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Influence of land use patterns on food security in Narok East sub-county, Narok county, Kenya

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Abstract

Global food security is likely to remain a problem worldwide for many years if the world cannot formulate methods to control the situation. Crop yields have dwindled in many areas due to declining investments in research and infrastructure as well as increasing water scarcity which are preconditions for global food security. By the year 2016, an estimated 120,000 people in rural areas and 30,000 in urban centers of Narok County were food insecure. This has attributed to a mismatch in food availability, access and utilization. The purpose of this study was to establish Influence of Land Use Patterns on Food Security in Narok East sub-County, Narok County, Kenya which like other counties in the ASAL areas experience cases of food insecurity. The study adopted human capability approach**.** A descriptive research design was adopted for the study. The target population comprised of 25078 households distributed proportionally in the 4 wards and are involved in different farming activities. 378 household heads were determined using the sample size determination formula by Krejcie and Morgan (1970) from the target population which became the sample. Furthermore, 1 sub-County Agricultural Extension officer and 4 ward crop officers were used in the study. The number of respondents for the study became 383 in total. Primary data was collected using a questionnaire and an interview guide. Data analysis was done using descriptive statistics of frequencies, percentages and inferential statistics of correlation, ANOVA and regression analysis. Statistical Package for Social Sciences software version 26 and the Excel software were used as a data analysis tools for the study. The results was presented using frequencies, percentages, tables and charts. The relationship between the variables was tested at a significant level of 5%. Results show that there is a very strong positive and significant correlation between land use patterns and food security ($r = .752^{**}$ and a p-value of 0.000). This implies that the relationship between the variables is very significant hence land use patterns have a strong influence on food security in Narok East sub-County. The study concludes that the null hypothesis that there is no relationship between land use patterns and food security was rejected because the ANOVA model indicated a very significant and statistical relationship between the two variables. The study will beneficial to the farmers in the ASAL areas who have consistently experienced food security issues. The study will also benefit the National Government, County Governments and other Non Governmental Organizations in the area of food security as it will provide appropriate data that was used for policy making processes.

Keywords: arid and semi-arid areas, food security, land use patterns, Narok East sub-county, Narok county

Introduction

Collectively, food insecurity reduces global economic efficiency by 2% –3% yearly (USD 1.4–2.1 trillion), with individual nation costs projected at 10% of GDP (Harrigan 2014) [21]. Global food security is likely to remain a problem worldwide for the next 50 years and beyond if the world cannot formulate methods to control the situation. While agro-ecological approaches give some promise for yield improvement, increases in investment and policy reforms could significantly improve food security globally if well implemented (Harrigan. 2014) [21]. Béné, (2020) [6], further establishes that the number of hungry people worldwide is growing, reaching 1.1 billion in 2019.

Africa has been struggling in one form or another with food insecurity for almost half a century due to a number of factors including distribution obstacles, global climate change, lack of successful local agriculture and inability or disinterest to act by local officials (Warr, 2015) [49]. Although most people would concur that each of these factors carries at least some logic, there is far less international accord on the best solution to the crisis. Ever since food aid to Africa began in the late 1950s, the predicament has been characterized as a supply affair. Inadequacy of successful and widespread agriculture in SSA led to the inability of local governments to provide enough food for their populations (FAO, 2011) [16].

Nationally, due to increased population growth food production is estimated to be lower than consumption. According to Gwada *et al.* (2020) [20], annual agricultural production will need to rise by an estimated 75% from 2015 levels in order to meet consumption in 2030. In 2008, an estimated 1.3 million people in rural areas and 3.5 – 4 million in urban areas were food insecure. An estimated 150,000 persons residing predominantly in high-potential areas of the Rift Valley province were highly food insecure due to the post-election crisis (Omari, 2016) [37].

Only about 2% of arable land in Kenya is equipped for irrigation. Farmers struggle to gain access to adequate seed, fertilizer and other inputs (Poulton & Kanyinga, 2014) [42]. The effects of land use processes – a source of grave, albeit familiar, concern for many people in Kenya and in East Africa generally – present formidable threats to farmers. In 2017, the government declared a national drought emergency for all 23 of Kenya's arid and semi-arid counties especially those that emanate from the northern hemisphere of the Country. While most Kenya households have worthy

food utilization (88%), around four million individuals (12% of families) have unacceptable utilization, which translates into a diet that comprises essentially of a staple, enhanced with green vegetables and oil.

According to the global food security index of 2017, Kenya is food insecure and was ranked position 86 out of 113 countries. A snap review of Kenya's food balance sheet shows that Kenya imports most of the basic food commodities including wheat, Maize, Rice, Beans, Potatoes, sugar and Milk (M'Kaibi, *et. al*, 2017) [34]. Imports contributed 25% of the key grains consumed in 2010 and this increased to 32% in 2015 and was projected to reach 36% in 2016.The big four agenda on Food Security proposes that there is need for proper policy and strategic interventions with a view to mitigating the challenges the sector faces (PDU,2018) [40]. However, one of the main challenges in the implementation of Food security initiatives in the Agenda four is inadequate budgetary allocation towards the realization of food security goal in Kenya. According to Kivisi (2019) [28], pre- and post-harvest crop losses, inadequate research-extension- farmer linkages to increase agricultural productivity, lack of mechanized methods of production as well as high costs and adulterated farm input like fertilizer, seeds, pesticides and vaccines are some of the main challenges the Big Four Agenda is currently facing in Kenya. To achieve food security and proper nutrition for all Kenyans, the government targets to increase production of maize from 40 million 90 kg bags annually to 67 million bags by 2022; rice from around 125,000 metric tons currently to 400,000 metric tons by 2022 and potatoes from the current 1.6 million tons to about 2.5 Metric Tons by 2022. In the 2018/2019 budget, Ksh. 17.9 billion was allocated for ongoing irrigation projects countrywide with a view to transforming agriculture from subsistence to productive commercial farming (Gwada, Ouko, Mayaka, & Dembele, B. 2020) [20].

Narok County has the proportion of households in pastoral livelihood zone with acceptable food consumption score has declined from 93 percent 2016 to 68 percent in 2018, while in the agro-pastoral livelihood zone, it has declined from 20 percent to three percent in the same duration, indicating declining household dietary diversity and food frequency. The mean coping strategy score is at 17 as of 2019 implying that households are employing severe coping strategies and engaging less in consumption-related mechanisms (Gwada *et. al*, 2020) [20]. Many farmers have complained time and again on these delays and in the long run this has compromised the planting season hence low yields.

According to Kivisi (2019) [28], maize production in the mixed farming and agro-pastoral areas decreased by 42 percent of the Long-Term Average (LTA), reducing availability of food at the household level. The area under production of maize declined. This was attributed mainly to increased cases of Maize Lethal Necrosis Disease (MLND) in the previous years that encouraged more farmers to abandon maize production for beans and Irish potatoes (Narok County Integrated Development Plan, 2018) [35]. Similarly, the projected yield exhibited a corresponding decrease as a result of poorly distributed rainfall during the production period. Area and production of beans increased above the LTA as farmers had easier access to seeds. Government subsidized fertilizer was also available in appreciable quantities when farmers needed it.

According to the Kenya National Bureau of Statistics (2019), Narok County has a population of 1,153,273 with a population density of 47 persons per square kilometer. Narok County is largely divided into 4 livelihood zones namely mixed farming, agro pastoral, pastoral and formal employment. More than one third (33.8%) of the population in Narok County lives under poverty line (KNBS, 2019). Even though the county is endowed with natural resources such as those found in the Maasai Mara Reserve, the Mara River and has arable land suitable for agriculture. The main economic activities in Narok County are tourism given the Maasai Mara, commercial farming (wheat), and livestock farming. Majority of farmers in Narok County work without basic agricultural inputs or modernized technology and also lack adequate financial and extension services to promote sustainable production.

Statement of the Problem

Food security remains one of the main concerns for the residents of Narok East sub County, Narok County. Despite significant food security initiatives in the sub-County, food insecurity and extreme rural poverty has continued to pose major socio-economic problems to many households in the sub County to date (Kileteny and Wakhungu, 2019) [27]. The transition rate of food poor households to self-reliance of food supplies has largely remained inadequate (Gwada *et. al*, 2020) [20]. The Government and other development agencies have over time invested large amount of resources in order to address food security concerns through projects and programmes but minimal success has been realized. According to Kenya National Bureau of Statistics (2019), an estimated 120,000 people in rural areas and 30,000 in urban centers of Narok County remain food insecure. A good percentage of this population resides in Narok East which is drier and experiences high levels of drought throughout the year. Kileteny and Wakhungu (2019) [27], attributes food insecurity to low allocation of funds to the agricultural sector by Narok County government which has made it difficult to carry out the extension services to enhance farmer's knowledge in improving agricultural production.

The most productive areas in the County are faced with poor accessibility in terms of road network system which according to Action aid (2017) report, the county loses an estimated 40% of its produce due to poor post-harvest practices. There is poor marketing and logistics practice which makes it difficult to distribute the harvest to the most affected people in the sub-County. Food insecurity remains one of the most crucial challenges to economic development in most ASAL areas such as Narok East sub-County, Narok County (Kileteny & Wakhungu, 2019) [27]. Whereas it appears that there are many factors that determine the success or failure of food security initiatives in Narok County, the thrust of this study was to establish the extent to which land use patterns determine Food Security in Narok East sub-county, Narok County, Kenya.

General Objective of the study

The general objective of the study was to assess Influence of Land Use Patterns on Food Security in Narok East sub-County, Narok County, Kenya

Hypothesis of the Study

The study was guided by the following hypothesis;

$H0_1$: There is no relationship between land use patterns and

food security in Narok East sub-County, Narok County, Kenya

Literature Review

Human Capability Approach

This is an economic theory pioneered by Sen (1981) [4] and advanced by Nussbaum (2001) [36] and mainly focuses on what people are capable of doing. According to Sen, pertinence of real freedoms in assessing an individuals advantage in the community and ensuring that such freedoms can be fully disributed for the whole community to enjoy available resources and opportunities is very key under this theory (Richardson, 2017). The theory is widely applied by the United Nations Development Progrogramme especially when generating the human development indices since 1990 (Boni and Walker, 2016) [7]. The focus of the theory is mainly on advocacy for better livelihood among people in the society (Singh, *et al.* 2017) [57].

The approach further affirms that for peoples' capabilities to be at the center of development, there is need for them to own both movable and immovable property like land for their own utilization. Policies should be put in place on land ownership, land tenure systems and these policies should be pro-poor to enable them flourish in all dimensions of life. Despite improving the capacity of farmers to enhance food security, there is need for entitlement to these resources because ownership of resources enhances confidence hence increased investment and productivity.

Land Use Patterns on Food Security

According to Baltissen and Betsema (2016) on "Linking Land Governance and African Food Security: Outcomes from Uganda, Ghana and Ethiopia," land governance in Uganda is characterized by the inconsistency between relatively progressive legislation and only limited implementation. Baltisen and Betsema, (2016) [5] further assert that women's position on land and inheritance also remains weak, both legally and in practice, undermining their livelihoods and social status. As the main parties on food security initiatives in Uganda, women are still marred with many challenges which have emerged to be a hindrance towards food security.

Baltisen and Betsema (2016) [5], further establish that the basis for Ghana's land governance and administration is a complex mix of political, legislative and customary procedures and frameworks. The current system of land management is one of legal pluralism which results in competing claims and potentially risky investments. The Ghana National Land Policy was introduced in 1999 to resolve a series of issues such as poor land management; land market conflicts and the state's expropriation of large tracts of land combined with a lack of landowner consultation. Women are key players in the agricultural sector in many developing countries especially the Sub-Saharan Africa, and poor land inheritance structures have put women in a compromising situation in developing countries with regard to food security.

In their study on ' Influence of Livelihoods on Household Food Security in Pastoral Areas of Narok County, Kenya, ' Kileteny and Wakhungu (2019) [27], established that livelihoods are conceptually seen as comprising different types of capital that can profit individuals and, in particular, human, social, cultural, physical and natural resources possessed by and are at the disposal of individuals. Pastoralists have developed various adaptation mechanisms within this volatile, fragile, and complex climate to maintain an ecological balance between themselves and the natural environment (Hashim, *et. al*, 2016) [22]. Kileteny and Wakhungu (2019) [27], further maintain that natural capital includes land, water, and all of the earth's habitats needed for human survival and well-being. In this case, land use is very poor due to inadequate government incentives, harsh climatic conditions and the very tastes and preferences of the indigenous people living in the larger Narok County.

Kumba *et al.* (2015) [32], in their study on 'Influence of agricultural land use on household food security situation in Kisii Central Sub-County, Kenya ' further aver that Kisii Central Sub-County is marred with household food insecurity and around 60 percent of the population were found to be food insecure as of 2014. This situation was attributed to many factors including a decline in land assets due to high population growth (2.72 percent per year) and an average population density of 1056 people per square kilometer. This is a threat to agricultural sector as arable land has been reduced as a result of increased land sub-division and non-agricultural uses such as construction and settlement that are rampant in Kisii County. The land holdings are small, with an average of about 0.5 hectares for farm families of around five which are not tenable for agricultural purposes.

In addition, soil fertility has gone down as a result of continuous crop production and this has a negative impact on food production since most crops are correlated with low yields (Place and Hoffman, 2004). This dilemma is further compounded by the use of low yield levels to raise inputs for both food and cash crops, resulting in low crop income levels (Dietz, *et. al*, 2014) [12]. Kisii Central Sub-County is also faced with a 54.2 per cent high level of poverty that has a negative impact on agricultural production and household food security. Food security in the home is based on the premise that households can meet most of their food needs through their own production and/or market purchases. Therefore, land use becomes an important determinant of subsequent source of livelihood.

According to Omari (2016) [37], one of the main aspects considered for the analysis in a study on "Stakeholder Issues Influencing Implementation of Food Security Projects in Msambweni District, Kenya" was the extent at which land ownership influences food security projects in Msambweni District. The results stated that land ownership was found to be a determinant of food security for households. Relatively land-rich households almost all met 80 per cent of their calorie requirements. The study further suggested that a household with a greater holding of land was found to be in a better food security position than that of land-poor households. The overall findings of the study postulated that land holding is the most common asset in rural areas and this was a good indicator of deprivation and hence households with small farms were vulnerable to food insecurity. Additionally, the quality of the land was found to provide a general overview of what households could expect in terms of food security.

Indicators of Food Security

Accessibility to food is a measure of the capacity to secure privileges that are characterized as the set of assets a person needs to get access food (FAO, 2011) [16]. Food security had been majorly connected to national food production and

worldwide trade until the 1970s, however, since then the idea has extended to incorporate access to food for households and individuals. According to Sanchez *et. al.* (2009) [44], food accessibility is established by the physical amounts of food that are produced, stored, prepared, supplied and exchanged.

Food availability is a measure of the capacity to ensure privileges, which are characterized as the set of assets that a person needs obtaining access to food (FAO, 2011) [16]. Until the 1970s, food security was connected majorly to national food production and worldwide trade however since then the idea has extended to incorporate households' and people's access to food. According to Sanchez *et. al.* (2009) [44], food availability is determined by the physical amount of food produced, stored, processed, supplied and exchanged. Food accessibility is the net residual sum after production, the quantity of stocks and imports and the deduction of exports for every item included in the food balance sheet (World Bank, 2018) [52].

Zuberi and Thomas (2011) [53], further note that high food market costs are commonly an impression of deficient accessibility; persistently high expenses force needy individuals to lower consumption underneath the minimum needed for healthy and active living, and may prompt food changes and social unrest. Rising water, land and fuel shortage is likely to put greater pressure to food upheavals, even without climate change. Where these weaknesses are exacerbated by the impacts of climate change, the implementation of alleviation techniques that make rivalry for land-use and the attribution of market value to environmental services to moderate climate change, they can possibly cause critical changes in relative costs for different food items, and a general increment in the cost of a normal food basket.

Research Methodology

Research Design

The study adopted a descriptive research design. Descriptive research is defined as a method that describes the characteristics of the population or phenomena under study (Kothari, 2019) [30]. For the purpose of this study, the design assisted in collecting data that helped in ascertaining determinants of food security in Narok County, Kenya. The research design assisted in assessing respondents' expectations, views and opinions about the relationship between the variables (Orodho, 2009) [39]. This approach guided the study to gather both quantitative and qualitative analytical data. Quantitative data was collected from farmers (household heads) while qualitative data was collected from agricultural extension workers from Narok East sub-County, Kenya. The unit of analysis in the study was both at the sub-County and household levels in Narok County, Kenya.

Target Population

A study population according to Kothari (2019) [30] consists of all items in any field of study. The number of Households in Narok East sub-County is 25,078 (KNBS, 2019). There are 30 Agricultural Extension Officers in the County who were considered for the study as they are distributed in all the sub-counties in Narok County (Kenya National Bureau of Statistics, 2018). Narok County has 30 wards and each ward is represented by a ward crop officer. From the 30 Agricultural Extension workers, 4 Ward Agricultural Extension Workers/crop officers at the ward level and 1 Sub-county crop officer were used as key informants in the study.

Sampling Frame

A sampling frame is a list of all the items in a given population (Kothari, 2019) [30]. Gay (2009) [19] further explores that the difference between a population and a sampling frame is that the population is general and sampling frame is specific in nature with specific characteristics within which a sample was drawn from. In Narok East sub County, a list of all households carrying out different farming activities was obtained from the agricultural office and formed the sampling frame. For the agricultural officers, the list was obtained from the sub-County Agricultural office. The study was a census for the Ward Agricultural Extension workers. Stratified and simple random sampling techniques was used to select the sample from households (farmers) in the sub-County for the study.

Sample Size and Sampling Technique

According to Kothari (2019) [30], the sample size of a social study needs to be large enough in order to reduce sampling errors which affect the accuracy of the results. For this study, the sample was computed using sample size formula developed by Krejcie and Morgan (1970) as shown below:

$$n = \frac{\chi^2 \times N \times P(1-P)}{\left(ME^2 \times (N-1)\right) + \left(\chi^2 \times P \times (1-P)\right)}$$

Where
n = sample size
χ^2 = chi-square for the specified confidence level at 1 degree of freedom = (3.841) from tables
N = population size
P = population proportion (0.50 in the table)

$$n = \frac{3.841 \text{ x } 25078 \text{ x } 0.5 \text{ x } 0.5}{0.05^2 \text{x } (25078 - 1) + 3.841 \text{ x } 0.5 \text{x } 0.5}$$

= 24081/ (63.65)
= 378 Households

A sample for the study was selected from the households using simple random sampling method. The ballot method was employed where all households was allocated a random number and the numbers written on small pieces of papers that was put in a box and shaken then from each ward an equal number was selected through proportional allocation to make the 378 households. For the agricultural extension officers 4 agricultural ward/crop officers and 1 sub-county crop officer were used in the study. Therefore, for the agricultural extension workers the study was a census since Narok East sub-County has 5 agricultural extension workers (4 ward agricultural extension officers and 1 sub-County Agricultural extension officer).

Data Collection Instrument

An ordered questionnaire was adopted for this study as the principal instrument for data collection. A questionnaire collects data from respondents especially in cases where the respondents are spread out to a larger area and can be able

to read and write. Questionnaires, however, face the problem of high non-response rates, and thus need a lot of follow-up (Gay, 2009) [19]. A total of 378 copies of the questionnaires was prepared and issued to the respondents for the actual study and they was collected back for data analysis after two days. For the Agricultural extension workers, an interview guide was used in the study. A total of 5 copies was produced for the study

Data Collection Procedure

Once the proposal was approved, questionnaires and interview schedules were prepared for data collection purposes. Department of Development Studies provided the researcher with an introduction letter. An authorization letter/permit was further requested from NACOSTI in order to be given permission for data collection. The questionnaire was administered to individual respondents and collected back after two days for data analysis.

Pilot Study

Questionnaires were pre-examined before the actual study. A pilot test is a small-scale first-round study before the main research is conducted to assess the quality and reliability of data collection instruments (Kothari, 2019) [30]. Orodho (2008) [38], further states that a pilot test helps to unearth ambiguous questions and shortcomings in the questionnaire or the validity to which empirical assessments accurately measure the concept at hand. For the pilot test, 10% of sample was selected and used and hence 38 farmers and 1 ward agricultural extension worker were used to establish the validity and reliability of research instruments. The pilot study was done in Narok West sub-County, Narok County since it has similar characteristics like those of Narok East sub-County, Narok County, Kenya.

Validity of the Research Instruments

Validity refers to the degree to which the test sample reflects the substance intended for analysis by the test (Orodho, 2008) [38]. Factor analysis using Statistical Package for Social Sciences Software version 26 was used to test for validity. According to Field (2009), a validity index of 0.6 and above was appropriate for this study. In order to establish the overall validity of the research instrument for the study, Coefficient of Validity index was established as follows;

CVI = Level of agreement between any of the two questionnaires X 100%
Number of items in the questionnaire
= 23/31*100%
= 0.7419
= 0.74

The above index establishes that the research instrument merits to be used in the study as it agrees with Field (2009), that a validity index of 0.6 and above is appropriate for the study

Reliability of the Research Instruments

Reliability refers to the degree to which a given measurement method provides similar results over a number of repeated tests (Orodho 2008) [38]. Software version 26 of the Statistical Package for Social Sciences (SPSS) was used to measure the reliability index within which any research instrument with a reliability coefficient of 0.7 and above is acceptable as being reliable in a given study. For this study, a reliability index of 0.837 was established. These results corroborates findings by Saunders, Lewis and Thornhill (2009) and Christensen, Johnson and Turner (2011), who stated that reliability scales of 0.7 and above, indicate satisfactory reliability.

Data Analysis and Presentation

Descriptive Statistics

Data from questionnaires was summarized, edited, coded, tabulated and analyzed. Editing was done to improve the quality of data for coding. Editing involved going through the questionnaires to ensure that respondents have responded to questions appropriately. Questionnaires were analyzed using descriptive statistics of frequencies, means and percentages. Descriptive statistics used the Excel software for data analysis.

Inferential Statistics

The Social Sciences Statistical Package (SPSS) version 26 was used as a tool for data analysis. Analysis was done and used to check the essence of the connection between dependent and independent factors while regression and ANOVA was used to test the model's fitness to explain the connection between variables. Factor analysis was used to establish the overall variance between the items of each variable so that they can be used in the correlation and regression analysis. The study used both simple regression to test the relation on each variable and the multiple regressions to test the combined effect of the independent variables on the dependent variable.

Research Findings and Discussions

Findings of the Study

The study presented its findings in this section after data analysis for the purpose of tabulation and interpretation.

Response Rate

The study distributed a total of 378 questionnaires and only 299 were returned and used for the analysis. Figure 1 shows the response rate.

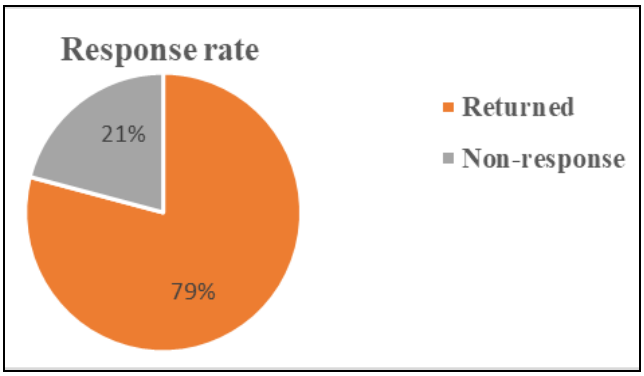

Fig 1: Response Rate

Figure 1 shows a 79% response rate, which was considered appropriate for the study. According to Marton (2006), a response rate of above 70% is considered appropriate for a descriptive study. The interviews were conducted successfully and all the five officers who were targeted were interviewed.

Demographic Data

Demographic variables are important in any descriptive survey because they have an influence on the response and the overall results of the study. For this study the demographic variables considered were; gender, education level, size of household, crops grown, land ownership titles, size of the land under crop cultivation and level of income.

In regard to gender of the respondents the study sought to establish the distribution of male and female respondents who participated in the study. Gender has an influence on the factors influencing food security in any country because the male have a different perspective on issue of food security from that of women. The results are presented in figure 2.

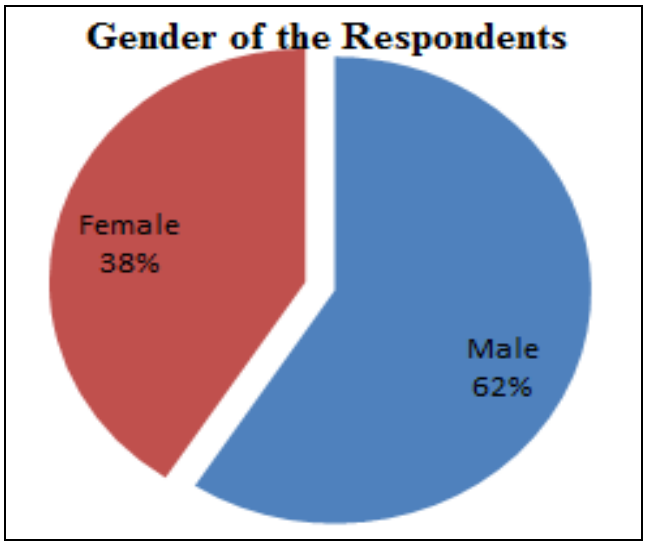

Fig 2: Gender of the Respondents

The results presented have indicated that there were more male 62% respondents compared to 38% female, though the margin was not very large to have influence on the overall findings of the study. This implies that most of the households that participated were headed by the male. This is true for patriarchal communities where the men are key decision makers in the family. A similar finding was noted by Alawode, Olaniran and Abegunde (2020), in their study on effect of land use and land market on food security status of farming households in South-Western Nigeria noted that majority of the farmers over 67% were male.

The study also sought to assess the response on the level of education of the respondents. This variable was important to this study because of the presumption that the level of education gives a person a better understanding of a situation and helps this person make appropriate decision on how to manage it. The results are presented in Figure 3.

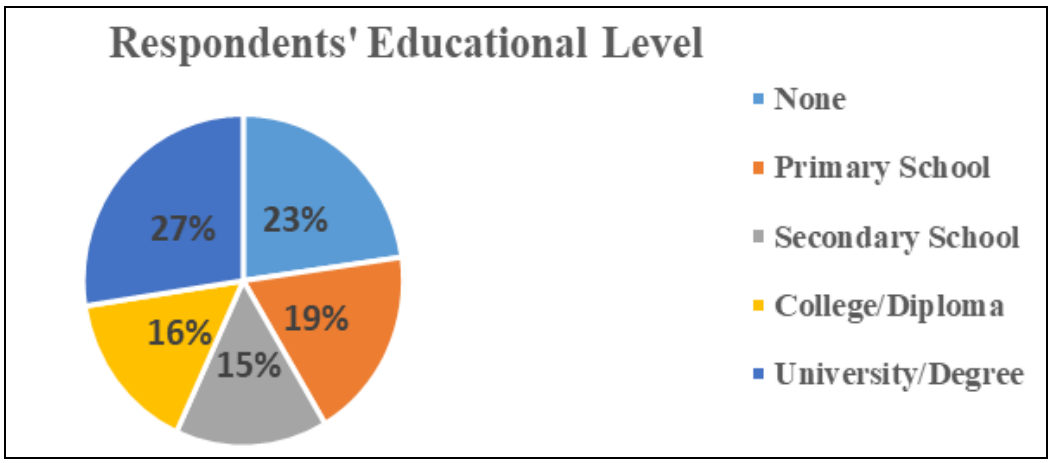

Fig 3: Education Level of Respondents

The results show that most of the respondents (27.8%) had attained university /degree level of education, 22.7 % had not attained any formal education, and 18.7% had only attained primary education while 15.7% and 15.4% had attained secondary school level and college / diploma respectively. This implies that most of the farmers had basic education which they use in making appropriate decision in their farming activities. Alawode, Olaniran and Abegunde (2020), also established the same in their study conducted where they noted that most of the farmers who have no good formal education can be contributing to the low productivity and hence food insecurity in many developing nations.

The study also sought to find out the average house hold size among the target population. This was important for this study as it helped to assess the implication of the size of the house hold on food security in the area. The results are presented in Figure 4.

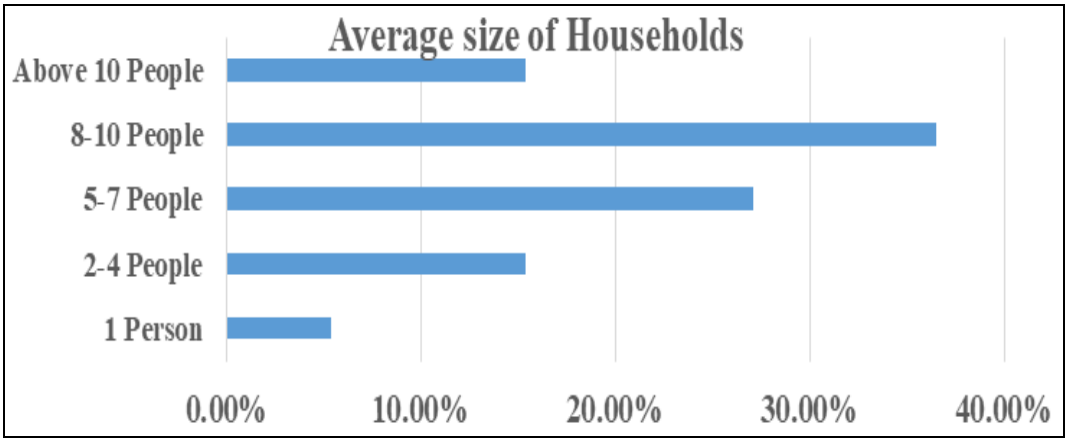

Fig 4: Average Size of Households

From the results, it is indicated that majority of the households in the sub-County (36.5%) had an average of 8-10 persons followed by 27.1% who had an average of 5-7 persons, 15.7% had an average of above 10 persons while 15.4% had an average of 2-4 persons. This shows that most households were large and hence their demand for food was relatively higher a fact that could compromise food security in the area.

The study also sought to find out the type of crops grown in the study area. The results are presented in figure 5.

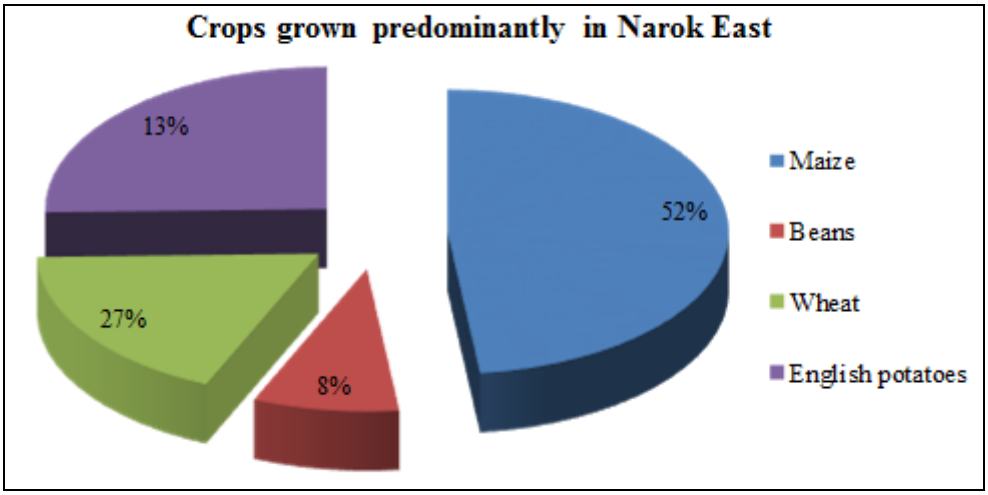

Fig 5: Response on types of crops grown in Narok East sub-County

The results show that most households (52 %) are involved in the growing of maize, followed by 27% who grow wheat. The study further establishes that 13% grow English potatoes and only 8 % grow beans. The results indicated that most farmers grow maize and wheat which are long duration crops and might affect the food security in the area.

In terms of the land ownership title, the study sought to find out whether the households owned the land and whether they had legal ground to the land. This was important because in some instances the ownership of land determines the level of input and effort of a person to improve the productivity of the land. The results are presented in Figure 6.

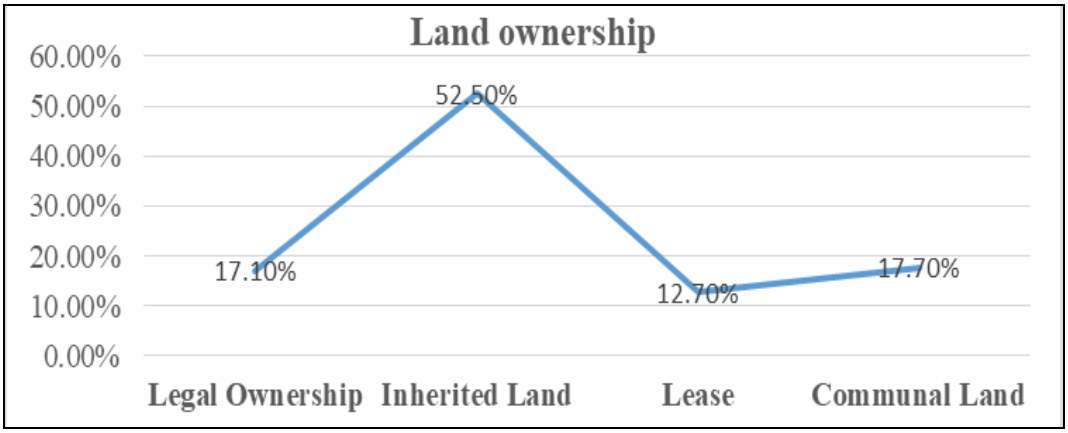

Fig 6: Response on Land Ownership

The results in figure 6 show that most (52.5%) of the respondents indicated that the land they possess was inherited, 17.7% indicated that they had communally owned land, 17.1 percent indicate that land was legally owned while only 12.7% indicated that the land was leased. Land ownership has an implication on the level of development one can be able to undertake on the land and this might have an influence on the food security in the area. This agrees with the findings of Alawode (2013), who noted that the extent to which land ownership is acquired and acquisition has an influence on the way the land is used for agricultural production. The researcher further established that in rural areas, land can be acquired or transferred through inheritance, gift, purchase, loan, pledge and allocation by family head, local chief or any land custodian.

In regard to the size of the land under crop production the response of presented in Figure 7 bellow.

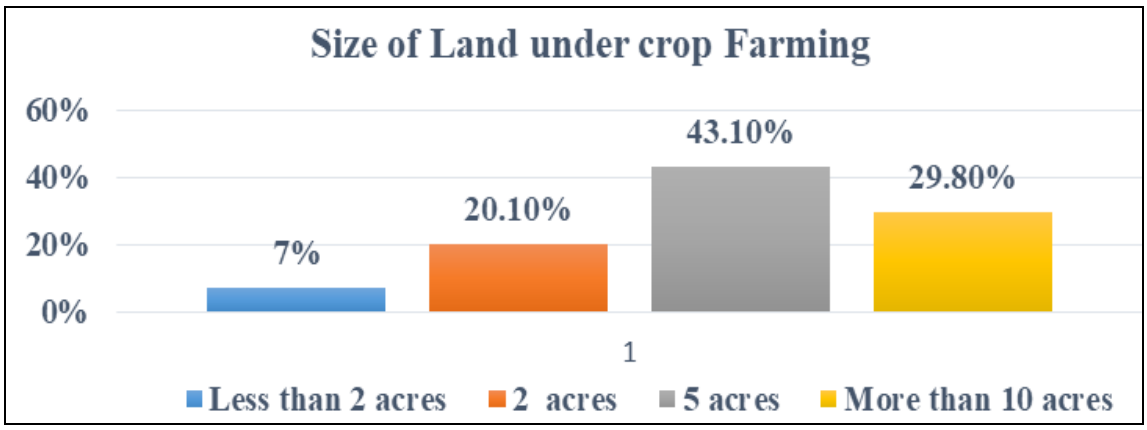

Fig 7: Size of Land under Crop Farming

The results show that 43.1% of the households had at least 5 acres of land under crop cultivation followed by 29.8% who had more than 10 acres, 20.1% had only 2 acres and 7.0 % had less than 2 acres under crop cultivation. This show that majority of the households had relatively large pieces of land for use in crop farming. This implies that the available land under crop farming is large enough to enhance food production. This agrees with the findings of Alawode, Olaniran and Abegunde (2020) alluded to this fact by indicating that Land tenure system and the extent of competition by non-agricultural land users remain a major factor determining the extent of use of most agricultural lands in the rural areas in most African countries.

The study also sought to establish the number of years that respondents had been engaged in farming. This was important because to established the years of experience which are very important to assess the level of productivity and influence of the farming activities on food security in the area. The results are presented in figure 8

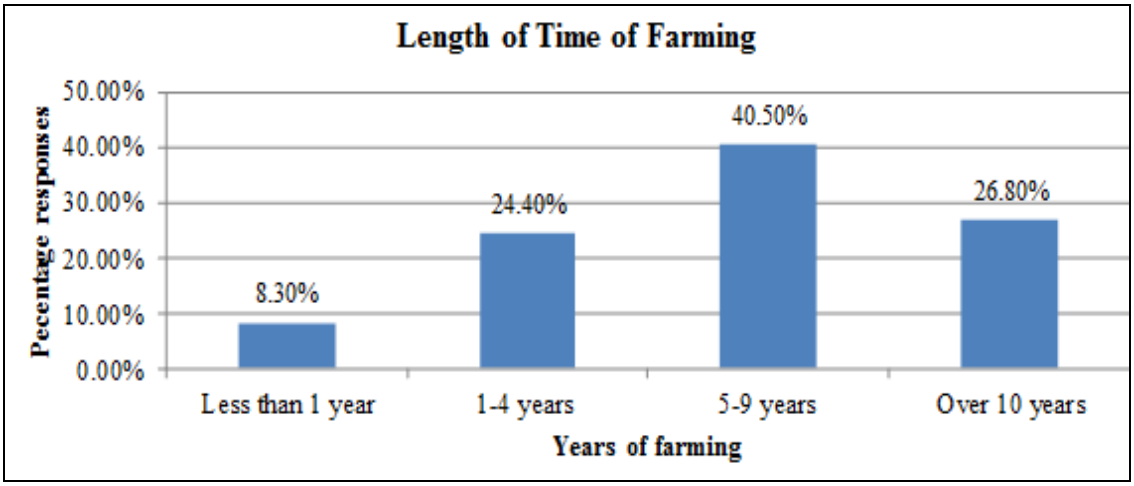

Fig 8: Years of Farming

The results show that majority of the respondents (40.47%) have been undertaking farming for between 5-9 years followed by 26.76% who have been in farming for over 10 years and 24.4% who have been in farming for between 1-4 years. The result shows that most of the respondents have been in the farming activities for more than 5 years. This implies that they have accumulated experience and understand how the farming activities influence food production and hence food security in the area.

The last demographic variable was to assess the level of income of the households. This was an important aspect of the study because the level of income has a great influence on the farming activities that a farmer can undertake and it influences the level of productivity. The results are presented in Figure 9.

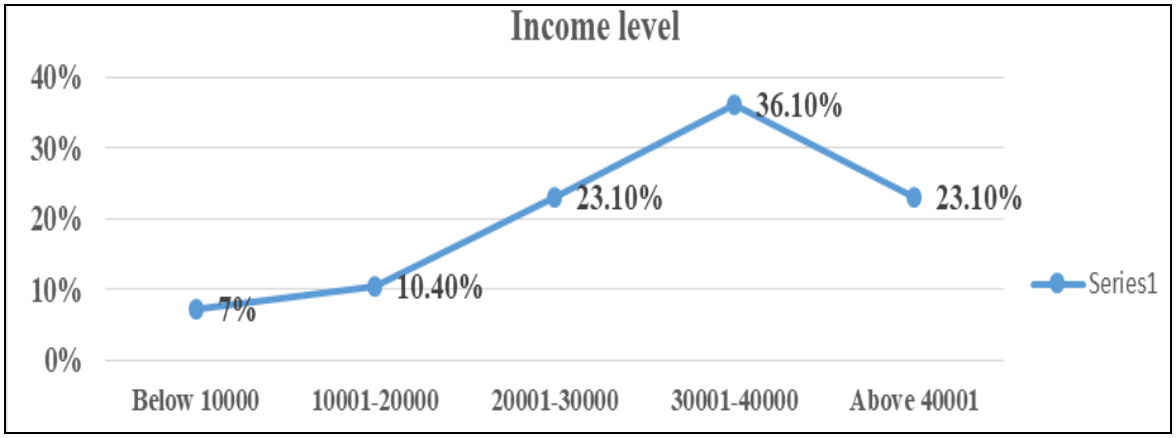

Figure 9: Response on the Level of Income

The results show that majority of the respondents (36.1%) earned between Ksh 30,001 to 40,000, 23.1 % earned between Kshs 20,001 and 30,000 while another 23.1% earned above Kshs 40,001. Only few 10.4% and 7.4% earned between Kshs 10,001 and 20,000 and below Kshs 10,000 respectively. This implies that most households have average income that might not be enough to support their farming activities. The results agree with the findings of Chen and Ravallion (2008) who noted that over 1.4 billion people in the world live on less than US $1 a day which is the international poverty line. This was considered as a major contributing factor to the level of food insecurity on the developing countries as suggested by FAO (2010).

Analysis for the Descriptive Statistics

This section presents the descriptive analysis of the results where the mean, percentages, standard deviation are discussed. In this section **SD** will stand for *Strongly Disagree*; **D** -*Disagree*, **NS**- *Not Sure;* **A** -*Agree*; **SA**- *Strongly Agree,* and **S.D**.- *Standard Deviation*

Extent to Which Land use Patterns Determines Food Security

The third objective of the study sought to establish the extent to which Land use patterns determine food security Narok East Sub-County. The respondents were also required to give their opinion and views by indicating the extent to which they agreed or disagreed with the various statements. The results of the study were analyzed descriptively using percentages, means and standard deviation in order to make deductions on how the respondents gave their response to various statement items describing the extent to which land use patterns determine food security in the study area. The results were presented in Table 1.

Table 1: Land use patterns and Food security

Statement	SD	D	NS	A	SA	M	S. D
Food security has been determined by land use patterns in Narok East Sub-county	1.7%	6.0%	4.7%	19.7%	67.9%	4.46	.952
Land sub-division has determined food production in Narok East Sub-county	0	10.4%	3.0%	13.4%	73.2%	4.49	.967
The number of acreage on farming determines food security in Narok East Sub-county	0	3.7%	5.0%	21.4%	69.9%	4.58	.753
Mechanization practices have an implication on food security in Narok East Sub-county	0	34.8%	13.4%	19.1%	32.8%	3.50	1.267
Most farmers have indigenous ways of utilizing land for promoting food security in Narok East Sub-County, Narok County	1.0%	30.1%	20.4%	14.0%	31.4%	3.54	1.314
Land use is a prerequisite on food security in Narok East Sub-county	1.7%	0	4.0%	23.7%	70.6%	4.62	.721

The results show that most of the respondents (67.9%) strongly agreed, 19.7% agreed while only 1.7 % strongly disagreed while 6.0% disagreed with the statement that food security has been determined by land use patterns in the study area. Results further indicate that 4.7% of respondents were not sure as to whether food security has been determined by land use patterns in the study area. The results are further confirmed by the mean value of 4.46 and a standard deviation of.952. This implies that land use pattern in the study area is a determining factor of food security. This was confirmed by the interview results where Agricultural extension officers noted that the available land has been subdivided to smaller portions making productivity of food limited. On whether land sub-division has determined food production in Narok East sub-County. The results indicated that 73.2% of the respondents strongly agreed with the statement, 13.4% agreed while 10.4% disagreed. A further 3% of respondents were not sure with the statement. The mean response was noted as 4.49 with a standard deviation of 0.967. This implies that and sub division has an influence on food production and hence affects food security in the area. The study also sought to establish whether the number of acreage on farming determines food security in Narok East Sub-county. The results show that most of the respondents (69.9%) and 21.4% strongly agreed and agreed with the statement while only 5% were not sure of the statement. A further 3.7% of the respondents disagreed as to whether number of acreage on farming determines food security in Narok East Sub-county The mean response of the study 4.58 and a standard deviation of.800 indicate that majority of the respondents agreed with the statement. This implies that the number of acreage under farming affects the production of food and hence is a determinant of food security in the study area.

On whether mechanization practices have an implication on food security in the study area, the results indicated that majority of the respondents (32.8%) strong agreed, 19.1% agreed while 34.8% disagreed and 13.4% were not sure with the statement. The mean response was 3.50 with a standard deviation of 1.267 indicating that most of respondents agree

that mechanization practices have an implication on food security in the study area. This implies that mechanization practices have an implication on food security as they improve food production. Response from the extension officers further indicated that there is shortage of agricultural machinery which is critical in improving food productivity. Lack of machinery has adversely affected land preparation, planting and harvesting hence dwindling food productivity in the study area.

The study also established that majority respondents (31.4%) and 14.0% strongly agreed and agreed respectively that most of the farmers have indigenous ways of utilizing land for promoting food security. 30.1% of respondents disagreed with the statement while 20.4% were not sure as to whether farmers have indigenous ways of utilizing land for promoting food security. A further 1% of the respondents strongly disagreed farmers have indigenous ways of utilizing land for promoting food security. The mean response of 3.54 and standard deviation of 1.314 indicates that most of the respondents agreed with the statement. This implies that the way the farmers utilize their land especially the traditional way affects their production in the study area.

The study also sought to assess whether land use is a prerequisite on food security in Narok East Sub-county. Most of the respondents (70.6%) strongly agreed, while 23.7% agreed. Further analysis indicated that 1.7% of the respondents strongly disagreed while 4% were not sure as to whether land use is a prerequisite on food security in Narok East Sub-county. The results further indicated that the response of 4.62 and standard deviation of 0.721 shows that majority of the respondents agreed with the statement. The results therefore indicate that land use is a determinant of food security in the study area.

Indicators of Food Security

The respondents were also required to rate the various indicators of food security which formed the dependent variable. These indicators were food availability, food utilization and food access. The results were analyzed descriptively using percentages, means and standard deviations in order to make deductions on how the respondents analyzed the various statement items describing the extent at which the study area is food secure. The results were presented in Table 2 as shown below.

Table 2: Response on the Indicators of Food Security

Statement	SD	D	NS	A	SA	M	S. D
Food availability has determined food security at household level in Narok East Sub-county	1.7%	2.3%	7.7%	14.7%	73.6%	4.56	.862
Food utilization determines food security at house hold level in Narok East Sub-county	0	12.7%	1.0%	23.1%	63.2%	4.37	1.009
Food security is determined by food access at household level in Narok East Sub-county	5.7%	4.0%	17.1%	13.4%	59.9%	4.18	1.189
Households have access to food whenever they need it in Narok East Sub-county	6.4%	12.7%	2.0%	11.0%	67.9%	4.21	1.319
Food is utilized by farmers to meet their dietary needs at household level in Narok East Sub-county	0	6.4%	7.0%	23.7%	62.9%	4.43	.877

The results shown on table 4.2 indicate that most of the respondents (73.6%) strongly agreed, 14.7% agreed while 1.7 % and 2.3% strongly disagreed and disagreed respectively that food availability determines food security at household level in Narok East Sub-county. Further analysis however revealed that 7.7% of the respondents were not sure as to whether food availability determines food security at household level in Narok East Sub-county. The mean response was 4.56 with a standard deviation of 0.862 confirmed this statement. This implies that availability of food was a determinant of food security in Narok East Sub County. Most household heads are of the opinion that when food is available at the household, food insecurity dwindles to the greatest extent.

The study also sought to find out whether food utilization determines food security at house hold level in the study area. The results show that most of the respondents (63.2%) strongly agreed, 23.1% agreed while 12.7% disagreed that indeed food utilization determines food security at house hold level in the study area. However, 1% of the respondents still were not sure as to whether food utilization determines food security at house hold level in the study area or not. The mean response was 4.35 with a standard deviation of 1.009 implied that food utilization is a determinant of food security in the sub-county. This means that if the available food is well utilized at household level, then it will have an influence on food security Narok East Sub-county generally.

The results also show that most of the respondents (59.9%) strongly agreed while 13.4% agreed that Food security is determined by food access at household level in Narok East Sub-county. Only 4 % and 5.7% of the respondents disagreed and strongly disagreed with the statement food security is determined by food access at household level in Narok East Sub-county. However, 17.1 percent of the respondents were not sure as to whether food security is determined by food access at household level in Narok East Sub-county. The mean response was 4.21 with a standard deviation of 1.189 confirms that majority of the respondents agreed with the statement but still a good number of respondents still are of a different opinion. This implies that food security is determined by food access at the house hold level in the study area if all other factors are held constant.

It was also noted that majority of the respondents (67.9%) and 11 % strongly agreed and agreed with the statement that households access to food whenever they need it. Further analysis indicated that 12.7% and 6.4% of the respondents strongly disagreed and disagreed with the statement that households' access to food whenever they need it indicates food security in the area. However, 2% of the respondents are not sure whether households access to food whenever they need it. The mean of 4.43 and a standard deviation of 1.319 confirm this argument. This implies that access to food by households in Narok east Sub County depicts a certain level of food security. However, the extension workers further revealed that generally majority of the households have no access to food. Further analysis from interviews reveals that most households in Narok East Sub-county are generally food insecure since access to food in the study area has been hampered by other factors like inadequate roads and the purchasing power of residents.

Furthermore, the study also sought to examine whether food is utilized by farmers to meet their dietary needs at household level in Narok East Sub-county. The findings of the study indicated that 62.9% of the respondents strongly agreed and 23.7% agreed with the statement above. Further analysis indicated that 7% of the respondents were not sure of whether food was utilized by farmers to meet their dietary needs in the study area. The study further established that 6.4 % of the respondents disagreed with the statement above. This was further supported with a mean of 4.43 and a standard deviation of 0.877 which shows that majority of the respondents agreed with the statement above

Analysis of Inferential statistics

The study sought to assess whether there was a statistically significant relationship between the variables. The analysis was done at three levels, determining the factor loading, Pearson's correlation and regression analysis.

Correlation Analysis for Land Use Patterns on Food Security

The study sought to establish the nature of the relationship between household income, agricultural extension services, land use patterns, post-harvest technology and food security. This was tested using correlation coefficients as suggested by Cohen, West and Aiken, (2003). Correlation analysis helps to test the linearity of the study variables in order to make inferences. The study used Pearson correlation (r) to test whether the relationship between the variables was significant or not at 95% level of confidence. The relationship between the two variables was considered significant if the p value was less than 0.05. It was considered to be weak if the correlation (r) < 0.5 and it was considered to be strong if the correlation (r) was > 0.5. The results are presented in Table 3.

Table 3: Pearson Correlation analysis between land use patterns and food security

		Land use patterns	Food Security
Land use patterns	Pearson Correlation	1	.752**
	Sig. (2-tailed)		.000
	N	299	299
**. Correlation is significant at the 0.05 level (2-tailed).			

The results further show that there is a very strong positive and significant correlation between land use patterns and food security (r =.752** and a *p*-value of 0.000). This implies that the relationship between the variables is very significant hence land use patterns have a strong correlation hence influence on food security in Narok East Sub County. This supports the work of Alawode, Olaniran and Abegunde (2020), who established that the land use pattern adopted by the farmers has a significant positive effect on the food security status of the household at 5% level, implying that adoption of an appropriate and use pattern enhances the food security status of farming households. They further noted that the adoption of land improvement techniques has a significant positive effect on the food security status of farming households at 1% level.

Test of hypothesis

The study used Analysis of variance test to either accept or reject the null hypothesis. ANOVA is used to compute the F-statistic which is a measure of the variance in the means of the test variables. ANOVA is used to test the hypothesis and establish whether the test is significant at 5% level of significance. It also helps in checking whether the model fit is appropriate in making inference to the entire study population. The study established the model fitness by comparing the F- calculated and F-critical values. The results are shown in Table 4.

Table 4: ANOVA Relationship between land use patterns and food security

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	114.671	1	114.671	385.455	.000[b]
	Residual	88.356	297	.297		
	Total	203.027	298			

The results show that the F-statistic was very significant at 5% level of significance, implying that the model is a good predictor of the relationship between land use patterns and food security. The results shown in Table 4.4 shows that the F- calculated was greater than F-critical values. The F-calculated ($F_{0.05,\ 1,\ 297}$) was 385.455 which was much greater than F-Critical, ($F_{0.05,\ 1,\ 297}$) of 3.878. Since F-calculated, was greater than F-Critical, then the null hypothesis that there is no relationship between land use patterns and food security was rejected and the study concluded that the model is a good predictor of the relationship between land use patterns and food security. Hence land use patterns is a determinant food security in Narok East sub-County.

Table 5: Model Summary

Independent variable	R	R-Square	Adjusted R Square	Std. Error of the Estimate	P-value
Land use patterns	.752[a]	.565	.563	.545	.000[b]

Dependent variable: Food Security

For land use patterns and food security, results show that the correlation is very strong, positive and significant (R = 0.752; p-value = 0.000). Land use patterns is established to be very strong predictors of food security in the study area. Further analysis was done using the R-square which indicates the proportion of variance in the dependent variable that can be explained by a unit change in the independent variable. The results show that a unit change in land use patterns can explain 56.5% change in food security (R^2 = 0.565) This implies that land use patterns is a significant determinants of food security in Narok East sub-County.

The results were further analyzed to develop the simple linear regression models for the above objective. The results were presented in Table 6.

Table 6: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.517	.198		2.614	.009
	Land use patterns	.913	.047	.752	19.633	.000

From table 6, the data indicates that the simple linear regression can be modeled as follows for this variable; *y* =

0.517 + 0.913x +0.198. The model is statistically significant given that the *t*- statistic (19.633) is more +2 and *p*-value <0.05.

Analysis of Variance

The ANOVA was used to check the ability of the regression model to be used to predict the relationship between the variables. Using the F-statistic and the mean square differences, the results were computed and presented in Table 7.

Table 7: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	126.910	4	31.728	178.701	.000[b]
	Residual	76.117	294	.259		
	Total	203.027	298			

The results show that the F statistic was very significant at 5% level of significance implying that the model is a good predictor of the change in the food security in the sub-County. In order to establish whether the model was fit for use in further prediction, the F-statistic computed was compared to the F-critical values. The result for F-calculated showed $F_{(0.05,\ 4,\ 294)}$ =178.701 compared to the F-Critical, $F_{(0.05,\ 4,\ 294)}$ which was 2.403. Since F-calculated is greater than F-Critical at $F_{(0.05,\ 4,\ 294)}$. Therefore, the study concluded that the model is a good predictor of the relationship between the independent and dependent variables. This is further supported by the p-value of 0.000 which is very significant at 5% level of significance. The study therefore notes that the land use patterns are very strong determinants of food security in the sub-County.

Regression Coefficients

The study further sought to determine the regressions model based on the coefficient beta values. The results were presented in Table 8.

Table 8: Regression Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-1.000	.312		-3.204	.002
Land use patterns	.744	.056	.612	13.308	.000

The results show that the standardized coefficients of beta values explain the contribution of independent variables to the dependent variable. The *t*-statistic shows whether the contribution of each variable is statistically significant or not. From the results shown, the study established that the contribution of land use patterns to food security accounts to 61.2%. The contribution is statistically significant given that the t-statistic of 13.308 is greater than + 2 and the *p*-value of < 0.05.

Summary, Conclusions and Recommendations

Summary of the Findings

Demographic variables

The response rate was 79% which was accepted as appropriate for further analysis of the study results. In regard to gender of the respondents, the study established that 62% of the households were headed by the males which implied that men were the main decision makers in the household unit in the study area. In regard to level of education which was an important aspect to the study, it was established that there was varied levels of education where some had degrees while others had the basic education. The study further assessed the size of the house hold as a factor determining food security in the study area. It was established that majority of the households (36.5%) had an average of 8-10 persons. It was also important to establish the type of crops grown in the study area. The results indicated that most households (52%) in the study area are involved in maize production. On land ownership, the study established that most respondents (52.5%) indicated that the land was mainly inherited or communally owned which might be a contributing factor to the state of food security in the study area.

It was also established that the size of land under crop cultivation was at least 5 acres in comparison to the actual size of the land. This implies that most households had committed a small proportion of land for food production hence contributing to the food security issues in the study area. The study further established that most of the respondents had been in the farming practice for between 5-9 years hence it implies that they have accumulated experience and understand how the farming activities determine food production and hence food security in the study area. The study also established that at least 36.1% of the respondents earned between Ksh 30,001 to 40,000, indicating an average income which was not enough to sustain increased demand for food production in the study area.

Extent to which Land use Patterns Determine Food Security in Narok East sub-County

The objective study sought to establish the extent to which Land use patterns determine food security Narok East sub-County. The opinion of the respondents was sought to analyze the extent to which land use patterns determine food security at the household level in the study area. The study established that most of the respondents agreed that food security is determined by land use patterns in the study area. This implies that the various activities dedicated towards utilizing the available land may be directed towards food production or otherwise. This was also informed by the response from the Agricultural extension officers who noted that land use patterns affected the food production in the study area since it cannot be controlled by the County especially private land. Farmers are the key stakeholders who determine how they want to utilize their land in the manner they so wish.

The study also established that land sub-division affected food production in Narok East sub-County since as households continued to sub divide land for other uses, their ability to produce enough food was also curtailed. Land sub-division affected the number of acreage under production which in turn affected the amount of food produced and hence food insecurity at the household level. The results also showed that mechanization practices have an implication on food security as they improve food production. However, most respondents indicated that the necessary machinery were very limited in the study area and this affected their ability to enhance food production. Response from the extension officers further indicated that there is shortage of agricultural machinery which is critical in improving food productivity. Lack of machinery has adversely affected land preparation, planting and harvesting

hence dwindling food production in the study area as farmers end up preparing land and planting when the planting season is long overdue.

Further analysis established that land use is a prerequisite on food security in Narok East sub-County as indicated by majority of the respondents. Based on the inferential analysis, the study established that there was a very strong positive and significant correlation between land use patterns and food security in the Narok East sub-County. The null hypothesis that there is no relationship between land use and food security was rejected because the ANOVA model indicated a very significant and statistical relationship between the variables.

Conclusions

The main objective of this study was to analyze influence of land use patterns on household food security in Narok East sub-County, Narok County, Kenya. The findings of the study revealed that most of the households in Narok East sub-County were food insecure. Furthermore, the study concluded that there was a strong relationship between land use patterns and food security in the study area. In general, food insecurity still remains prevalent among farming households in the study area. Further analysis of the data further revealed households with higher acreage of land under farming were able to achieve comparable levels of food security as compared to those who did farming on a small parcel of land. Also, adoption of appropriate land use techniques also impacted positively on the food security status of the households that took place in farming activities in the study area generally.

Recommendations

The study further provided key recommendations as follows;

First, Narok County Government should establish alliances/collaboration with all sectors in the agricultural sector in order to develop programs for improving food security and income generation among the households in order to boost the income of farmers at the micro level.

Thirdly, the study recommends that the government should build a platform to promote dialogue and cooperation among relevant institutions and establish programs in all sectors with the aim of developing an extension and information services network for households in Kenya and Narok County in particular.

The County Government should discourage land sub-division in order to free more land for food production and hence food security in the study area. Policies on land use should be formulated in order to discourage farmers from utilizing land for aspects that is not food production.

The County Government should formulate a reasonable crop production system is necessary to improve land use efficiency. Therefore, there is need to improve the agricultural sector by using suitable crop strains, developing technology and implementing a reasonable strategy.

Additionally, Research and development needs to be promoted and supported by both National and the Narok County government so as to ensure continued research and dissemination of research findings to the household level so as to benefit farmers at the micro level.

Areas for further study

The current study proposes the following areas for further studies;

Further studies on land use patterns needs to be conducted in other ASAL counties to compare the findings. This will enable the current study to be inferred to the larger research universe since this will further establish the gaps that are inherent in the current study and universalize the findings

There is also need for further studies that will focus a multi stakeholder approach including the farmers, seed distributors/companies, private agricultural extension workers, NGOs in the field of Agriculture and the National Government in order to build more literature on food security in Narok County specifically and in the Country generally.

There is need to establish other factors that determine food security in Narok East sub-County other than the aforementioned as it will enable more research to be done and help farmers in achieving their farming objectives.

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