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**The effects of climate change on household food security in  
Kajiado and Kiambu County, Kenya**

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**ABSTRACT**

*Climate change effects and the adaptation strategies applied are not uniform across different agro-ecological zones. Undertaking comparative analysis of climate change effects on household food security in different regions is critical to achieve effective climate change adaptation measures that suit different agro-ecological zones. This study investigated the effects of climate change on household food security in Kajiado County in the Arid and Semi-Arid region of Kenya characterized by high temperatures, erratic rainfall and falling between agro climatic zones IV-VII and Kiambu County in the highlands of Kenya characterized by low temperatures, less erratic rainfall and falling under agro climatic zones I-III. The data was collected in Kajiado East and Kajiado Central, Kajiado County and Kabete and Kikuyu in Kiambu County using key informant interviews, focused group discussions, household interviews and personal observations. The findings are comparative analysis of the effects of climate change on household food security in two different agro-ecological zones (AEZs). The results indicated increased frequency of climate change related phenomena including increased cold nights, hot days, erratic rainfall and extended drought periods especially in Kajiado. In Kiambu, 76.9% of the respondents indicated the area under agriculture was sharply decreasing in comparison to respondents in Kajiado where 24.4% agreed it was sharply decreasing. According to the results, more people in Kajiado County experienced climate change related household food insecurity than their counterparts in Kiambu. In Kajiado, 74% of the respondents agreed*

*there was an increasing need for household food relief due to climate change related extended drought periods while majority in Kiambu indicated less need for food relief in their County due to climate change related extended drought periods.*

**Key Words:** *Climate change, adaptation, farmers, pastoralists, food security.*

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## **1.0 Introduction**

Warming in Sub-Saharan Africa is expected to be greater than the global average (Pachauri et al., 2014). Africa is predicted to bear the brunt of climate change mostly due to its dependence on rain fed agriculture as the main foreign exchange earner and a source of employment for millions (World Bank, 2013). Studies on climate change in the region indicate significant damages on the livelihoods of people in the next few decades (IPCC, 2014).

Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO 1996) . Food systems determine the food security situation of any society or nation. Efficiency and productivity of the food systems from availability, accessibility, utilization and nutrition status have played a significant role in reduction of food insecurity across the globe. However, increased climate variability and change has posed a major threat to the efficiency and productivity of the food systems.

Although global agriculture produces enough to feed the existing world population, availability of food does not necessarily translate to food security. Food insecurity trends in many countries indicate same levels as they were in the 1960s (Tittonell, and Giller, 2013; FAO 2014) with global malnutrition affecting nearly 3 billion people today which is close to half the world population. On the other hand obesity and lifestyle diseases are going high especially in developed countries (WHO 2016).

According to Rosenzweig (2007), with changing climate, an estimate of between 75 and 250 million people are likely to experience water stress and rain fed agriculture output could be halved in Africa by the year 2020 with application of existing production systems. The Agricultural sector is a major contributor to Kenya's economy. It directly accounts for 26 percent of GDP and indirectly 27 percent through its linkages with other sectors of the economy. It makes up 65 percent of Kenya's export earnings and is a major source of employment for more than 68 percent of Kenya's rural population. The livestock sector accounts for 12 percent of GDP and it's a source of employment for nearly 50 percent of agricultural labor force (RoK 2013).

In Kenya 80 % of the country including Kajiado County is categorized as ASALS (Arid and Semi-Arid Lands) where climate change related decline in rainfall and increased temperature has been observed over periods of time (Orindi et al., 2007; Ngaina and Mutai, 2013; Christensen et al., 2007; Darkoh et al., 2014), the decline of the rainfall is mainly in long season with the short rains extending to January and February (GoK, 2010). Over the last century, Kiambu region has experienced a mean temperature rise at a rate of 0.005°C per year from 1929 to 2009. An accelerated climate change related temperature rise was observed from the year 1991. A decline in rainfall trends was observed in Central Kenya related to climate variability leading to reduced maize production (Ovuka and Lindqvist, 2000) .

Climate change and climate variability has contributed to declining food security in Kenya over the last three decades. Droughts and floods have increased in frequency and intensity leading to high crop failure and livestock deaths in Kenya (Kenya, 2010) . The number of people categorized as food insecure during the year 2009 and 2010 were estimated to be 3.8 million with majority in Arid and Semi-Arid regions of the Country. During the

2011 long drought the number of people facing food and nutrition insecurity increased to 10 million leading to dependence on relief food from Government of Kenya and donors (GoK, 2011; GOK 2013). Agriculture being the backbone of Kenya's economy, its susceptibility to Climate variability and climate change could cost the country US\$500 million a year (2.6 percent of the country's GDP). (National Climate Change Action Plan 2013-2017).

Kajiado County borders Nairobi to the North and covers an area of 21901km<sup>2</sup>. The County had a population of 687, 321 people of which 50.2% were male and 49.8% female. (Kenya, 2010). To the Southwest the County is bordered by the Republic of Tanzania and is situated between longitudes 36°5' and 37°55' East and latitudes 1°10' and 3°10' South. Kajiado is part of the Arid and Semi-Arid region of Kenya which make up for 80 percent of total land mass. These parts of the Country are known for erratic rainfall and high temperatures beyond 35° especially during the day time. (Amwata, 2013) The County's annual rainfall has a bimodal distribution pattern where the long rains are usually expected between March to May while the short rains occur between November and January. The average rainfall ranges from 300-800 mm per year occurring sporadically in both time and space. The main source of livelihood for the majority of the inhabitants who are Maasai community is pastoralism keeping livestock including cattle, goats and sheep. The predominant land use system in place is free grazing where the land is utilized communally and individually by different people (Bosco et al., 2015).

Kiambu County covers an area of 2,543.5 Km<sup>2</sup> and lies between latitudes 00 25' and 10 20' South of the Equator and Longitude 360 31' and 370 15' East. In 2009, the county had a *Population* of 1,623,282 people (Kenya, 2010). Kiambu County (figure 1.3) is within the agro ecological zones I to III where the leading income generating cash crops include tea, coffee, pine-apples, and sisal and horticultural crops including fruits, vegetables and flowers. Due to its proximity to Nairobi, Kiambu has witnessed increased urban population growth and is currently considered the most urbanized county in the Kenya after Nairobi, Kisumu and Mombasa counties. The demand for housing has exerted a lot of pressure on other land uses leading to shortage of available land especially areas around urban centers (Musa and Odera 2015).

The purpose of the study was to undertake a comparative analysis of the effects of climate change on household food security in two different agro-ecological zones mainly, Kajiado County in Northern arid regions of Kenya and Kiambu County in Central highlands of Kenya.

## **2.0 Data and Methodology**

### **2.1 Data**

Primary data sources included undertaking key informant interviews which targeted County Livestock Director, County Gender and Social Development Director, the County Agriculture Director National Drought Management Authority County Coordinator, Kenya Meteorological Department County officer, local elder and a local Non-Governmental Organization. A total of six gendered focus group discussions were undertaken together with administration of 312 open-ended and close-ended household questionnaires in Kabete and Kikuyu in Kiambu County and Kajiado East and Central in Kajiado County. The field work was done between September 2017 and December 2017 where Questionnaires were administered to acquire information on demographic characteristics, Rainfall and Temperature Patterns, climate change impact on household food security, Role of gender in climate change adaptation. Additionally relevant published policy documents on effects of climate change on household food security was gathered to foster a critical analysis of the issues. Secondary data sources utilized in this study included publications such as book reviews, peer reviewed articles, text books, national surveys among others.

## 2.2 Methodology

The field studies were conducted in two different agro-ecological zones (AEZs) mainly Kajiado East and Central, Kajiado County representing Arid and Semi-Arid Lands of Kenya inhabited by pastoralists and Kabete and Kikuyu, Kiambu County representing highlands of Kenya where farming is the main source of livelihood for majority of the populations. In administering the household questionnaires, the study applied systematic random sampling to identify target households for interviews and purposive sampling was applied in selection of the respondents for the Key informant interviews and Focused Group Discussions.

The findings represent comparative analysis of the effects of climate change on household food security in two different agro-ecological zones (AEZs). Onwuegbuzie and Weinbaum, (2017) provided a framework for using a popularized qualitative analysis approach, namely, qualitative comparative analysis, via a process called Qualitative Comparative Analysis-Based Research Synthesis (QCARS). Kenworthy and Malami (1999) in determining the share of parliamentary seats held by women in 146 Countries across the world in 1998 used ordinary least squares regression to analyze, socioeconomic, political and cultural determinants of cross-national variations. Vogel and Henstra (2015) qualitatively synthesized insights from policy studies literature and existing adaptation research thus contributing to the conceptual and methodological foundations for comparative analysis of local adaptation policies and policy-making. Knieper and Pahl-Wostl (2016) applied fuzzy set Qualitative Comparative Analysis to examine data on water governance, water management, and environmental performance from a recent international study together with context data on per capita income, corruption, hydro-climate, and use pressure from other datasets. This paper adopts mix of qualitative and quantitative approach of comparative analysis in studying the effects of climate change in Kajiado and Kiambu County which are in different agro-ecological zones. Climate data (rainfall and temperature) were analyzed using descriptive analysis. Data collected from household survey on perception of pastoralist on climate change, household characteristics and adaptation strategies to climate change and variability were also analyzed using descriptive statistics and presented in tables and charts.

## 3.0 Result and Discussions

This section presents the findings of the study and it includes demographic, Frequency of climate change related drought, Effects of climate change on livestock and crop production, Climate change related food shortage at household levels, household need for food relief in the last five years, Coping strategies during food shortage at household level and conclusion.

### 3.1 Demographics

Majority of the respondents in both Kiambu and Kajiado County were men and there were more female respondents in Kajiado than in Kiambu County. In Kajiado County, 46.8% of the respondents had a total of more than 7 members in their households while in Kiambu County only 8.3% of the households had more than 7 members. The main source of livelihood for majority of the respondents in Kajiado was mainly pastoralism while the major source of livelihood for the people in Kiambu was farming followed by self-employment and employment respectively.

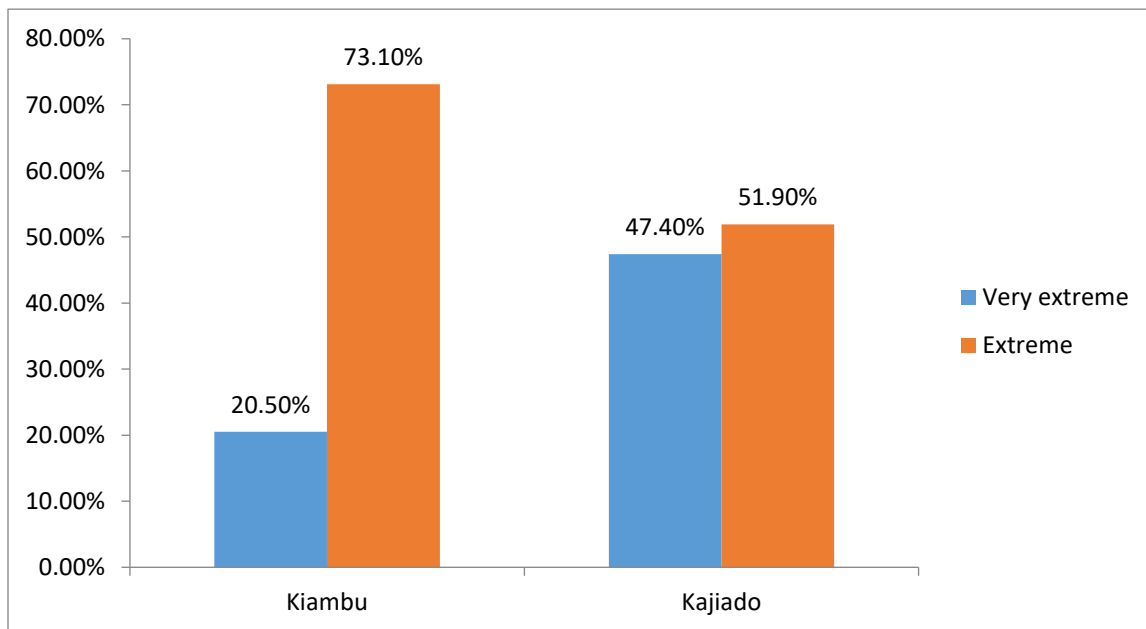
### 3.2 Comparative analysis of effects of climate change on household food security between Kiambu and Kajiado

Food security depends on well-functioning of the food systems from availability, accessibility, utilization and nutrition status. Climate change poses a major threat to the efficiency and productivity of the food systems thus increasing food insecurity across the world. Climate change has different impacts on different agro-ecological

zones hence creating complex and different challenges in terms of adaptation options and strategies (Belay et al., 2017). However, some agro-ecological zones bear the brunt of climate change more than others especially arid and semi-arid areas due to already precarious climatic conditions such as high temperatures and erratic rainfalls (Opiyo et al., 2016). The comparative analysis of how climate change affects communities in ASAL and highland regions is discussed below.

**3.2.1 Frequency of climate change related drought**

Respondents were asked about their perception of climate change where the overwhelming majority linked long-term variations in the average temperature and rainfall in the last two decades. They mentioned increased rainfall variability in both temporal and spatial distribution and increased frequencies of climate extremes such as droughts and flood. In Kajiado County, 156 respondents of average age between 35- 40 were interviewed. According to *figure 1* below, 47 percent of the respondents agreed climate change related drought periods had become *very extreme* in recent years while 52 percent agreed that droughts attributed to climate change had become *extreme*. Majority of the respondents from both the key informant interviews and focus group discussions in Kajiado stated that the drought frequency used to be 10 years period in the 1970s, 1980s, 1990s and up to early 2000 while now it has increased to less than three years. The extended drought periods greatly diminished the food security potential of many households in the County through loss of their livestock which is the main source of livelihood. The disruption of the livelihoods of agro pastoral communities by a changing climate leading to food insecurity has been observed in other studies (Orindi et al., 2007; Ngaina and Mutai, 2013; Huho and Kosonei, 2014). Majority of the respondents in Kiambu also confirmed increasing drought periods over the Central highlands of Kenya. Mean temperature in Kiambu County over the last century has increased at a rate of 0.005°C per year from 1929 to 2009. From the year 1991 an increased temperature was observed negatively affecting the coffee and tea sector. However, the situation is not as worse as in Kajiado, which is part of the ASAL counties of Kenya. The responses are shown in *figure 1* below.



**Figure 1: Frequency of droughts**

### 3.2.2 The area under agriculture

In Kajiado County, majority of the respondents agreed that the area under agriculture was shrinking. This has been shown by 59.6% of the respondents indicating that area under agriculture was *slowly decreasing* while 24.4% agreed it was *sharply decreasing*. This is in agreement with what has been observed in Kenya's Arid and Semi-Arid Lands especially in Maasai land where population pressure from farming communities are continuously encroaching into the known spaces of pastoralists due to social and environmental pressures (Mbithi and Barnes, 1975; Thom and Martin, 1983). According to Campbell et al., (2000), over the last three decades Kajiado has witnessed significant land use and land cover change as a result of social-economic, political and cultural interactions. Climate change has further reduced agricultural production in ASAL regions including Kajiado through reduction of water availability which could be utilized for subsistence farming or small scale irrigation. Climate change related rising temperatures, without corresponding increase in rainfall amount to balance the increased plant water needs as a result of higher evapotranspiration lead to significant reductions in agricultural production potential in Arid and Semi-Arid regions of Kenya. (Fischer and Velthuisen, 1996). This has led to majority of the Maasai community maintaining the pastoralism lifestyle instead of venturing into farming as an alternative source of livelihood. On the other hand, 76.9% of the respondents in Kiambu County indicated the area under agriculture was sharply decreasing while 19.2% indicated that the area under agriculture was slowly decreasing. The County is part of the Central Highlands of Kenya known for their high agricultural potential. Major crops grown in the area include coffee, tea and high value cash crops targeting export markets (Jaetzold and Schmidt 1983). However, due to its proximity to Nairobi, Kiambu County has seen massive population increase thereby creating demand for housing to accommodate them. The high population growth, effects of climate change including low temperatures and shortage of water, unsustainable agricultural practices led to shrinking of land under agriculture thus reducing productivity and livelihoods (Lewis 1985; Ekbom et al. 2001; Okoba and De Graaff 2005; Asamoah 2010; Okoba and Sterk 2010). The results are shown in *table 1* below.

**Table 1: Area under agriculture**

Area Under Agriculture	Kajiado County		Kiambu County	
	respondents	Percent	respondents	Percent
sharply decreasing	38	24.4	120	76.9
slowly decreasing	93	59.6	30	19.2
Not changing	9	5.8	-	-
Slowly increasing	13	8.3	5	3.2
sharply increasing	3	1.9	1	.6
<b>Total</b>	<b>156</b>	<b>100.0</b>	<b>156</b>	<b>100.0</b>

### 3.2.3 Effects of climate change on livestock and crop production

According to *figure 2 and 3*, climate change effects are felt more by the pastoralists in Kajiado than the farming communities of Kiambu. Majority of the respondents in Kajiado agreed with the statements that there has been increased loss of livestock, crops, decrease in water availability, fodder availability, increased pest and diseases and increased use of fertilizers due to climate change related reduced land productivity. This is in agreement with what has been observed in ASAL areas of Kenya where rainfall and temperature patterns have shifted thereby

putting pressure on livelihoods (Orindi et al., 2007; Christensen et al., 2007; Hoffmann, 2010; GoK, 2010a ; Ngaina and Mutai, 2013; Darkoh et al., 2014). Majority of the people in ASALs practice pastoralism due to its adaptation advantage of herd mobility in search of water and pasture. (Fratkin et al., 1999; Wasonga et al., 2010).

In Kiambu majority of the respondents agreed with increased loss of crops as shown by 41 percent *strongly agreed* and 52.1 percent *agreed* on the statement of climate related crop loses. Also 74 percent of the respondents in Kiambu *agreed* with increased pest and disease. The increased loss of crop yields and pest and diseases in central highlands of Kenya has been observed by other studies (Kuria 2009; GoK, 2010a; Macharia et al., 2012). However, majority disagreed with the statements of climate change related increased loss of livestock, decreased in fodder and water availability in Kiambu. The result indicate that although both Kajiado and Kiambu County are faced with the threat of climate change, communities in Kajiado County bears its brunt more than their counterparts in Kiambu County as shown by the respondents from both Counties.

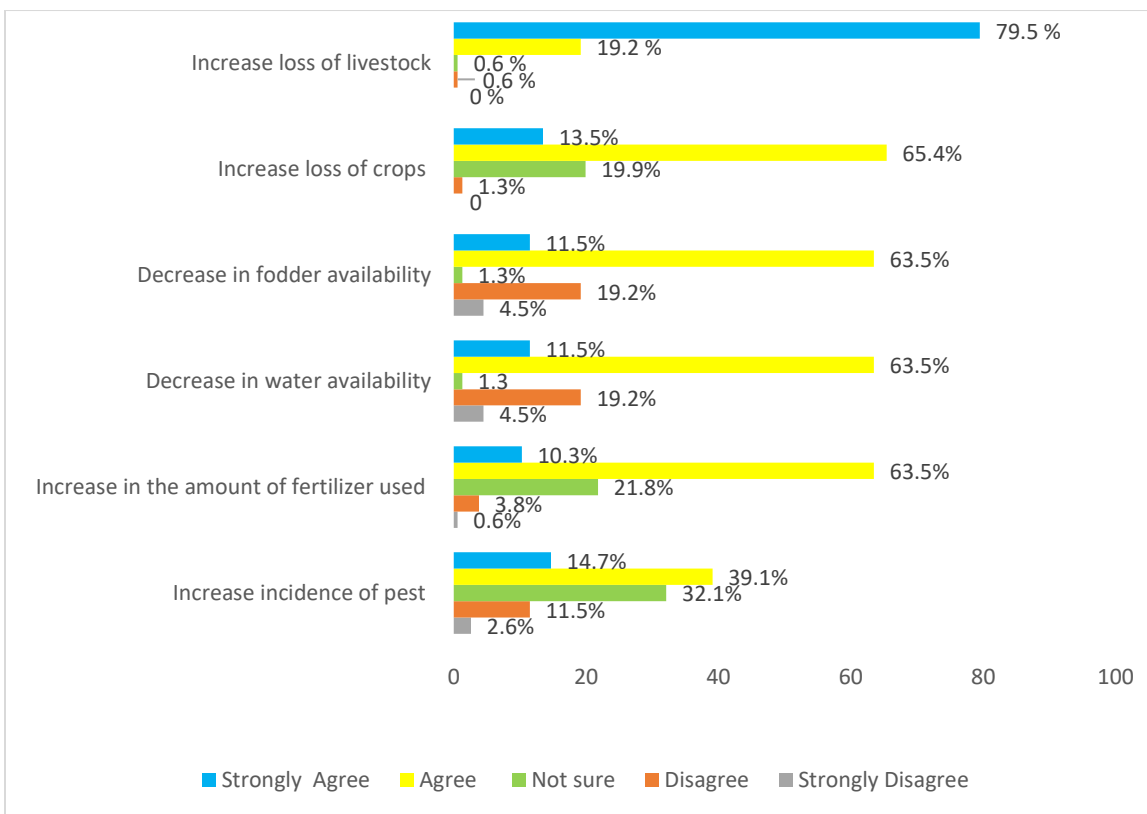


Figure 2: Effects of climate change on livestock and crop production in Kajiado

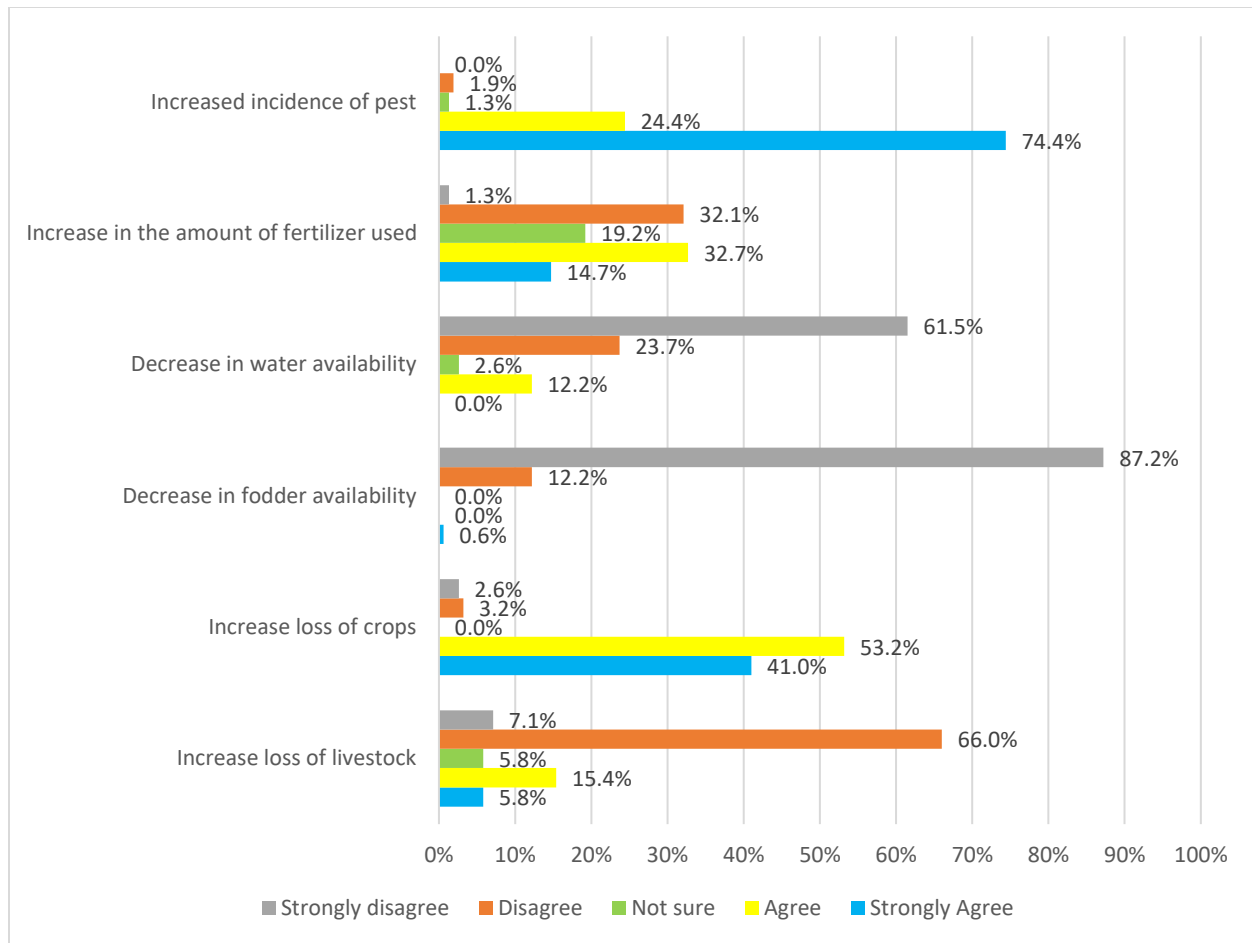


Figure 3: Effects of climate change on livestock and crop production in Kiambu County

**3.2.4 Climate change related food shortage at household levels in Kajiado and Kiambu**

Majority of the respondents in Kajiado County experienced a food shortage due to climate change related extended drought periods killing their livestock and also reducing its market value thus making them more poor and vulnerable. Therefore more people in Kajiado experienced food shortage in the last five years in comparison to their counterparts in Kiambu where a very small percentage experienced climate change related food insecurity. Kajiado is part of ASAL Counties in Kenya where climate change impacts are more severe while (Orindi et al., 2007; GoK, 2010a; Fraser et al., 2011) Kiambu is part of the highland regions of Kenya falling under the agro ecological zones I to III. The region has more favorable soils and climatic condition that can support agriculture hence household food security (Jaetzold and Schmidt 1983). The percentage of the respondents in Kiambu that remain food insecure are those lacking nutritious food especially among children under five and the elderly that are dependent on the national Government’s cash transfer programme. The safety net is aimed at improving the lives of the poor and vulnerable persons above the age of 65 years (Marangu, 2014; Chege et al., 2016).

**3.2.5 Household need for food relief in the last 5 years**

According to Figure 4, majority of the respondents in Kajiado County pointed to an increasing need for food relief over the last five years while majority of the respondents from Kiambu pointed to never needing food relief in the last five years. Less awareness on climate change, lack of County climate change policies, weak climate



risk management practices such as crop and livestock insurance and mobile based early warning systems on drought emergencies reduces community adaptation capacities in especially in Kajiado County.

This is in agreement with what has been observed in ASAL areas of Kenya where rainfall and temperature patterns have shifted thereby putting pressure on livelihoods. This is in agreement with what has been observed in Arid and Semi-Arid region of Kenya, Kajiado included where climate change has increased pressure on communities livelihoods (Orindi et al., 2007; Christensen et al., 2007; Darkoh et al., 2014) as they already operated below the poverty line and remain dependent on frequent government interventions during extended drought periods. (Fraser et al., 2011; Amwata et al., 2015). The result are further supported by the report of Kenya National Bureau of Statistics (KNBS) and Society for International Development (SID) (2016) report ranking Kiambu as the second county after Nairobi with the lowest poverty index of 24.2% while Kajiado ranked position 12 contributing 11.1% to the national wealth while Kajiado was ranked 12 contributing only 3.8 per cent to national wealth.

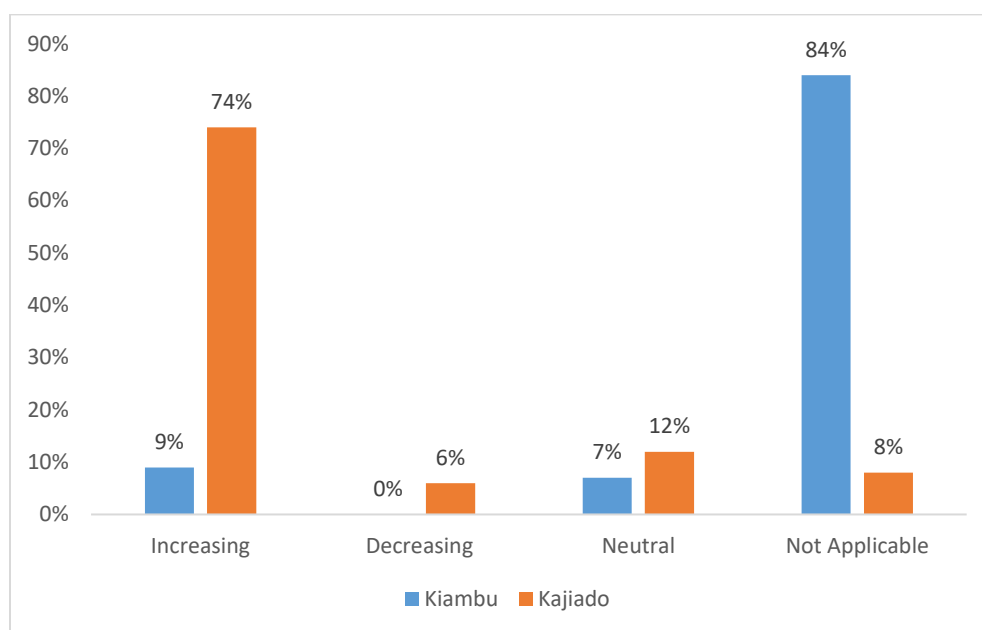


Figure 4: Households needs for food relief for the last 5 years

### 3.2.6. Coping strategies during food shortage at household level

Table 2 below indicates respondent’s alternative means of accessing food when they experienced climate change related food shortages. Since majority of the communities in both Kajiado and Kiambu are dependent on agriculture as major source of livelihoods, its susceptibility to climate change increases people’s vulnerabilities through loss of crops and livestock thus making them poorer.

According to the result, majority of the respondents in Kajiado relied on family members and friends support, followed by dependence on relief aid from donors including Government and Non-Governmental Organizations. Also they adopted climate change adaptation strategies included herd mobility, selling beads, herbs and honey.

In Kiambu County, 63 percent of the respondents had sufficient household food security and they practiced climate change adaptation strategies included water harvesting, irrigation, apiculture, agroforestry, fodder conservation and poultry . Kiambu is the second county after Nairobi with the lowest poverty index in Kenya and

contributes 11.1% to the national wealth while Kajiado was ranked 12 in the poverty index contributing only 3.8 per cent to national wealth (KNBS and SIDS, 2013).

**Table 2: Coping strategies during food shortage at household level**

	Kiambu County		Kajiado County	
	Frequency	Percent	Frequency	Percent
Relief aid	1	1	41	26
Family & friends support	26	17	72	46
Remittance	3	2	6	4
Charity	0		1	1
Loans	28	18	11	7
N/A	98	63	25	16
<b>Total</b>	<b>156</b>	<b>100</b>	<b>156</b>	<b>100</b>

#### 4.0 Conclusion

The comparative analysis of the effects of climate change on household food security in Kajiado and Kiambu Counties in different agro-ecological zones indicated that both regions experienced the effects of climate change on household food security. However, negative impacts of climate change are felt more by the pastoralists in Kajiado than the farmers in Kiambu since Kajiado falls under ASAL regions of Kenya which are more susceptible to the vagaries of climate change than Kiambu which is part of the highlands with conducive climatic conditions. There is need for effective climate adaptation strategies such adoption of drought resilient crops and kitchen gardens, herd mobility, water harvesting, fodder conservation, livelihood diversification including irrigation, apiculture, poultry and agroforestry especially in Kajiado County. There is need for climate risk management through enhanced crop and index-based livestock insurance, mobile and local radio based early warning systems on rainfall patterns and drought emergencies. The County Governments should put in place climate change policies to ensure effective mainstreaming into County Integrated Development Plans. This will ensure adequate resources to invest in effective adaptation measures. Finally, there is need for more awareness creation on climate change at grassroots levels, capacity building on effective adaptation strategies and Sustainable Land Use Management to cushion both the pastoralists and farmers against the effects of climate change on household food security.

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