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RESEARCH ARTICLE

EFFECTS OF FARM SIZE UNDER FOOD CROPS ON FOOD SECURITY AMONG SMALL-SCALE FARMERS IN KAKAMEGA CENTRAL SUB-COUNTY, KENYA

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Abstract

Food security is first priority among Millennium Development Goals (MDGs) with the goal of eradicating poverty and hunger among nations and specifically in Kenya. Increased agricultural productivity is a more sustainable solution to the world's 870 M food insecure people. Approximately 10Million people in Kenya, 51.45% of Western Kenya population and 50-70% of households in Kakamega County suffer chronic food insecurity. Small farm sizes, low yields, are among the principal factors contributing to food insecurity in rural areas. The study therefore sought to investigate the effects of farm size allocated to food crops on food security among small-scale farmers (SSFs) in Kakamega Central Sub-county. The study used a cross sectional survey research design. Multi-stage proportional-to-size sampling design was used to select a sample size of 96 SSFs in 5 locations and 13 sub-locations of Lurambi and Municipality divisions. The results were analyzed using descriptive statistics (means and percentages) and regression analysis. The study revealed that farm size allocated to food crops had statistically significant effect on food security. The study recommends that farmers should allocate higher proportion of their farm to food crops, use and that the Agricultural Extension Officers should and extension service providers in order to increase the level of farmer awareness on farm planning and crop diversification in order to help farmers to make informed decision on choice of enterprises that improve food security.

Introduction

1.1 Background

Food security is first priority among Millennium Development Goals (MDGs) with the goal of eradicating poverty and hunger among nations and specifically in Kenya. Contrarily an approximate 870 million (M) of the world's population is food insecure of whom 98% are in the developing countries (Food and Agriculture Organization-FAO, 2012). In Sub-Saharan Africa (SSA) one person in every four, lacks adequate food for a healthy and active life (Bremner, 2012**).** The poor people who are the majority and undernourished, live in rural areas, rely mainly on small-scale agriculture for their food security and own less than 2 hectares (Ha). Food self-sufficiency, a production-based food entitlement, has been found to be the principal indicator of food security contrary to purchased entitlement to food in developing countries.

About half of Kenya's estimated 38.5M people are poor and live in the rural, suffer from chronic food insecurity and poor nutrition according to Government of Kenya-GoK (2012a). The target of Economic Recovery Strategy (ERS) is to reduce people affected by food insecurity from 48.4% to 10% by 2015 (GoK, 2012b). The GoK's new 2010-

2020 Agricultural Sector Development Strategy targets a 30% reduction of food insecurity and 25% reduction of poverty in 2014 to surpass the MDG target yet these may not be achieved without improved, sustainable agricultural productivity.

In Western Kenya food insecurity is 51.45% compared to the national figure of 48.8% (MoA, 2011). In the year 2011 about 50% SSFs in Kakamega County had kept between 1 to 3 bags of maize for home consumption and the rest of the farmers relied on unreliable market sources which are beyond the influence of individual poor farmers (Langat, Sulo, Nyangweso, Ngeno, Korir & Kipsat, 2010; MoA, 2011). In Kakamega County food situation declined in the months of April and May 2012 owing to disposal of stocks by households to meet the cost of farm inputs and other household needs like school fees and increased food commodity prices on the market (FAO, 2012).

Food security has been equated to Self-sufficiency in maize production. However on-farm yields are low averaging 1.5–2.6 tonnes per hectare compared to on-station yields of about 5–8 tonnes/ha (MoA, 2010). According to GoK (2010a) the use of improved seed has remained low due to poor distribution systems. About 99% of households used retained seed with 63% frequency of use while the formal seed purchases was 83% with only 18% frequency of use (Ayieko & Tschirley, 2006; GoK, 2010a).Therefore lack of diversification and reliance on market for food has resulted in food insecurity of approximately 70% of households especially in the cash cropping zone especially sugarcane and about 50% of households in the mixed farming (FAO, 2012).
According to Kenya National Bureau of Statistics –KNBS (2007) 53.5 % of the population in Kakamega face poverty compared to the regional figure of 52.2% and the national figure of 47% (KNBS, 2010; National Council for Population and Development, 2011). The most affected include the landless, female-headed households, subsistence farmers, and the unemployed youths. The farmers in the area hold at most 0.7 ha on which they grow a variety of both food and cash crops. Higher inequalities of dietary energy consumption than the national level has been recorded in rural areas and female headed households (KNBS, 2007). Therefore there the study sought to investigate and document from farmers on specific factors that affect improvement of their food security and livelihoods. The specific objectives of the study were to Investigate the effects of farm size allocated to food crops on food security and secondly establish the effects of the type of improved maize variety seed used on food security among SSFs in Kakamega Central Sub-county;

1.2 Relationship between Food Security and Food Self-sufficiency
A household is food secure when it has access to the food needed for a healthy life for all its members and when it is not at undue risk of losing such access due to poor production, high food prices, inadequate wages or inadequate access to market (FAO, 2012; Joshi & Maharjan, 2007; KNBS, 2007). In Kakamega County food situation declined in the months of April and May 2012 owing to disposal of stocks by households to meet the cost of farm inputs and other household needs like school fees. Lack of food stocks was compounded by the increased food commodity prices on the market further stressing households. Consequently, 70% of households in the cash cropping zone and about 50% of households in the mixed farming zone were stressed in 2011 as they mainly depended on the market for their stable food supply (FAO, 2012).

Food self-sufficiency is ability to meet consumption needs (particularly for staple food crops) from own production rather than by buying or importing (Joshi & Maharjan, 2007; Peljor & Minot, 2010). Food self-sufficiency is a useful strategy to achieve food security. Relying on the market to meet food needs is a risky strategy because of volatility in food prices and possible interruption in supplies. Indicators of food self-sufficiency include home-produced food as share of all food consumed, home-produced cereals as a share of all cereals consumed, and home-produced maize as a share of all maize consumed (Peljor & Minot, 2010). The measures of food self-sufficiency, measures of food shortages, per capita cereal production and per capita maize production are positively correlated with the average number of months of food self-sufficiency (Peljor & Minot, 2010).

1.3 Effects of Farm Size on Food Security
The farm size allocated to food security influence the production level and therefore food security. A farmer first tests and then adopts improved seeds by allocating part of the land to improved maize, and then decides to use other field operations based on socio-economic conditions and the relative importance of the technology being promoted. As the farm size increases the adoption of IMV decreases (Joshi & Maharjan, 2007; Salasya, Mwangi, Mwabu & Diallo, 2007). Morris, Tripp and Dankyi (1999) found that IMV adopters own significantly more land than non-adopters and plant a significantly greater area to maize, suggesting that MV adoption may be positively correlated

with wealth. The explanation is that farmers who have a greater stake in agriculture in general, and in maize farming in particular, have greater incentives to learn about and adopt MVs.

2.0 Material and Methods

The study applied a cross-sectional survey research design. A cross-sectional survey research design is a method that involves observation of all of a population, or representative subset, at one specific point in time in a geographic place (Monette, Sullivan & Dejong, 1990). In this study a cross-sectional survey was to allow collection of original, large amount of data to describe and make inferences about food security status of SSFs in Kakamega Central Sub-county the Western part of Kenya. The sub-county covers an area of 246.6 km^2 with an arable land of 220 km^2. The Sub-county consists of Lurambi Division and Municipality Division with 5 locations (wards) and 13 sub-locations. The Sub-county lies within altitude 1,250m-2,000m A.S.L. with an average annual rainfall ranging from 1200-2000mm-bimodal per year. The average temperature range between 42- 27 $^{\circ}$C most of the year. The main agricultural Zones are Upper Midland zone: UM0 UM1, and Lower Midland: LM1- and LM2.

The target population was maize small-scale farmers (with 5acres or below) in Kakamega Central Sub-county. The Sub-county population as from the 2009 population census was 160,229 persons with 11,508 farm families distributed in 37,989 households (KNBS, 2007). The average land holding per household in the Sub-county is 0.7ha, with an average household number of 8 persons. The dependency ratio is 88.9% while food insecurity is 51.5% (KNBS, 2007).

Table 1 shows household representatives proportionately selected from 4 sub-locations.

Multistage proportion-to size random sampling design using three levels of administrative areas; divisions, locations, and sub-locations as sampling unit was used in order to allow more accurate and convenient sample from the Sub-county. Simple random sampling was used to give equal chances of inclusion in the sample of each of the sampling unit. The sample size from the division, location, and sub-location was at least 30% of the total units while the household representatives was proportionate to the overall sample size of the study. The overall sample size was arrived at by using Fidells formula (n=n>50 + 8m) and 17% upward adjustment to take care of non respondents. Thus the formula: n= (n>50+8m) + ([n>50+8m]*0.17) was used to ensure generalizability and regression analysis (Pallant, 2001). Where, n= sample size, m=number of independent variables. A questionnaire was constructed and used because it allowed collection of data from greater number of respondents with greater confidentiality and at minimum cost across the study area.

A research permit was obtained from National Commission of Science, Technology and Innovations (NACOSTI) with the assistance of Egerton University Graduate School. Sub-county agricultural officials were informed about the study by a copy of the research permit. Agricultural extension officer assisted in mobilizing farmers for data collection in the villages. The researcher was introduced by the research guide to the respondent and the respondent was requested to fill a questionnaire. Where the respondent could not read and write an interpreter (from that community) was used to help interpret the items as answers of the respondent were being entered.

Data was analyzed using descriptive statistics (frequencies, means and percentages) and regression analysis by using SPSS version 17 and the results tabulated or graphically represented. Regression analysis was used to estimate the mean of the dependent variable from a given level of the independent variable (predictor), to test the hypothesized relationship at 5% significance level and to predict the mean value of the dependent variable. Regression analysis of effects of the independent variables; farm sizes and type of improved maize variety, on food security was made using the formula $\hat{y}=a+b_1X_1+b_2X_2+\dots b_iX_i+ ę$ where

ŷ=dependent variable a= the intercept on y axis X= independent variable X_i=value of independent variable at X_i^{th} level, b_i =parameters of X_i the independent variables and ę=the uncorrelated random error term such that it's mean is zero and variance is squared deviation. It was estimated using the sample data. All tests were interpreted at 0.05 significance level (95% acceptance level) and a probability significance of ($P<0.05$) which is commonly used for applied sciences and education research (Kozak et al., 2008).

The overall food security was measured in terms of percentage of farmers with adequate number of stock of maize from own farm production to last for a normal year (two cropping seasons=12 months) and the number of months of food self-sufficiency. The percentage of food insecure households was categorized into three categories: food secure (1) food insecure without hunger (2) and food insecure with severe hunger (3) using HFSSI.

Results and Discussions

Table 1

Sample Size per Sub-location (n=96)

Sub-location	Frequency	Percentage
Shibuli	28	29.2
Emukaya	19	19.8
Indangalasia	25	26.0
Shirere	24	25.0
Total	**96**	**100.0**

The results were analysed using descriptive and regression analysis and the findings are in the following subsections

Effects of Farm sizes allocated to selected food crops.

Investigate the effects of farm size allocated to food crops on food security among SSFs in Kakamega Central Sub-county;

For this objective farmers were asked to indicate the total farm size (Figure 1) and the size of farm they had allocated to key food crops (Figure 2). The responses were then grouped into 5 categories on a scale of 0.9 units.

According to Figure 2 farmers in the area own 3.28 acres on average and the majority 38.54% own between 1.1-2.0 acres. Those who own 3.1-4.0 acres were 26.04%; 2.1-3.0 acres were 17.71% and 0.1-1.0 acres were 12.50%. The highest land size (above 4.1 acres) was owned by only 5.21%. For this study, land size was a sign of wealth and under subsistence agriculture, holding size is expected to play a significant role in influencing farmer households' food security (Kuwornu, et al., 2013). Morris, Tripp and Dankyi (1999) found that IMV adopters own significantly more land than non-adopters and plant a significantly greater area to maize.

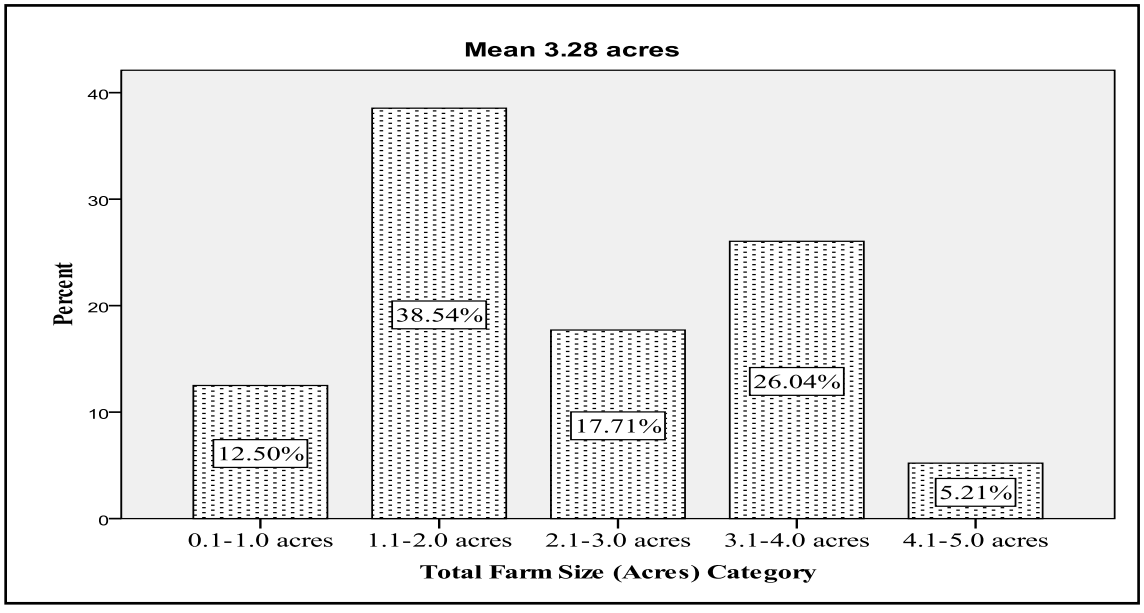

Figure 1 Farmers categorized according to their farm size

The mean farm size under maize was 1.177 acres. The Bean crop was intercropped with maize and on average it was grown in 1.031 acres. The least farm size was beans with 0.05-1.0 acres with 70.8% respondents and the highest farm range was between 1.1-2.0 acres with 15 (14.7%) respondents. The respondents who did not plant beans were 13.5%. Sweet potatoes were grown under 0.05-1.0 acres by 40.2% of the respondents while 59.4% did not plant sweet potatoes during the reporting season.

Table 2

Farm Size under Selected Food Crops (n=96)

Farm size(Acres)	Maize		Sweet potato		Bananas		Beans*		Groundnuts	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
0.05-1.0	75	78.1	39	40.6	29	30.2	68	70.8	12	12.5
1.1-2.0	19	19.8	-	-	-	-	15	14.7	-	-
Not Planting	2	2.1	57	59.4	67	69.8	13	13.5	84	87.5
Total	**96**	**100.0**	**96**	**100.0**	**96**	**100.0**	**96**	**100.0**	**96**	**100.0**
Mean		1.177		0.406		0.302		1.031		0.125

Note: *Beans crop is intercropped with maize where a farmer grew it.

Table 2 represents the portion of farm size under various food crops. Banana crop was grown under farm size range 0.05-1.0 acres by 29 (30.2%) respondents and a mean farm size 0.302 acres. The respondents who did not grow banana crop were 69.8 % (67). Groundnut crop was the least grown crop with 12 (12.5 %) respondents in the category 0.05-1.0 acres. The least farm size under maize ranged between 0.05-1.0 acres with 78.1% respondents and the highest was between 1.1-2.0 acres with 19.8 % respondents. There were 2.1% farmers who did not grow maize during the reporting season.
The study used maize self-sufficiency as a good indicator of food security because farmers still valued maize as the stable food crop. They allocate more farm size to maize than other food crops. The size of the farm allocated to each food crop was on the lowest size range for most farmers which would threaten their food security status.

Table 4 shows that the majority of respondents (60.42%) had allocated between 0.1-1 Ha of land and out of these only 9 were food secure (1) 31(32.29%) were food insecure without Hunger and 18 were food insecure with severe hunger. Second majority was those who had allocate between 1.1-2.0Ha. Out of these the majority of the respondents were food insecure without hunger and 4 were food secure. Although 2.08% had not allocated any farm to food crops they were food secure and could be that they had allocated more of their income to food purchase.

Table 4
Effects of portion of Land under Food crops on Household Food Security

Total farm size food crops * House Hold Food Security

Portion of land under food crops	House Hold Food Security Index			Total
	1.00/ (0.24-2.62)*	2.00/ (2.86-5.58)*	3.00/ (5.6-9.05)*	
	Fr (%)	Fr (%)	Fr (%)	Fr (%)
0.0(Zero) Ha	2 (2.08)	0 (0.00)	0 (0.00)	2 (2.08)
0.1-1.00 Ha	9 (9.37)	31(32.29)	18 (18.75)	58 (60.42%)
1.1-2.00 Ha	4(4.17)	15(15.63)	8 (8.33)	27 (28.13)
2.1-3.00 Ha	3(3.13)	2(2.08)	4 (4.17)	9 (9.37)
Total	**18 (18.75%)**	**48(50%)**	**30 (31.25%)**	**96 (100)**

NB*: Household food Security Index score measured in 1998 Food Security Scale Value

The result showed that declining farm size made it harder for farmers to grow enough food to secure a livelihood and to feed their families (Bremner, 2012). According to Bremner a survey in Kenya indicated that majority of farmers' land production is not sufficient to support their families. Two out of three felt that there is not available land for their children to stay in the community and farm. Sugarcane farming has replaced most indigenous food

crops and vegetables, despite their ecological suitability and high nutritive value. The actual land area devoted to food crops in sugarcane farming areas would be much lower than 50% and there is high risk of hunger and famine in the region given the long cropping cycle of sugarcane and its low net income (Waswa et al., 2009).

Regression Analysis on Effects of Farm size Allocated to Food Crops on Household Food Security.

Ho1: The farm size allocated to food crops has no statistically significant effect on food security among SSFs in Kakamega Central Sub-county;

The effect of farm size allocated to selected food crops commonly grown in the area was measured by asking the respondent the size of farm they had allocated. The crops which met significant regression limit were entered into the regression equation as:

X_1=Farm size under groundnuts
X_2= Farm size under maize
X_3= Farm size under bananas
X_4= Farm size under Sweet potatoes

From Table 5 farm sizes allocated to food crops; groundnuts, maize bananas and sweet potatoes contributed 0.101 (10.1%) of the variation in food security index of the households. From the ANOVA, $F_{4, 91}$ 2.543 and a p-value (0.045) the contribution of the farm size under food crop as a whole is statistically significant at significance level of 0.05. Therefore farm size allocated to food crops has statistically significant effect on food security of a household.
A study by Shumiye (2007) found that the proportion of food insecure households was 80.2% and 80.9% among households who have farm size less than the average of the sample households and yearly grain production less than the sample average yield.

Table 5
Effects of Farm Sizes under Food Crops on Food Security Scale Index

Food Security Scale Index								
Farm size under food crops	Model Summary	Unstandardized Coefficients		Standardized Coefficients			ANOVA	
		B	Std.					
Model	R-Square		error	Beta	t	Sig.	F	Sig
1(Constant)	0.101	5.828	0.501		11.63	.000	(df 4,91)	
Maize		0.796	0.481	.172	1.65	.101	2.54	.045[a]
Sweet potatoes		-4.956	2.831	-.274	-1.75	.083		
Bananas		7.129	2.899	.265	2.46	.016		
Groundnuts		1.970	2.908	.100	.677	.500		

a. Predictors: Farm size under groundnuts, farm size under maize, farm size under bananas, farm size under sweet potatoes.
df- degrees of freedom and 95% confidence level

To compare the strength of contribution of each food crop to food security the standardized coefficients (Beta) values were used. Sweet potatoes had largest contribution of 0.274, however showed negative correlation. Bananas followed with a positive contribution of 0.265 then maize with 0.172. The least contribution was groundnuts with 0.100. Inavailability of maize among most families has let them to depend on other food crops although farmers still allocate relatively more farm size to maize.

Conclusion and Recommendations

Farmers in the area own an average of 3.28 acres and the majority 38.54% own between 1.1-2.0 acres. The highest land size (above 4.1 acres) was owned by only 5.21%. The least farm size under maize ranged between .05-1.0 acres by 78.1% respondents and the highest was between 1.1-2.0 Ha by 19.8 % respondents. The mean farm size was 1.177 acres. Farmers grow other food crops like sweet potatoes, bananas, and groundnuts but on very small farm averaging 0.278 acres in order to diversify and improve food security.

Farm sizes allocated to food crops; groundnuts, maize bananas and sweet potatoes contributed 0.101 (10.1%) of the variation in food security index of the households. Therefore farm size allocated to food crops has statistically

significant effect on food security of a household at significance level of 0.05. Sweet potatoes had largest contribution of 0.274, however showed a negative correlation. Bananas, maize and groundnuts had positive correlation of 0.265, 0.172 and 0.100 respectively with food security index.

The conclusion of the research findings was that farm size allocated to food crops has statistically significant effect on food security of small scale farmers in Kakamega central sub-county at significance level of 0.05. Bananas, maize and groundnuts had positive correlation with food security index meaning the more land allocated to a variety of food crops the more food secure the household becomes

The recommendations based on the research findings is that farmers are recommended to allocate more proportion of their farm to a variety of food crops in order to diversify food in their diet, reduce risk of crop failure and thus improve their food security status.

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