ISSN 2348-3156 (Print)
International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
Vol. 6, Issue 1, pp: (355-365), Month: January - March 2018, Available at: www.researchpublish.com

CHALLENGES FACED BY LOCAL FARMERS IN ADOPTING CLIMATE SMART AGRICULTURE (CSA) IN LOWER NYAKACH DIVISION

[1]Ochola Sylvance Onyango, [2]Ikanda Fred Nyongesa

Department of Sociology and Anthropology
[1,2]Maseno University, Private Bag, Maseno, Kenya
*Corresponding Author: Ochola Sylvance Onyango: 0720987870; Email: Ocholasylvance@gmail.com

Abstract: **The World Bank (2015) estimates that around 1.01 billion people – 14.5 per cent of the world's population – still live in extreme poverty (on less than $1.25 per day), with 46.8% of the population in Sub-Saharan Africa experiencing extreme food deficit. This situation is majorly blamed upon climate change effects, thereby putting into question the adoption of climate smart agricultural practices by small holder farmers who are basically the producers of 70% of food crops in the World. In Kenya, most rural families in Nyakach Sub County consume below an average of 91 two kilogram tins per year as recommended by the World Food Organization (FAO), International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) (FAO, IFAD & WFP, 2014). This study sought to investigate the challenges faced by local farmers in adopting climate smart agriculture in Lower Nyakach Division in Kenya. Specific objectives were to: establish how climate change has impacted on food crop production; indigenous climate smart agricultural practices are employed; and the challenges faced by local farmers in adopting climate smart agricultural practices for adaptation to climate change. Descriptive cross sectional design was used on a target population of 2504 households stratified in 4 sub locations. The sample size comprised 10% of the target population as recommended by Gay & Diehl (1992), representing 250 households. Data was collected using structured questionnaire from household heads. Descriptive statistics were used to analyse quantitative data using Statistical Package for Social sciences (SPSS) version 20. It was found that farmers were aware of common short and inconsistent patterns of rainfall, and floods in the recent past accompanied with strange diseases like *Miguna Miguna* and invasion of army worms. Multi cropping, intensive weeding, planting early maturing crops, and applying manure on the farms are some of the indigenous climate smart practices. Lack of credit and extension services were some of the challenges faced in adopting climate smart agriculture. It is recommended that extension officers should use village *barazas* to disseminate climate change information, and that capital support be availed to farmers to enhance their capabilities. Further studies should be done on contribution of radio broadcasts on adaptation to climate change, and effect of climate information flow on adaptation practices to climate change.**

***Keywords*: CSA, Adoption, Climate change, local farmers, Challenges, Rural Agriculture, Capabilities.**

1. INTRODUCTION

World population is predicted to reach 9.6 billion people by 2050; in the same time period, food insecurity is expected to rise by a further 15–40 per cent as a result of climate change (CIDSE, 2014). Around 1.01 billion people – 14.5 per cent of the world's population – still live in extreme poverty, i.e. on less than $1.25 per day (World Bank, 2015). In sub-Saharan Africa, it is 46.8 per cent of the population (ibid.) experience extreme food deficit. Despite average worldwide

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per capita food supply of 2, 800 kcal/day, one billion people continue to suffer from food insecurity and the health of billions more is compromised by nutritional deficiencies (FAO, 2013). Agricultural systems and global food security are wholly dependent on natural resources, including healthy soils and vast web of interconnected species that compose global biodiversity (FAO, 2015b). Despite growing awareness of the need to maintain the natural resource base, unsustainable agricultural practices are still the norm, and food security is dependent on just a few key species; 60 per cent of all nutritional needs are met by only four crops: rice, wheat, maize, and potato (FAO, 2015b). Climate change increases the likelihood of extreme and unpredictable weather, and of crop diseases that are new or occur in new locations; should disease or climate severely impact one of these key species, it would have devastating implications for global food security.

While on the one hand we live in a world in which nearly 805 million people are suffering from chronic hunger (IFAD, WFP, FAO, 2014), this situation is set to be exacerbated by climate change, which poses a major threat to food security: the Intergovernmental Panel on Climate Change (IPCC, 2014) predicts that food insecurity could increase by between 15–40 percent by 2050 (IPCC WGII, 2014). According to FAO (2015a), climate change is already disrupting food production systems, with serious implications for food security and economic development, hence the need to heed climate smart agricultural practices. According to Mabe, et al. (2012), climate change is a significant shift in the average weather condition especially average temperature and precipitation of an area, and it is predicted that most land areas will have warmer and fewer cold days and nights. Similarly, Intergovernmental Panel on Climate Change Working Group (IPCCWG II, 2007: 30) defines climate change as a change in the climate that persists for decades or longer, arising from either natural causes or human activity. Scientists attribute climate change to the emission of greenhouse gases (GHGs), such as carbon dioxide, methane and nitrous oxide (IPCC, 2007).

Climate-Smart Agriculture (CSA) is rapidly gaining traction as a possible response to this challenge. Climate-smart Agriculture is defined by the Food and Agriculture Organization (FAO, 2013) as agriculture that sustainably increases productivity, enhances the resilience of livelihoods and ecosystems, reduces and/or removes greenhouse gases (GHGs) and enhances the achievement of national food security and development goals. However, practicing CSA by small scale farmers in rural settings may prove unsustainable, given limited resources as well as lack of support and financial limitation. In the view of Vermeulen (2010), small-scale farmers produce almost 80 per cent of food on regional markets in Africa and Asia. Moreover, eighty-five per cent of the world's farms are less than 2 hectares, worked by families and indigenous peoples. Strengthening the livelihoods of rural populations is therefore intrinsically linked to poverty reduction efforts and is a key area to focus climate smart agricultural strategies in the food production sector. However, evidence available among Sub Saharan Africa points at food deficiency of higher scale, thus questioning whether small scale farmers are outweighed by massive challenges in adopting CSA.

In Kenya, farmers have continued to link reduction in agricultural production to climate shifts for the last 3 decades. Voluntary Service Overseas Evaluation Report (VSO, 2012) estimated that 53.4% of people in Kisumu County (Kenya) live below the food poverty line, compared to 8.4% in Nairobi. In Lower Nyakach Division in Kisumu County where households rely on maize crop as staple food, there are often poor harvests every season, with an approximate two to three bags yields to feed a household of five persons annually (Obuoyo, Ochola & Ogindo, 2016). Ochieng (2014) asserts that 65.0 percent of the residents of the division are food insecure due to infestation of maize farms by striga, declining soil fertility due to overuse and soil erosion. This further questions adaptation strategies employed by the farming households in addressing changes in climatic conditions. Records from Nyakach Sub County Agricultural Office (2016) indicate that between 2012 and 2015, Lower Nyakach Division with four administrative locations has realised a steady decline in maize crop production. Table 1.1 presents the trend of maize crop production in the area.

Table 1.1: Trends of Maize Crop Production in Lower Nyakach Division

	2012	**2013**	**2014**	**2015**	**No of Households**
Jimo East	4585	4467	4412	4362	917
Rarieda	2120	2052	1992	1968	424
Gem Nam	2155	2064	2008	1987	431
Moro	3670	3567	3501	3484	734
Total	**12530**	**12150**	**11913**	**11801**	**2504**

Source: Nyakach Sub County Agricultural Office (2016)

Table 1.1 illustrates that between 2012 and 2015, there was a decline of 712 bags in maize production in Lower Nyakach Division. Between 2012 and 2013, the production declined by 380 bags; 220 bags between 2013 and 2014; and 112 bags between 2014 and 2015. With a population of 2504 households (Kenya Population Census Report, 2009), each household received approximately five bags of maize from their farms to feed an average of five persons per household (KPC, 2009). Similarly in 2013, 2504 households were to feed on 12150 bags obtained from the farms: this translates to 4.9 bags per household; in 2014, the amount reduced to approximately 4.8 bags per household, while in 2015, it declined to approximately 4.7 bags. This therefore implied that in a household of five persons, each person consumed 0.94 bags (or 37.6 two kilograms tins) of maize in 2015. This is far below an average of 91 two kilogram tins per year as recommended by the World Food Organization (FAO), International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) (FAO, IFAD & WFP, 2014).

1.2 Statement of the Problem:

It is estimated that 53.4% of households in Kisumu County live below the food poverty line, compared to 8.4% in Nairobi. In Lower Nyakach Division, households comprising five persons seem to be relying on farm harvests of between four and five bags of maize annually. This is an indication of food deficiency. Adaptation of CSA has the benefit of preserving the environment and in turn ensuring sustainable crop production, although such practices are unique to each region, hence the need for region specific enquiry. In Kenya, little evidence is available concerning the level to which CSA strategies in mitigating climate change have been undertaken by small scale farmers. Evidence exist of several households in areas like Kisumu County facing reduced food crop production, ostensibly due to climate change effects. Little is known concerning adaptation strategies to climate change amongst the farmers. This study therefore sought to answer the following research questions:

1.3 Research Questions:

i. How has climate change impacted on food crop production by local farmers in Lower Nyakach Division?

ii. Which indigenous climate smart agricultural practices are employed by local farmers for adaptation to climate change in Lower Nyakach Division?

iii. What are the challenges faced by local farmers in adopting climate smart agricultural practices for adaptation to climate change in Lower Nyakach Division?

1.4 General Objective of the Study:

The general objective of the study was to establish the challenges faced by local farmers in adopting climate smart agriculture (CSA) in Lower Nyakach Division

1.5 Theoretical Underpinnings:

This study was informed by the capabilities theory advanced by Sen (1992, 1999, and 2004). The theory emphasizes on the distinction between the means and the ends of well-being and development, and that only the ends have intrinsic importance, whereas means are only instrumental in the achievement of well-being and development. Capability theory examines capacities necessary for people to lead functioning lives. Functioning lives reflects the collection of 'beings' and 'doings' that can be viewed in various outcomes in one's achievements (Goerne, 2010). A capability approach focuses on whether or not people possess capacities necessary to construct a fully functioning life. On the other hand, Nussbaum, (2011) considers capacities as natural systems that directly depend on a stable climate system.

Since changes in climatic conditions will affect what individuals are able to achieve with the resources that they have, capability theory was found suitable for the present study. Schlosberg (2012) asserts that capability approach provides a concept that can encompass the current framing of climate change in a way that is more applicable to the development of adaptation strategy. Since this approach addresses the basic requirements that are necessary for human life to function and flourish; it is important to align adaptation strategies with climate change for the purpose of protecting basic functioning of human communities. If climate change impedes agricultural practices, or/and undermines local infrastructure, then functioning will be limited. In that case, climate change is a barrier to functioning lives of individuals (Schlosberg, 2011: 19). Additionally, Nussbaum (2011) considered the potential mental health impacts, such as the increased stress of farmers who have been affected by climate change, and the overall anxiety of rapid climate change, as a barrier to capability of emotional health.

2. LITERATURE REVIEW

There is no dispute that every person on earth depends on the primary production of agriculture for their food security. The agricultural sector in developing countries employs 50 per cent of the population; in the least developed countries (LDCs) it is as high as 72 per cent (Cheong et al., 2013). The sector is particularly vulnerable to extreme weather events: between 2003 and 2013, it absorbed 22 per cent of the US$494 bn in damages caused by natural hazards and disasters in developing countries (FAO, 2015a). Effective adoption to climate smart agriculture, however, requires location-specific understanding of climate change (Gamble et al., 2010). This is especially true for small farmers, who often use local climate knowledge for decision making. Although climate may seem an unlikely candidate for management, small farmers are however not limited to reacting to it (Astier et al., 2011). Small farmers have developed innovative farming strategies for withstanding challenging climatic conditions (Altieri and Nicholls, 2013). Effectiveness of such practices in mitigating climate change effects has however not been proved, especially among rural farmers in developing countries.

Wood, Jina, Jain, Kristjanson and DeFries (2014) used a 12-country data set from sub-Saharan Africa and South Asia to explore the links between access to weather information, household and agricultural production-related assets, and participation in local social institutions change and the likelihood that farmers made farm-associated changes, such as adopting improved crop varieties, increasing fertilizer use, investing in improved land management practices, and changing the timing of agricultural activities. They found evidence that access to weather information, assets, and participation in social institutions are associated with households that have reported making farming changes in recent years, although these results vary across countries and types of practices.

Rogé, Friedman, Astier and Altieri (2014) used workshops in the Mixteca Alta region of Oaxaca, Mexico, in which groups of small farmers described how they had adapted to and prepared for past climate challenges. Farmers reported that their cropping systems were changing for multiple reasons: more drought, later rainfall onset, decreased rural labor, and introduced labor-saving technologies. Examination of climate data found that farmers' climate narratives were largely consistent with the observational record. There have been increases in temperature and rainfall intensity, and an increase in rainfall seasonality that may be perceived as later rainfall onset. Farmers also identified 14 indicators that they subsequently used to evaluate the condition of their agroecosystems. Farmers ranked landscape-scale indicators as more marginal than farmer management or soil quality indicators.

Elum, Modise and Marr (2016) examined the trend in climate parameters, farmers' perception of climate change, constraints faced in production and to identify the strategies (if any) that farmers have adopted to cope with the effects of changing climate in three selected provinces in South Africa. The analytical results revealed that the climate parameters have significantly changed over time and these were substantiated by farmers' experiences. The farmers are engaging in various climate-response strategies like the planting of drought-tolerant varieties is most common. Also observed, is that the lack of awareness of insurance products and inability to afford insurance premiums were the principal reasons majority of the farmers did not have insurance.

Mugiy and Hofisi, (2017) explores the challenges affecting small-scale farmers in the Zvishavane District of Zimbabwe in coping with climate change vulnerability. The qualitative research methodology encompassing semi-structured interviews was used to collect data from small-scale farmers and other key informants in the study area. The study portrays that small-scale farmers are struggling to cope with climate change due to resource constraints, lack of access to credit and inputs, aid bottlenecks coupled with contradiction of programs among other critical issues.

Ochieng, Kirimi and Mathenge (2016) estimated the effect of climate variability and change on revenue from all crops, maize and tea separately, using a household fixed effects estimator. It was found that climate variability and change affects agricultural production but effects differ across crops. Temperature has a negative effect on crop and maize revenues but a positive one on tea, while rainfall has a negative effect on tea. They found that tea relies on stable temperatures and consistent rainfall patterns and any excess would negatively affect production. Temperature has a greater impact on crop production than rainfall. Implementing adaptation measures at national, county and farm levels as well as putting in place policies that prevent destruction of the natural environment will assist to address the challenges posed by climate variability and change.

Ndambiri, et al (2012) assessed how farmers in Kyuso District have adapted to the effects of climate change using a sample of 246 farmers from six locations that were sampled out through a multistage and simple random sampling procedure. The analysis revealed that 85% of the farmers had adapted in various ways to the effects of climate change. In this regard, the age of the farmer, gender, education, farming experience, farm income, access to climate information, household size, local agro-ecology, distance to input/output market, access to credit, access to water for irrigation, precipitation and temperature were found to have significant influence on the probability of farmers to adapt to climate change.

Mulinya (2017) examines the adaptation strategies to climate change of small scale farmers in Kakamega. The study sought to examine farmer's perceptions to climate change and factors that influenced small scale farmers in adapting to climate change. Out of 9 adaptation strategies that the farmers were aware of, planting of drought tolerant crops was ranked first among farm adaptive measures, while rain water harvesting was ranked as least utilized. Out of seven factors surveyed, age, education, family size, farm size, family income, gender and farming experiences were significantly related to adaptation strategies. Despite different support and technological interventions being available, lack of finances, lack of information, shortage of labour expertise were noted by the respondent as major constraints to coping with climate change effects.

Mulinya, Ang,awa, and Tonui (2016) sought to explore the existence and determine the characteristics of climate variability/change, assess its impact on small scale farmers and explain their resilience and adaptive strategies. It was established that there were changes in rainfall amounts and temperature in the region. The rainfall amounts were having a negative trend of 3mm per annum, a sign of reduction over time, whereas temperatures had a positive trend of 0.04 0 C on yearly basis. Despite these changes in climate crop farmers had put in strategies to cope with the changing trends, though they were faced with many challenges/ constraints in trying to implement these strategies.

3. MATERIALS AND METHODS

3.1 Study Area:

Lower Nyakach is one of the three divisions that make up Nyakach Sub County in Kisumu County. It is bound to the north by Nyando division in Nyando Sub County, to the South by Upper Nyakach division, to the West by West Nyakach division and Lake Victoria to the North West. The divisions forming the Nyakach Sub County are Lower Nyakach, Upper Nyakach and west Nyakach divisions. The Division's total area is 182.6 Km^2 and total population of 58,789 according to Kenya Population Census Report (Republic of Kenya, 2009). The rivers that run through the area are River Awach and River Nyando, which often flood adjacent farms and villages during heavy downpour of rainfall, at times making it difficult for cultivation. The rest of the area, however remains dry and are non productive agriculturally. Maize and sorghum are the staple foods in the area. However, each household of five persons is only able to obtain approximately two bags of such produce to be consumed each year. Households in Lower Nyakach therefore rely on supplies from Upper Nyakach Division and Kericho County, although this is a stressor to household income.

3.2 Methodology:

This was a descriptive cross sectional survey design that employed quantitative data collection method and analysis. Study population comprised of household heads from four sub-locations in Lower Nyakach Division, namely Jimo East, Moro, Gem-Nam, and Rarieda, totaling 2504 in number. According to Gay & Diehl (1992; cited in Mungure, 2015: 21), the number of respondents acceptable for a study depends upon the type of research involved: descriptive, correlational or experimental. Gay and Diehl (1992) contend that for descriptive research, the sample should be 10% for a large (more than 2000) population, and 20% for a small (less than 1500) population (Hill, 1998: 6; Akyina & Alubokin, 2016: 42). Therefore 10% of the targeted heads of households were selected as the sample size, making up 250 households. To ensure proportional representation of each sub location according to the population of each unit, proportional stratified random sampling technique was employed, where each individual sub location served as a stratum. This enabled the researcher to select a sample in accordance with proportional percentage of the population of each sub group (stratum) or each sub location (Paton, 2002). For example, Jimo East, with a population of 917 households, had a proportional representation calculated as:

$$\frac{917}{2504} \text{x } 100 = 36.6\%$$

Therefore, 36.6% of 250 households equal 92 households from Jimo East sub location. The same proportional calculation was applied to other sub groups. The sample size and sampling procedure is as shown in Table 3.1.

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International Journal of Social Science and Humanities Research ISSN 2348-3164 (online)
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Table 3.1: Sample Size

Sub location	Target Population	Sample size	Percent
Jimo East Rarieda	917 424	92 42	36.6 16.9
Gem Nam	431	43	17.2
Moro	734	73	29.3
TOTAL	**2504**	**250**	**100**

Source; adopted from Kenya Population Census Report (KPC, 2009)

The study used questionnaire method to collect data from randomly selected 250 household heads from the 4 locations sampled by the researcher. The questionnaire was administered in person by the researcher. The significance of this method is that it enabled the researcher to draw short simple questions, which were closed ended, and which also required short and precise answers from the respondents, (Tsai, Lin, & Sai, 2001).

4. RESEARCH FINDINGS

4.1 Biographical Profile of Respondents:

Table 2 and 3 presents a summary of demographic profile of the sampled household heads.

Table 4.1: Demographic Profile of Head Teachers and Teachers

Profile	Measurement	Frequency	Percentage
Return Rate of Questionnaires			
Gender	Male	96	22
	Female	154	78
	Total	**250**	**100**
Age	Below 30	23	13.04
	31 - 35	51	
	36 - 40	35	60.87
	41 - 45	28	
	46 - 50	37	17.39
	51 and above	76	8.70
	Total	**250**	**100**
Education Level	None	12	00
	Primary	123	
	Secondary	105	8.70
	Tertiary	10	91.3
	Total	**250**	**100**
Approximate farm size	Less than 1 ha	6	26.09
	1 – 2 ha	14	60.87
	3 – 4 ha	2	8.70
	More than 4 ha	1	4.35
	Total	**250**	**100**
Family Size	1 – 3 Members		
	4 – 6 Members		
	7 – 9 Members		
	10 – 12 Members		
	13 and above		
	Total	**250**	

Table 4.1 illustrates that majority most (61.6%) of the sampled household heads were females, while 38.4% were males. This suggests that among rural households which commonly engage in small scale or subsistence farming, women form the majority. This finding seems to indicate that most rural households engaging in small scale farming activities are headed by females. The Table further indicates that that most (30.4%) of the sampled household heads were aging 51

years and above, while 20.4% of the household heads were between 31 and 35 years of age. On the other hand, 14.8% of the respondents were of between 46 – 50 years of age; 14% of the sampled household heads aged between 36 and 40 years; 11.2% of the respondents being between 41 and 45 years old; and the remaining 9.2% of the respondents were of below 30 years of age. Findings in the Table indicate that over 50% of the sampled household heads were 45 years and above, suggesting that they were adults who have been participating in food production for the benefit of households which they head.

The Table further illustrates that the highest number (49.2%) of the sampled household heads had primary level of education, while 42% of them had secondary level of education. Furthermore, 4.4% of the sampled respondents did not attend school entirely, and the remaining 0.4% of the respondents failed to indicate their education level. It has been revealed by the Table that the highest numbers of households were headed by adults whose education levels are up to primary schooling only. This suggests that awareness to climate change might prove difficult to these household heads, because most of climate change information is seldom relayed through local vernacular languages. With regard to the farm size, the highest number (48.4%) of the sampled households own between 1 and 2 hectares of land, while 23.2% of them own between 2 and 3 hectares of land. On the other hand, 18.4% of the households whose heads participated in the study own less than 1 hectare of land and 10% of them were found to own more than 3 hectares of farm size. This finding indicates that more than 66% of the respondents own below 2 hectares of land. This suggests that farmers in Lower Nyakach Division have limited options for crop diversification owing to farm size.

Concerning the size of the household, the table shows that the largest number (50%) of the sampled households had between 4 and 6 members, while 23.2% had between 7 and 9 members. Equally, 19.6% of the sampled households had between 1 and 3 members; 4.8% had between 10 and 12 members, and the remaining 1.2% of the sampled households had 13 and above members. However, 1.2% of the sampled household heads did not indicate the size of their families. This finding suggests that the average size of families in the study area is 5 members. Thus, households composed of 5 members and with less than 2 hectares of land would be expected to employ intensive farming inputs to adapt to climate change (Ndambiri, et al, 2012). This would call for high adaptive capacity or capability.

4.2 Climate Change and Food Crop Production:

The first objective of the study sought to assess the level of awareness of local farmers on climate change. Using translated language to suit local dialect, the researcher presented statements related to the level of awareness in regard to shifts in climatic conditions, whereby the sampled household heads were requested to express their agreements as: **1**- Strongly Disagree; **2**- Disagree; **3**- Neither Agree nor Disagree; **4**- Agree **5**- Strongly Agree to the statements presented by the researcher. Table 4.2 presents the distribution of respondents by level of awareness of local farmers to climate change.

Table 4.2: Distribution by Level of Awareness of Local Farmers

No	Items	1	2	3	4	5
1	We've experienced decreased rainfall in recent past	00	11.2	0.8	87.6	0.4
2	We have received intense rainfall in recent past	00	30.4	6.4	62.4	0.8
3.	Prolonged draught has become common in the village	00	7.6	4.8	74.0	13.6
4	Floods have become common on arrival of rainy seasons	00	22.0	1.6	63.6	12.8
5.	Short and inconsistent patterns of rainfall are common	00	4.4	2.0	92.4	1.2
6.	Heavy rainfall have caused delay of land preparation	00	38.8	5.2	38.8	17.2
7	We rely on internet for weather information	18.8	78.4	0.8	1.6	0.4

Table 4.1 illustrates that, 74% also agreed that there has been prolonged droughts in the village; while 63.6% of the sampled household heads agreed that there has been floods during rainy seasons. Equally, 62.4% of the sampled household heads agreed that instances of intense amounts of rainfall had been some shifts in climatic conditions in the area. On the other hand, the respondents disagreed that: they rely on internet for weather information (78.4%); and that they receive weather information from extension officers (68.0%). This therefore implies that rainfall patterns have become short, inconsistent and decreased in amount in Lower Nyakach Sub County. Moreover, radio has remained a common source of weather information in the area, while internet seems to be inaccessible due to low level of education and location of the area, being far away from urban centres. Plate 4.1 presents a picture of a maize disease invasion in the study area.

Plate 4.1: Picture of strange disease invasion on Maize Crop

Plate 4.1 and 4.2 presents pictures of maize crop that have suffered from invasion of strange diseases. The type of attack shown in the second picture is the outcome of the stalk yellowing. This finding agrees with the capabilities theory that examines capacities necessary for people to lead functioning lives, and considered by Nussbaum, (2011) as natural systems that directly depend on a stable climate system. Dependence on rainfed agriculture by local farmers in this area therefore exposes them to unstable climate, resulting into infestation of strange diseases and poor crop harvest. Equally, farmers in the division (Lower Nyakach) have experienced food insecurity due to other infestations of maize farms by striga, declining soil fertility due to overuse and soil erosion (Ochieng, 2014), all of which are impacts of climate change.

4.3 Indigenous Climate Smart Agriculture Practices and Food Crop Production:

The second objective of the study sought to establish the indigenous adaptation strategies used by local farmers in addressing climate change and to enhance crop production. To this end, the researcher presented statements related to indigenous farming practices adapted to combat shifts in climatic conditions, whereby the sampled household heads were requested to express their opinion to the presented statements as: **1**- Strongly Disagree; **2**- Disagree; **3**- Neither Agree nor Disagree; **4**- Agree**5**- Strongly Agree. Table 4.3 presents the distribution of respondents by level of awareness of local farmers to climate change.

Table 4.3: Distribution by Indigenous Adaptation Strategies

No	Items	1	2	3	4	5
1	We often plant drought resistant hybrid seeds	1.2	23.2	11.2	64	00
2	We use tractors to plough our farms	6.4	71.6	2.8	19.2	00
3	Most of us plant early	2.0	64.4	2.0	31.6	00
4	We apply manure intensively in our farms	0.8	40.4	8.4	49.2	1.2
5.	Most of us use crop rotation in our farms	00	57.2	1.2	39.2	2.4
6	Multi cropping has become our only alternative	0.4	1.6	00	89.2	8.8
7.	Weeding is done more than once	00	0.4	00	83.6	16.0
8.	We normally plant early maturing crops	3.6	10.4	8.4	76.0	1.6

Findings presented in Table 4.3 reveal that the sampled respondents agreed that: Multi cropping had become their only alternative (89.2%); weeding is done more than once (83.6%); they normally plant early maturing crops (76.0%); they often plant drought resistant hybrid seeds (64.0%); and that they apply manure intensively in their farms (49.2%) as some indigenous adaptation strategies that they have used to mitigate the effects of climate change. This implies that, to minimise risks associated with crop losses, farming household heads resort to planting more than one type of crops as well as weeding intensively, although this may require large parcels of farm sizes. Perhaps due to the small sizes of farms revealed in this study, food deficit has been rampant among most households in this area. The capability of the farming households to own large farms is low, hence limiting their choice for crop rotation among other practices. These findings concur with Ndambiri, et al (2012) that showed that 85% of the farmers in Kyuso (Kenya) had adapted in various ways to the effects of climate change. Mulinya, et al (2016), however, noted in Kakamega (Kenya) that although crop farmers had put in strategies to cope with the changing trends, they were faced with many challenges/ constraints in trying to implement these strategies.

4.4 Challenges faced in Adoption of Climate Smart Agriculture:

The last objective of the study sought to determine the challenges facing local farmers in adapting strategies meant to address climate change aimed at enhancing food crop production. Thus, the researcher developed a questionnaire with statements related to challenges facing farmers in adapting strategies for climate, whereby the sampled household heads were requested to express their agreements to the statements as: **1**- Strongly Disagree; **2**- Disagree; **3**- Neither Agree nor Disagree; **4**- Agree**5**- Strongly Agree. Table 4.4 presents the distribution of respondents by level of awareness of local farmers to climate change. Table 4.4 presents distribution by challenges faced in adaptation strategies.

Table 4.4: Distribution by Challenges faced in Adapting to Climate Change

No	Items	1	2	3	4	5
1	Lack of Government subsidies	0.8	9.2	3.2	70.4	16.4
2	Inadequate extension services	1.2	6.8	0.4	77.6	14
3.	Lack of financial resources	1.6	0.4	00	75.2	22.8
4	Small sizes of land	00	40.8	4.0	48.4	6.8
5.	Poor farming practices	00	35.6	3.2	50.0	11.2
6.	Late preparation of farms	00	42.4	2.8	42.4	12.8

Table 4.4 illustrates that amongst the challenges faced in adapting measures that mitigate climate change effects, the sampled households agreed that: inadequate extension services (77.6%); lack of financial resources (75.2%); lack of government subsidies (70.4%); poor farming practices (50.0%); small sizes of land (48.4%); and late preparation of farms (42.4%) are some of the factors which constrain adaptation to climate change among household heads in the sampled sub locations. This implies that while the farming household heads perceive the government, through the agricultural extension services, as duty bound to assist them in adapting to climate change; this has remained a big challenge. This has been coupled with lack of adequate financial resources, which points at the low level of income among the households in the study area.

This implies that extension services to the farmers seem to be wanting. This is besides lack of adequate income to purchase inputs and employ appropriate machineries in land preparation. This therefore renders the local small scale farmers in this Division incapable of leading their desired live of food security in the household. Elum, et al (2016) also came up with similar findings: that the lack of awareness of insurance products and inability to afford insurance premiums were the principal challenges faced by farmers in South Africa in adopting climate smart agriculture. Resource constraints, lack of access to credit and inputs, aid bottlenecks coupled with contradiction of programs among other critical issues were found by Mugiy and Hofisi (2017) as challenges experienced by farmers in Zimbabwe in adopting climate smart Agriculture.

On the other hand, the farming household heads did not agree that unavailability of information concerning forthcoming climate and lack of information on adaptation practices (80% & 49.2% respectively), are challenges that they face in adapting strategies meant to mitigate climate change effects. This therefore isolates lack of resources as a major challenge in adaptation to climate change, hence begging for individual capability in this in ensuring adaptation. As stated by Ribot (2010), it is the responsibility of individual communities to define their own vulnerabilities and designing climate smart strategies that are planned to shield them from climate change that threatens their ability to function. In this regard, farmers in Lower Nyakach Division face challenges in adapting to climate change due to lack of resources.

Thus, as evident from studies done in other developing countries, farmers in Lower Nyakach Division face lack of timely and adequate climate change information hence are unable to adopt proper adaptation measures to climate change. Equally, inadequacy of extension services with regard to necessary adaptation practices to be adopted in the face of shifts in climate continues to worsen adaptation initiatives for mitigating climate change among farmers in the Division.

5. CONCLUSIONS

Based upon the study findings, it is concluded that level of awareness of climate change by farmers in Lower Nyakach Division are not enhancing adaptation to climate change among the farming households. In the area, floods continue to wash away crops, leaving the firms bare and resulting into exposed dry earth unfit for crop production. Additionally, there are inadequate extension services to the farmers, further rendering them unprepared for the climatic changes. This is worsened by their lack of capability in adopting appropriate climate change measures to mitigate effects of climate change.

ACKNOWLEDGEMENTS

This research paper appreciates the contribution of all household heads who participated in the study. The information they provided enable analysis of data and consequently the findings of the study. In addition, the representative of the county commissioner of Lower Nyakach Division is appreciated for the role they played in providing permission for data collection from the sampled households under study. Finally, the study appreciates the contribution made by everybody towards this work.

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