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Food security and land utilization in Tanzania: A case study of the Ludewa district of Iringa-Tanzania

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Abstract

Among other variables, this paper quantified the effect of the land size for maize production on rural food security status in Ludewa district of Iringa region, Tanzania, using logit regression model. In this study, the structured questionnaire was used to collect primary data. The results suggested that, size of land for maize production has a significant (at 5%) and positive impact on rural food security status. Other variables which showed significant impact on rural food security were: household size (at 1% level), education status of the head of household (at 10% level), fertilizer application (at 1%), and extension services (at 10%). Therefore, the policy which promotes the expansion of land for maize production was recommended.

Keywords: Food security, Land, Maize, Tanzania

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1. Background to problem statement

Reducing the proportion of chronically undernourished people by half by 2015 is the Millennium Development Goals (MDGs) first strategy (Babatunde et al., 2007). Among other strategies, agriculture development in East Africa has big role to play to reduce number of people who are chronically undernourished. Tanzania agricultural sector in particular, has four important roles to play: provider of food security; earner of foreign exchange; major Gross Domestic Product (GDP) contributor; and the vehicle for inter-sectoral backward and forward linkages (Economic and Social Research Foundation, undated). Therefore, revitalizing the agricultural sector, and smallholder agriculture in particular, is a precondition for achieving high and sustainable growth, poverty reduction and food security in East Africa (Salami, 2010). In 2006, the World Food Summit defined food security as: "All people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life." Broadly, the concept of food security is built on three pillars: i) Food availability: sufficient quantities of food are available to people on a consistent basis; ii) Food access: people have sufficient resources to obtain appropriate foods for a nutritious diet; iii) Food utilization: people have sufficient knowledge of nutrition and care practices and access to adequate water and sanitation to derive sustenance food (Shapiro, 2010). For the sake of achieving the objective of this paper, main concentration is on food availability.

Food availability in Tanzania is characterised by domestic production; i.e., 95% of the country's food requirements are normally met with local production (Ministry of Agriculture, Food Security and Cooperatives, Tanzania, 2009 cited in Bese et al., 2009). Therefore, to enable farmers to achieve food availability which is one of food security pillars, agriculture needs policies that will increase productivity and land utilization. In the subsequent sections it is indicated that in Tanzania the arable land has not been used to its potential. This implies that the expansion of cultivated land especially for maize production is one of the key areas to ensure food availability and hence food security. This is justified in Global Monitoring Report (2012) which indicated that "policies that distort production and trade in food commodities also potentially impede the achievement of long-run food security". Despite these facts, little has been done to quantify the effect of land size cultivated on rural food security status.

Therefore the study intends to fill the gap left by previous studies by quantifying the effect of land size for maize production on rural food security status. White maize was chosen among other crops due to its importance in food security. According to Agricultural Council of Tanzania (ACT) (2010), Tanzania essentially produces white maize. As indicated in Maltsoglou and Dawe (2009), based on the per capita calorie ranking, the most important food crops in Tanzania are maize, cassava and rice.

2. Literature review

2.1. Introduction

The section presents various issues concerning food security. Mainly, the situation of food security in Tanzania is reviewed to get the insight on the status of food security. Also land utilization status and its

relationship with food security in Tanzania. Furthermore, the relationship between maize and food security in Tanzania were reviewed.

2.2. Situation of food security in Tanzania

Though worldwide food security and poverty alleviation has improved still Eastern and Southern African countries domestic food production has not kept pace with food demand (Bese et al., 2009). In Tanzania studies have shown that despite the significant growth of the economy, the levels of poverty and malnutrition remain high particularly for children and other vulnerable groups. Food insecurity is as high as 45% in some regions. Chronic malnutrition is endemic with 38% of children under 5 in Tanzania stunted, making it one of the 10 worst affected countries in the world, and the third worst in Africa (Pauw and Thurlow, 2010). There have been only slight declines in national poverty levels since 2000/01 despite robust and sustained economic growth during the intervening years. "Recent trends suggest that while average per capita agricultural GDP expanded rapidly during 1998–2007, caloric availability at the household level hardly improved" (Pauw and Thurlow, 2010, p.1). It is acknowledged that malnutrition is one of the most serious threats to economic growth. It also results in big losses to the Tanzanian economy by reducing work productivity and earning potential (Pauw and Thurlow, 2010).

In line with these facts, Bese et al. (2009) argued that food security is an issue of great political, economical, social, and ethical importance. Governments are obliged to give it top priority on their agenda to ensure food security for all people at all times. This justifies the relevance of any effort including research on food security theme.

2.3. Land utilization and food security in Tanzania

Tanzania is a blessed country which about 46% (44 million hectares) of its total land area is suitable for agricultural activities (United Republic of Tanzania, 2011). Tanzania could be self sufficient and a major food-exporting country, but so far Tanzania's agricultural potential is largely undeveloped. Wolter (2008) indicated that despite of this potential Tanzania has in agriculture, still land is underutilized as only 11% of the total suitable land area is under cultivation.

Tanzania smallholder farmers who dominate agricultural activities cannot afford efficient technology, loans and they are mostly depend on irregular weather patterns and consequently they end up with small farm sizes (0.9 – 3.0 hectares) and falling land and labor productivity. The final outcome of this is rural poverty (Shapiro, 2010).

Specifically, Iringa region of Tanzania which is the study area has total arable land of about 2,214,000 hectares but only an average of some 514,843 or 23.3% of the arable land is under cultivation. This includes an annual average of 477,054 hectares of food crops and about 37,789 hactares under cash crops. The proportion of the area cultivated against arable land area varies from 37.6 % in Mufindi district to 9.4% in Ludewa district. Thus, the region has a large untapped land resource that requires development in terms of

crop production either by peasant or commercial farmers (Ministry of Planning, Economy and Empowerment, Tanzania, 2007).

2.4. Maize and food security in Tanzania

Tanzania's major food crops are maize, cassava, sweet potato, paddy rice, and beans. National food security remains highly dependent on the people's preferences; i.e., 33% of the population prefers to consume maize, though the demand for rice has steadily increased throughout the country (Bese, et al., 2009). According to Mwakalinga and Massawe (2007) maize provides 60% of dietary calories and more than 50% of utilizable protein to more than 37 million Tanzanians. Essentially, maize supply equals national food security, food shortages and famines have always been equated to shortage of maize.

3. Methods and materials

3.1. The study area

The study was conducted in Ludewa district which is one of the six (6) districts constituting Iringa region. Ludewa is boarded by Njombe district in the North and Ruvuma region in the South and East and it covers a total of 6,325 Sq Km. It is generally endowed with rich soils and therefore is one of the few agricultural potential districts in Tanzania. Ludewa lies between $10^{0}00^{1}00^{11}$ latitude and longitude $34^{0}45^{1}00^{11}$. Ludewa has a humid (> 0.65 p/pet) climate. In Ludewa, most of the land area is not cultivated; most of the natural vegetation is still intact. The climate is classified as a humid subtropical (dry winter, hot summer), with a subtropical dry forest biozone. Ludewa district was chosen due to its potentiality in maize production and also due to the fact that, 95% of the people live in rural area and depend on agriculture as their main economic activity. Main food crops cultivated include maize, sorghum, wheat, beans, and cassava. Cash crops include coffee, sunflower, tobacco, and pyrethrum.

3.2. Variables measurements and analytical technique

After identifying variables for food security, the food security index (Y) was constructed and used to determine food security status of each individual rural household based on the food security line using recommended daily calorie required approach. All conversions from grams of maize to calorie and estimation of daily calorie required by gender and by age were based on the guidance by FAO (1997). (See appendices A&B). After obtaining the daily required calorie by household, the requirement of calories per year per household (R) was calculated. The annual household calorie requirement was then compared with the available calories (C) in order to be able to determine if the particular household is food secure or not. The available calorie for household consumption was obtained by converting the available household grams of maize per year into calorie. Available grams of maize (A) was obtained by; taking supply of maize (S_m) to household minus leakages (L_m).

$$A = S_m - L_m \qquad (1)$$

Whereby, S_m = f (home production, purchase, gift of maize received) and the L_m = f(sales, amount used for local brews, gift of maize given out)

The available grams of maize for household consumption was converted into calorie using the formula as indicated in FAO (1997) i.e 100g of maize equals 357 kcalorie.

$$C_i = A/100 * 357 \qquad (2)$$

After calculating the calories available for household per year (C) and calories required by household per year (R), the food security index was established by taking the difference of the two and hence deciding on the food security status of the household;

$$Y_i = C_i - R_i \qquad (3)$$

Yi = Food security status of ith households which take the value of 1 for food secure households (i.e. $C_i \geq R_i$) or 0 for food insecure households (i.e $C_i < R_i$).

This method of identifying food security status is in line with one of the two methods suggested by Maxwell (1996) as cited in Babatunde, et al. (2007).

Based on the household food security index(Y_i), the Logit model was estimated to identify the determinants of food security with main variable of concern being size of land for maize production. The implicit form of the model was expressed as:

$$Y_i = \beta_i X_i + U \qquad (4)$$

Y_i = The food security status of ith household

X_i = Vector of explanatory variables

β_i = vector of the parameter estimates

U = The error term

3.3. The explanatory variables that were employed in the analysis

3.3.1. Age of the household head (Age)

The age of household was recorded in term of years and it is expected to impact the food supply/production in two ways. One way is, young members of the household are expected to have ability to supply labour power compared with old people. On the other hand old people are expected to be more experienced in farm activities and hence produce more. Given the two situations explained above the expected sign can be negative or positive respectively.

3.3.2. Household size (fsz)

In this study household definition based on the Tanzania population and housing census of year 2012 which define household as "a person or group of persons who reside in the same homestead/compound but not necessarily in the same dwelling unit, have same cooking arrangements, and are answerable to the same household head". The negative sign is expected because the food requirements increase with the increase of the number of members of household.

3.3.3. Number of years head of household spent in school (nsch)

To simplify the analysis, the status of household education was measured in term of number of years head of household spent in school. The positive sign is expected as more educated head of household is expected to be more efficient in food production decision making.

3.3.4. Maize cultivated land (lnmaize)

Maize cultivated land is that farmland devoted to maize production and it was measured in acres. The larger the land devoted to maize production the more maize will be produced and vice versa with other factors remaining constant. So, the household that devotes its more land to maize production is likely to be food secure and therefore its impact on food security is positive.

3.3.5. Fertilizer application

The variable was measured by simply identifying those households who applied fertilizers and who did not apply fertilizers in their farms. 1 was allocated to those who applied fertilizer and 2 allocated to those who did not apply fertilizer. The expectation was that those who applied fertilizer could increase the volume of production and hence solve the problem of food insecurity and the opposite is also true. Hence, the expected sign is positive.

3.3.6. Extension services

This variable was captured by asking respondents if they had ever visited by the extension officers for their services and the answer was yes (this was allocated 1) or no (this was allocated 0). The expectation is that, the household receiving extension services is expected to be more efficient from the point of production onward. Therefore, production will be high and postharvest losses will be minimized and hence food security. The expected sign is positive.

4. Results and discussions

4.1. Descriptive analysis

Table 1 shows the results from descriptive analysis for useful variables in this study. Means for calorie available (i.e 5.5955E6) per year and calorie recommended per year indicated that generally the study area has excess calorie hence food secure. Percentage wise analysis shows that 54% (n = 221) of the households were food secure and 46% (n = 188) were food insecure. Therefore, households in the study area are generally food secure.

Another analysis was on the age of head of household which revealed that ages of heads of household ranges between 19 and 85 years and the mean age was about 44 years. Un-economically productive ages (i.e < 15 years and > 64 years) constitute 8.9%. This means that the big portion of the farmers in the study area (91.1%) was economically active.

Result also showed that household sizes were generally big ranging from 1 to 13. The mean was about five (5) people and maximum was thirteen (13) people. The size of household has implication in food requirements. Based on the results, it can be concluded that sizes of households in the study area were somehow big.

The results for land size for maize production indicated that the mean acreage cultivated was 2.44 and further analysis shows that more than 65.3% of households planted maize in at most 2 acres. Analysis of education status of head of households revealed that 85.5% of heads of households have only seven (7) years of primary education or less due to drop out. This could have negative impact on food security as majority have low level of education.

Table 1. Summary descriptive statistics of selected variables

Variable	N	Minimum	Maximum	Mean	Std. deviation
Calorie available per household	409	142800	40983600	5.5955E6	5.20370E6
Calorie recommended per household	409	668865	11195996	4.1229E6	1.71382E6
Age of head of household	409	19	85	43.84	13.23
Household size	409	1	13	5.1	2.00
Land for maize production	409	0	50	2.44	2.01
Number of years head of household spent in school	409	0	14	6.85	2.20

4.2. Quantitative analysis

Empirical results from the logit model estimated are summarized in Table 2. The results showed that the model fitted the data correctly as Prob>Chi2 = 0.00000 and five (5) out of six (6) variables included in the

model were significant. The variables involved in the analysis are; age of the head of household, household size, number of years household head spent in school, size of land planted with maize (in acres), fertilizer application and extension services.

Table 2. Empirical results from logistic model estimated

Variable	Coefficient	dy/dx	Z	P>IzI
Age	.0052353	.0012943	0.62	0.538
Fsz	-.247649	-.0612268	-4.06	0.000
Nsch	.0972204	.024036	1.81	0.070
Lndmaize	.2371679	.0586356	2.98	0.003
Fzer	-1.37211	-.3392299	-3.18	0.001
Ext	.9610069	.2375919	2.66	0.008
Constant	1.344567		1.69	0.091
Chi^2	49.11			
Prob>Chi^2	0.0000			
-2Log likelihood value	256.83027			
Number of observation	408			

In the analysis it revealed that household size (fsz) has negative relationship with food security status and it is significant at 1% level. This result justified that as the household size become bigger, it becomes susceptible to food insecurity. The negative sign obtained was expected because the food requirements increase with the increase of the number of members of household.

Education status (nsch) which was captured in terms of number of years household head spent in school revealed positive relationship as it was expected and significant at 10% level. This implies that the more the heads of household are educated the more the food secure the household will be. The policy implication here could be that government should advocate for education to enhance the ability of people to increase land productivity and also expansion of land cultivated.

Maize cultivated land (lnmaize) showed positive sign as it was expected and significant at 5% level. This implies that one of the solutions for food security is the increase of land size cultivated with maize. Therefore,

policies which motivates the expansion of land cultivated are useful to minimize the problem of food insecurity if not to shy away from it completely.

The variable for fertilizer application was captured as "yes" for those who applied fertilizer and "no" for those who did not apply fertilizer. Although the result carried unexpected sign, that is, negative sign, it showed significant relationship at 1%. May be the negative sign resulted from the fact that if excess fertilizer is applied, the soil becomes toxic and hence reduction in production.

The result for extension services showed positive sign as expected and it is significant at 10% implying that the household receiving extension services is efficient in carrying production and postharvest activities. Therefore, production is maximized and postharvest losses are minimized and hence food secure.

Age of the household head (Age) is the only variable which is insignificant with positive sign. The positive sign can be justified by ideology that the old people have more experience in agricultural activities compared to young people.

5. Conclusions and recommendations

Following the results from this study, it can be concluded that apart from the increase of land productivity, the expansion of cultivated land by households is equally important as far as the rural household food security is concerned. Other results showed that small household size, education, fertilizer application and extension services are important aspects to rural household food security. Based on the marginal effect results, with exception of fertilizer application and extension services, other variables, although significant, have little influence on food security status.

Based on the results obtained, this study recommends the thorough implementation of the policy on the ground and the making of other policies which will focus on the development of land in terms of increasing land cultivation by households.

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Appendices

Appendix A: Comparative energy and protein content of some cereals, tubers, legumes and oilseeds (per 100 g)

Food	**Energy *(kcal)***	**Protein *(g)***
Maize, white	357	9.4
Rice, brown hulled	357	8.1
Fonio meal	343	10.5
Millets	345	10.4
Sorghum	345	10.7
Cowpeas	342	23.1
Beans *(Phaseolus spp.)*	336	23.0
Groundnuts	549	23.2
Sesame	558	17.9
Soybeans	405	33.7
Cassava flour	340	1.5
Cassava, fresh	153	0.7
Yam flour	317	3.5
Yam, fresh	104	2.0
Sweet potato	114	1.5
Taro	113	2.0
Plantain	128	1.0

Source: FAO/United States Department of Health. Education and Welfare (1968)

Appendix B: Daily requirements for energy and protein

Group/age *(years)*	Energy *(kcal)*	Protein *(g)*	
		Diet A[a]	Diet B[b]
Children (both sexes)			
0-6 months	585	10	-[c]
6-12months	960	14	-
1-3 years	1250	14	23
3-5	1510	18	26
5-7	1710	20	30
7-10	1880	26	38
Boys			
10-12	2170	34	50
12-14	2360	43	64
14-16	2620	52	75
16-18	2820	57	84
Girls			
10-12	1925	35	52
12-14	2040	42	62
1416	2135	46	69
16-18	2150	45	66
If pregnant	+200	+6	+7
Men, active			
1 8-60	2 944	49	57
>60	2 060	49	57
Women, active			
Child-bearing age	2140	41	48
Pregnant	2 240	47	55
Lactating	2 640	59	68
>60	1830	41	48

Source: WHO (1985)

Appendix C: Outputs from logit model estimated

```
Logistic regression                               Number of obs   =        408
                                                  LR chi2(6)      =      49.11
                                                  Prob > chi2     =     0.0000
Log likelihood = -256.83027                       Pseudo R2       =     0.0873
```

fstus	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
age	.0052353	.0085076	0.62	0.538	-.0114394	.02191
fsz	-.247649	.0610003	-4.06	0.000	-.3672074	-.1280905
nsch	.0972204	.0536986	1.81	0.070	-.0080269	.2024676
lndmaize	.2371679	.0795447	2.98	0.003	.0812631	.3930727
fzer	-1.37211	.4309615	-3.18	0.001	-2.216779	-.5274408
ext	.9610069	.3617636	2.66	0.008	.2519633	1.670051
_cons	1.344567	.7945685	1.69	0.091	-.2127587	2.901893

```
. mfx

Marginal effects after logit
      y  = Pr(fstus) (predict)
         =  .55260889
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
age	.0012943	.0021	0.62	0.538	-.002828	.005417	43.8775
fsz	-.0612268	.01506	-4.06	0.000	-.090748	-.031705	5.10539
nsch	.024036	.01327	1.81	0.070	-.00198	.050052	6.88971
lndmaize	.0586356	.0196	2.99	0.003	.020212	.097059	2.45527
fzer	-.3392299	.10698	-3.17	0.002	-.548907	-.129553	1.08578
ext	.2375919	.08905	2.67	0.008	.063066	.412118	.144608