

# Farmers' Level of Awareness of Climate Change and Available Mitigation Extension Services in Lower Nyakach Division, Kenya

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**Abstract:** For effective climate change adaptation methods, awareness of locals should be used in conjunction with scientific knowledge systems for impact reduction. However, there is evidence that the majority of Kenya's population is unaware of climate change, despite climate variability being experienced in the country. Reduced crop yields in some rural areas like Lower Nyakach Division points to the fact that level of awareness among local farmers may be low, further questioning the availability of extension services in the area. The general objective of the study was to assess the farmers' level of awareness and extension services available for mitigation of climate change effects in Lower Nyakach Division, Kenya. Specific objectives were to: examine the source of climate change information available to local farmers; explore the effects of climate change experienced by local farmers, and to assess the extension services available to local farmers for mitigation of climate change effects. 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. 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. Radio is the main source of weather information, implying that radio broadcast is a better avenue for passing weather information. However, there are inadequate extension services, lack of financial resources, and lack of government subsidies. 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:** Awareness; Extension services; Climate change; Adaptation: Lower Nyakach Division.

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## 1. INTRODUCTION

According to Intergovernmental Panel on Climate Change (IPCC, 2007) Fourth Assessment Report (AR4), the most current and acceptable definition of climate change, which states that "climate change is a change in the state of the climate that can be identified (eg., by using statistical tests) by changes in the mean and /or the variability of its properties, and that persists for an extended period typically decades or longer". A review of the climate change literature shows that more attention has been paid to climate change system modeling, climate change impacts, adaptation and risk assessment, but relatively little attention has been devoted to the perceptions and options for adaptation of those experiencing climate change (Li, Tang, Luo, Di, Zhang, 2013). In the case of climate change impacts on smallholder agriculture, what is apparent is the gap between scientists' analysis of global climate change and rural farmers' awareness (Ayanladea, Radeny and Morton, 2017). Despite the great advancement of climate science in understanding and dealing with the problem of climate change and its impacts on the agricultural sector at the international level, awareness and the concern for the problem at local levels, especially among the rural farmers in Africa, remains crucial (ibid). Studies in other part of the world have shown that farmers cope with climate change based on their perceptions of changing climate (Li et al., 2013; Abid et al., 2015).

First, one has to perceive climate change and associated risks; then steps taken to minimize the adverse effects of climate change. According to Ali and Erenstein (2017), perception should be more or less correct; otherwise steps taken based on wrong perception could have an adverse effect. Correct perception depends on the knowledge and access to information. However, Tripathi and Mishra (2017) argue that knowledge depends on the educational attainment and experience of the person. Perception is a cognitive process that involves receiving sensory information and interpreting it. Despite perceiving the phenomenon correctly, sometimes people do not respond to effects of CC due to constraints, including lack of capacity, lack of resources, and lack of information. One therefore questions the role played by extension services, particularly from the Ministry of Agriculture. According to FAO (2015), it has been observed that agricultural extension is involved in public information and education programs that could assist farmers in mitigating the effects of climate change. Maponya and Mpandeli (2013) assert that such involvements include awareness creation and knowledge brokerage on the issues of climate change; building resilience capacities among vulnerable individuals, communities and regions; encouragement of wide participation of all stakeholders in addressing climate change issues and developing appropriate framework for coping/adapting to climate change effects/impacts.

Though good agricultural management practices have the potential to be the basis for effective climate change adaptation methods, local knowledge should be used in conjunction with scientific knowledge systems for impact reduction (Ayanladea, et al, 2017). When crop yields are low, due to losses as a result of climate change as evidenced in changing times for the start and stop of rainy (growing) and dry seasons, farmers pay dearly for their ignorance or unpreparedness. However, Ochieng (2014) contends that the majority of Kenya's population is unaware of climate change, notwithstanding climate variability being experienced in the country (Otieno, Pauker and Maina, 2009; GoK, 2010). Nevertheless, the Kenyan government is aware of and concerned about climate change as a development issue. In this regard, the government has developed the *National Climate Change Response Strategy – 2010* and its implementation plan, the *National Climate Change Action Plan 2013-2017*, which outlines actions to be taken to mitigate and build resilience to the impacts of climate change. Most rural farmers in Kenya have however not been obtaining adequate produce from their farms. Whether this is owed to lack of awareness to climate change or availability of extension services is not known.

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 seems to suggest that farmers in this area have failed to adopt farming practices that are capable of mitigating climate change effects. This therefore queries their level of awareness with regard to climate change. Furthermore, availability of extension services that is supposed to offer climate information and expertise advice on ways of addressing changes in climate in this area need to be investigated. This is because records from Nyakach Sub County Agricultural Office (2016) indicate that between 2013 and 2016, Lower Nyakach Division with four administrative locations has realised a steady decline in maize crop production. Table 1 presents the trend of maize crop production in the area.

**Table 1: Trends of Maize Crop Production in Lower Nyakach Division**

	2013	2014	2015	2016	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
<b>Total</b>	<b>12530</b>	<b>12150</b>	<b>11913</b>	<b>11801</b>	<b>2504</b>

Source: Nyakach Sub County Agricultural Office (2016)

Table 1.1 illustrates that between 2013 and 2016, there was a decline of 712 bags in maize production in Lower Nyakach Division. Between 2013 and 2014, the production declined by 380 bags; 220 bags between 2014 and 2015; and 112 bags between 2015 and 2016. 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 2014, 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 2016, 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 2016. 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). Furthermore, the report in Table 1.1 questions the effectiveness of available extension services for mitigating effects of climate change by farmers in Lower Nyakach Division.

### ***1.1 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. This seems to be true because several households in areas like Kisumu County have been facing reduced food crop production, ostensibly due to effects of climate change. Climate change is real and its impacts have become obvious in Kenya (GoK, 2010; RoK, 2013) necessitating the need for adaptation and mitigation at the country level. However, adaptation to and mitigation of climate change require the public to be fully aware and perceive climate change as a problem of global concern. Yet, the vast majority of Kenyans is unaware of climate change, but is at least concerned about the changing weather patterns in the country (Otieno, Pauker and Maina, 2009; GoK, 2010). This study therefore sought to answer the following research questions:

### ***1.2 Research Questions:***

- i. What is the source of climate change information available to local farmers in Lower Nyakach Division?
- ii. What are the effects of climate change experienced by local farmers in Lower Nyakach Division?
- iii. Which extension services are available to local farmers for mitigation of climate change effects in Lower Nyakach Division?

### ***1.3 General Objective of the Study:***

The general objective of the study was to assess the farmers' level of awareness and extension services available for mitigation of climate change effects in Lower Nyakach Division, Kenya.

## **2. THEORETICAL AND LITERATURE REVIEW**

### ***2.1 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. According to Sen (1992), major constituents of the capability approach are functionings and capabilities. Functionings are the "beings and doings" of a person, whereas a person's capability is "the various combinations of functionings that a person can achieve. Capability theory examines capacities necessary for people to lead functioning lives. In the view of Goerne (2010), functioning lives reflects the collection of 'beings' and 'doings' that can be viewed in various outcomes in one's achievements. 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 (2011) 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.

## 2.2 Literature Review:

There is quite an array of research works in the science of various aspects of climate change, although it is unknown whether the outcome of these studies have been made available to rural farmers (Ovuyovwiroye, 2013). Several studies have attested to understandings (of climate change and adaptation strategies) as the first step in mitigating vulnerability caused by variations in weather over time. Pidgeon and Lorenzoni (2006) reviewed major studies to analyse how climate is conceptualized among the public in Europe and the United States of America (USA). Specifically, the analysis established widespread awareness and concern about environmental issues and climate change. In a study done in India by Tripathi and Mishra (2017) on farmers' perception of climate change, it was revealed that although the farmers are aware of long-term changes in climatic factors (temperature and rainfall, for example), they are unable to identify these changes as climate change. Farmers are also aware of risks generated by climate variability and extreme climatic events. Mpandeli and Maponya (2014) carried out a study to establish challenges and constraints facing rural farmers in Limpopo province (South Africa). They found that most farmers in rural areas did not have access to other sources of information such as flyers, magazines and the internet and getting information remains a challenge. The farmers were only able to access limited climate change information through local chiefs and the tribal authority. Oduniyi (2013) also revealed that the information received and the size of the farm had an impact on climate change awareness among farmers in Mpumalanga province (South Africa). This is evidence that sources of climate change information seem to be limited to most rural farmers. According to UNDP (2007), the low level of awareness on climate change across sub-Saharan African is attributed to limited awareness campaigns on one hand and too many problems ranging from poverty to political conflicts on the other hand, hence climate change is never a priority issue.

Other studies have established that some farmers in rural areas have attained correct perception of changes in climate, although these are entirely based on observations on changes in the weather conditions and not interpretations of climate change. In Nigeria, Ayanladea, et al (2017) examined smallholder farmers' perceptions of climate change, climate variability and their impacts, and adaptation strategies adopted over the past three decades. The results show that about 67% of farmers who participated had observed recent changes in climate. Another study in Nigeria (Ovuyovwiroye, 2013) also established in a study that people in either rural or urban areas have limited knowledge about climate change although their sources of information slightly differ. The BBC World Service Trust (2010) conducted research to explore public awareness and understanding of climate change in Tanzania. The findings were that Tanzanians have noticed changes in the weather, seasons and drought but most have little understanding of the relationship between these issues and climate change, and are unfamiliar with the concepts of climate change and global warming. Another study done in Tanzania to establish people's indigenous knowledge on Climate Change & Variability and their adaptive capacity was by Mary and Majule (2009). Findings showed that local people perceived changes in rainfall and temperature to have affected crops and livestock in a number of ways resulting in reduced productivity.

Kalungu, Filho and Harris (2013) assessed smallholder farmers' perception of the impacts of climate change and variability on rain-fed agricultural practices in semi-arid and sub-humid regions of Kenya. It was found that more farmers at the drier sites reported having perceived more changes in the past 30 years than in the past 10 years in nearly all the selected agricultural practices. In another study, Ochieng (2014) assessed the level of climate change awareness among primary school teachers in Kisumu City. A medium level of awareness was found amongst the teachers, although gaps were noted in their knowledge

Universally, agricultural extension role in agricultural sector is educational. Extension officers are expected to provide and disseminate information to farmers (Sala, et al, 2016). Other services expected of extension officers, in their role and responsibilities, include providing institutional support and facilitating farmers' needs to support agricultural production. Several models of extension exist in enabling extension services to be more client – oriented. In all of these models, government policy is considered important (Simpson and Burpee, 2014). A general consensus exists that extension services, if properly designed and implemented, improve agricultural productivity hence a improved food security (Simpson (2016)). The term 'extension' is here understood to mean 'advisory and other services' that help rural families to make the best possible use of the productive resources at their disposal (Sigoi, 2014). Agricultural extension brings about changes in household food security, through education and communication in farmers attitude, knowledge and skills (Simpson, Franzel, Degrande, Kundhlande & Tsafack (2015).

Although some studies have revealed positive relationship between extension services and adaptation to climate change, focus on the availability of such services to rural farmers seem to be limited. Maponya and Mpandeli (2013) investigated the role extension services plays in climate change adaptation in Limpopo province in South Africa. A representative

sample of 300 farmers aged 16 to 65+ years (46% males and 54% females) participated in the study. The results showed that there is a great association among gender, employment, information of climate change, adaptation to climate change, information received through extension services, food scarcity, food security and agricultural production

Sigei (2014) sought to determine the contribution of agricultural extension service on household food security in Nandi County. The study further established that farmers adopted inputs and practices recommended by the extension services such as improved seeds, timely preparation of land and planting and timely harvesting among others. However, respondents found difficulty in accessing credit. On the other hand, Achiando (2012) did a study aimed at identifying indigenous knowledge and perception of effectiveness of communication systems for adaptation to climate change by smallholder farmers in Kilifi District, Kenya. It also aimed at determining the extent to which agricultural information and communication systems (AICS) have integrated indigenous knowledge for climate change adaptation by information end users. Findings indicated that 84% of the respondents have had contact with extension providers. Farmers have perceived AICS to be effective in disseminating knowledge regarding climate change management strategies.

A study done in Kenya by Oremo (2013) sought to identify small scale farmers' perception and adaptation measures to climate change in Kitui County. It was found that extension service, educational attainment, membership to social and economic group, and access to water were the major factors influencing adaptation uptake. Improving these factors will be important to enhance adaptive capacity at the household level. Ochieng (2014) sought to establish the factors that limit the adoption of Striga weed control mechanisms in Nyakach district in Kisumu County. Increase in access to credit by farmers increases their adoption of control methods of striga by 31%. An increase in the level of income of the respondents decreases their adoption of striga control methods by 0.0084%. Increase in the level of education increases the level of adoption of striga control methods by 68%. Increase in access to the extension services increases the adoption by 13%. A unitary increase in age of the farmer increases adoption increases by 2.4%. There is a positive relationship between gender and adoption: with every male farmer, adoption of striga control methods is likely to increase by 14%.

### 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<sup>2</sup> 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:

$$\frac{917}{2504} \times 100 = 36.6\%$$



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 2.

**Table 2: Sample Size**

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

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

**Table 3: Demographic Profile of Head Teachers and Teachers**

Profile	Measurement	Frequency	Percentage
Return Rate of Questionnaires			
Gender	Male	96	38.4
	Female	154	61.6
	<b>Total</b>	<b>250</b>	<b>100</b>
Age	Below 30	23	9.2
	31 - 35	51	20.4
	36 - 40	35	14
	41 - 45	28	11.2
	46 - 50	37	14.8
	51 and above	76	30.4
	<b>Total</b>	<b>250</b>	<b>100</b>
Education Level	None	12	00
	Primary	123	49.2
	Secondary	105	8.70
	Tertiary	10	91.3
	<b>Total</b>	<b>250</b>	<b>100</b>
Approximate farm size	Less than 1 ha	46	18.4
	1 – 2 ha	121	48.4
	3 – 4 ha	58	23.2
	More than 4 ha	25	10
	<b>Total</b>	<b>250</b>	<b>100</b>
Family Size	1 – 3 Members	49	19.6
	4 – 6 Members	125	50
	7 – 9 Members	58	23.2
	10 – 12 Members	12	4.8
	13 and above	6	2.1
	<b>Total</b>	<b>250</b>	<b>100</b>

Table 2 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 Level of Awareness of Climate Change Effects:

The first objective of the study sought to assess the level of awareness of local farmers on climate change Effects. 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 3 presents the distribution of respondents by level of awareness of local farmers to climate change.

**Table 4: Distribution by Level of Awareness of climate change Effect**

No	Items	1	2	3	4	5
1	We often receive weather information through <i>barazas</i>	9.6	29.6	28.4	32	4
2	Radio has been a common source of weather information	0.4	1.2	0.8	76.0	21.6
3	We've experienced decreased rainfall in recent past	00	11.2	0.8	87.6	0.4
4	We have received intense rainfall in recent past	00	30.4	6.4	62.4	0.8
5.	Prolonged draught has become common in the village	00	7.6	4.8	74.0	13.6
6	Floods have become common on arrival of rainy seasons	00	22.0	1.6	63.6	12.8
7.	Short and inconsistent patterns of rainfall are common	00	4.4	2.0	92.4	1.2
8.	Heavy rainfall have caused delay of land preparation	00	38.8	5.2	38.8	17.2
9	We receive weather information via extension officers	7.6	68.0	0.8	22.8	0.8
10	We rely on internet for weather information	18.8	78.4	0.8	1.6	0.4

Table 3 illustrates that, with regard to level of awareness of shifts in climate change, 92.4% agreed that they were aware of common short and inconsistent patterns of rainfall; 87.6% agreed that there has been decreased rainfall in recent past; 76% of the sampled household heads also agreed that radio is a common source of weather information in the area; another 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.

Interviews held with the agricultural officers also produced an outstanding theme pointing to lack of information seeking from the side of the farmers, with the following statement emerging from one of the two Agricultural Officers:

*Only a few farmers from this division do seek necessary weather information from the agricultural extension officers (A1).*

Without seeking weather information from sources like agricultural officers (also referred to as extension officers), it is likely that by the virtue of being a common mass communication gadget, radio stands as a common source of information, including weather information, in the division. Additionally, owing to the fact that majority of the household heads who participate in small scale farming in the area are females with primary level of education, limitation in language of communication might suggest that vernacular radio stations are the only optional source of information. This finding resonates with that of The BBC World Service Trust (2010) when it conducted a research to explore public awareness and understanding of climate change in Tanzania. It found that although Tanzanians have noticed changes in the weather, seasons and drought, most of them have little understanding of the relationship between these issues and climate change due to lack of weather information from experts. It is therefore important to note that the capability of these farmers to access appropriate weather information seems to be limited in terms of lack adequate language for communication and knowledge of where to get such information.

With regard to weather information as held by farmers in the division, an outstanding themes emerging from two FGDs was soil degradation as well as emergence of pest and strange crop diseases such as *Miguna Miguna* (the yellowing of the entire maize crop) that have taken place in the recent past. A common theme derived by the researcher was:

*There has been increase in land degradation, and soil erosion leading to formation of gullies There has also been emergence of pests and diseases like “Miguna Miguna”, yellowing of maize plants, affecting maize crops in the region; unpredictable weather patterns, and prolonged drought and floods ( F3).*

This excerpt from FGDs implies that the sampled farming household heads are aware of climate changes and the effects that this has had on crop production. Plate 4.1 presents a picture of a maize disease invasion in the study area.



**Plate 1: Picture of strange disease invasion on Maize Crop**



Plate 1 presents pictures of maize crop that have suffered from invasion of strange diseases. According to the farmers who participated in the FGDs, the developing cob is first attacked during flowering stage, and then the entire crop turns yellow. The type of attack shown in the second picture is the outcome of the stalk yellowing. This was another statement that emerged from the discussants:

*Ochondo mako bando te, ma gima inyalo ka en man nus mar bando) ..... the entire cob is consumed by the disease such that one can only get half of what was expected from the field (F5).*

This statement indicates that the farmers lose almost half of what they were expected to harvest due to this invasion. This finding seem to concur with Mary and Majule's (2009) results in a study which established that changes in rainfall and temperature have affected crops and livestock production in a number of ways resulting in reduced productivity in Tanzania. Nevertheless, Pidgeon and Lorenzoni (2006) did not find any perceived negativity as well as threat attributable to changes in climate in a study among the public in Europe and the United States of America. This might have been due to contextual differences and individual capabilities in developed and developing countries. Perhaps the capabilities of farmers in Europe to adapt measures that mitigate effects of climate change enable them to realize uninterrupted crop production throughout farming periods. This is in line with Schlosberg (2009) assertion that changes in climate affects what individuals are able to do with the resources that they have. For instance, if climate change impedes agricultural practices, then functioning of lives becomes limited. In that case, climate change is a barrier to functioning of lives. Capabilities of farmers in places like Tanzania and Lower Nyakach Division to own sufficient resources to mitigate effects of climate change has therefore led to low production of food crops hence affecting functioning of lives of households.

#### 4.3 Extension services for mitigating Climate Change:

The last objective of the study sought to determine the extension services available for mitigating climate change among the farming households. Thus, the researcher developed a questionnaire with statements related to how various aspects of extension services lead to lack of adaptation for enhancing food crop production in the wake of climate change, 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 5 presents distribution by extension services available.

**Table 5: Distribution by extension services for mitigating Climate Change**

No	Items	1	2	3	4	5
1	Lack of information on adaptation practices	1.2	10.2	4.8	43.6	40.2
2	Unavailability of information on forthcoming climate	0.8	80.0	2.0	15.6	1.6
3	Lack of Government subsidies	0.8	9.2	3.2	70.4	16.4
4	Inadequate professional whether interpretation	1.2	6.8	0.4	77.6	14
5.	Lack of financial resources	1.6	0.4	00	75.2	22.8
6.	Late preparation of farms due to inadequate information	00	42.4	2.8	42.4	12.8

Table 5 illustrates that amongst the extension services that deter adaption measures for mitigation of climate change effects, the sampled households agreed that: lack of information on adaptation practices (83.8%); inadequate extension services (77.6%); lack of financial resources (75.2%); lack of government subsidies (70.4%); 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.

Interviews conducted with KII also generated information with a theme of inadequacy of services to the small scale farming household heads. For instance, one KII stated that:

*Farmers lack financial resources and enough capital to engage in mechanised farming in the wake of climate change (A3).*

One of the four KII commented that:

*Poor infrastructure and inadequate climate change implementation has remained barriers to adaptation to climate change in the entire country (C3).*

This suggests that low financial resources inhibits the farmers in their effort to use machineries like tractor for soil preparation, as well as water conservation implements to adapt to drought. This conforms to Eriksen et al's (2008) assertion that the most vulnerable people to climate change effects are often the poor and the marginalised. Similarly, Sigei (2014) also found that among extension services that famers in Nandi District lack related to difficulty in accessing credit.

Similar sentiments were also deduced from FGDs in all the four sub locations. In the four FGDs, most common statement from discussants emerged that:

*We have been constrained by lack of professional information that could support us to apply the modern farming methods, use of resistant seeds and the machinery involved to combat climate change effects (F4).*

In another FGD session, it emerged that:

*Due to inability to cope with changes in climate, farmers have been unable to combat strange crop diseases like Miguna Miguna, thus escalating the state of poor maize harvests (F2).*

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.

On the other hand, the farming household heads did not agree that unavailability of information concerning forthcoming climate (80%) is one area of extension services that lead to lack of initiation of adaptation measures for mitigating 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 just adaptation 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.

Findings in this section seem to agree with those obtained by Mpandeli and Maponya (2014) in a study carried out in South Africa, that most farmers in rural areas did not have access to other sources of information such as flyers, magazines and the internet and getting information remains a challenge. They were only able to access limited climate change information through local chiefs and the tribal authority. Inability to access essential climate information and lack of knowledge of sources of climate information was also established in Ovuyovwiroye (2013) in a study that focused on level of climate change awareness in Nigeria. The results show that majority of the respondents either in the rural or urban areas have limited knowledge about climate change while their sources of information slightly differ. It is therefore clear that the theory of capability advanced by Sen (1992, 1999, and 2004) seems to apply to local farmers in Lower Nyakach Division. The poor harvests, and hence food insecurity, results from lack of functioning of individual farmers which may enable them acquire well-being (food security for that matter).

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.

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