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Gendered Determinants of Vulnerability to Food Insecurity in Chamwino District, Tanzania

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

Abstract
Chamwino District is vulnerable to food insecurity, but the extent of such vulnerability differs with household headship. However, gendered determinants of vulnerability to food insecurity remain to be explored. This paper is based on a study which was conducted in Chamwino District using a cross-sectional research design involving 400 households. Using multiple linear regression, amount of food stored and reducing meal size significantly influenced ($p \leq 0.05$) FHHs' vulnerability to food insecurity, while amount of food stored, total annual income per adult equivalent, distance to the nearest market place, reducing size of the meal and income generating activities significantly influenced ($p \leq 0.05$) MHHs' vulnerability to food insecurity. The findings suggest that factors which determine vulnerability to food insecurity vary across gender. Therefore, interventions to reduce vulnerability to food insecurity in Chamwino District should focus on gender issues and markets within reach of farm households, among other things. Radical transformation of rural areas in order to create off-farm employments is recommended, and use of food storage structures in rural areas would help reduce vulnerability to food insecurity.

Key words: *food insecurity, gender*, *vulnerability,*

Introduction

While considerable attention has been given to studying food insecurity in developing countries, there are relatively few empirical studies in literature on vulnerability of rural households to future food insecurity (Babatunde *et al.,* 2008: 117). Yet, reducing vulnerability is a pre-requisite for achieving global and national food security targets due to the fact that there are no comparative estimates on people's vulnerable to undernourishment. Several studies related to income or consumption poverty point out that the number of vulnerable people is much larger due to slow progress towards attainment of the goal of halving the number and share of malnourished people by 2015 set by the Millennium Development and World Food Summit (Lovendal & Knowles, 2005: 1).

Vulnerability to food insecurity is generally high in rural areas of African countries among poor farming households (Sileshi *et al.*, 2019: 2). In rural areas of many African countries, female headed households (FHHs) are often more vulnerable than male headed households (MHHs) and more prone than the latter to be affected by food insecurity (Babatunde *et al.*, 2008: 1; Ndobo & Sekhampu, 2013: 311; Mason *et al.,* 2014; Kassie *et al.*, 2014). Female headed households are more

[1] University of Dodoma, emmyassenga2006@gmail.com
[2] Sokoine University of Agriculture, kimkayunze@yahoo.com

vulnerable than male headed households due to the fact that they have less access to and control of agricultural assets as well as inputs, education, livestock, credit, extension services and input and output markets, and land, which constrain them from gaining control over agricultural productivity (Kassie *et al.*, 2012; World Bank, 2014; Debela, 2017; Mukasa & Salami, 2016, cited in Lutomia *et al.*, 2019: 2). Access to land is not only a question of land size, but also a question of soil quality. To say it differently, land of good quality, in many cases, is controlled by men. Women's isolation from the public arena, time scarcity due to the fact that they do household chores (including caring for children and sick people), cleaning household compounds, fetching water, collecting firewood, food production and limited mobility limit their access to markets in various ways (FAO, 1988, cited in Kassie *et al.*, 2014). For instance, women usually have less information about prices, rules, and rights to basic services.

Moreover, distance from the market place may limit the ability to sell or purchase in the market place in absence of adequate transport facilities, and thus differences between Female Headed Households (FHHs) and Male Headed Households (MHHs) in access to transportation will also matter (Kassie *et al.*, 2014). Some of these gender differences may be a result of events that made the household a FHH in the first place, such as financial distress following death of the male head of the household thereby forcing the widow to sell assets, as well as associated loss of household labour linked to loss of a productive household member, but many differences are linked to various forms of gender inequality (Kassie *et al.*, 2014). Less education is often provided for female rather than for male children, such that female household heads will have less education than their male counterparts in other households (Meinzen-Dick *et al.*, 2010; Quisumbing, 2003 cited in Kassie *et al.*, 2014). Moreover, legal and social traditions surrounding the subdivision of assets tend to favour males at the expense of females such that when assets are allocated after a death or a divorce, female farmers tend to receive fewer and lower quality assets than their male relatives, for example, less productive or smaller plots of land, or fewer and less productive livestock (Kassie *et al.*, 2014).

Various studies have been conducted on vulnerability to food insecurity. For example, Babatude *et al.* (2008), using frequencies and severe coping strategies, found that FHHs were more vulnerable to food insecurity than MHHs among farming households in Nigeria. Ndobo and Sekhampu (2013), using Household Food Insecurity Access Scale, reported that FHHs were more vulnerable to food insecurity than MHHs in urban areas of South Africa townships. A study done by Mason *et al.* (2014) on "Determinants of food insecurity in Tanzania: Gendered dimensions of household headship and control of resources" revealed that FHHs are more vulnerable to food insecurity than MHHs in Tanzania. Assenga and Kayunze (2018: 36), using Household Food Insecurity Access Scale, found that FHHs are more vulnerable to food insecurity than MHHs among farming households in Chamwino District and that the extent of such vulnerability differs with household headship. However, determinants of vulnerability to food insecurity among male and female headed

households remain to be explored. The determinants of vulnerability to food insecurity have a gender differential.

A gender-based analysis of determinants of vulnerability to food insecurity could be useful for designing policies and intervention programmes that would specifically target highly vulnerable households in rural areas (Babatunde *et al*., 2008: 117). More generally, knowledge on factors that determine such vulnerability and methods employed to deal with it could be of great value to government, non-governmental organizations and development agencies in designing effective strategies to improve food security, both now and in future (Babatunde *et al.,* 2008: 117). Therefore, this paper provides empirical evidence on gendered determinants of vulnerability to food insecurity in Chamwino District, Dodoma Region.

Methodology

Description of the study area

The study was conducted in Chamwino District, Dodoma Region. The district was selected since it has a history of chronic food insecurity, which leads to chronic malnutrition, reflected by stunting. Mbwana *et al*. (2017: 1) found that 41 percent of children under age of five years were stunted in the district in 2017.

Research design, sampling procedures and sample size

A cross-sectional research design was used in this study, and the sampling unit was a household since food scarcity is ultimately experienced at the household level (Maxwell, 1996). Chamwino District was selected purposively because of its history of chronic food insecurity. Three wards were purposively selected due to their history of receiving food aid from the government [District Agriculture, Irrigation and Cooperative (DAICO)] of Chamwino District, Personal communication, 2014), and six villages were selected purposively from the three wards. The villages were Fufu and Suli in Fufu Ward, and Idifu as well as Miganga in Idifu Ward, where chronic food insecurity was relatively high. The other villages were Membe and Mlimwa in Membe Ward, where chronic food insecurity was relatively low. Respondents were randomly selected from the sampling frame established from village registers by listing all households headed by males and females with children aged 7 to 17 years. The sample size was 400 households. The following formula for sample size determination by Cochran (1977, cited in Bartlett *et al*., 2001) was used to determine the sample size:

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

n = sample size; z = a value on 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 95 percent confidence interval; p = estimated variance in the population from which the sample is drawn, normally 0.5 for a population, whose size is unknown; d = acceptable margin of error (or precision) where the general rule is that in social science research, d should be 5 percent for

categorical data and 3 percent for continuous data (Krejcie & Morgan, 1970 cited in Bartlett *et al.*, 2001). In this research, 5 percent was used since substantial categorical data were collected. Using a z-value of 2.0, a p-value of 0.5 and a d-value of 0.05, the sample size (n) was determined to be 400, i.e.

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

Data Collection Methods

Primary data were collected using a questionnaire which was administered to household heads. The questionnaire that was used to collect information on household food security and included, among other items, a nine-item household food insecurity access scale (HFIAS). The scale was used to assess whether or not households had experienced problems in accessing food during the reference period of 30 days prior to the survey date. The person responsible for meal preparation was interviewed to provide information on modifications a household made in diet or food consumption patterns due to limited resources to acquire food.

Determination of household food insecurity access

The Household Food Insecurity Access Scale (HFIAS), which was developed by the United States Agency for International Development (USAID) was used to measure vulnerability to food insecurity in terms of scores on the scale. There are two sub-questions to each of the questions in the HFIAS scale whereby the first group of questions are called the nine occurrence questions, and there are two response options available to the respondent, 'Yes' or 'No' (where No = 0 and Yes =1). The second group of questions refers to nine frequencies of occurrence questions; these questions are asked with the intention of making a follow-up to occurrence questions and to establish whether or not the condition (vulnerability to food insecurity) ever occurred. Next to the 'No' response option there is a skip code, meaning the interviewer can skip the related frequency-of-occurrence follow-up question if the respondent answered 'No' to the occurrence question (Coates *et al.,* 2007). Scores on the HFIAS were calculated using answers based on the nine frequency-of-occurrence questions. The scale takes the lowest score of 0 and the highest score of 27; the higher the score, the higher the probability of a household being vulnerable to food insecurity (USAID, 2007 cited in Ndobo & Sekhampu, 2013). The HFIAS has been used by various researchers in measuring vulnerability to food insecurity, for example, Ndobo and Sekhampu (2013); Grobler (2013); and Kimani-Murage *et al*. (2014).

The HFIAS was tested for reliability using Cronbach's alpha, which is the most common of all measures of scale reliability (Pallant, 2007; Field, 2009). Results of reliability test exhibited a good internal consistency, a Cronbach's Alpha of 0.765. A value of 0.7 to 0.8 is acceptable for Cronbach's Alpha (Field, 2009: 675).

Data processing and analysis

Quantitative data were analysed using IBM Statistical Package for Social Sciences (SPSS) Version 20 and Microsoft Excel software. Data for calculating income per adult

equivalent (adult equivalent units at household and total annual household income) were entered in SPSS. The data were exported from SPPS into Excel where income per adult equivalent was computed. The computed income per adult equivalent was exported from Excel into SPSS. The SPSS was used to run multiple linear regression, which is an inferential analysis. Inferential analysis was done using multiple linear regression to determine the impact of independent variables on vulnerability to food insecurity, which was measured using household food insecurity access scale scores. Principal Component Analysis (PCA) was performed before regression analysis. Factor loading through rotated component matrix, scree plotting and component plotting in rotated space were employed. According to de Vaus (2002), variables (coping strategies) with loading factors above 0.3 were considered in the regression analysis. Reducing meal size, migrating to other areas for casual labour and receiving money remittance from relatives were selected based on rotated component matrix method, which had loading factor values above 0.3 (Table 1). Other coping strategies were not selected for the regression, following the accepted concept of PCA as the loading factors were below 0.3.

Table 1: Factor loading values for coping strategies as obtained after principal component analysis

Variables	Components		
	1	2	3
Migrated to other areas for casual labour	0.393	-0.019	-0.060
Money remittances from relatives	0.384	-0.045	-0.140
Borrowing cash	-0.011	0.004	-0.002
Reducing meal size	0.088	0.440	-0.128
Skipping meals	0.095	0.193	0.166
Sale of wild fruits	-0.042	0.061	0.012
Eating inferior/less preferred food	0.012	0.011	0.015
Food remittance from relatives	0.050	-0.104	0.002
Getting support from relatives	-0.015	0.004	0.001
Sale of firewood	-0.021	0.015	0.003
Food loan	-0.004	0.006	0.000

Moreover, before running the model, collinearity and multicollinearity diagnostics were done to check linear association between independent/explanatory variables and correlation among the independent/explanatory variables, respectively. Natural log transformation of skewed variables was done before running the regression analysis to make them have a normal distribution. According to Pallant (2007: 155), multiple linear regression (MLR) does not require distribution of data that are skewed for both dependent and independent variables. The multiple linear regression model was specified as follows:

$Y = a + \beta_1 X_1 + \beta_1 X_2 + \beta_1 X_2 + \ldots + \beta_1 X_{11} + e$,

Where,

Y = vulnerability to food insecurity as measured using Household Food Insecurity Access Scale scores (continuous variable). According to Ndobo and Sekhampu (2013), the higher the score, the higher the probability of a household being vulnerable to food insecurity.
a = Constant or Intercept of the equation
$\beta_1 \ldots \beta_{11}$ = Regression coefficients
e = Error term representing a proportion of 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 = Distance to the nearest market place (measured in kilometres), X_4 = Age of household head (measured in years), X_5 = Household size (number of members), X_6 = Sex of household head (1 = Male, 0 = Female), X_7 = Non-farm Income Generating Activities (IGAs) (1 = Yes, 0 = No), X_8 = Food stored in the household (measured in kilograms), X_9 =Livestock ownership (1 = Yes, 0 = No), X_{10} = Money remittances from relatives (1 = Yes, 0 = No), X_{11} = Reduction of meal size (1 = Yes, 0 = No).

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, wages, rentals, remittances and receipts in kind (Deaton, 1997). These were the households' sources of incomes that 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, a survey must collect detailed data on all transactions, purchases of inputs, sales of output, and assets transactions, and do so for the whole range of economic activities for wage earners as well as for the self-employed.

$$\text{Per AE income per person} = \frac{\text{Total income during one year in household}}{\text{Adult equivalent units at home}}$$ (Rahim *et al.*, 2011).

Results and discussion

Determinants of vulnerability to food insecurity in male and female headed households

A multiple linear regression model was used to determine impacts of some factors on vulnerability to food insecurity at the household level. The results in Tables 2 and 3 show regression estimates of determinants of vulnerability to food insecurity in both MHHs and FHHs with coefficients of determination (R^2) ranging from 0.398 in MHHs to 0.464 in FHHs. The model predicted vulnerability to food insecurity fairly well. This implies that the predictor variables accounted for 39.8 percent and 46.4 percent of variation in the variance of the dependent variable that was vulnerability to food insecurity in terms of HFIAS scores in MHHs and FHHs respectively. Such relatively low coefficients of determination are acceptable in social sciences unlike in natural sciences where higher levels are expected. The beta values (β-values) inform about the

relationship between vulnerability to food insecurity for each predictor. If the value is positive, there is a positive relationship between the predictor and vulnerability to food insecurity, whereas a negative coefficient represents a negative relationship (Field, 2009).

Table 2: Determinants of vulnerability to food insecurity in female headed households

Predictor variables	Un-standardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.287	0.415		3.106	0.003		
Amount of food stored (kg)	-0.080	0.039	-0.248	-2.068*	0.044	0.796	1.257
Total annual household income per AE	0.013	0.056	0.032	0.233	0.817	0.592	1.689
Land size cultivated (hectare)	-0.091	0.079	-0.147	-1.160	0.252	0.709	1.410
Age of household head (years)	-0.095	0.165	-0.070	-0.577	0.567	0.784	1.275
Distance to the nearest market place (km)	0.094	0.052	0.213	1.805	0.077	0.819	1.221
Household size	0.028	0.015	0.235	1.892	0.065	0.738	1.355
Money remittance from relatives (Yes = 1, No = 0)	-0.061	0.043	-0.169	-1.425	0.161	0.808	1.237
Reducing meal size (Yes = 1, No = 0)	0.106	0.036	0.333	2.917**	0.005	0.0876	1.142
Education of household head (years)	0.000	0.006	-0.009	-0.071	0.944	0.711	1.407
Non-farm income generating activities (Yes = 1, No =0)	-0.062	0.040	-0.190	-1.566	0.124	0.771	1.297
Livestock ownership (Yes = 1, No = 0)	-0.003	0.039	-0.008	-0.068	0.946	0.765	1.308
Migrated to other areas for casual labour (Yes = 1, No = 0)	0.040	0.033	0.069	1.203	0.203	0.458	2.182

Dependent variable: HFIAS scores; R = 0.682; R^2 = 0.464; Adjusted R^2 =0.339; F statistics = 3.705; Durbin – Watson = 1.917; **significant at 1%; *significant at 5%

The results in Tables 2 and 3 show that amount of food stored (in kilogrammes, kg) in the households had negative significant influence ($\beta = -0.248$; $p \leq 0.05$) and ($\beta = -0.286$; $p \leq 0.001$) on vulnerability to food insecurity in FHHs and MHHs, respectively. This means that an increase in 1 kg of food stored in a household, with all other predictor variables held constant, caused a decrease in vulnerability to food insecurity by 0.248 and 0.286 HFIAS scores in FHHs and MHHs, respectively. This implies that vulnerability to food insecurity decreases with an increase in amount of food stored in the household. Results from this study corroborate previous findings from a study by

Assenga and Kayunze (2018) who found that vulnerability to food insecurity decreased with an increase in amount of food stored at the household.

Table 3: Determinants of vulnerability to food insecurity in male headed households

Predictor variables	Un standardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1.371	0.161		8.504	0.000		
Amount of food stored (kg)	-0.073	0.014	-0.286	-5.244***	0.000	0.849	1.178
Total annual household income per AE	-0.034	0.017	-0.118	-2.073*	0.039	0.784	1.275
Land size cultivated (hectare)	-0.010	0.027	-0.021	-0.357	0.722	0.736	1.358
Age of household head (years)	0.042	0.072	0.034	0.588	0.557	0.757	1.322
Distance to the nearest market place (km)	0.057	0.019	0.155	2.964**	0.003	0.922	1.085
Household size	-0.003	0.004	-0.036	-0.673	0.501	0.873	1.145
Money remittance from relatives (Yes = 1, No = 0)	0.000	0.015	0.000	0.007	0.994	0.930	1.075
Reduce size of meal (Yes = 1, No = 0)	0.110	0.014	0.408	7.807***	0.000	0.927	1.079
Education of household head (years)	0.001	0.003	0.016	0.275	0.783	0.797	1.255
Non-farm income generating activities (Yes = 1, No = 0)	-0.054	0.015	-0.195	-3.674***	0.000	0.901	1.110
Livestock ownership (Yes = 1, No = 0)	-0.023	0.016	-0.084	-1.469	0.143	0.769	1.301
Migrated to other areas for casual labour (Yes = 1, No = 0)	0.040	0.033	0.069	1.203	0.203	0.458	2.182

Dependent variable: HFIAS scores: R = 0.631; R^2 = 0.398; Adjusted R^2 = 0.370; F statistics = 14.99; Durbin – Watson = 1.642; ***significant at 0.1%, **significant at 1%, significant at * 5%

Moreover, the results in Tables 2 and 3 show that consumption related coping strategies, for example reducing meal size showed positive significant influence (β = 0.333; $p \leq 0.01$ and (β = 0.408; $p \leq 0.001$) on vulnerability to food insecurity in both FHHs and MHHs, respectively. Holding other predictors constant, households, which were reducing meal sizes were found with increased vulnerability to food insecurity by 0.333 and 0.408 HFIAS scores compared to households that were not reducing meal sizes both in FHHs and MHHs, respectively. This finding is in line with an argument by Coates *et al*. (2007) that households that already worry most about food insecurity

tend to use consumption related coping strategies, for example reducing meal size to cope with food shortage.

Non-farm income generating activities had negative significant influence ($\beta = -0.195$; $p \leq 0.001$) on vulnerability to food insecurity in MHHs (Table 3). Holding other predictors constant, households that were doing non-farm income generating activities were found to be less vulnerable to food insecurity by 0.195 HFIAS scores compared to households which were not doing non-farm income generating activities. This implies that vulnerability to food insecurity in male headed households decreases with increased involvement in income generating activities. Similar results have been reported by Babatunde *et al*. (2008) and Assenga & Kayunze (2018). The latter reported that vulnerability to food insecurity decreases with involvement in income generating activities.

Total annual household income per adult equivalent had negative significant influence ($\beta = -0.118$; $p \leq 0.05$) on vulnerability to food insecurity in MHHs (Table 3). An increase of Tanzanian shilling (TZS) 1, with all other predictor variables held constant, caused a decrease in vulnerability to food insecurity by 0.118 HFIAS scores. This implies that an increase in household income decreases chances for a household being vulnerable to food insecurity. This result is consistent with results from a similar study by Ndobo & Sekhampu (2013) on food security. They found that household income is the most important determinant of food security (*ibid*.).

Distance to the nearest market place showed positive significant influence ($\beta = 0.155$; $p \leq 0.01$) on vulnerability to food insecurity in MHHs (Table 3) An increase of 1 km, with all other predictor variables held constant, caused an increase in vulnerability to food insecurity by 0.155 HFIAS scores. According to Kassie *et al*. (2014), distance from home to the market place may limit the ability to sell or purchase in the market in absence of adequate transport facilities.

The prominent difference in determinants of vulnerability to food insecurity between both FHHs and MHHs is that total annual household income per adult equivalent (AE), non-farm income generating activities and distance to the nearest market place were significant in MHHs but not in FHHs. It implies that distance from the market place may limit FHHs' ability to sell or purchase in the market in absence of adequate transport. Moreover, MHHs have more access to credit, which can be invested as capital in IGAs. In both household types, increasing amount of food stored in the household could help to reduce vulnerability to food insecurity.

Conclusions and recommendations

Based on presented results in this paper, it is concluded that total annual household income per adult equivalent (AE), distance to the nearest market place, amount of food stored, non-farm income generating activities and reducing meal size are big determinants of vulnerability to food insecurity in male-headed households. It implies that increasing income, amount of food stored and income generating activities would

reduce the risk of male-headed households falling into food insecurity in future. In female-headed households, amount of food stored and reducing size of meal consumed are the main determinants of vulnerability to food insecurity. In both household types, amount of food stored and reducing size of meal consumed are big determinants of vulnerability to food insecurity. Therefore, it is recommended that interventions to reduce vulnerability to food insecurity in Chamwino District should focus on gender issues and markets within reach of farm households, among other things, so that they can sell their produce and buy food. Besides, there is a need for radical transformation of rural areas to create off-farm employments. Additionally, use of food storage structures in order to increase food stored in households would reduce vulnerability to food insecurity.

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