Socio-economic and Demographic Determinants of Food Security in Chamwino District, Tanzania

Emiliana A. Assenga[1] and Kim A. Kayunze[2]

[1] Department of Development Studies, The University of Dodoma (UDOM), P. O. Box 259, Dodoma, Tanzania Email: emmyassenga2006@gmail.com

[2] Department of Development Studies, Sokoine University of Agriculture (SUA), P. O. Box 3024, Morogoro, Tanzania, Email: kimkayunze@yahoo.com

Abstract

The general causes of food insecurity in Tanzania include use of a low level of technology, dependency on rainfall and lack of proper inputs. While these factors are fairly well known, the socio-economic and demographic determinants of food security status in Chamwino District are not known empirically. In this paper: (1) socio-economic and demographic characteristics of surveyed households are analysed and (2) the impact of socio-economic and demographic characteristics on food security is determined. A cross-sectional research design was used to collect data from 400 households which were randomly selected. Based on multiple linear regression, four socio-economic and demographic variables (household size, land size cultivated, total annual household income per adult equivalent and age of household head) significantly ($p \leq 0.05$) positively influenced food security. It is concluded that socio-economic and demographic factors greatly affect food security in the study area and that addressing these factors could improve food security. It is recommended that public and private institutions should be more involved in addressing the food insecurity problem in Chamwino District by focusing on the demographic and socio-economic factors which reduce food security.

Keywords: Demographic and socio-economic factors, food security, determinants of food security

1.0 Introduction

Food security is a concept that has developed considerably over years. Food security occurs when people can get enough food to eat that is safe, that they like to eat, and that helps them to be healthy (Seivwright et al., 2020). The converse of food security is food insecurity. Food insecurity is an inability to access food of sufficient quantity and quality to satisfy minimum dietary needs (Park et al., 2012, cited in Hashmi et al., 2019). Hashmi et al. (2019) indicate that food insecurity has been increasing throughout the world;

hunger and malnutrition remain a serious problem, especially in developing countries. Global data suggested that 690 million people around the world were considered food insecure in 2019 (FAO et al., 2020). Of these, 9.1% were inhabitants of Africa; 22% were inhabitants of sub-Saharan Africa while 27.2% were inhabitants of East Africa.

Data on food insecurity from Tanzania indicate that Chamwino District has chronic food insecurity. Chronic food insecurity leads to chronic malnutrition which is reflected by stunting in children of under the age of five years. Stunting reflects a failure to receive adequate nutrition over a long time. Mbwana et al. (2017) reported that 41% of children under the age of five years were stunted in Chamwino District, Tanzania in 2017.

According to Khanam (2020), food insecurity mostly affects people living below the poverty line, especially due to economic factors, such as rising food prices and unemployment. Poor people mostly depend on markets for their food and spend about 70% of their income purchasing food from markets. Tanzania, like most other sub-Saharan African countries, is faced by a challenge for maintaining sustainable food security to all the people at all times. General causes of food insecurity in Tanzania, which are also the same in most other developing countries, are lack of proper inputs, low level of managerial skills and technologies and lack of resources (Oni et al., 2013), dependency on rainfall, poor livestock and animal husbandry, poor processing of crop and livestock products, weak agricultural extension services, poor markets for agricultural and livestock products (Kayunze et al., 2007) and environmental degradation (Smith et al., 2000).

Besides environmental degradation that can alter the food security status of households and usually makes them vulnerable to food insecurity, socio-economic and demographic characteristics of households can also influence food security status of households (John et al., 2013; Bulawayo and Sichone, 2019). John et al. (2013) argue that since human beings have less control over natural occurrences, focusing on socio-economic and demographic characteristics of households will provide a better alternative in addressing food security challenges. Moreover, socio-economic and demographic

factors are crucial for assessing changes in household food security (Ndobo and Sekhampu, 2013).

The effects of socio-economic and demographic variables of households are also considered in food security studies to understand the factors that determine the food security status of households (Ndobo and Sekhampu, 2013). Food security studies are also conducted with an attempt to see how socio-economic and demographic variables affect chances of households being food secure (Ndobo and Sekhampu, 2013). Therefore, for this paper, socio-economic and demographic determinants of food security status in Chamwino District were analyzed. The specific objectives of the paper were to: (1) analyse socio-economic and demographic characteristics of surveyed households and (2) determine the impacts of socio-economic and demographic characteristics on food security. The empirical knowledge generated from the study on which this paper is based can be used as a reference source when setting programmes geared towards improving food security in Chamwino District.

2.0 Theoretical Review

The paper is guided by the Entitlement to food theory by Sen (1981) which focuses on possession of wealth materials which can be exchanged for food or can be used to get food through other means. The entitlement approach is based on three conceptual categories, namely endowment set, entitlement set and entitlement mapping (also called E-mapping). Endowment set is defined as the combination of all those resources that are legally owned by a person conforming to established norms and practices. The said resources include both tangible assets, such as land, equipment, money, animals and intangibles such as knowledge and skills, labour-power, or membership of a particular community.

Entitlement set is defined as the set of all possible combinations of goods and services (not just the one actually being enjoyed) that a person can legally obtain by using the resources of his endowment set. Resources may be used in many different ways to obtain the final goods and services. For example, a farmer may use his land, labour, and other resources to produce the food he wants; a labourer may exchange his labour-power to secure his food; a

fisherman may first use his labour, equipment and fishing boat to catch fish and then exchange it to get the rice he wants; an unemployed person may use his resource of 'citizenship of a welfare state' to claim a transfer of state funds in the form of unemployment benefit. These acts of production, exchange, and transfer are all different ways of using one's resources (Osman, 1993). Entitlement mapping (E-mapping) is simply the relationship between endowment set and entitlement set. It is the rate at which the resources of the endowment set can be converted into goods and services included in the entitlement set (Nayak, 2005). Kerr (2005) argues that much of the literature on food security assumes that if income is increased the overall food security of households will increase since any income produced will be shared within the household.

3.0 METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Chamwino District in 2015. The district was selected since it has a history of chronic food insecurity. Chronic food insecurity leads to chronic malnutrition which is reflected by stunting in children of under five. Stunting reflects a failure to receive adequate nutrition over a long period of time (URT, 2010). In 2007, in Chamwino District, 34.9% of children under five had the low height for age (stunting); 1.1% had low weight for height (wasting) and 21.9% had low weight-for-age (underweight) which reflect both chronic and acute malnutrition (PMO - RALG, 2007).

The problem of malnutrition in Chamwino District is also reported by Mbwana et al. (2017) who found that 41% of children under the age of five were stunted in the district in 2017. This level of stunting in the district is higher than that reported at the national and Dodoma Region levels in 2015 which were 34% and 37% respectively. Chamwino District is among the districts of Dodoma Region. This region has recurrent higher levels of stunting in Tanzania. According to URT (2010), Dodoma Region was among the four regions of Tanzania which had stunting levels that exceeded 50%. These were Dodoma (56%), Lindi (54%), Iringa (52%) and Rukwa (50%). According to URT (2010), nationally, 42% of children under the age of five were stunted in Tanzania. According to URT (2015), Dodoma Region was

among 9 regions considered to have "very high" chronic malnutrition (stunting) exceeding a 40% threshold. These regions included Iringa, Njombe, Kagera, Dodoma, Ruvuma, Rukwa, Kigoma, Katavi and Geita. The district had chronic food insecurity for the previous five years (2009-14) (DAICO, Chamwino District, personal communication, 2014). In 2012, the district was among food-insecure districts in Tanzania (URT, 2012). The need for food aid from the government to the district increased during the years 2009 to 2014. Generally, food aid in tonnes for the above period was 93.8 (2009/10), 25 (2010/11), 53.8 (2011/12), 69 (2012/13) and 10 (2013/14) (DAICO of Chamwino District, personal communication, 2014).

3.2 Research Design, Sampling Procedures and Sample Size

A cross-sectional research design was used to collect data used for this paper. Based on the nature of the study that was about vulnerability to food insecurity, and the absence of longitudinal data; the above design was best suited (Chaudhuri et al., 2002). Moreover, literature (for example, Babbie, 1990; Bailey, 1998) shows that cross-sectional design can provide information that is useful for descriptive purposes as well as for determination of relationships between and among variables. Further, a cross-sectional research design is cost-effective and allows the inclusion of participants or groups of people from whom a comparison can be made (Matthew and Ross, 2010).

The sampling unit for this study was a household since food scarcity is ultimately experienced at the household level (Maxwell, 1996). A household is as a person or a group of persons, related or unrelated, who live together and share a common source of food (URT, 2010). Chamwino District was selected purposively because the district had a higher stunting level for children of under-five age compared to the national and regional levels in 2017. In 2010, Dodoma Region was among the four regions of Tanzania with higher stunting levels for under-five age (URT, 2010). Three wards were purposively selected due to their history of receiving food aid from the government (DAICO of Chamwino District, personal communication, 2014) while six villages were selected purposively. These were Fufu Ward (Fufu and Suli Villages) and Idifu Ward (Idifu and Miganga Villages) where

chronic food insecurity was relatively high and Membe Ward (Membe and Mlimwa Villages) where chronic food insecurity was relatively low.

The respondents were selected randomly from the sampling frame which was established from the village register by listing all households headed by male and female heads with children aged 7 to 17 years old. Children aged 7 to 17 years were included since the study intended to capture the role of children in household food security. According to Kayunze (2000), children start doing significant work at the age of seven years. Children participate in farm and non–farm activities after school hours.

The sample size was 400 households which were selected from six villages. The formula for sample size determination by Cochran (1977), cited by Bartlett et al. (2001) was used to determine the sample size. The sample size is justified on the fact that "too large a sample implies a waste of resources, and too small a sample diminishes the utility of the results" (Cochran, 1977), cited by Bartlett et al. (2001). Therefore, the following formula was used to determine the reasonable sample size:

n = sample size;

n = $\frac{Z^2 * p\,(1 - p)}{d^2}$ (Cochran, 1977, cited by Bartlett *et al.* (2001), where:

Z = a value on the abscissa of a standard normal distribution (from an assumption that the sample elements are normally distributed), which is 1.96 or approximately 2.0 and corresponds to a 95% confidence interval;

p = estimated variance in the population from which the sample is drawn, which is normally 0.5 for a population whose size is not known;

d = acceptable margin of error (or precision), whereby the general rule is that in social research d should be 5% for categorical data and 3% for continuous data (Krejcie and Morgan, 1970), cited by Bartlett *et al*. (2001). In the research on which this paper is based, 5% was used since substantial categorical data were collected.

Using a Z-value of 2.0, a p-value of 0.5, a q-value of 0.5, and a d-value of 0.5% (which is equivalent to 0.05), the sample size (n) were determined to be 400.

$$n = \frac{2^2 * 0.5\,(1 - 0.5)}{0.05^2} = (4 \times 0.25)/0.0025 = 1/0.0025 = 400.$$

In addition, 14 key informants were purposively selected based on their positions and are considered to have much knowledge and experience about food security in the research villages.

3.3 Data Collection

Primary data were collected using a questionnaire which was administered to household heads. Key informant interviews were held with people who were considered to have in-depth understanding and knowledge on food security in the district. Key informants included one District Agricultural, Irrigation and Cooperatives Officer (DAICO), six Village and Ward Extension Officers; three village government leaders and three Ward Executive Officers (WEO). Twelve focus group discussions were conducted in the 6 villages where the research was done (2 FGDs per village) with 8 to 10 participants in each FGD. The FGD participants were a mixture of old and young farmers, youth and women, and villagers doing various activities. In the study, secondary information was collected through reviewing the literature on the state of food insecurity in Tanzania and in reports on the trend of food aid from Chamwino District Office.

3.4 Data Processing and Analysis

Qualitative and quantitative methods were employed to analyze the data that were collected. Qualitative data were analyzed by being summarized by their themes and comparing and contrasting arguments given by different interviewees. Quantitative data were analysed using IBM SPSS Statistics Version 20 Software and Microsoft Excel software to compute descriptive statistics, frequencies, percentages, statistical means, and standard deviations of individual variables. Multiple linear regression was used to determine the effects of socio-economic and demographic factors on food security. The dependent variable, food security, was measured in terms of dietary energy consumed (DEC) per adult equivalent per day. Dietary energy consumed per adult equivalent per day based on household-level data take into account the composition of the household and different caloric needs to be based on age and sex of household members, unlike DEC per

capita per day, dietary diversity and household food insecurity access scale (HFIAS) (Carlo et al., 2010) which are other methods of determining food security. Variables were checked for normality before multiple linear regression was run since it assumes that variables have normal distributions (Jason and Waters, 2002).

Normality was checked by computing distribution curves of all variables recorded at the ratio level which were to be included in the multiple linear regression model and observing them visually to find whether any of them was skewed. All variables which were found to be skewed (Age of household head, education of household head, total annual household income per adult equivalent, land size cultivated and hours spent by children in the family farm) were transformed into normal distributions using $\log_{10}$ transformation. Variables which were found to have normal distributions (household size, kCal consumed per adult equivalent per day and hours spent by parents on the family farm) were not transformed. Multicollinearity was checked by computing tolerances and variance inflation factors (VIF). According to Landau and Everitt (2004), tolerance values of more than 0.1 and VIF values of not more than 10 show that there is no multicollinearity. None of the tolerances or VIF values was less than 0.1 or greater than 10 respectively. Hence, there was no multicollinearity. The multiple linear regression model used to determine the impact of socio-economic and demographic factors on food security in terms of dietary energy consumed per adult equivalent per day was as follows:

$$Y = a + b_{1}x_{1} + b_{2}x_{2} + b_{3}x_{3} \ldots\ldots + b_{12}x_{12} + e$$

Where:

Y = Dietary Energy Consumed per adult equivalent per day (continuous variable)

a = Constant or intercept of the equation

b_1... b_{12} = Regression coefficients,

e = Error term representing the proportion of the variance in the dependent variable that was unexplained by the regression equation.

x_1 = Total annual household income per adult equivalent, x_2 = Land size cultivated (measured in hectares), x_3 = Age of household head (measured in years), x_4 = Household size (number of members), x_5 =

Sex of household head (1 = Male, 0 = Female), x_6 = Non-farm Income Generating Activities (IGAs) (1 = Yes, 0 = No), x_7 = Education of household head (years of schooling), x_8 = Occupation of household head (1 = non-farm, 0 = crop production), x_9 = Marital status of household head (1 = married, 0 = unmarried), x_{10} = Hours spent by parents on the family farm, x_{11} = Hours spent by children on the family farm, and x_{12} = dependency ratio.

3.5 Total Annual Household Income per Adult Equivalent (AE) Calculation

Net monetary values of all products produced and services provided by all household members over the previous 12 months were added up from the following household sources of income: products and services, salaries and wages, rentals, remittances and receipts in kind (Deaton, 1997). These were the households' sources of income which were used in this study. The amount of money obtained from those sources was divided by adjusted adult equivalent (AE) units of relevant households. According to Deaton (1997), to get better estimates of income, detailed data must be collected on all transactions, purchases of inputs, sales of output, and assets transactions, and this should be done for the whole range of economic activities for wage earners as well as the self-employed (Deaton, 1997).

$$PerAEincomeperperson = \frac{Total\ income\ during\ year\ in\ household}{Adult\ equivalent\ unit\ at\ home}$$ (Rahim *et al.*, 2011)

3.6 Adult Equivalent Units Computation

Cognisant of the fact that if variables like income and dietary energy consumed (DEC) are expressed per capita they do not reflect good comparative figures in households with different sizes and composition by age and sex, DEC was expressed per adult equivalent following the procedure used by Collier et al. (1990). In order to calculate adult equivalent units, the sex and age of every household member were recorded. A two-step procedure was followed whereby in the first step adult equivalent scales for East Africa by age and sex were added up for all household members to get all the household members in terms of adult equivalents. The equivalent scales are presented in Table 1. The second step involved adjusting the above

adult equivalents for economies of scale due to the fact that larger households need fewer resources per person due to sharing some facilities. The economies of scale are taken into account by multiplying the adult equivalent units by the average cost (Table 2) corresponding to the number of people in the household. The adjusted adult equivalent units were used as denominators for calculating values per adult equivalent in particular households.

Table 1: Adult equivalent scales 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: Latham (1965) and Deaton (1980) cited by Collier et al. (1990)

Table 2: Household economies of scale

Household size	Marginal cost	Average costs
1	1.00	1.000
2	0.89	0.946
3	0.798	0.897
4	0.713	0.851
5	0.632	0.807
6	0.632	0.778
7	0.632	0.757
8	0.632	0.741
9	0.632	0.729
Above 10+	0.632	0.719

Source: Latham (1965) and Deaton (1980) cited by Collier et al. (1990)

3.7 Dietary Energy Consumed Computation

In order to determine food security based on dietary energy consumed per adult equivalent, all food items consumed by all household members were used. Based on data collected using a household questionnaire, quantities of all food items consumed for 30 days were recorded. Quantities of dietary energy consumed in all the food items were computed based on Tanzania Food Composition Tables by Lukmanji et al. (2008). Dietary energy consumed was adjusted for the number of individuals in the household based on sex and age. Table 1 gives the adult equivalent scales that translate children into adult equivalents and also compare women and men. Moreover, household size is represented by the number of adult equivalents rather than simply the number of individuals. The basis for such translation has mostly been the nutritional requirements of individuals by age and sex. Based on these adjustments, the quantities of DEC by all household members were expressed per adult equivalent units per day based on all foodstuffs consumed for 30 days.

4.0 Results and Discussion

4.1 Socio-economic and Demographic Characteristics of Surveyed Households

The socio-economic and demographic characteristics of focus were sex categories of household heads, age of household heads, marital status of household heads, years of schooling of household heads, main occupations of household heads, total annual household income per adult equivalent, income-generating activities, land size cultivated, age dependency ratio and household size. The average household size was 5.9 with the minimum and maximum sizes of 2 and 14 respectively. The average household size of 5.9 is higher than the national average household size in Tanzania that is 4.8, according to the 2012 Population and Housing Census (URT, 2013). It is possible that large household size results from extended family and the presence of other unrelated household members recorded at the time of interview. Other socioeconomic and demographic characteristics of the respondents are presented in Table 3.

Table 3: Socioeconomic and demographic characteristics of the respondents (n = 400)

Characteristic	Frequency	Per cent
Level of education of the household head		
No formal	97	24.2
Primary	292	73.0
Secondary	11	2.8
Sex of the household head		
Male	318	79.5
Female	82	20.5
Age of the household head		
19 - 31	26	6.5
31 - 40	138	34.5
41 -50	117	29.2
Above 50	119	29.8
Marital status of the household head		
Single	10	2.5
Married	312	78.0
Separated	44	11.0
Widow	33	8.2
Widower	1	0.2
Occupation of the household head		
Self-employed off farm	6	1. 5
Crop production	394	98.5
Having non-farm income-generating activities		
Yes	158	39.5
No	242	60.5

4.1.1 Age of the household head

In terms of age, the minimum and maximum ages of the household heads were 19 and 91 years respectively, while the average age was 46.1 years. More than two-thirds (70.2%) of the household heads (Table 3) were below the age of 50 years, and the remaining household heads were 50 and more years old. This finding is consistent with NBS (2014) which reported that the

Tanzanian population is characterized as a young population. A few (6.5%) of the heads were in the age range of 19 to 30 years. The low per cent of youth in the sample may be attributed to the tendency of young people to migrate from rural to urban areas.

4.1.2 Sex and marital status of the respondents

Opinions were sought from both male and female household heads over issues related to household food security. This was important because household food security is determined by roles played by both men and women in the household. Table 3 shows a large per cent (79.5%) of men compared to women (20.5%). This implies that most households were male-headed in the study area. This finding is similar to findings by NBS (2014), which reported that one-quarter of all households in Tanzania were headed by women. With regard to marital status, 78% of the household heads were married; the rest had various marital statuses as seen in Table 3. Married people are more likely to be food secure than unmarried ones like widows and widowers. This is mostly because married people in most cases help each other in producing and buying food (Kayunze, 2008).

4.1.3 Years of schooling

The average number of years household heads had gone to school was 5.2. The minimum and maximum years of schooling were zero and 13 respectively. About a quarter (24.2%) of the household heads had not gone to school while about three-quarters (73%) had primary education, and a few (2.8%) had secondary education (Table 3). The overall results emphasize the general picture that rural areas of Tanzania are inhabited by people with low education. This result is in agreement with NBS (2014) which found that, in rural areas, a quarter of adults have never had any formal education.

4.1.4 Main occupations of the respondents

The main occupations of household heads are summarized in Table 3. The findings show that the main occupation of the majority of the household heads (98.5%) was crop production. None of the households had livestock keeping as their main activity, implying that entitlement to food in terms of livestock ownership is poor in the district. During focus group discussions at Suli village, the participants reported that only 3% of the households

owned cattle. Livestock is an important asset that increases access to food by selling the livestock or their products and by-products to get cash to buy various foodstuffs. Since non-farm income-generating activities can help people obtain income to increase food security, the respondents were asked if they were undertaking any non-farm income-generating activities. The results are presented in Table 3 and show that 39.5% were doing non-farm income-generating activities while 60.5% were not. Household heads were also asked to report incomes earned by all household members from various sources in the household per year. The average total annual income was 243,776.50 Tanzanian shillings (TZS); the minimum and maximum amounts were TZS 0.00 and 2,650,000 per household respectively.

4.1.5 Land Owned and Cultivated

The land is a very important resource for agricultural production and other economic activities. In rural areas like Chamwino District where the main economic activity is agricultural production, households owning more land are likely to be more food secure by producing more food on the land or leasing the land to get cash to buy food. This paper focuses on land utilized in terms of cultivated land. This is in line with an argument by Zamaliah et al. (2002) that land ownership *per se* may not be an important predictor of food security, but its utilization may be protective against household food insecurity. The average land cultivated in hectares was 2.55 with the minimum and maximum of 0.00 and 28 hectares respectively. This result is consistent with NBS (2014) which reported that the average land size cultivated in Tanzania was 2.1 hectares.

4.2 Influence of Socioeconomic and Demographic Characteristics on Food Security

The results showed that the mean dietary energy consumed (DEC) was 3573.4 kCal per adult equivalent per day. They also showed that the minimum and maximum DEC were 1530.3 and 6461.0 kCal per adult equivalent per day respectively, with a standard deviation of 862.0 kcal per adult equivalent per day. The results further showed that 84.2% of the households surveyed were food secure as they consumed 2200 kCal and more per adult equivalent per day while 15.8% were food insecure since they consumed less than 2200 kCal per adult equivalent per day. The proportion

of food-insecure households was higher than the national level of food insecurity in Tanzania which was 9.7% in 2011/12 (NBS, 2014). The large per cent of food secure households in Chamwino District was due to the fact that the survey was conducted during an early post-harvest season when households still had food they had harvested. These results are contrary to results by Kingu (2015) who reported that 69.6% and 63.3% of households were food insecure in Singida and Iramba Districts respectively whose climate does not differ much from that of Chamwino District and which are also in Central Tanzania. The differences are partly due to the fact that Kingu (2015) collected data many months after the harvesting season (November 2010) when households had little food.

Multiple linear regression was used to determine the influence of socio-economic and demographic variables on food security (kCal consumed per adult equivalent per day) at the household level. The coefficient of determination, R^2, was 0.228 implying that the predictor variables explained 22.8% of the variation in the variance of the dependent variable. The other percentage was contributed by other variables which were not included in the model (Gujarati, 2004; Field, 2018). For social sciences, such a level of the coefficient of determination is reasonable, unlike in natural sciences where higher levels of R^2 are needed. Using linear regression analysis for determining the influence of socio-economic and demographic factors on dietary energy consumed per adult equivalent per day, only age of the household head, household size, land size cultivated in hectares and total annual household income per adult equivalent were found to be significant determinants of food security (Table 4). The β-values tell us about the relationship between food security and each predictor (Field, 2018). If the value is positive there is a positive relationship between the predictor variable and food security, whereas a negative coefficient represents a negative relationship (Field, 2018).

Table 4: Impacts of socioeconomic and demographic variables on dietary energy consumed per adult equivalent

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1758.753	729.816		2.410	0.017		
Income generating activities (1 = Yes, 0 = No)	184.159	100.155	0.098	1.839	0.067	0.933	1.072
Marital status of household head (1 = Married, 0 = Unmarried)	228.782	184.100	0.104	1.243	0.215	0.382	2.621
Sex of household head (1 = Male, 0 = Female)	-186.245	193.210	-0.082	-0.964	0.336	0.368	2.720
Main occupation of household head (1 = Non-farm, 0 = Crop production)	-502.489	399.864	-0.067	-1.257	0.210	0.947	1.056
The education level of household head (years of schooling)	-1.566	18.292	-0.005	-0.086	0.932	0.720	1.389
Hours spent by children on a family farm	120.027	111.325	0.062	1.078	0.282	0.799	1.251
Total annual household income per adult equivalent	217.745	106.584	0.115*	2.043	0.042	0.834	1.199
Hours spent by parents on a family farm	402.027	284.339	0.090	1.414	0.158	0.661	1.512
Household size	96.544	32.422	0.177***	2.978	0.003	0.750	1.334
Age of household head (years)	-20.819	4.693	-0.275***	-4.436	0.000	0.689	1.451
Land cultivated in hectares	8.797	4.292	0.118*	2.050	0.041	0.799	1.252
Dependency ratio	0.610	0.549	0.062	1.110	0.268	0.860	1.163

Dependent variable: Dietary energy consumed per adult equivalent per day: R = 0.478, R^2 = 0.228, Adjusted R^2 = 0.196, F statistics = 7.17, Durbin-Watson = 1.79, ***significant at 0.1%, ** significant at 1% and *significant at 5%

Age of household head showed negative significant influence (β = -0.275; $p \leq 0.001$) on food security (Table 4). An increase of 1 year of age of the household head with all other predictor variables held constant caused a decrease in dietary energy consumed per adult per day of 0.275 kCal. This result is in conformity with results by Babatunde et al. (2007) and Mannaf and Uddin (2012) who found that households with older heads were more food insecure. This was supported by focus group discussion findings; participants in focus group discussions reported that characteristics of food-insecure households included household heads being older people. This was probably due to the fact that older people could hardly work and lived with their grandchildren who also worked little (Kayunze, 2000).

Household size had positive significant influence (β = 0.117; $p \leq 0.001$) on food security. An increase of 1 member of a household with all other predictor variables held constant caused an increase in dietary energy consumed per adult equivalent per day of 0.117 kCal. This implies that the larger the household size the higher was food security at the household level. This probably implies that households with economically active members who can participate in farm and non- farm activities are more food secure than households with members who are not economically productive. This result is consistent with some previous results elsewhere in Tanzania. For example, Matunga (2008) found that larger households were more food secure compared to smaller households in Chamwino District. Khanam et al. (2020) reported a positive impact of household size on food security in Bangladesh. Kayunze (2000) found a positive impact of household size on a net household product in Mbeya Region. Kamuzora (2001) found less poverty in larger households in Kagera Region. There is a close relationship between poverty and food security (Webb and Rogers, 2003, cited by Lovendal and Knowles, 2005). However, this result is contrary to results of some other similar studies by Babatunde et al. (2007), Kayunze et al. (2007), Shariff and Khor (2008), Mende et al. (2015), Khanam et al. (2020) who found that household size had a negative influence on food security. The influence of household size in this study was positive probably due to the fact that the sample included households headed by men and women, with children aged 7 to 17 years old, who were participating in various activities (i.e. farm and non-farm activities), and the hours spent on these activities were out of

school hours. Therefore, because every household member in the surveyed households was economically productive, this could be the reason for the positive influence of household size on food security.

Land size cultivated showed positive significant influence ($\beta = 0.118$; $p \leq 0.05$) on food security. An increase of 1 hectare of land cultivated with all other predictor variables held constant caused an increase in dietary energy consumed per adult equivalent per day of 0.118 kCal. This implies that food security increased as land size cultivated increased. These results are in agreement with findings by Babatunde et al. (2007), Kayunze et al. (2007) and Khanam et al. (2020) who found that food security increased as land size cultivated increased. Total annual household income per adult equivalent showed positive significant influence ($\beta = 0.115$; $p \leq 0.05$) on food security (Table 4). An increase of TZS 1 with all other predictor variables held constant caused an increase in dietary energy consumed per adult equivalent per day of 0.115kCal. This implies that the higher the household income, the more the household would be food secure. This could be expected because increased income, other things being equal, means increased ability to buy to food. These findings are supported by results by Babatunde et al. (2007), Ndobo and Sekhampu (2013), Hashmi et al. (2019), Bulawayo and Sichone (2019) and Khanam et al. (2020) who found that food security increased as household income increased. The main occupation of the household head showed negative, but insignificant influence ($\beta = -0.067$; $p > 0.05$) on food security. In agreement with the entitlement theory, land and income were significant and positively influencing food security. Holding other predictors constant, households which were doing non-farm activities were found to consume less dietary energy by 0.067 Kcal per adult equivalent per day compared to households which were doing crop production. This is contrary to the prior expectation that households with employed heads or heads who were mainly involved in non-farm income-generating activities would be more food secure than those who were unemployed or not involved in non-farm income-generating activities. The negative sign on the beta coefficient probably was due to the fact that the majority (98.5%) of the household heads were doing crop production as their main activity (Table 4). Employment status of the household head or involvement of household head in non-farm income-generating activities helps to diversify sources of

farm households' livelihoods and reduces the risks of food shortage during periods of unexpected crop failure (Mannaf and Uddin, 2012). Sex of a household head showed negative, but insignificant influence ($\beta = -0.082$; $p > 0.05$) on food security. Holding other predictors constant, female-headed households were found to consume less dietary energy by 0.082 kcal per adult equivalent per day than male-headed households. Years of schooling showed negative, but insignificant influence ($\beta = -0.005$; $p > 0.05$) on food security. An increase of one year of schooling with all other predictor variables held constant caused a decrease in dietary energy consumed by 0.005 kcal per adult equivalent per day. However, this is surprising because it is generally expected that households headed by heads with more years of education are more food secure than those headed by people with fewer years of schooling. It is partly explained by the finding that, in the sample of households surveyed, only 2.8% of the household heads had gone beyond primary school.

Hours spent by children on the family farm showed positive but insignificant influence ($\beta = 0.062$; $p > 0.05$) on food security. An increase of 1 hour spent by children on the family farm with all other predictor variables held constant caused an increase in dietary energy consumed per adult equivalent per day of 0.062 kCal. This implies that, as children increase hours spent on the family farm, food security increases. This finding is supported by Chamwino District Agriculture, Irrigation and Cooperatives Officer who reported that children contribute to food security because they work with their parents in the family farm after school hours. This result is in agreement with an argument by Runge et al. (2010) who pointed out that children are an investment because they frequently work during childhood. For example, in rural areas, they do household chores and work on the family farm.

4.5 Conclusions and Recommendations

Based on these results, it is concluded that land size cultivated, household size, age and income are the most important factors which determine food security in the study area. Therefore, it is recommended that involvement of public and private institutions in addressing the food insecurity problem in Chamwino District should be done by focusing on these factors, among other factors, in order to reduce food shortage. There must be targeted policy

interventions aimed at increasing money available at the household level. Specific policies providing access to land would be needed in order to increase food security at the household level. Except for the chronically ill and the disabled, all household members aged 15 to 64 years should participate in various farm and non-farm activities in order to increase food security at the household level.

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