Determinants of Household Food Security Status Among Smallholder Farmers in Laikipia County, Kenya

Angela A. Kenduiwa[1*], Charles W. Recha[2], Rose A. Mwonya[1] & Dolphine Odero-Wanga[1]

[1]*Department of Applied Community Development Studies, Egerton University, Kenya*

[2]*Department of Geography, Environment and Development Studies, Bomet University College, Kenya*

Corresponding author: angekenduiwa@gmail.com

Abstract

There are numerous factors that determine household food security status among smallholder farmers; and a variety of methods have been developed to measure food security. This study sought to establish the factors that determine household food security status among smallholder farmers in Laikipia County. Multistage sampling technique was used to select 384 smallholder farming households in Laikipia County during the 2021/2022 cropping season. Data was collected by using a questionnaire to household respondents and an interview schedule for key informants. Data collected was analysed using Statistical Package for Social Sciences (SPSS) version 28. Food security was measured using Food Consumption Scores (FCS) and Household Dietary Diversity Scale (HDDS). Descriptive statistics and ordered logistic regression analysis was used to establish the lead determinants of food security status. Results showed that the most accessed food groups were cereals and grain (82.0%), milk and other dairy products (49.5%), green leafy vegetables (45.3%) and roots and tubers (43.8%). The average Food Consumption Score (FCS) was 8.5 - food security status of 'poor'. While the Household Dietary Diversity Scale (HDDS) was 3.9, implying households accessed four (4) out of sixteen (16) food groups. Gender (0.56), marital status (0.6), land size under cash crops (0.5) and land ownership (0.28) were the lead determinants of the Food Consumption Score. The study recommends that targeted support for female- and older-headed households, land titling, agribusiness and cash crop capacity building, robust extension services, and continued fertilizer subsidies should be implemented in order to improve food security situation among smallholder farmers in Laikipia County.

Keywords: Food Security Status, Determinants, Smallholder Farmers, Laikipia

Introduction

According to Ogundari and Awokuse (2016), food security is a situation that exist when people, always, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Food security has four main components: food availability, access to food, food utilization, and stability in the availability of and access to food (FAO, 2016). Globally, the number of people in a worse situation of food insecurity is on the rise. FAO (in Mumuni and Aleers, 2023) reported a rise in food insecurity from 25% to 37% in 2000 and 2020 respectively. In Eastern Africa, FAO et al. (2021) showed that prevalence of moderate to severe food insecurity within the population was 65% - higher than the continent's – 60%. The statistics are a pointer that much of the population in East African is vulnerable to food insecurity – necessitating a robust discourse and understanding of the causes and solutions. In Kenya, agriculture is the backbone of Kenyan economy and community development. However, as a result of gradual climate change and with over 80% of Kenya's land mass being arid or semi-arid, only less than 20% is suitable for farming (UNDP, 2017). Further, Kenya's reliance on rain-fed agriculture has undermined food security. According to Carlson & Shumba, (2011), agriculture's sensitivity to climate-induced changes is likely to intensify problems of declining agricultural productivity, economic productivity, poverty, and food security.

There are numerous factors that determine household food security status among smallholder farmers. Increased income is associated with greater food consumption and improved nutritional status of household members (FAO, 2019). Households with lower incomes relatively scores higher in HFAIS and are expected to be less food secure in terms of access. According to Mason *et al.* (2015) access to credit positively affects household food security status meaning that households with credit access has more chance to be food secure than those without credit access. Access to credit gives the household the opportunity to invest in agricultural business or other non-farm activities which may enhance the household food security profile. According to Tekle and Berhanu (2015), credit can also help households to smooth consumption especially during the food shortage period. Reincke *et al.* (2018) found that households that were able to save part of their income were more food secure as compared to their counterparts who were not able to save.

Agricultural productivity has direct implications on income as well as on the household food security (Muzari 2016). Hassan *et al.* (2018) established that the HFAIS score decreased with the increase in number of cattle owned by the farmers. Thus, through cattle ownership, households are able to afford increased consumption of milk and meat in the households. Farmers with more domestic animals had better opportunities to increase income and consume diversified foods, such as fish and meat. In a related study, Adjimoti and Kwadzo (2018) found that livestock and crop diversification played an important role in household livelihood strategies. Often, livestock contributes to food security status of households through provision of income, nutrition, draft power, manure and as savings of assets. On the other hand, crop diversification provides farmers with different crops that they cannot access either because of the cost or because of the poor infrastructural constraints (physical access). Jerneck (2017) found that smallholder farmers with a higher share of infertile land are more food insecure in terms of access. In an investigation of climate change adaptation and sustainability in sub-Saharan small-scale agriculture, Jerneck (2017) also found that access to land as a productive resource influence food security. Therefore, denial of resource access regarding land, through both statutory and customary law is a key factor that can shape the policy debate on food security.

Hassan *et al.* (2018) found that market difficulty had a significant positive correlation with the HFAIS. Farmers who faced difficulties to access markets could not purchase enough agricultural inputs and food items. In the same way, they could not sell their commodities at profitable prices to increase their income. Therefore, it was difficult for them to maintain dietary diversity. Consequently, the difficulty with market access negatively influenced their household food security. A similar association of distance to main markets with household food security was found in another research in Africa (Kassie *et al.*, 2012). According to Hassan *et al.* (2018) had surprising observation that farmers with better access to information had lower food security was due to unobserved variables, such as the quality of information and effective use of the information access to farm information had a positive association with the HFAIS. According to Gecho *et al.* (2014), household head's education, among other factors, was an important determinant of household food security. Results make a case for provision of education and appropriate information about food security to households.

In their investigation of grain storage technologies for reducing post-harvest insect and pathogen losses in maize while improving smallholder farmers' food security in developing countries, Tefera *et al.* (2011) found that access to storage facilities was significant and positively associated with household food security status. Elsewhere, Reincke *et al.* (2018) reported that the number of household members significantly influenced household food availability. The more members (waged employees) a household had, the higher the food availability scores as computed through the Availability Index (AVIN). According to Graeub *et al.* (2016), growing of traditional cereals such as millet and sorghum has a positive and significant influence on household food availability. A key observation in the study was that smallholder farmers who cultivated traditional crops were found to be more food secure. Climate change is another important factor that influences household food availability. According to Brüssow *et al.* (2017), households that experienced drought in the last five years scored low on food availability. Thus, development of strategies to deal with occurrence of drought can contribute to household food availability. According to Coates *et al.* (2007), drought, gender, savings from income, are major factors that influence Household Food Insecurity Access Scale (HFAIS). The role of gender in food security is reinforced by CARE (2020) where gender-based discrimination was identified as a major cause of poverty, food and nutrition insecurity.

In view of the aforementioned literature, the study sought to investigate determinants of household food security status in the semi-arid Laikipia county, Kenya. In Laikipia county, most households are food insecure (Laikipia CIDP, 2013). This grim situation has often called for regular government intervention in the malnutrition problems through "emergency nutrition supplementation" food aid (GoK, 2013). Study findings would contribute to key policies and programmes the government of Kenya has put in place in ensuring food security amidst climate change. These include the Kenya Climate Smart Agriculture Strategy 2017-2026, Climate Change Act 2016, National Climate Change Response Strategy (2010). The next sections of the paper present a description of the study areas, methods of data collection and analysis, results & discussions, and finally a conclusion.

Methodology

The Study Area

The study was carried out in Laikipia County, Kenya (Figure 1). Most of Laikipia County is dry and largely unfavourable for cultivation. Less than 2% of land is deemed highly viable for agriculture. More than half of the county land is defined as wildlife habitat (Butynski & De Jong, 2014). In addition, the county consists of a rangeland plateau with a varying altitude of 1500 to 2611 metres above sea level at Ewaso Nyiro basin in the north and Marmanet forest. In the northern part, the mean annual rainfall is estimated to be 400mm while in the south-west it is 1200 mm (GOK, 2014). Like most parts of Kenya, Laikipia county Kenya has three rainfall seasons – March-May, June-August and October- December. The March-May and October-December are the main growing seasons but highly variable (Kenya Meteorological Department, 2020). Agro-ecological zones range from Upper Highlands (UM) 2 to the West near Nyahururu to the Upper Midland (UM) 6 in the north. The Upper Midland zone is the largest AEZ and is largely associated with ranching. Laikipia County is a multi-ethnic county with a substantial number of agro-pastoral and pastoral communities, ranchers, and horticulturalists. The county also hosts numerous wildlife conservancies (Laikipia CIDP, 2013). It is made up of extensive semi-arid lands as well as arable and urban areas. Pressures on water and land resources has greatly gone up in recent years, with increased farming activities, rapid population growth, and periodic drought as well as climate variability (Laikipia CIDP, 2018).
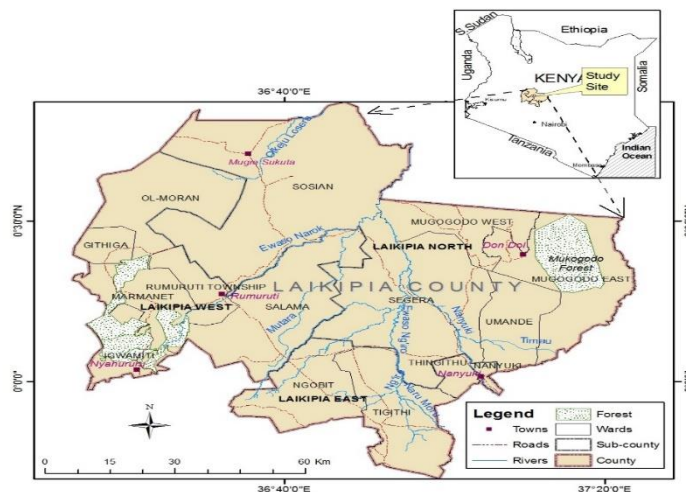

Figure 1: Map of Laikipia County, the study area
Source: State Department of Lands, Laikipia County (2022)

The land use systems in Laikipia are strongly reflected by population dynamics in the sub-county. In the upper region, intensive maize, wheat, and beans farming is practiced as well as rearing of dairy animals. In the lower region, agro-pastoralism and pastoralism is practiced. Irrigation farming has also been practiced in the lower region where tomatoes and onions are grown. Most immigrants moving to Laikipia are Kikuyu peasants from high potential regions in Central Province who continue their habitual systems of rain-fed mixed farming in their new home area (GLOPP, 2007). The main crops grown include wheat, maize, beans, potatoes, and vegetables. Maize takes about 51 percent of the total planted area. Crop farming is mainly undertaken in the southwestern parts of the county due to favourable weather conditions (Laikipia CIDP, 2018). Efforts are now being put in place to promote the resistant crops such as millet, sorghum, sunflower,

and black beans (dolichos). There is an emerging trend of increased horticulture production both at large-scale and small-scale levels. This constitutes production of cut flowers, tomatoes, French beans, Aloe, chilies, and watermelons. There are also pockets of pineapple farms, orange trees, and coffee bushes (Laikipia CIDP, 2018). Laikipia County has a total population of 518,560 of which 259,440 are males, 259,102 females and 18 intersex persons. There are 149,271 households with an average household size of 3.4 persons per household and a population density of 54 people per square kilometre (KNBS, 2019). Laikipia County was selected because of its adverse effect of climate change, its prevalence of climate-smart agricultural practices and its vulnerability to drought. In addition, majority of the farmers are smallholders.

Sampling

A multi-stage sampling technique was used to obtain a representative sample of 384 smallholder farmers households. In the first stage, three sub-counties were purposively selected – Laikipia East, Laikipia West and Laikipia North. In the second stage, five wards were purposively (owing to the importance of farming activities) selected (Ngobit and Tigithi wards from Laikipia East Sub-county; Salama and Marmanet wards in Laikipia West Sub-county; and Sosian ward in Laikipia North Sub-county). The determination of the sample size followed proportionate to size sampling methodology (Kothari, 2004) as shown in the equation below:

Equation 1

$$n = \frac{z^2 pq}{E^2}$$

$$n = \frac{1.96^2 0.5^* 0.5}{0.05^2} = 384$$

Where; n = Sample size; Z= confidence level (α=0.05); p = proportion of the population containing the major interest q = 1-p E= allowable error. Since the proportion of the population is not known, p= 0.5, q= 1-0.5=0.5, Z= 1.96 and E = 5%. Table 1 shows the population and the household sample size from each of the sub-counties studied. Systematic random sampling was used to select every tenth household from the sample size. A questionnaire was used to collect data from the sampled households (all of whom were farmers).

Table 1: Sample Size Selection per Sub-County in Laikipia County

Sub-County	Population	Households	Percent	Sample size
Laikipia East	187,707.92	26,888.54	36.2%	139
Laikipia West	195,810.42	28,049.19	37.8%	145
Laikipia North	135,041.67	19,344.27	26.0%	100
Total	518,560.00	74,282.00	100.0%	384

Source: Rep. of Kenya (2019)

Data Analysis

First, the study sought to analyse food availability status at household level. Food security was measured using Food Consumption Scores (FCS) and Household Dietary Diversity Scale (HDDS). FCS is a computation that takes the weight of various food groups that have been accessed during a reference period. HDDS is a measure of the different food groups that a household is able to access during a reference period.

The dependent variable (household food security status) was measured in terms of Household Dietary Diversity Scale (HDDS) and Food Consumption Score (FCS) and the resultant scores classified into five groups (Very low, Low, Moderate, High and Very high). Using a 24-hour recall period, this study sought to determine the households' dietary diversity by assessing consumption over the reference period. A total of 16 food groups were assessed. These include: Cereals/grain, roots/tubers, legumes/nut, orange vegetables (vegetables rich in Vitamin A), green leafy vegetables, other vegetables, orange fruits (fruits rich in Vitamin A), other fruits, meat, liver/kidney/heart/other organ meats, fish/shellfish, eggs, milk/other dairy products, oil/fat/butter, sugar/sweet and condiments/spices. FCS and HDDS were computed through qualitative assessment of the content of food consumed during a reference period (24hours in the case of this study). During FCS computation, the following weights were applied: Cereals and Tubers (2); Pulses (3); Vegetables (1); Fruit (1); Meat and fish (4); Milk (4); Oil (0.5); Sugar (0.5); and Condiments (0).

In order to use ordered logistic regression analysis, food security variable (Food Consumption Scores (FCS) and Household Dietary Diversity Scale (HDDS) were transformed into ordered variables which were classified into five groups (1 = Very low, 2 = Low, 3 = Moderate, 4 = High and 5 = Very high). *Ordered logistic regression analysis* was used to examine factors determining household food security status among smallholder farmers in Laikipia County, Kenya. The selected factors determining household food security status (derived from the FCS) included sex of the household head, age of the household head, number of years of formal education, marital status, household size (members), land ownership, land size under food crops (acres), land size under cash crops (acres), total land size owned (acres), number of extension contacts (in the last 1 year), total farm income (in the last 1 year), total non-farm and off-farm income (in the last 1 year) and perceived soil fertility of the farm (1-5 likert scale).

Results and Discussion

Figure 2 shows the frequency distribution of households who were reported to access each of the food groups in Laikipia county. The most accessed food groups were cereals and grain (82.0%), milk and other dairy products (49.5%), green leafy vegetables (45.3%) and roots and tubers (43.8%).
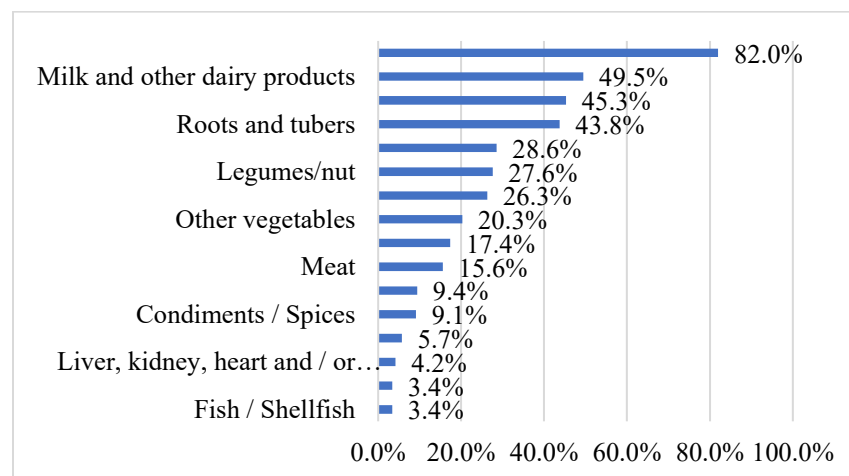

Figure 2: Household access to selected food groups in Laikipia County

Table 2 shows the mean Food Consumption Score (FCS) and Household Dietary Diversity Scale (HDDS) in Laikipia county. With respect to Food Consumption Score (FCS), an average household in this study scored a mean of 8.50 (standard deviation = 4.78). According to Jordan (2019), the household food security status can be described as "poor" when the FCS scores lies between 0-21, "borderline" when the FCS scores lies between 21.5 - 35, and "acceptable" when the FCS scores lies above 35. With a mean value of 8.5, household food security status in Laikipia County can be described as "poor". On the other hand, with respect to Household Dietary Diversity Scale (HDDS), an average household in this study scored a mean of 3.92 (Std. Dev. = 2.01). This imply that an average household in Laikipia County was accessing about four food groups out of a total of sixteen possible food groups. The common food groups accessed by the respondents were: Cereals/grain; milk and other dairy products; green leafy vegetables; and, roots and tubers (Figure 2).

Table 2: Food Security status scores in Laikipia county

Food security scores	Obs	Mean	Std. Dev.	Min	Max
FCS	384	8.50	4.78	1	25
HDDS	384	3.92	2.01	1	11

These findings agree with NDMA (2022) assessment that reported 33% of households in Laikipia County did not portray acceptable levels of food security with respect to FCS. Households whose food security was acceptable were mainly drawn from mixed farming zones while majority of households with poor and borderline FCS were in less arable areas where mixed farming was not common. Pastoral livelihood zone presented majority of households with poor FCS.

Table 3 shows the Ordered Logistic Regression analysis results for the determinants of household food security among smallholder farmers in Laikipia county. Ordered logistic regression analysis was executed between the food security (measured in terms of FCS) as the independent variable and household characteristics (dependent variables). The log likelihood for the fitted model of -494.94 and the likelihood ratio chi-squared value of 58.95 at 13 degrees of freedom (Prob> chi2 = 0.000) indicate that the thirteen parameters in the model are jointly significant at 5%. Pseudo R^2 of 0.056 meet the statistical threshold confirming that household food security in the study area was well attributed to the selected factors

The coefficient for sex of the household head (0.557) was positive and statistically significant at 5% (p-value = 0.007). In the study, there was 44% and 56% representing female and male respectively. When it came to household heads, female and male were 23% and 77% respectively. According to Tesfaye et al. (2022), rural female farmers in East Africa have lower agricultural productivity than male farmers. This can be attributed to reduced women participation in decision-making, constraints related to customary laws which favour men, and limited access to productive resources (including land, extension services, processing and transport (Regmi and Weber, 2000). It is our view therefore that male-headed households were more likely to be food secure compared to female-headed households. This view is supported by the findings of CARE (2020) where male-headed households were more food secure than female-headed households. Thus, gender-based discrimination is one of the causes of poverty and food and nutrition insecurity.

Table 3: Ordered logistic regression results for the determinants of household food security

Household food security using FCS parameter	Coef.	Std. Err.	Z	P>z	[95% Conf. Interval]	
Sex of the household head	0.557	0.206	2.704	0.007	0.152	0.961
Age of the household head (in years)	-0.017	0.004	-4.250	0.000	-0.035	-0.052
Number of years of formal education	0.015	0.028	0.536	0.592	0.009	0.024
Marital status (1 = Married, 0=otherwise)	0.614	0.234	2.624	0.009	0.156	1.072
Household size (members)	-0.064	0.026	-2.462	0.014	-0.082	-0.046
Land ownership (1=Own with title deed, 0=Otherwise)	0.277	0.056	4.946	0.000	0.002	0.279
Land size under food crops (acres)	0.027	0.124	0.218	0.826	0.216	0.270
Land size under cash crops (acres)	0.519	0.128	4.055	0.000	0.268	0.769
Total land size owned (acres)	0.143	0.091	1.571	0.118	0.036	0.321
Number of extension contacts in the last 1 year	0.211	0.092	2.293	0.022	0.030	0.392
Total farm income in the last 1 year	0.021	0.0036	5.833	0.000	0.017	0.025
Total non-farm and off-farm income in the last 1 year	0.011	0.0029	3.793	0.000	0.005	0.017
Perceived soil fertility of the farm (1-5 Likert Scale)	0.175	0.026	6.731	0.000	0.072	0.278

Note: N = 379, Log likelihood = -494.94, LR chi2 (13) = 58.95, Prob> chi2 = 0.000, Pseudo R^2=0.056

The coefficient for age of the household head (in years) (-0.017) was negative and statistically significant at 5% (p-value = 0.000). This implies that older farmers were less likely to be food secure in their households compared to young farmers and hence age of the household head (in years) is an important determinant of household food security. The findings agree with Ogunmodede and Omonona (2020) who indicated that an increase in the age of the household head subsequently increases the incidence to food insecurity. In their study on food security in Nigeria, the researchers found that food insecurity escalated at the age between 21 – 70 years. In a related study, Mungai (2014) and Bashir *et al.*, (2010) reported that an increase in age decreased the probability of being food secure. Contrary to these assertions, Onianwa and Wheelock (2006) concluded that an increase in the age of households reduced their food insecurity by 2%. These findings bear similarity with Demeke and Zeller (2010) and Bogale and Shimelis (2009) who found that food-secure households have an older head of the household. In Laikipia county (as per this study), 15% of the respondents were aged 60years and above, while those aged 21-40 years and 41-60 years were 31% and 54% respectively.

The coefficient for marital status (0.614) was positive and statistically significant at 5% (p-value = 0.009). This implies that married farmers were more likely to be food secure in their households compared to their non-married counterparts and hence marital status is an important determinant of household food security. The findings of this study agree with Chege et al. (2016) and Yusuf et al. (2015) which found a positive and significant relationship between food security and the marital status of the household head. The argument in these studies is that joint attempts to provide for the food requirements of the household improve the chances of being food secure. In Laikipia county, majority of the respondents were married (71.6%). Other respondents were single (12.8%), widowed (10.2%), divorced (3.1%) and separated (2.3%). Thus, married households are more likely to be food secure.

The coefficient for household size (members) (-0.064) was negative and statistically significant at 5% (p-value = 0.014). This implies that farmers with more members were less likely to be food secure in their households compared to those with fewer members. The findings of this study agree with Bahiru et al. (2023) and Gecho *et al.* (2014) who found that large families were more likely to experience food insecurity than households with a small number of family members. In contrast, Reincke *et al.* (2018) while investigating factors influencing food security of smallholder farmers in Tanzania, reported that the number of members of the family improved household food availability due to combination of efforts through earning of wages.

In Laikipia county, Majority (68.8%) of the respondents had a household size of 1-5 members. About 30.4% of the total respondents had household size of 6-10 members. There were very few respondents with households that had more than ten members as represented by 0.8% of the total responses (Table 4). The mean household size of the respondents in Laikipia was 4.84 – slightly higher than the national average of 3.9(KNBS, 2019). Despite the high number of household members, a majority of the households (88%) had annual income of less than KES. 100,000, implying high vulnerability to food insecurity.

Table 4: Household Size in Laikipia county

Household Size	Frequency	Percent
1-5	264	68.8
6 – 10	117	30.4
11 and above	3	0.8
Total	384	100.0

Mean = 4.84; Median = 5; Mode = 5; Minimum = 1; Maximum = 12

The coefficient for land ownership (0.277) was positive and statistically significant at 5% (p-value = 0.000). The positive and significant correlation is further supported by the fact that majority of the farmers (82%) owned land with title deeds. Besides ownership, farmers in Laikipia county have a mean land acreage 3.1. This implies that farmers with title deeds were more likely to be food secure in their households compared to these without title deeds. Therefore, land ownership is an important determinant of household food security. The findings of this study agree with Bahiru et al. (2023) that indicated that farmland ownership is positively related to food security and is statistically significant at the 1% probability level. According to the study households that owned land (with legal documentation) were more food secure than households who did not own land. This could be because land ownership is a proxy for a variety of factors such as wealth, credit availability, capacity to bear risk, and income. Larger farms are associated with greater wealth and income, as well as greater capital availability, increasing the likelihood of investment in farm inputs that increases food production and ensure food security. Large farms are associated with greater efficiency in the use of farm resources than small farms. They noted that small holdings discourage the use of modern inputs due to a lack of purchasing power in the hands of small farmers.

In Laikipia county, the average acreage under food crops among the study respondents was 1.37 acres while the mean acreage under cash crops was 0.95 acres. The least and the maximum acreage of land size under both food and cash crop were 0.1 and 5.0 acres, respectively. The coefficient for land size under cash crops (acres) (0.519) was positive and statistically significant at 5% (p-value = 0.000). This implies that farmers with greater involvement in cash crop farming were more likely to be food secure compared to those who don't grow cash crops and hence land size under cash crops (acres) is an important determinant of household

food security. In a study of climate change adaptation and sustainability in sub-Saharan small-scale agriculture, Jerneck (2017) found that access to land as a productive resource influenced food security. Thus, households with small pieces of farmland are more likely to be vulnerable to food insecurity. The positive relationship between cash crops and food security is also evidence that farmers in Laikipia county are moving away from subsistence farming and embracing agribusiness. This view and study findings are corroborated by Graeub *et al.* (2016) who found that growing of traditional cereals such as millet and sorghum as cash crops had a positive and significant influence on household food access and availability.

The coefficient for number of extension contacts in the last 1 year (0.211) was positive and statistically significant at 5% (p-value = 0.022). This implies that farmers with more contact with extension service providers were more likely to be food secure in their households compared to their counterparts who had less extension contact. Indeed, as shown in Table 5, a majority of farmers had contact with extension officers within a year. There should however be concern that nearly a third (34%) of smallholder farmers did not have contact with extension officer. The positive and significant relationship between food security status and the number of extension contacts signify the importance of extension services in agricultural productions and subsequently food security. These results agree with Danso-Abbeam et al. (2018) who found that the role of agricultural extension today goes beyond the transfer of technology and improvement in productivity, but also, it includes improvement in farmers' managerial and technical skills through training, facilitation and coaching, and enhancement of rural food security, something that greatly enhanced the levels of food security among the farmers that had access to agricultural extension services.

Table 5: Number of Extension Contacts in Laikipia County

Access to Extension Services	Sub – County			Total
	Laikipia North	Laikipia West	Laikipia East	
None	30.2%	38.4%	34.8%	34.7%
Once	22.0%	30.6%	29.6%	27.2%
Twice	20.8%	11.2%	28.7%	17.9%
Thrice	10.0%	7.6%	7.0%	8.0%
More than three times	17.0%	12.2%	0.0%	12.2%
Total	100.0%	100.0%	100.0%	100.0%

The coefficient for total farm income in the last 1 year (0.021) was positive and statistically significant at 5% (p-value = 0.000). This implies that farmers who realized more income from farming were more likely to be food secure in their households compared to those who received less farm income. Therefore, total farm income is an important determinant of household food security. The findings of this study are consistent with Hassan *et al.* (2018) who established that the HFAIS score decreased with the increase in farm income as measured by the number of cattle owned by the farmers. This confirms that greater farm income (especially through ownership of cattle) is associated with greater food security at the dimension of food access. Thus, through more farm income, households are able to afford increased consumption of variety of foods in the households. Farmers with more domestic animals had better opportunities to increase income and consume diversified foods, such as fish and meat. Similarly, FAO (2019) that found that households with lower farming incomes relatively scores higher in HFAIS and are more likely to be less food secure in terms of access. Agricultural productivity has direct implications on income as well as on

the household food security. Increased income is associated with greater food consumption and improved nutritional status of household members (FAO, 2019).

The coefficient for total non-farm and off-farm income in the last 1 year (0.011) was positive and statistically significant at 5% (p-value = 0.000). This implies that farmers who had more income coming from off-farm and non-farm activities were more likely to be food secure in their households compared to their counterparts who had less off and non-farm incomes. Unfortunately, in Laikipia county, a vast majority of smallholder farmers (88%) and an annual income of KES 100,000 – this translates to paltry monthly income of KES 8000 or less. According to Reincke *et al.* (2018), household's ability to save part of their income is also a major determinant of food availability among smallholder farmers. Households that were able to save part of their income were more food secure as compared to their counterparts who were not able to save. With very low income, it is unlikely that majority of farmers can save.

The coefficient for perceived soil fertility of the farm (0.175) was positive and statistically significant at 5% (p-value = 0.000). This implies that farmers who perceived their farms as having fertile soils were more likely to be food secure in their households compared to their counterparts who complained of low fertility. The findings of this study are consistent with Jerneck (2017) who found that smallholder farmers with a higher share of infertile land are more food insecure in terms of access. Despite the positive and significant relationship, a majority farmers in Laikipia county rated their as moderately fertile (43%) and fertile (39%) (Table 6). It therefore behoves the stakeholders in the agriculture sector to initiate programmes of fertilizer subsidy and use of farmyard manure in improving agricultural productivity.

Table 6: Extent of Soil Fertility in Respondents' Farms

Ratings	Frequency	Percent	Cumulative Percent
Very fertile	39	10.2	10.2
Fertile	151	39.3	49.5
Moderately fertile	164	42.7	92.2
Not fertile	24	6.3	98.4
Very infertile	6	1.6	100.0
Total	384	100.0	

Conclusions

The study sought to examine determinants of food security status among households in Laikipia county, Kenya. The Food Consumption Score (FCS) was correlated with household characteristics. In Laikipia county, the commonest food groups accessed by the respondents were: Cereals/grain; milk and other dairy products; green leafy vegetables; and roots and tubers. Based on the FCS, farming households were found to be having a food security status of 'poor'. While an average household in Laikipia County was found to access four food groups out of a total of sixteen possible food groups. The study further established sex, age of household head, marital status, land ownership, acreage under cash crops, income and soil fertility were key determinants of food security status in Laikipia county. Specific interventions that are geared towards addressing the food insecurity situation among female headed households as well as those that are headed by older persons should be prioritized. The government should enhance the process of legalizing the documentation of land through prompt issuance of title deeds to and ensure all farming households have ownership to land. More effort is required to build the capacity of smallholder farmers towards agribusiness

and promotion of cash crop farming. The government should support both private and public extension services provision and continued support of fertilizer subsidy programme for greater food security among farmers.

References

Carlson, A., & Shumba, E. (2011). *Status of and response to climate change in Southern Africa: Case studies in Malawi, Zambia and Zimbabwe*. WWF–World Wide Fund for Nature.

FAO. (2016). *The state of food and agriculture: Climate change, agriculture and food security*. FAO.

FAO, ECA, & AUC. (2021). *Africa – Regional overview of food security and nutrition 2021: Statistics and trends*. FAO. https://doi.org/10.4060/cb7496en

Mumuni, S., & Aleer, M. J. (2023). Zero hunger by 2030 – Are we on track? Climate variability and change impacts on food security in Africa. *Cogent Food & Agriculture, 9*, 2171830. https://doi.org/10.1080/23311932.2023.2171830

Ogundari, K., & Awokuse, T. (2016). *Assessing the contribution of agricultural productivity to food security levels in SSA countries*. Paper presented at the Agricultural & Applied Economics Association Annual Meeting, Boston, MA, United States.

UNDP. (2017). *Adaptation to climate change in arid and semi-arid lands (KACCAL)*. http://www.ke.undp.org/content/kenya/en/home/operations/.../Adaptation_to_Climate_Change.html