.1
	Reduce number of meals eaten	86	62.8
	Skip entire day without eating	6	4.4
Long term coping strategies	Petty trade	39	28.5
	Casual work	39	28.5
	Sell of livestock, charcoal gardening and carpentry	12	13.3

NB: Multiple responses existed hence column tallies may exceed 137 and 100% respectively

Conclusion and recommendations

This paper aimed at providing an understanding of Kahama district's farming households' food security. Specifically, the paper aimed at; examining factors influencing food production and supply among farming households, determining farming households food security status on basis of Dietary Energy Consumed (DEC) per day and at identifying the surveyed households' food insecurity coping strategies. Based on the empirical results it can be concluded that food insecurity exists in the study area in terms of DEC per AEU per day and DEC per capita per day. Generally, most of the surveyed households consumed less than the 2200Kcal and 2100 Kcal respectively in relation to the above. Based on the observations presented the paper concludes that use of inorganic fertilizers and a households annual income were positively and significantly associated with a household's production or supply of grains/food hence, its food security. This therefore shows the importance of a household's adoption of technologies in production of own grains/food crops. The paper also concludes that use of inorganic fertilizers and a household's expenditure on food was positively and significantly associated with a household's food security. This suggests the need for proper investment in crop production as a way of ensuring households' food security.

The paper further concludes that, a household head's education level, household size, eating of less preferred food by households and purchasing food on credit were negatively and significantly associated with a household's food security. The negative association of education and food security is nonetheless contrary to the usual expectation. This may either be due to the majority of respondents being primary school leavers or that the few who had secondary education had not been able to use the same to enhance households' capabilities to adopt better production technologies and acceptance of technical advice from extension workers than those with a lower or no formal education. Lastly, it is concluded that the most popular food insecurity coping strategies in the study areas were reliance on less preferred foods, reduction in number of meals and borrowing food from friends or relatives. However, literature cautions

that these strategies are only helpful for less food self-sufficient households to sustain their lives but not to make them food secure. In addition, eating of less preferred foods has been reported to have a negative repercussion on households' food security.

Based on the study observations and conclusions, extension services in the study need to address issues of low crop productivity. This could be done through farmers field schools (FFS), agricultural resource centres and farmers exchange visits. Moreover, through FFS and farmers exchange, farming households could see the importance of adopting improved technologies, which might in turn improve their productivity and presumably improve their food security. In addition, farming households need to further diversify their livelihood strategies especially into sustainable and environmentally friendly off-farm income generating activities. Therefore, the local government authority and other development partners need to work in partnership with residents of Kahama district and particularly those from Isagehe and Msalala Divisions on the appropriate livelihood diversification strategies to be taken. In lie of this there is need for capacity building trough training household members in entrepreneurship skills but also on how to access and manage credit for the income generating activities to be undertaken. Doing the above will enable households avoid the effects of some of their food insecurity coping strategies such as charcoal burning and doing casual work. Income from the off-farm activities could also be a good source of household income, which could then be invested in improved technologies for higher agricultural productivity.

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Appendix I: Caloric requirements by age and sex for East Africa

Age group	Sex	
	Male	Female
0 – 2	0.40	0.40
3 – 4	0.48	0.48
5 – 6	0.56	0.56
7 – 8	0.64	0.64
9 – 10	0.76	0.76
11 – 12	0.80	0.88
13 – 14	1.00	1.00
15 – 18	1.20	1.00
19 – 59	1.00	0.88
Above 60+	0.88	0.72

Source: Collier *et al.* (1990)

Appendix II: Agricultural technologies used by households for the season 2011/12 (n=137)

Technologies available	Frequency	Percent
Use animal power during cultivation (plough)	110	80.3
e tractor or power tiller	9	6.6
Use improved seeds	91	66.4
Use insecticide or herbicides	33	24.1
Use organic fertilizers	98	71.5
Use inorganic fertilizers	43	31.4

NB: Multiple responses existed hence column tallies may exceed 137 and 100% respectively