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# Determinants of household dietary practices in rural Tanzania: Implications for nutrition interventions

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**Abstract:** A household cross-sectional survey of a sample of 120 households to analyze consumption practices and determinants of household dietary diversity in rural areas of differing agro-climatic conditions in Tanzania was conducted in four villages of Morogoro and Dodoma regions. The respondent was the mother/woman or any other person responsible for food preparation and serving in the household. The inclusion criteria were those women who had given consent to participate, those from a rural area and in the age bracket 15 to 49 years. Data were collected using the Food and Agriculture Organization dietary diversity questionnaire with twelve food groups. Two independent multinomial logistic regression models were used to establish relationships between dietary diversity and categorical variables in Morogoro and Dodoma regions. The mean dietary diversity scores were 4.7 and 4.1 for Morogoro and Dodoma, respectively. The Cereals were highly consumed by all households that participated in the study during the past 24 h preceding the survey and that the consumption of animal based protein foods was below 40%. Determinants of household dietary diversity in Morogoro included literacy status of the mother and prior nutrition training/knowledge. In Dodoma, cultivated land size, literacy status of the mother and distance to a water source determined household

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## PUBLIC INTEREST STATEMENT

Undernutrition and food insecurity are major problems faced by most of the developing countries. In Tanzania, vitamin and mineral deficiencies are high; about 59% and 34% of children below five years are iron and vitamin A deficient respectively. Most people in rural areas are dependent on staple foods with little diversity increasing the risk of insufficient intake of vitamins and minerals. This article explains some of the causes and what determines a household to consume a variety of foods or not, using data collected in two regions of different environmental conditions. It was found that households in the surveyed areas highly consume cereals with very few varieties of other foods. Factors that influence lack of food variety consumption included literacy status of the mother, prior nutrition training/knowledge, cultivated land size and distance to a water source. Governments and organizations should pay attention to these factors when designing nutrition interventions.

dietary diversity. It is therefore recommended that nutrition and food security interventions should not only empower rural women but also pay special attention to differences in agro-ecological environments of the areas in determining interventions to address malnutrition and for effective successful implementation and outcomes.

**Subjects: Environment & Agriculture; Food Science & Technology; Health and Social Care**

**Keywords: household dietary diversity; agro-climatic/ecological; rural; nutrition**

## 1. Introduction

Undernutrition and food insecurity are major problems faced by most of the developing countries. In Tanzania, vitamin and mineral deficiencies are high; about 59% and 34% of children below five years are iron and vitamin A deficient respectively. Most people in rural areas are dependent on staple foods with little diversity increasing the risk of insufficient intake of micronutrients (NBS & ICF Macro, 2011).

The dietary practices of households in various communities have significant repercussions on the quality of life of its members. Dietary practice generally shows the types, variety and quality of food intake and is extremely reliant on the socio demographic characteristics of the population in question. Knowledge on the individual food items consumed by a household, frequency of intake and their nutrient content helps to make general evaluations of the dietary practices of that household. Dietary diversity is one of the most frequently used indicators for purposeful assessment of healthy dietary practices. Dietary diversity refers to a simple count of food groups that a household or an individual has consumed over the preceding time frame usually 24 h. Dietary diversity can be measured at the household or individual levels. At the household level, dietary diversity is generally regarded as a measure of access to food, that is; capability of a household to obtain an adequate quality and quantity of food to meet all household members' nutritional requirements for productive lives; while at the individual level it mirrors dietary quality, generally the micronutrient sufficiency of a diet (Burlingame, 2011).

Food security involves four important aspects of accessibility, availability, utilization and stability in the interaction between people and food which is essential to ensure nutrients play their important role in the health of the human body. Dietary diversity has been positively associated with these four pillars of food security (Hillbruner & Egan, 2008; Steyn, Nel, Nantel, Kennedy, & Labadarios, 2006). Nearly all dietary guidelines propose consuming a large variety of foods, across and within major food groups (Fogli-cawley et al., 2006). This is because it is linked with increased energy and nutrient intake, thus various improved health results including nutrient adequacy and anthropometric indices (Bukania et al., 2014).

Therefore, obtaining information about the household dietary diversity in populations can serve as a simple but useful indicator of assessing household food security (Vakili, Abedi, Sharifi, & Hosseini, 2013b). The dietary diversity of people in a region is determined by a variety of factors including past consumption behavior of the community, traditional habits and extent of technology related with food production, processing, preparation and storage (Keding, Schneider, & Jordan, 2013), season in question (Kinabo, Kamukama, & Bukuku, 2003), agricultural biodiversity in the region and diversity of its farming systems (Herforth, 2010), economic status of the population (Taruvinga, Muchenje, & Mushunje, 2013) and socio-demographic characteristics of households as well as availability and accessibility of services such as water supply and health. Tanzania is an agro-ecologically varied country in East Africa and types and availability of food varies significantly within the country. Some regions experience only one annual rainfall season and hence only one harvest and others have two rainfall seasons and two harvests in a year (Meena, Lugenja, Ntikha, & Hermes, 2008).

This study aimed to examine food consumption patterns and determinants of household dietary diversity in rural households in the semi arid and sub humid environments with the objective of investigating the differences in food patterns, quality of the food eaten and a range of socio-demographic and economic factors that influence the observed dietary practices so as to provide reliable information to work out suitable intervention strategies and suggestions for action aimed at improving consumption patterns and nutritional status of rural populations. The paper hypothesises that there are differences in dietary diversity among households in the two agro-climatic conditions.

### 1.1. Description of study areas

The study was conducted in four villages of the Trans-SEC project from two different agro-climatic conditions in Tanzania; sub humid Morogoro region and the semi arid Dodoma region. Trans-SEC (an acronym) for the Innovating Strategies to safeguard Food Security using Technology and Knowledge Transfer Project is a project that aims to improve the food situation for the most vulnerable rural populations in Tanzania by applying food securing up grading strategies along local and regional food value chains. The two regions Morogoro and Dodoma represent two different food systems and have sufficiently diverse environmental and socio-economic conditions for investigating causative factors for food and nutrition insecurity thus allowing for the transfer of results to other regions in Tanzania. In Morogoro region, Kilosa district was selected and Changarawe and Nyali villages represented the sub humid climate. In Kilosa, the food systems are more varied mainly relying on sorghum, maize, legumes, rice, horticulture and livestock which are all produced locally (Mnenwa & Maliti, 2010). Kilosa is a bimodal area, with short (October–February) and long (March–May) rains with an average of 600–800 mm per annum. The long rains form the main production season while production during the short rain season is used to increase food availability and supply over the year. The Morogoro region contains areas with diverse levels of food security, mainly because it receives much more precipitation. The Kilosa district imports food crops from other regions during the deficit months which are sold in local markets. Foods sold in local markets include cereals such as maize and rice and legumes such as cowpeas, beans, pigeon and peas. The local food consumption in Kilosa is shaped by food cultural preferences. The food menu is highly cereal based. Maize and rice are major staples. Legumes are served as relish in the food menu. Vegetables are also consumed; predominantly leafy vegetables such as cowpea leaves and other indigenous vegetables (Mutabazi, 2013).

In Dodoma region, Chamwino district was selected and Ilolo and Ndebwe villages represented the semi-arid climate. Food production in Chamwino is predominantly rain fed. Dodoma region receives one rainfall season with an average of 350–500 mm per annum and is characterised by a prevalence of high food insecurity areas. Crops produced in the area include cereals (sorghum, bulrush millet and maize), roots/tubers (cassava and sweet potatoes), legumes (cowpeas, pigeon peas, bambaranuts, groundnuts, chickpeas, green gram and lablab beans) oil crops (sunflower, sesame, groundnuts), vegetables (pumpkins, cucumber, tomatoes, onions, leafy vegetables, green pepper) and fruits (pawpaw, guavas, mangoes, grapes, lemons and dates). There is also widespread collection of edible wild fruits and vegetables. The food system in Dodoma is mainly cereal based with bulrush millet as the preferred staple. Groundnuts are normally mixed in most of the relishes used together with the main dish. Edible wild products particularly vegetables and fruits are important in the local food menus (Mutabazi, 2013). The Chamwino district imports food crops from other regions during the deficit months. Foods imported include maize, beans and pigeon peas. During the deficit months imported food is sold at a price more than three times its price during the months of plenty. This is because there are no structured local markets in the case study villages but small middlemen traders are the ones dealing with grain and pulse business. With regard to the natural environment, both regions together account for 70–80% of the farming system types found in Tanzania (Graef et al., 2014).

## 2. Methodology

### 2.1. Study population

The population comprised care givers in the sampled households and the respondent was the mother/woman or any other person responsible for food preparation and serving in the household.

## 2.2. Sampling procedure and design

The study was cross sectional. Data was collected from January to April, 2015. A cluster sampling method was used to select four villages in Kilosa and Chamwino districts. The households were randomly selected from village household lists provided by the village offices. These lists contained information of the names of household head and the corresponding sub-village they live in. After sorting the lists alphabetically for each sub-village, 150 households were selected randomly for each village (proportionally regarding the sub-village size) summing up to 600 households in total for Dodoma and Morogoro. From this sample, 30 households were purposively selected to be included in the study making a total of 120 households. The selected households were those with were those with women who had given consent to participate, those from a rural area and in the age bracket 15 to 49 years. This was done to ensure sampling space for other Trans-SEC innovation groups and to avoid interactions among the intervention groups. Household heads and spouses were informed of the purpose, objectives and activities of the study. The household representatives were required to sign the form or apply a thumb print (in ink) to consent to participating in the study. Permission to conduct the study was obtained from the Sokoine University of Agriculture and the District Commissioners Offices of Kilosa and Chamwino.

## 2.3. The conceptual framework

The conceptual framework for this paper is based on the understanding that food and nutrition insecurity and malnutrition are major problems in developing countries. The framework focuses on the hypothesis of causes and consequences of malnutrition (UNICEF, 1998), which informs the repercussion of current dietary patterns and nutrient intake on nutritional status. Nutritional status of household members may be predisposed by in adequate dietary intake. Nevertheless, household dietary diversity apart from the fact that it can be used to assess household food security status, but also it is influenced by other factors such as income, area under cultivation, number of people in the household and food sources, availability and accessibility which may lead to monotonous food consumption. These factors may be further affected by individual factors such as age, gender, education level of household head, ethnicity and smoking to mention a few. The framework reflects on these associations as probable causes influencing dietary diversity and thus household food security.

## 2.4. Data collection

Interviewer administered questionnaire was used to collect information used in this study. Data collected included, demographic and socioeconomic factors such as sex of household head, marital status of household head, level of literacy of mother/caregiver, occupation of the respondent, total number of people living in the household, education level of the respondent, distance to a water source and size of cultivated land. Data on household dietary diversity was collected using a dietary diversity questionnaire developed by FAO. Respondents were visited at their homes during the survey and women/caregivers or people responsible for food preparation and serving responded to the questionnaire. The information collected on dietary consumption allowed to calculate a dietary diversity score (DDS), defined as the number of different food groups consumed by family members over 24 h. Using information collected from the household dietary diversity questionnaire, the DDSs for households were derived using the FAO guidelines for measuring household dietary diversity (FAO, 2008). One point was awarded to each food group consumed over the reference period, and the sums of all points were calculated for the DDS for each individual household. For this study, the twelve food groups, recommended by Food and Agriculture Organization of the United Nations (FAO, 2008), were used to assess household dietary diversity scores (HDDS). "Yes" and "No" categories were used. Yes was given a score of one (1) to each food group if the household consumed at least one food item from a particular food group for the past 24 h prior to the survey. No was given a zero (0) score for a particular food group if the household did not consume any food item from that food group [Table 1]. Finally the scores were counted from each food group and summed up and HDDS were calculated based on the FAO guidelines for measuring household and individual dietary diversity.

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| Table 1. Food groups included | | |
|---|---|---|
| | *Score 1 if any of the food item within a food group was consumed and 0 if the food item was not consumed in the past 24 h and its frequency of consumption* | Score |
| | | 1 = Consumed |
| | Food groups | 0 = Not consumed |
| 1 | Any (Bread, rice, or other foods made from grains, oats, maize, barley, wheat, sorghum, millet or other grains)? (Other locally available grain)? | 1 |
| 2 | Any potatoes, yams, cassava or any other foods made from roots or tubers? | 1 |
| 3 | Any vegetables? | 1 |
| 4 | Any fruits? | 1 |
| 5 | Any beef, pork, lamb goat, rabbit, wild game, chicken, duck or other birds, liver, kidney, heart or other organ meats? | 1 |
| 6 | Any eggs? | 1 |
| 7 | Any fresh or dried fish or shellfish? | 1 |
| 8 | Any food made from beans, peas, lentils or nuts? | 1 |
| 9 | Any cheese, yogurt, milk or other milk product? | 1 |
| 10 | Any foods made with oil, fat or butter? | 1 |
| 11 | Any sugar or honey? | 1 |
| 12 | Any other foods such as condiments, coffee or tea? | 1 |

A DDS of less than 3 food groups was regarded as low household dietary diversity and hence food insecurity. Four to five food groups was regarded as medium dietary diversity and ≥6 food groups was regarded as high dietary diversity hence food secured. Founded on this type of grouping, three uniform equally elite categories were formed. Category (1) low dietary diversity (LDD), category (2) medium dietary diversity (MDD), and category (3) high dietary diversity (HDD) for independent analysis.

### 2.5. Data analysis and statistical methods

Data entry and analysis were done using IBM SPSS Version 21 statistical software program. Data were reported as frequency, percent and mean ± SD. Two independent multinomial logistic regression models were used to analyze the factors influencing household dietary diversity for Dodoma and Morogoro regions. The three formed dietary diversity categories (LDD, MDD and HDD) were considered as the dependent variable. Independent variables were household size, literate status of a mother, and distance to water source, also cultivated land size and prior nutrition knowledge. Cultivated land size was used as a primary indicator of socio-economic status of households. Differences were considered significant when $p < 0.05$. The associations between respondent characteristics and HDDS were determined using beta coefficients. Before the analysis, key econometric assumptions were considered and tested as necessary.

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## 3. Results

### 3.1. Socio-demographic characteristics

Ninety-two percent of household heads were males and married (80%). Household size of 61% of the households was between three to five people. The level of illiteracy was higher in Dodoma (43%) compared to Morogoro (24%), also Dodoma had higher number of caregivers who had no formal education (38%) compared to Morogoro (24%), the differences between the two regions were not

| Table 2. Demographic characteristics of households (*n* = 120) | | | |
|---|---|---|---|
| | **Dodoma (*n* = 61)** | **Morogoro (*n* = 59)** | **Total** |
| **Characteristics** | **(%)** | **(%)** | **(%)** |
| *Sex of household head* | | | |
| Male | 86.9 | 96.6 | 91.7 |
| Female | 13.1 | 3.4 | 8.3 |
| *Marital status of household head* | | | |
| Married-monogamous | 73.8 | 88.1 | 79.5 |
| Married-polygamous | 9.8 | 3.4 | 6.6 |
| Widowed | 6.6 | 1.7 | 4.1 |
| Divorced | 3.3 | 1.7 | 2.5 |
| Single | 1.6 | 1.7 | 1.6 |
| Cohabitation | 4.9 | 3.4 | 5.7 |
| *Level of literacy of caregiver/mother* | | | |
| Not able to read or write | 42.6 | 23.7 | 34.4 |
| Can read and write to some extent | 14.8 | 20.3 | 17.2 |
| Can read and write | 42.6 | 55.9 | 48.4 |
| *Occupation of respondent* | | | |
| Farmer | 95.1 | 100 | 95.9 |
| Self employed | 1.6 | 0 | 2.5 |
| Other | 3.3 | 0 | 1.6 |
| *Total number of people living in the household* | | | |
| 3–5 | 59.5 | 62.7 | 61.4 |
| 6–8 | 27.8 | 28.8 | 28.7 |
| 9–12 | 12.7 | 8.5 | 9.9 |
| *Education level of respondent* | | | |
| No education | 37.7 | 23.8 | 29.1 |
| Primary education | 60.7 | 69.5 | 66.8 |
| Secondary education | 1.6 | 6.8 | 4.1 |
| *Distance to water source* | | | |
| ≤30 min walk | 24.3 | 52 | 35.8 |
| 30–60 min walk | 36 | 38 | 15 |
| ≥60 min walk | 39.7 | 10 | 32.5 |
| *Cultivated land size* | | | |
| ≤2 acres | 66 | 67 | 66 |
| ≥2.1 acres | 34 | 33 | 34 |
| *Prior nutrition training* | | | |
| Yes | 11.5 | 11.5 | 10.8 |
| No | 79.5 | 88.5 | 89.2 |

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| Table 3. Consumption of various food groups among villages | | | | |
|---|---|---|---|---|
| **Food groups** | **Morogoro** | | **Dodoma** | |
| | **Changarawe (*n* = 30)** | **Nyali (*n* = 29)** | **Ilolo (*n* = 30)** | **Ndebwe (*n* = 31)** |
| | **(%)** | **(%)** | **(%)** | **(%)** |
| Cereals | 100 | 100 | 100 | 100 |
| Vegetables, Vitamin A rich & other vegetables and tubers | 57 | 72 | 73 | 65 |
| White tubers and roots | 13 | 10 | 10 | 16 |
| Vitamin A rich fruits & other fruits | 7 | 7 | 10 | 3 |
| Flesh & organ meat (iron-rich) | 37 | 38 | 20 | 19 |
| Eggs | 13 | 14 | 7 | 29 |
| Fish | 30 | 17 | 13 | 0 |
| Legumes, nuts and seeds | 47 | 79 | 50 | 65 |
| Milk and milk products | 10 | 14 | 7 | 13 |
| Oils and fats | 87 | 93 | 67 | 61 |
| Sweets | 93 | 86 | 87 | 88 |
| Spices, condiments, beverages | 97 | 100 | 33 | 77 |

statistically significant. About 66% of households cultivated land of 2 hectares or less. Other demographics of the households and respondents are indicated in Table 2.

### 3.2. Food consumption patterns
All households consumed cereals in the immediate 24 h preceding the survey. Consumption of vegetables ranged from 57 to 73% across all the villages. Households from villages in Morogoro seem to consume more oils and fats (87 and 93% for Changarawe and Nyali respectively) compared to villages in Dodoma region (61 and 67% for Ilolo and Ndebwe respectively) (Table 2).

Animal source foods such as meat and milk were consumed by fewer households. As shown in Table 3, only 20 and 38% of households in Dodoma and Morogoro consume flesh and organ meat respectively. Milk and milk products was consumed by not more than 14% in all the villages.

### 3.3. DDS
The results of this study show that villages in Dodoma region had more households with dietary diversity of less than 3 food groups; that is 27 and 19% for Ilolo and Ndebwe respectively, compared to villages in Morogoro region which is 16 and 17% for Changarawe and Nyali respectively (Table 4). However, these differences were not statistically significant.

### 3.4. Mean DDS in the four villages
Of the four villages Changarawe had the highest mean HDDS (4.73 ± 1.363), followed by Nyali village (4.59 ± 1.211), then Ndebwe (4.1 ± 1.237) and finally Ilolo had the lowest mean score (4.07 ± 1.015), (Table 5). HDDS in Morogoro region was significantly higher than in Dodoma region ($p < 0.05$).

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| Table 4. Prevalence of household diversity scores in the four villages | | | | |
|---|---|---|---|---|
| Dietary diversity scores | Morogoro | | Dodoma | |
| | Changarawe (%) | Nyali (%) | Ilolo (%) | Ndebwe (%) |
| 2 | 6 | 0 | 4 | 3 |
| 3 | 10 | 17 | 23 | 16 |
| 4 | 23 | 38 | 37 | 39 |
| 5 | 33 | 31 | 33 | 29 |
| 6 | 20 | 10 | 3 | 13 |
| 7 | 8 | 0 | 0 | 0 |
| 8 | 0 | 4 | 0 | 0 |

| Table 5. Mean DDS in the four villages | | | | |
|---|---|---|---|---|
| Sample size | Morogoro | | Dodoma | |
| | Changarawe n = 30 | Nyali n = 29 | Ilolo n = 30 | Ndebwe n = 31 |
| Mean DDS | 4.73 ± 1.363 | 4.59 ± 1.211 | 4.07 ± 1.015 | 4.1 ± 1.237 |

### 3.5. Dietary diversity strata

Cut-off points for measuring dietary diversity were defined by creating strata (Ruel, 2003). Relying on 12 food groups, strata of DDS were made to establish the fraction of participating households as high, medium and low DDS. Figure 1 indicates that the majority of the households fell into the medium DDS. Comparing households in Morogoro and Dodoma, 27% of households in Morogoro were in the HDD stratum compared to only 8% of households in Dodoma (Table 6).

### 3.6. Determinants of dietary diversity

Regression framework was used to investigate the determinants of dietary diversity among the sampled households. Both models indicated pseudo $R^2$ of 0.773 and 0.731 for Morogoro and Dodoma respectively. For Morogoro, the analysis indicates that literacy status of the mother and prior nutrition training influence dietary diversity while in Dodoma cultivated land size, literacy status of the mother and distance to a water source determine household dietary diversity (Table 7).

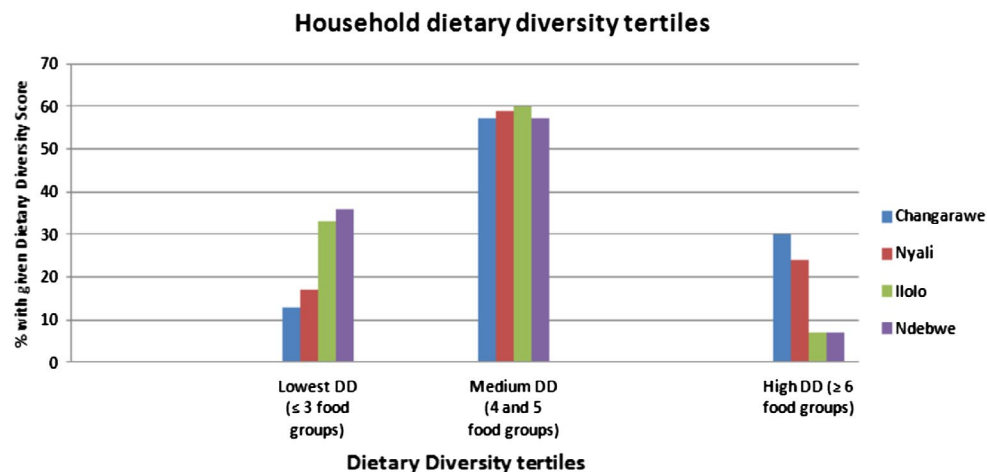**Figure 1. Dietary diversity strata.**

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### Table 6. Grouping of households according to dietary diversity

|  | Low dietary diversity | Medium dietary diversity | High dietary diversity |
|---|---|---|---|
| Dietary diversity score | 0–3 | 4–5 | 6–12 |
| Morogoro (%) | 20 | 53 | 27 |
| Dodoma (%) | 35 | 57 | 8 |

## 4. Discussion

The purpose of this study was to inform on the household consumption patterns and factors determining DDS at household level in rural areas in Tanzania. One hundred and twenty households from semi arid rural Dodoma region and sub humid rural Morogoro region participated in the study. The selection of the study villages may allow transfer of results to other regions in Tanzania because they represent the majority of farming systems in Tanzania. This study assessed dietary diversity based on a simple count of food groups that households consumed over a period of 24 h. The results indicated a minimum of 2 and maximum of 8 HDDS. The mean HDDS for the whole population under study was 4.36.

Cereals (maize, millet, sorghum, rice, wheat or any other foods made from these; for example stiff porridge) were the most commonly consumed food group in both Morogoro and Dodoma regions. Oils and fats, sweets (particularly sugar) and spices (specifically salt and pepper) and beverages (specifically tea and local alcoholic beverages) were also highly consumed. The very high consumption of cereals may suggest that diets in these villages are predominantly based on starchy foods. Consequences of consuming such a diet are that it is bulky, has a low concentration of macro and micronutrients nutrients and a low bioavailability of minerals. The outcome of this is usually impaired growth, development, and body's resistance to infections. Moreover, complementing such a diet to children too early may lead to frequent infections, which will further impair nutritional status and consequently, increase the risk of infectious diseases (Michaelsen et al., 2009). Other studies also documented high consumption of cereals compared to other food groups (Ajani, 2010; Vakili, Abedi, Sharifi, & Hosseini, 2013a).

The results indicated low consumption of animal based protein rich food groups such as meat, eggs and milk. Sweets consumption in terms of sugar was high. A study in Somalia also found very high

### Table 7. Multinomial logistic regression estimates of the effect of the explanatory variables on Dietary diversity in Morogoro and Dodoma

| Independent variables | Morogoro | | | | Dodoma | | | |
|---|---|---|---|---|---|---|---|---|
|  | LDD | | HDD | | LDD | | HDD | |
|  | *p*-value | *B* | *p*-value | *B* | *p*-value | *B* | *p*-value | *B* |
| Intercept | 0.318 | −4.281 | 0.047 | −6,781 | 0.294 | −3.122 | 0.000 | −4.562 |
| Cultivated land size | 0.084 | −1.456 | 0.326 | 3.024 | 0.021* | −2.014 | 0.001* | 4.231 |
| Household size | 0.711 | −0.568 | 0.914 | −0.631 | 0.361 | −0.346 | 0.462 | −0.294 |
| Literacy status of mother | 0.046* | −0.223 | 0.028* | 0.172 | 0.049* | −0.381 | 0.008* | 0.324 |
| Sex of household head | 0.201 | 0.591 | 0.423 | 0.771 | 0.991 | 0.673 | 0.472 | 0.822 |
| Prior nutrition training | 0.006* | −0.381 | 0.038* | 0.271 | 0.731 | −0.632 | 0.481 | 0.573 |
| Distance to water source | 0.642 | 1.236 | 0.231 | 2.032 | 0.035* | −0.539 | 0.241 | 1.451 |
| Baseline category | Medium dietary diversity | | | | | | | |
| Number of responses | 29 | | | | 35 | | | |
| Pseudo *R*$^2$ | 0.773 | | | | 0.731 | | | |

*Significant at *p* < 0.05, unmarked = not significant.

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sugar consumption because the Somalis usually add sugar in each meal (FAO, 2004). In this study this can be accounted by the frequency (one or two times per day) of tea and porridge consumption which usually contain sugar. It was evident that the consumption of sweets and spices was very high except in Ilolo village. Also oils and fats were more often consumed in Morogoro than Dodoma region. Oils and fats were added to relishes, green leafy and other vegetables. Results further revealed that very few households consumed fruits and vegetables. The given reason for this was that fruits and vegetables are seasonal; so during lean seasons these must be purchased, a practice which the majority of households cannot afford financially. This may imply that the population studied may be at risk of getting several chronic diseases because evidence indicates that inadequate intake of fruits and vegetables is among the risk factors to non communicable diseases (WHO, 2002). The Food and Agriculture Organization (FAO) categorises consumption of less than 3 food groups as poor dietary diversity, 4–5 food groups as MMD and greater or equal to 6 food groups as HDD. The lowest DDS observed in the households of this study was 2, while mean DDS ranged from 4 to 4.7 in all the villages. The food items that were mostly included in the group of HDDS 3 were stiff porridge made from maize or bulrush millet and either beans or indigenous leafy vegetables and spices in form of salt. Food items in the medium HDDS group mostly included stiff porridge, beans/indigenous vegetables, tea, spices in form of salt and oils. The high HDDS group included foods such as meat and fruits in addition to the ones mentioned in the medium HDDS. A study in Rwanda reported lower DDS than 4 (Sirotin et al., 2012). However, it is tricky to compare countries based on DDS due to the various approaches used to explain and categorize this indicator (Kennedy, Fanou, Seghieri, & Brouwer, 2009). In this study the LDD observed in Dodoma compared to Morogoro could be attributed to drier climate in Dodoma than Morogoro which may result in less income and food opportunities in the agricultural sector. An additional cause could be the lower availability of modern vegetables in Dodoma that are cultivated elsewhere especially in dry seasons, further more, limited domestication of indigenous vegetables which could be produced during the dry season and are suited to the climate. There was a significant difference in DDS between Morogoro and Dodoma households ($p < 0.05$). Morogoro households had a significantly higher DDS than Dodoma households. This may be due to the environmental and agricultural capability as defined by the agro ecological zones differences.

Determinants of household dietary diversity were approximated by two independent models of multinomial logistic regression for Morogoro and Dodoma. The model fit of both models indicated that a high percentage of variation was explained by the model as indicated in Table 6 by pseudo R2 of 0.773 and 0.731 for Morogoro and Dodoma respectively. It is shown that high literacy status of the mother/caregiver was positively associated with HDD and low literacy status was negatively associated with LDD. This suggests that compared to the base group, if the mother/caregiver is able to read and write, the household is more likely to achieve HDD than a LDD and vice versa. This may be because illiteracy is a crucial component of the ability of a household to make earnings for accessing food of various micronutrient components. Moreover, literate women are more likely to have information from different media and be aware of educational messages especially those displayed in print media compared to illiterate women. Other studies in Africa also reported illiteracy being associated with LDD (Amare et al., 2012; Sirotin et al., 2012).

In Morogoro region, it was indicated that lack of prior nutrition training increased the risk for a low household DDS. This may be because nutrition training mirrors the role of education in combating malnutrition. It makes people aware of dietary needs thus the need to practice what they have learned. Similar results were reported by other studies which found out that prior awareness in nutrition was issues was associated with dietary diversity of households (Nyangweso et al., 2007). In Dodoma region, results indicate that small cultivated land size was negatively associated with LDD and large cultivated land size was positively associated with HDD. This suggests that compared to the base category, a household that cultivated a small land area is more likely to achieve LDD compared to a household that cultivates a larger land area. The influential association between cultivated land size and dietary diversity may be due to the fact that households that cultivate larger land areas produce enough food to feed their household members and also produce surplus to sell and increase their household income to buy other foods thus increase dietary diversity.

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Correspondingly, another study reported increased risk of malnutrition in participants that had smaller farm lands compared to those with larger ones (Haileslassie, Mulugeta, & Girma, 2013). Cultivated land size has also been reported to ultimately increase crop yields because larger farms increase crop diversity and enable households to cultivate some cash crops (for income) which in turn may increase variety food consumed at household level (Shah & Tubiello, 2005). Another factor that was associated with dietary diversity in Dodoma is the walking distance (in minutes) to a water source which was negatively associated with LDD. The findings of this study suggest that households that are in a walking distance of more than sixty minutes to the source of water are more likely to have lower dietary diversity than households that are within thirty minutes walking distance to the source of water. A study of (Abubakar, Uriyo, Msuya, & Swai, 2012), in the Kilimanjaro region of Tanzania showed that water shortage increases the risk for malnutrition in children. This is probably caused by several factors including own production of vegetables is hindered due to the lack of water, longer hours to fetch water for household consumption reduces the quality of care and feeding frequency due to lack of time for care and food preparation as most time is spent in fetching water for household and other uses.

## 5. Conclusion

This study examined the food consumption practices and factors influencing household dietary diversity in rural Morogoro and Dodoma; regions in Tanzania with differing agro-climatic conditions. The paper suggests that rural consumption practices in the studied villages are highly on based on starchy staples, high consumption of sugars, oils and fats with very minimum consumption of fruits and animal based protein foods. With regards to dietary diversity, the average number of food groups consumed was 4.7 and 4. 1 for Morogoro and Dodoma respectively, indicating a MMD. There were no significant differences found in DDS between the two agro-ecological zones. This contradicts the common pattern of low food availability in drier zones which may be due to better coping strategies among households in semi arid zones. However, the factors influencing dietary diversity in the two zones were slightly different. This paper informs that important determinants of dietary diversity in Morogoro are literacy status of the mother and prior nutrition training while in Dodoma; important determinants are cultivated land size, literacy status of the mother and the walking distance to a water source.

## 6. Policy inferences

This paper draws attention to the literacy status of the mother, nutrition training, cultivated land size and the distance to a water source as important factors in improving dietary diversity of rural households of semi arid and sub humid environments. Nutrition interventions should focus on lessening malnutrition, food insecurity and improving dietary practices separately in different agro-ecological environments with more inclusive approaches. Hence, the following policy inferences are suggested for successful implementation:

- Nutrition interventions should not be too general and should take conditions specific to agro-climatic environments in consideration.
- Providing public and household based nutrition training to women in rural areas while taking into account agro-climatic conditions of the localities.
- Land reform plans that encourage land re-allocation could be supported in order to help households who do not own enough land for cultivation.
- Improve access to portable water: provision of common bore-wells that can cater drinking and household consumption water needs of residents in areas where there is a need of walking of 60 min or more to fetch water.
- General programs to increase literacy among rural women.
- Further research to document determinants of stunting, wasting and underweight across all agro-ecological zones.

## Competing Interests
The authors declare no competing interest.

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