Effects of Land Management Practice on Adaptation of Smallholder Farming System in Kakamega County, Kenya

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Abstract

Recent incidences of extreme weather changes have led to severe drought in most parts of the country, a situation which has severely affected the agricultural sector which is one of the main economic pillars of the Kenyan economy. Recent studies have shown that Western Kenya has experienced rapid population growth (4.7%), land sub-division and food shortage over the years. This study aims to bring to light effects of land management practices such as land subdivision, land demand and food security on adaptation of smallholder farming systems in Kakamega County, Kenya. The theoretical underpinning of the study was guided by Boserup Theory and Adaptation Theory. The anniversary concurrent triangulation mixed methods research design was used. Data was collected using questionnaires and a focus group discussion. Cornbrash's alpha coefficient of reliability was 0.83; construct validity was checked and confirmed through piloting. A sample size of 84 was computed at 30 percent of the target population of 280 farmers (Kothari, 2004). Data was analyzed quantitatively and qualitatively using SPSS and NVIVO 12 statistical programs respectively. Spearman's correlation analysis was conducted at 5 percent level of significance where the values of correlation coefficients were not statistically significant. Correlation analysis yielded, r = - 0.003 for food security, r = - 0.044 for land subdivision, while land demand had the highest r = 0.042. From the thematic analysis, it was evident that government support is crucial for sustainable agriculture in the County. The results shall be useful to smallholder farmers, development practitioners, and policymakers.

Keywords: Adaptation, Land use, Farming systems

Introduction

The world food-hunger-poverty problem is a major concern of Sub-Saharan Africa in the attempt to realise the Sustainable Development Goals (SDGs). Seventy percent of the world population lives in the rural areas and they are subsistent smallholder farmers. Therefore, the agricultural sector is an essential global instrument for food security, poverty alleviation and economic development (Kamoyo *et al.*, 2017; Alemu, 2016; Norton, 2014; Jayne, *et al.*, 2014). The sector's production has been declining over the years due to land degradation, local farming systems (Mabaya, 2016) and lack of knowledge on Sustainable Land Management Practices (SLMP). Sustainable Land Management (SLM) is the reinforcement basis for sustainable agriculture which is crucial in food security and grassroot economic development (Jayne *et al.*, 2014; Nambafu *et al.*, 2014). Low agricultural production has increased food demand for the soaring population which is competing for the same land resource. Agriculture is a human activity at risk from population growth, land subdivision and farming systems (Morara, 2014; Chitere, 2011).

Land management practice is the farmer's ability to effectively utilise land as a resource for maximum benefit and ensure resource sustainability and environmental conservation. Alemu (2016) posit that sustainable land management, land resource is the use for the production of goods and services to meet the changing human needs amidst climatic variability and food security challenges. It is observed that land is home and workplace for rural households. The empirical literature on land use indicates that population growth and land sub-division is a major threat to sustainable land management and food security (Kirui, 2016, Bhilare, 2013, Norton, 2014). In this view, the traditional system of land use in the Sub Saharan Africa has scaled upland degradation and constraints that are affecting food production. In the attempt to respond to the declining land productivity, Raufu (2012) observes that farmers have turned grassland, grazing and forests into cropland, while land has been sub-divided causing farmers to have small plots for agriculture. This, in essence, is a major factor in climate change.

The literature on food policy in Africa posits that land availability is a constraint on income stability in densely populated rural areas and the African farming system response to land constraints is a challenge in rural development (Headey & Jayne, 2014). Household knowledge on farm management, traditional farming systems and ability to adapt to technological farming and non-farm production is crucial to sustainable land management practice in the contemporary society and for the future generation.

Mabaya (2016) argues that agriculture is the mainstay of Kenya's economy and it accounts for 30% of Kenya's Gross Domestic Product (GDP). The sector has been declining due to persistent long drought periods and heavy rains that affect soil fertility (Nambafu *et al.*, 2014, & Kamoyo *et al.*, 2017). Agricultural land is turned to build land, increasing demand for food, deforestation, reduced grazing land, land sub-division, population pressure and animal pressure in search for pasture.

Agriculture is the mainstay for Kenya's economy (Mabaya *et al.*, 2016) and it is intensified on land where subsistent farmers encounter challenges of diminishing returns from the farm production. Research on land constraints posits land tenure, climate change, and economic powerlessness as key. The high rate of turning agricultural land into build land is alarming (Musa & Odera., 2015; Morara *et al.*, 2014; Muyanga & Jayne, 2012) yet demand for the scarce land is high and costly, favoring those with economic power.

Smallholder farm continuous activities and farming systems pose a challenge to land management. In the rural sector, rural subsistent smallholder farmers rely on agriculture for both domestic and commercial needs (Norton, 2014). It is therefore inevitable to observe that the already constrained land must feed the soaring population that has diverse perspectives on land management practices and technology in land management.

Degradation of the land resource by human activities is a major challenge in the attempt to realize the Sustainable Development Goals (SDGs) and ensure food security and environmental conservation Headey and Jayne (2014), Alemu (2016), Kamoyo (2017), (Mitiku *et al.*, 2006). Traditional land management practices have exhausted land nutrients and thus calls for sustainable land management to ensure food security. Empowering rural smallholder farmers in sustainable land management practices will enhance rural socio-economic stability and food security. To realize the SGDs on poverty alleviation, food and hunger, health policymakers should invest in land management practices and technological practices.

Traditional farming systems are giving diminishing returns, yet Kakamega County has fertile land, sufficient rainfall, and human labor resource. With the adverse climatic variability, smallholder farmers have susceptible poor farm output as they employ traditional methods of land use (Kirui, 2017, Musa & Odera, 2015). Awareness has been created on land management practices and land management technology, yet food poverty is at 47 percent (County Development Plan, 2013-2017) in the County.

Literature explored is silent on smallholder farming systems and land management practices in the County.

Therefore, this paper is an endeavor to examine the land management practices and smallholder farming systems as a strategy towards food security in Kakamega County.

Problem statement

Subsistence farmers in Western Kenya utilise land as a resource for domestic and commercial purposes. With the increasing population and food demand, smallholder farmers' farming systems and knowledge of climate variability pose a challenge to food security in the region. This study seeks to explore the low adaption of land management practices and use of land management technologies in Kakamega County.

Purpose of the study

The purpose of the study was to analyse the effects of land management practice on adaptation of smallholder farming system in Kakamega County.

Specific Research objectives

The specific objectives were to: -

i. Determine the effect of food security on adaptation of smallholder farming system in Kakamega County.
ii. Analyse the effect of land subdivision on adaptation of smallholder farming system in Kakamega County.
iii. Determine the effects of land demand on adaptation of smallholder farming system in Kakamega County.

Research questions

The questions were: -

i. What are the effects of food security on adaptation of smallholder farming system in Kakamega County
ii. What are the effects of land subdivision on adaptation of smallholder farming system in Kakamega County

iii. What are the effects of land demand on adaptation of smallholder farming system in Kakamega County

Literature Review

Land management practice is one of the farmer's basic requirements targeting sustainable agriculture and poverty alleviation. Theories that support development in the agricultural sector have a specific focus on the adaptation theories that sanction farmers to use land as a key resource for a sustainable livelihood. The literature reviewed focused on Boserup and other key contributors on socio-economic and ecological systems adaption to the changing environment.

Theoretical Review

Boserup Theory and adaptation Theory anniversary

Boserup argues that agricultural transition processes range from forest, bush and short-fallow to annual and multi-cropping systems where labor is minimal. With the surplus labor on the labor market, land overexploitation has led to diminishing agricultural output and climate variability. The Boserupian theory (1996) is crucial in the current studies of land management and population, population growth and climate change. According to Lemnen (2012), the Boserup theory emphasizes concerns on population growth, food demand and agriculture that lack equilibrium. In view of the land intensification concept, Norton *et al.* (2014) posit that agricultural intensification does not require more labor. In view of these, Kiio and Achola (2015) observe that land use is a human modification of the natural environment or wilderness into built and agricultural land. Land intensification by smallholder farmers has scaled up multi-cropping and mixed farming leading to soil degradation, low yield and food short shortage amidst the soaring population (Muyanga, 2014. Kiio & Achola, 2015. Mabaya *et al.*, 2016). Classical theories on population, environment and development nexus provide a limited implementation of the Brundtland Commission report (1987) and the Agenda 21 of the Earth Summit (1992).

Studies on land management practice explore adaptation theory to endorse farmers' knowledge, perception and use of land as a key resource for household livelihood and wellbeing. Humanity interacts continuously with the environment where socio-economic, ecological and institutional factors facilitate adaptation for both short-term and long-term benefits. The adaptation theory posits that socio-economic

and ecological systems adapt to the changing environment (Smithers & Smith, 2009). In this view, Netra *et al.* (2004) posit that climate adaptation is crucial for farmers to effectively manage the land resource. This calls for investment in innovation to enhance land produce and productivity. Investment in farming systems enhances effective land management practices, use of land management technologies that promote soil fertility and land productivity (Mabaya *et al.*, 2016, Nambafu *et al.*, 2014; Kamoyo *et al.*, 2017). Netra further argues that investment in non-climatic factors such as smallholder farmer training scales up attitude change and adaptation to land management practices.

Empirical Review

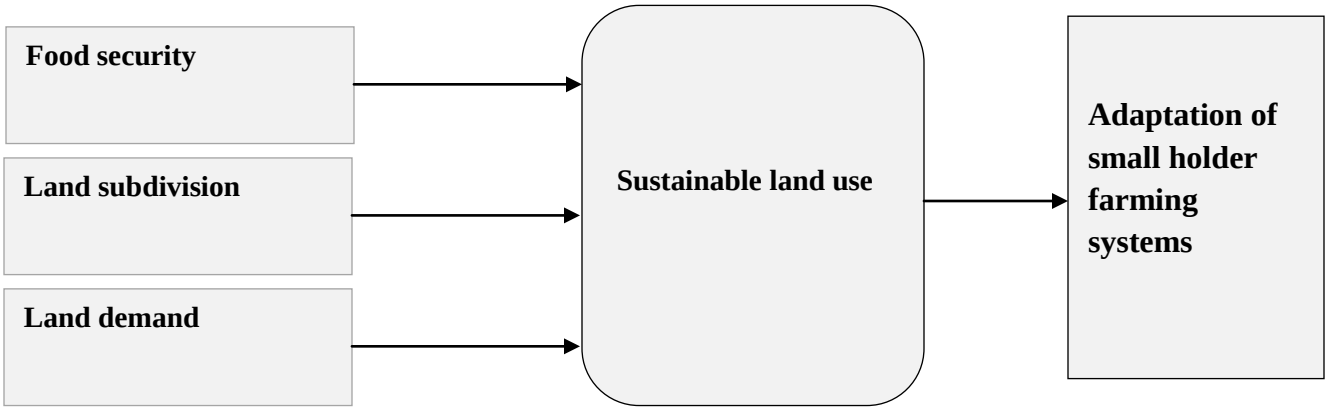
Previous studies on land management and agriculture in Western Kenya dates back to the Swynnerton plan in 1954 where farmers were given land title deeds as a strategy to enable them access credit services and invest in agriculture (Chitere, 2011:175). It is inevitable to observe that land is a scarce resource and land sub-divisions are reducing land productivity and limiting access to credit services. Empirical review on smallholder farmer security on land tenure in Malawi posit that when farmers have the title deed then they can lease or sublease the customary land so that they get money (Kamoyo *et al.*, 2017). Leased land is mismanaged due to excessive use of fertilizers to get maximum output. The impact of this practice is soil fertility depletion and poor outcome. Kirui further notes that socio-economic constraints inhibit smallholder farmers in Kenya to access credit and agricultural extension services for them to adopt sustainable land management technologies while land title deeds can positively influence adaptation. He alludes that lack of credit is a drawback to sustainable land management practices (Kirui, 2016). In this view, Norton (2014) asserts equitable land access and security rights will enhance economic growth, equity, and food security.

Studies on the ecosystem and production in Kenya indicate that floods and drought are key constraints to land use among smallholder farmers (Smithers & Smit, 2009). These extreme climatic conditions affect the agricultural sector and the rural community who rely on agriculture for both domestic and commercial use. This calls for adaption which is either planned or autonomous where change is inevitable (Smithers & Smith, 2009). Land is home and workplace for rural households where knowledge of land management practice and land management technology is crucial to meet food demand for the soaring population. The persistent climatic challenges on smallholder farmers are causing farmers to learn from experience and adapted to technologies that will enable them to get maximum benefit from the land and ensure

conservation. Climate change is a major concern for smallholder farmers who need to safeguard sustainable food security and maintain soil fertility (Netra *et al.*, 2004).

Conceptual Framework

The figure below depicts the relationship between three land management practices i.e. food security, land subdivision and land demand and how they influence adaptation of smallholder farming systems but with sustainable land use as the intervening variable.



Research Methodology

The study was conducted in Kakamega County in the Western part of Kenya, whose capital and largest town is Kakamega town. As of the Kenyan census of the year 2009, the area had an estimated population of 1,660,651 residents. The County covers close to 3,033.8 km² of area. The County is made up of four sub-counties (Districts) namely Butere, Khwisero, Kakamega central, and Navakholo. It borders counties like Bungoma to the North, Vihiga to the West, Nandi to the South and Uasin Gishu to the East. It lies between Longitude 34.7510 E, and Latitude 0.2820 N.

This study adopted concurrent triangulation mixed methods research design. This method is used where the researcher can cross-validate or corroborate findings within any given single study by use of two methods (Tashakkori & Teddlie, 2003). The current study utilized both the use of questionnaires as well as focus group discussions. A target population of 280 smallholder farmers in four sub-counties (Districts) in Kakamega County was obtained from the Ministry of Agriculture in Kakamega County government. Out of the target population, a sample size of 30% was obtained for the study making a sample size of 84

respondents. (Kothari 2004) confirms that the sample size should not be too small nor should it be excessively large. The sample gave a fair representation of the target population. It also gave an optimum representative sample size that is reliable.

A survey was conducted in Kakamega County where purposive sampling technique was used to identify four areas of study namely; Butere, Khwisero, Lugari, and Lurambi districts which are geographically concentrated areas with smallholder farmers. The districts vary in population density and have high agricultural potentials. A sample size of 84 smallholder farmers was randomly selected.

Focus group discussion was conducted on the agricultural experts from Kakamega County for all the four sub-counties (Butere, Khwisero, Lugari, and Lurambi), which comprised of four committee members and four farmers from all the four sub-counties. The focus group discussions were conducted and moderated by the researcher.

Tests of normality were carried out to assist in deciding which analysis would be more reliable. Therefore, three preliminary statistical tests were carried out on the data; this included homoscedasticity, normality tests as well as tests of independence. The results of homoscedasticity (homogeneity or equality of variances) by using Levene's test for homoscedasticity showed that all the p-values were more than 0.05 which was the significance level and hence showing lack of equality of variance in the dependent variable of the study.

Normality tests were conducted using the Shapiro-Wilks test where the computed value of test statistic had a p-value which was more than 0.05, the level of significance and hence showing that there was no normality in the data. Chi-square test proves that indeed there was dependence between each of the three land management practices i.e. food security, land subdivision and landed demand as independent variables and adaptation of smallholder farming systems as the dependent variable. This was checked by use of the Pearson Chi-square test statistic where all the values are greater than 0.05 which was the significance level.

This study therefore resorted to using Spearman's rho correlation analysis so as to establish how this trend and direction of how food security, land subdivision and land demand associates and adaptation of smallholder farming system in Kakamega County. After coding quantitative data in the SPSS statistical

software, analysis of the data was carried out by the use of frequencies, percentages, and measures of central tendency as well as Spearman correlation analysis.

With regard to focus group discussions, recorded audiotapes were transcribed, coded, classified records in order to establish the overriding themes using NVIVO 12 statistical software. This was critical to identify patterns and relationships and which made it possible to utilize thematic analysis.

The coded results were visualized by charts, treemaps, and cluster analysis. To enhance tape recording statement given by the participants immediately after transcription, copies of the transcribed manuscripts were given to participants to confirm whether statements given were properly transcribed.

The validity of the questionnaire was checked for construct by supervisors in the faculty of business administration. In order to measure the reliability of research instruments, Cronbach's alpha coefficient was used. Buntragulpoontawee et al. (2018) proposed the use of Cronbach's alpha in measuring reliability consistency of the instrument. Kurniawan, Jingga, and Prasetyo (2017) suggest a value of Cronbach's alpha to be more than 0.7 so as to meet the conditions of reliability for the study instrument for the research instrument. The value of this coefficient was 0.83 which was high enough to meet the conditions of reliability for the study instrument.

Research findings

This section provides a summary of results alongside discussions in line with the objectives of the study. Consequently, the results were obtained from 84(100%) respondents out of which 52(61.90%) were female and 32(38.10%) were male.

Correlation of land management practices on adaptation of smallholder farming systems

Basically, correlation analysis measures the strength and direction of the relationship between a given set of variables. After ranking the scores from the Likert scale items, SPSS was used in order to generate the value of Spearman's rho correlation analysis that was used to make inferences about the strength and direction of the relationship between land management practices and adaptation of smallholder farming systems in Kakamega County.

This was critical in answering the objectives of the study which are to determine the effect of food security on adaptation of smallholder farming system in Kakamega County, analyze the effect of land

subdivision on adaptation of smallholder farming system in Kakamega County and determine the effects of land demand on adaptation of smallholder farming system in Kakamega County.

Table 1 below provides a summary of results for Spearman's correlation analysis. The essence of carrying out this analysis is to be able to establish how land management practices influence adaptation of smallholder farming system in Kakamega County.

		Food_security_X1	**Land_div_X2**	**Land_demand_X3**	**Small_holder_adaptation_Y**
Food_security_X1	Correlation Coefficient	1.000	.036	.154	-.003
	Sig. (2-tailed)	.000	.742	.163	.982
	N	84	84	84	84
Land_div_X2	Correlation Coefficient	.036	1.000	.207	-.044
	Sig. (2-tailed)	.742	.000	.061	.692
	N	84	84	84	84
Land_demand_X3	Correlation Coefficient	.154	.207	1.000	.042
	Sig. (2-tailed)	.163	.061	.000	.705
	N	84	84	84	84
Small_holder_adaptation_Y	Correlation Coefficient	-.003	-.044	.042	1.000
	Sig. (2-tailed)	.982	.692	.705	.000
	N	84	84	84	84

Table 1: Correlation of land management practices on adaptation of smallholder farming systems

As clearly indicated in the results in the table above, it can be noted too that various land management practices have an influence on adaptation of smallholder farming systems in Kakamega County. The study findings show that the issue of food security having a correlation coefficient, r = - 0.003 implies that food security had the least impact on adaptation of smallholder farming system in Kakamega County.

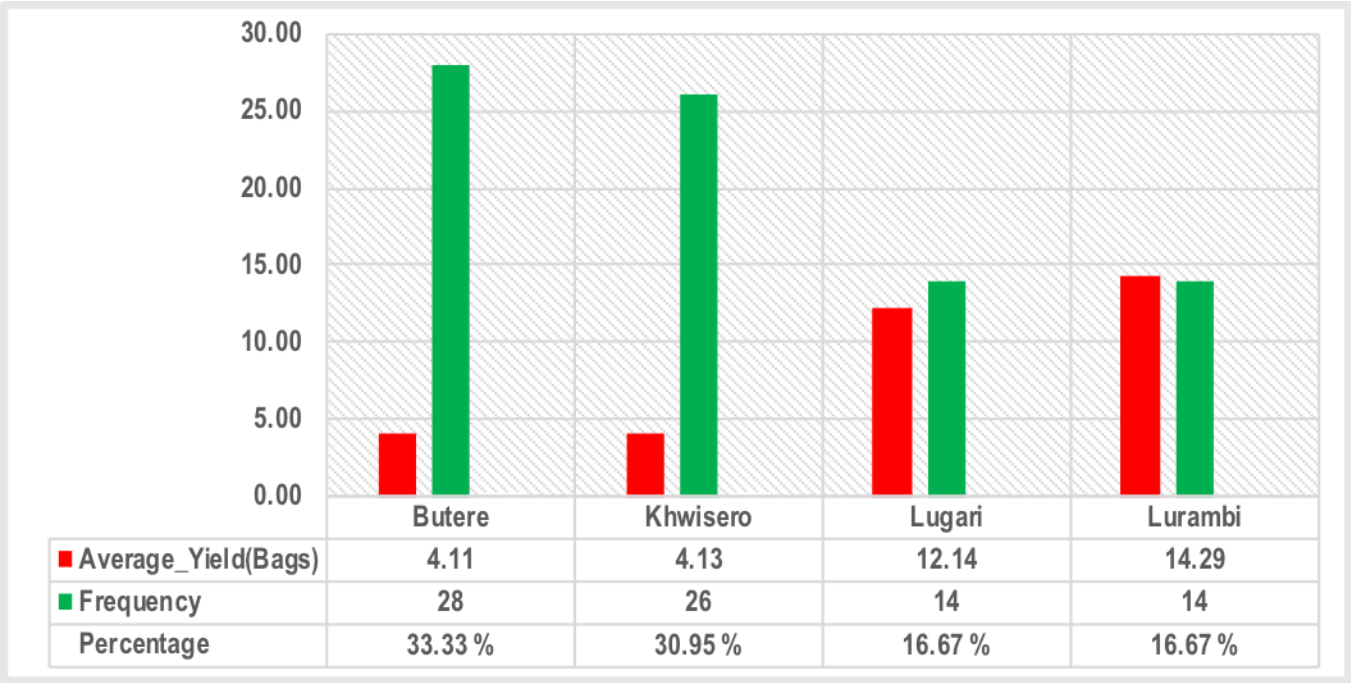
The table also clearly shows that land division with r = -0.04 comes second when it comes to how the three land management practices influence adaptation of smallholder farming systems in Kakamega County, while the issue of land demand had the highest influence on adaptation of smallholder farming

with r = 0.042. The negative value of the correlation coefficient indicates that there is an inverse or an indirect relationship between both food security and land subdivision on the adaptation of smallholder farming systems in Kakamega County. This means that an increase in either food security or land subdivision could lead to a decrease in the adaptation of smallholder farming systems or a decrease in food security and land subdivision could lead to an increase in the adaptation of smallholder farming systems in Kakamega County. It is land demand as a management practice that has a positive relationship with adaptation of smallholder farming systems in the County, implying that more land demand is associated with more adaptation of smallholder farming systems and vice versa in the County.

Food Security and Farming Systems

Majority of the respondents belong to local small-scale farmers groups who practice subsistent agriculture as the main economic activity. The smallholder farmers are trained in modern agricultural methods that are organized by field agricultural officers. In a focused group discussion, only 10% of the farmers completed the secondary school education. In this respect, the level of education of the farmers interviewed was low. The findings reveal that rural agriculture is done mainly by women and a few men. The farming technique was used to determine the type of food crops grown in each region. From the study findings, 69(82.14%) practice mixed farming, 38(45.24%) crop rotation, 36(42.86%) mixed cropping, 23(27.38%) mulching and crop cover, 12(14.29%) minimum tillage, and 6(7.14%) fallowing.

Figure 1 below presents a summary of annual average maize harvest in bags across the four sub-counties in Kakamega County namely Butere, Khwisero, Lugari, and Lurambi. It is clear from the figure that the highest yield is experienced in Lurambi and Lugari while low yields experienced in Butere and Khwisero. It is of high concern to report that 54(64.29%) harvested less than five bags of maize and have an average of eight persons per household. Only 7% engage in agribusiness posing a challenge on food sufficiency in the region. It is important to note that the figure below has a total of 82(97.62%) valid cases, 2(2.38%) was invalid because the respondents did not indicate the maize harvest.



	Butere	Khwisero	Lugari	Lurambi
Average_Yield(Bags)	4.11	4.13	12.14	14.29
Frequency	28	26	14	14
Percentage	33.33 %	30.95 %	16.67 %	16.67 %

Figure 1: The number of bags of maize harvested per plot

After harvest, 92 percent of the respondents preserve the harvest for household consumption while 8 percent sell directly to the market. Household post-harvest behavior emerged as a key concern among the farmers. It was observed that household members rip-off what they have preserved for the benefit of the family. It is clear that there is no consensus of post-harvest use of the product which reduces the months of food sufficiency for smallholder farmers. Kamoyo *et al.* (2017) affirm that smallholder farmers sell their harvest to meet the social and economic needs. Lack of income stability is a key challenge to rural development.

What is done after harvesting?

Table 2 below gives a summary of actions taken by farmers in Kakamega County after harvesting crops from the field. Clearly, the majority of the farmers preserve for household consumption followed by those who sell directly to the market. A small fraction of the farmers sell the crops that they harvest to the national cereals board.

Action	Frequency	Percentage
Preserve for household consumption	77	91.67 %
Sell directly to the market	18	21.43 %
Sell to National Cereals Board	3	3.57 %

Table 2: What is done after harvesting?

Effects of Striga weeds on farming systems

Most farmers in the region practice mixed farming where maize, beans, and sorghum are planted at the same time (Fig, 1). Mabaya *et al.* (2016) and Nambafu *et al.* (2014) observe that subsistent smallholder farmer's farms are affected by Striga weed which causes low yields. Seventy three percent of the respondents' farms are affected by the Striga weed. Despite farmers' becoming aware of the adverse effect of the weed, they argued that uproot and burn approach is not helpful because the weed keeps growing. Probing the respondents on the cause of the persistent growth of Striga, the majority said that the weed is drought resistant and is outweighing their cash crops. This confirms the argument given by Nambafu *et al.* (2014) that that long-term Striga prevalence affects farm output. The problem is escalated by armyworms and prolonged drought which is making them helpless. A few who could access pesticides argued that the armyworms still continue affecting the maize.

Crops that are grown in the region

As summarized in table 3 below, 80(95.24%) of the respondents grow maize, 74(88.1%) grow beans, 64(76.19%) grow sweet potatoes, 58(69.05%) grow bananas, 51(60.71%) groundnuts, 45(53.57%) cassava and 13(15.48%) sorghum. Maize is the main cash crop grown in the region while sweet potatoes are grown as a food supplement. Perennial crops such as cassavas and bananas are not given priority due to long duration and low productivity.

Crop	Frequency	Percentage
Maize	80	95.24 %
Beans	74	88.10 %
Sweet potatoes	64	76.19 %
Bananas	58	69.05 %
Groundnuts	51	60.71 %
Cassava	45	53.57 %
Sorghum	13	15.48 %

Table 3: Crops grown in the region

Study results revealed that 73(86.90%) of the farmers planted hybrid maize bought from the local market while 11(13.10%) planted seeds recycled from the previous harvest. The major challenges raised by respondents are lack of storage facilities, armyworms and weevils attack the maize reducing the productivity and long storage. Subsistence farmers cannot purchase modern seeds and fertilizers and other essentials for modern farming because of lack of capital. It was observed that not all seeds found on the local market are hybrid seeds. This has caused seed recycling, poor harvest and eventually, smallholders' farmers live in transient poverty.

Land subdivision and farming systems

Norton (2014) argues that population growth has increased land subdivisions at the household level which has drastically reduced agricultural land into small plots that can hardly produce enough to sustain a household throughout the year. In land ownership, 80 percent of the respondents own less than one acre of land while 20 percent own more than one acre of land. Land management is a male role which limits women in implementing knowledge that they have acquired in various training. Most farmers are trained in land management practices, climate change and growing of drought-resistant perennial crops. Representatives in the focus group discussion agreed that due to household leadership structure, men are more advantaged in knowledge application and implementation than women. Most women employ the slash and burn agricultural practices which are longer feasible without reusing the land with fallow practices. Since majority have ½ of an acre, and others ¼, fallowing is impossible. This has caused soil infertility due to lack of soil nutrients.

Population growth has a significant ($p < 0.05$) positive correlation on land subdivision and poor farming systems in rural development. The respondents noted that due to the increase in family size, or polygamous family, land must be subdivided as a strategy to empower the young couple to be independent. They said land subdivision reduces family conflict and fights over the resources. Culturally, land must be subdivided into male households despite the size. In response to land subdivisions, Todaro and Smith (2009) posit that land subdivision has also led to land degradation due to lack of knowledge to sustainable measures to ensure the land is fertile. Due to land scarcity, the soil is overexploited to produce enough food for a household. The respondents are aware of the course of climate change, but a few were of the view that it is not logical to preserve a forest or grassland when one does not have land for agriculture. Environmental conservation information is yet to be conceptualized and understood by all people at the grassroots.

Land demand and farming systems

Mabaya *et al.* (2016) argue that land is office and home for smallholder farmers. Since most subsistent farmers rely on the land for their social and economic needs, then land ownership is crucial. The respondents desire to have more land for agriculture but it has become a scarce resource. The knowledge acquired in land management technologies is yet to be implemented because the majority of the respondents opt for annual or short season crops to get maximum use of land, unlike perennial crops that take a long time to mature. The majority of the respondents are practicing agroforestry, intercropping and soil conservation by the use of organic manure. The rate of tree cutting is higher than the rate of planting, contributing to deforestation.

Smallholder farmer adaptation to climate change

The respondents are investing in agri-business alongside agriculture whereby they keep cattle, poultry; grow traditional vegetables and capsicum for commercial purposes. There is a positive correlation between land tillage technology and the size of the farm ($p < 0.05$). Majority of the respondents' with less than an acre of land use family labor in land preparation and crop cultivation. Since they practice intercropping and mixed farming, a hoe is more ideal to ensure accuracy. It was observed that there is inter-family sharing of agricultural tools and seeds for planting. Nambafu *et al.* (2017) argues that sharing of agricultural tools is one way of spreading Striga weeds from one farm to another

Thematic analysis

After transcription of information from the audio tapes, and subsequent coding in the NVIVO 12 statistical software, some of the themes generated during the focus group discussion touched on various aspects. One of the key areas focused on, was the fact that farmers in Kakamega County felt that there is a need for the government to provide adequate support in order to effectively practice agriculture. Some of the initiatives that were proposed by the cohort include subsidizing the price of key farm inputs and implements such as fertilizer and chemicals, especially in the realization of the fact that weed has been a major stumbling block for many farmers in the area.

An observation that was recorded from the focused group discussion was the fact that subdivisions of land has presented a major challenge especially when it comes to efforts to sustainably use agriculture as a source of food and also as an economic activity. One of the farmers in the discussion commented that:

> We suffer from a decrease in parcels of land and am not sure of what is going to happen to agriculture which has been a source of our livelihood for many years. We have experienced the increase in the population which has led to a decrease in parcels of land. For most of us who are used to farming, there is going to be a challenge.

Another participant remarked that:

> I wonder why people waste time on agriculture, yet they can invest their time in other economic activities that will bring in more benefits as compared to agriculture which I feel is a struggle, now that middlemen who seek to make profits from the farmers make it impossible to make any profit from cash crops.

Such sentiments from the participants in the focus group discussion revealed that there is a feeling amongst members of the community that time has come to focus on other economic activities other than agriculture, especially due to the fact that land subdivision has led to people owning very small parcels of land.

Conclusion and recommendations

The findings of this study reveal that smallholder farmer's practices do not allow the families to have food for storage until the next season. This is because they sell direct from the farm and do not have the post-harvest mechanisms in place. This means that, they may also lack good and adequate storage facilities.

This poses food insecurity and families may not be able to meet social and economic needs. In this view, smallholder farmers should invest in agribusiness to diversify sources of income.

The Striga weed is a nuisance to farmers' who feel uproot and burn is tedious, despite their knowledge of the adverse effect of the weed on agricultural production. There is a need for modern Striga control technologies where farmers should plant Striga resistant maize seeds, plant perennial crops such as cassava and employ the push and pull technologies.

Increased demand for land for individual settlement, agricultural activities and infrastructural improvement is scaling up food insecurity. Land tenure policies should be reviewed and effectively communicated at the rural setup. There is a need for organizations working in rural development to create awareness on the conservation of grasslands, wetlands and rural forests as a strategy to combat climate change. Household use of firewood can be reduced by use of clean energy.

Traditional agricultural methods and lack of knowledge of the correct seed for planting in given regions are a major drawback to sustainable rural development. The communities can have community-based organizations to help farmers link up with the elite labour, so as to inculcate the new technologies which only require a small space of land to produce high yields and returns.

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