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Assessing Climate Change Adaptation Strategies among Rural Maasai pastoralist in Kenya

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Abstract The aim of this study is to assess adaptation and coping strategies of Maasai pastoralist to climate change and identify viable adaptation options to reduce the impact of climate change among Maasai pastoralist in the arid and semi-arid (ASALS) in Kenya. The study was carried out in Kajiado County and multiple data collection techniques such as in-depth interview with 305 households, focus group discussion, and key informant interview were used to assess adaptation strategies of pastoralist household and identify viable adaptation options for the study area. Rainfall data used for the study was also collected from Kenya Meteorological Service (KMS) and used for standard precipitation index (SPI) analysis. SPI was used to analyze drought severity in the study area between 1970 and 2013. SPI was designed to quantify precipitation deficit for multiple time scale. Results showed that drought is the major climatic challenge affecting pastoralist in the study area. The SPI result showed increase in drought occurrence in Kajiado County in recent years with six years (2000, 2003, 2004, 2007, 2008 and 2011) having negative SPI values between 2000-2011. The year 2000 was also the driest year recorded in the study with an SPI value of -3.09. The study also showed that Maasai pastoralists already have many adaptation measures to cope with the impacts of climate extremes. However, increase in drought occurrence in the last few years is reducing their resilience. This study observed that most of the adaptation and coping strategies adopted by Maasai pastoralist are autonomous and are unlikely to build resilience of pastoralist livelihoods and ecosystems to cope with the projected magnitude and scale of climate change in the 21st Century. The study identified adaptation strategies such as effective early warning system, water harvesting, rapid infrastructural development, encouraging table banking and cooperative societies, Building and equipping schools, migration, livestock diversification and child education as long term no regret adaptation option that can enhance resilience of Maasai pastoralist to climate change and its extremes in the arid and semi arid lands of Kenya.

Keywords: *adaptation strategies, drought, climate change, Maasai pastoralist*

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1. Introduction

Geographical location is one of the key factors that determine vulnerability of communities to climate change and variability [26]. Over 80% of the lands in Kenya are classified as arid and semi-arid lands (ASALs) and they are by far the most vulnerable to climate change and variability [21]. The impacts of climate change and variability in Kenya have introduced a new dimension to the national fights against food insecurity and poverty. This is because Kenya depends on natural resources and especially agriculture for livelihood sustainability and economic growth. Studies have shown that fluctuations and variations in climate, particularly rainfall and temperature, adversely affect the physical, biological and socio-economic systems leading to disasters and calamities [1,27].

Kenya has identified its ASALs as the most vulnerable areas to climate change with huge impacts on livestock rearing, small-holder agriculture and tourism, which are the dominant sources of livelihoods in these areas [9]. About 10 million people which are about a third of the whole population of Kenya live in the arid and semi arid lands (ASALs). The main source of livelihood among people that live in the ASALs of Kenya is livestock production (largely through Pastoralism). Livestock production accounts for 26% of total national agricultural production and over 70% of the country's livestock and 75% of wildlife are in the ASALs [8].

The greatest challenge to pastoral livelihood in the ASALs is dealing with the unpredictability of rainfall both within and between seasons. Recent increase in drought events and dry spells in ASALs in Kenya has lead to severe economic and food security risks countrywide with a greater impact on populations whose livelihoods are dependent on agriculture and other related natural resources [21]. Scientific evidence shows that climate variability and change are expected to further exacerbate the variability in rainfall and temperatures [12,13,28] in ASALs.

Repeated occurrence of the incidents of droughts and dry spells have made it difficult for the pastoral communities in the ASALs to maintain their assets and lack of timely early warning information has reduced their capacity to respond when the conditions are still good. Drought ranks first among naturals hazards in the number of persons affected in Kenya and Africa [29,30]. Kajiado County which is one of the ASAL counties in Kenya is also affected by the severe impact of drought and dry spells. The County has experienced major incidence of drought since 1900, which have become more common in the last two decades [14]. Severe drought have been recorded in the following years 1960/1961, 1969, 1973/1974, 79, 1980/1981, 1983/1984, 1991/1992, 1995/1996, 1999/2000, 2004/2006, 2008/2009, and 2010/11 with widespread direct and indirect effects on the lives and livelihoods [10,22].

Adaptation is a broad concept covering actions taken by individuals, households, communities, private and public organization. Successful adaptation can reduce vulnerability by strengthening existing coping and adaptation strategies. For many decades, pastoral communities in ASALs have developed indigenous ways of adapting to varying degree of occurrence of dry spells and drought; however, recent increase in the frequency of occurrence of these weather events is stretching the resilience of the pastoral community and may have adverse effect on the future generation of Maasai pastoralist in Kajiado. Pastoral communities have for a long time used indigenous forecasting methods to predict seasonal climatic events [33]. Some of the Maasai pastoral communities observe clouds, wind and lightning that likely have their origins in traditional understandings of what contemporary researchers recognize as atmospheric science. Others watch the behaviour of livestock, wildlife and the local flora [1]. However, many traditional forecasting methods are perceived as becoming less reliable with increasing climate variability.

Studies [1,21,22,25] have analyzed and documented pastoralists' adaptation and coping strategies to climate change and variability at the community and household level. Given the projections for increasing drought impacts in the pastoral areas, it is important to inform policy makers on various adaptation and coping responses at local levels in order to reduce risks associated with drought. This study seeks to understand the drought pattern in Kajiado County using participatory methods and information from the meteorological station. The study also documented their coping and adaptation strategies and identified viable adaptation strategies that will enhance adaptation of the Maasai pastoralist communities to climate change and variability.

2. Materials and Methods

2.1. Study Location

The study was carried out in selected villages in Kajiado County in Kenya. Kajiado County is located in the southern tip of the former Rift valley province between longitudes $36^{o}5$ and $37^{o}5$ and latitudes $1^{0}0$ and $3^{0}0$ South [1]. It covers an area of 19,600Km^2 (CBS, 1981). The County has 173,464 households and a population of 687, 312 of which 50.2% are male and 49.8% are female. Kajiado County is bordered by Tanzania to the south, Taita Taveta County to the west, Narok County to the east and Nakuru, Kiamnau, Nairobi and Makueni Counties to the north. Kajiado has a population of 136,482 people and a land size of 2,610.30sq.km.

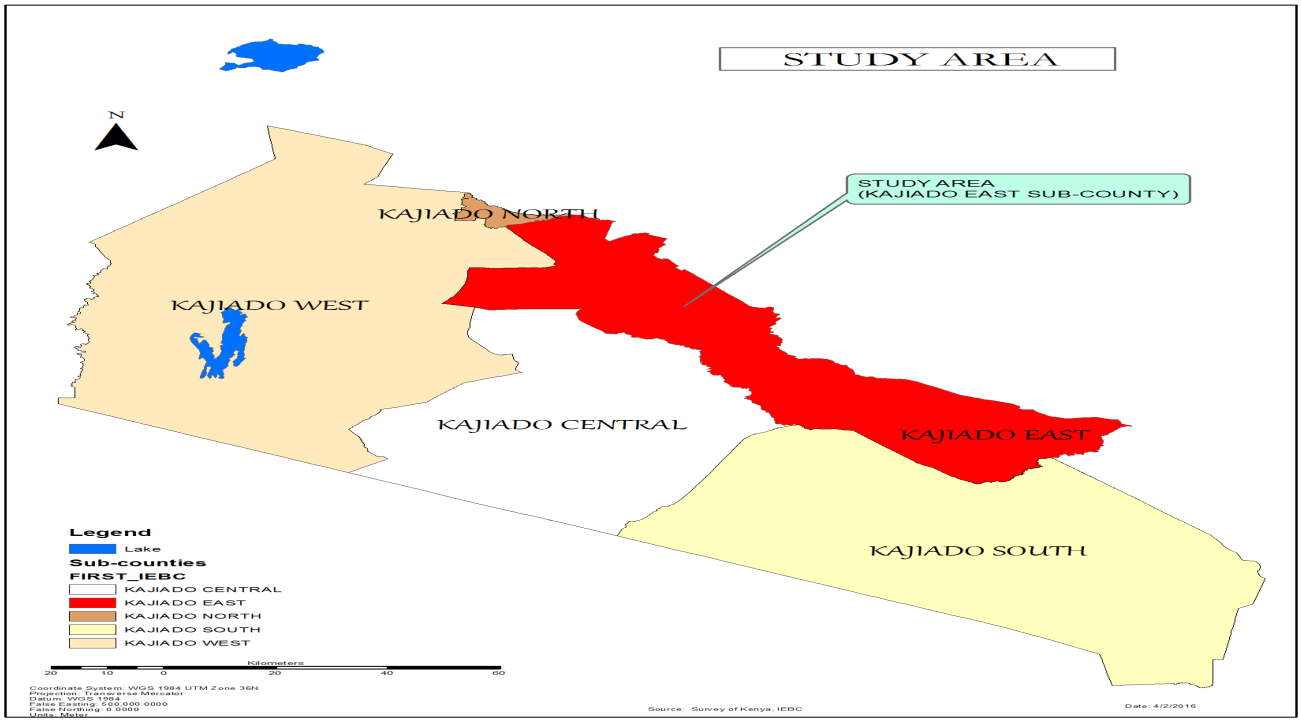

Figure 1. Map of the study area

2.2. Field Study Design and Data Collection Process

The field study was conducted in Kajiado east sub-county. Kajiado east was selected because of its geographical location, sources of livelihood and proneness to extreme climatic events especially drought and dry spells. The study used multistage sampling technique. The sampling was conducted based on the five administrative wards in the sub-county. The list of villages and households were collected by the administrative chiefs. The households in the villages were listed from 1 to N (N = group size) and then systematic selection of the households were carried out. Thus, the choice of the household interviewed was based on systematic sampling procedure [23]. A random start was used in choosing the first household to be interviewed and the interview were conducted in every seventh house hold. A total of 305 households were interviewed between November 2014 and February 2015.

2.3. Questionnaire Interviews

Information on different aspect of the study was obtained through the administration of questionnaire on individual pastoralist households and community leaders. The information collected using the questionnaire included (1) demographic information of households; (2) socio-economic characteristics of individual households including resource endowments, poverty levels, sources of income and infrastructural status; (3) climate-related extreme events and their impacts on the pastoralist livelihood; (4) adaptation and coping strategies of households to climate change and climate variability. The information collected from the questionnaire interviews was further validated through FGDs, informal interviews and general observations.

2.4. Focus Group Discussion and Key Informant Interviews

A total of four (4) focus group discussions (FGDs) were conducted separately with a gender parity (of eight men and eight women) from the sampled villages. The pastoralist that participated in the FGD were selected based on gender with the help of the local leaders. Focus group discussion created opportunity for further interaction with the community members and lead to verbal expression and opinions about climate change and its effect on the pastoralist livelihood. The discussions captured the local knowledge on climate variability and its impacts on pastoralist communities, vulnerability, and adaptation and coping options to extreme climate events

Further discussions were held with a total of 30 people considered to be key informant individually between November 2014 and January 2015. The key informants were selected from local organizations in Kajiado County, Staff of the County meteorological department, local chiefs, village elders and drought monitors, community-based animal health workers, and opinion leaders.

2.5. Standardized Precipitation Index (SPI)

The standardized precipitation index (SPI) was used to analyze drought severity in the study area between 1970 and 2013. Monthly rainfall data collected for Isinya, Kajiado east rainfall was used for the SPI analysis. SPI was designed to quantify precipitation deficit for multiple time scale [16]. The SPI in this study was calculated for the long rains (March to May), short rains (October to December) and also yearly from January to December. The SPI is calculated by dividing the difference between normalized seasonal precipitation and its long-term seasonal mean by standard deviation as follows:

$$\mathrm{SPI} = \frac{\mathrm{Xij} - \mathrm{Xim}}{SD}$$

Where Xij = Seasonal precipitation value at jth station
Xim = Long term seasonal mean precipitation
SD = Standard deviation

This study used the McKee et al. [16] SPI classification system (Table 1) to define drought intensity resulting from the SPI.

Table 1. SPI classification used in this study

SPI values	Classification
2.0	Extremely wet
1.5 to 1.99	Very wet
1.0 to 1.49	Moderately wet
-.99 to .99	Near normal
-1.0 to -1.49	Moderately dry
-1.5 to -1.99	Severely dry
-2 and less	Extremely dry

3. Results and Discussion

3.1. Gender and Educational Level of Respondents

Figure 2 shows the gender of household heads interviewed in the study area. 88% of the household interviewed are headed by males while only 12% of the household interviewed were headed by females. This shows that the Maasai communities are patriarchal in nature and this may affect access of female headed households to information and education about climate change and climate extremes that can enhance their coping strategies. Studies by [19,20] reported that women in pastoralist communities in Kenya are more vulnerable to climate change and extreme climatic events because they are not always involved in decision making in the communities and pastoralist women also have less access to family resources and finances reducing their ability to manage risk and external climatic shock.

The educational level of respondent (Table 2) shows a high level of illiteracy among Masaai pastoralist in Kajiado County. 50% of female and 31% of male respondent have no formal education. This shows a higher level of illiteracy among Maasai women when compared to men. Illiteracy hinders access to information and also speed of recovery from a climatic events and also constraints options for livelihood diversification [14,19]. 38% of female and 49% of male have access to primary education; 13% of female and 13% of male have access to secondary education; 3% of male have diploma degree and 2% of the male respondent have University degrees.

This concurs with the findings of [14,20] who reported high illiteracy levels among pastoralist in Kenya. GOK, 2013, also reported a high illiteracy rate of 65.2% for Kajiado County. Illiteracy limits the ability of an individual to take up opportunities such as employment and inhibits access to information and technical advice that could enhance adaptation to climate change.

3.2. Sources of Livelihood of Respondent

The sources of livelihood of are presented in Figure 3. The reports shows that 93% of respondent interviewed are involved in livestock keeping (pastoralism). Several studies [2,21,24,25] reported that pastoralism is the main source of livelihood in ASALs and pastoralist over years has developed mechanisms to cope with climate variability in the ASALs. However, increase in extreme climatic events such as drought in recent decades has made pastoralist develop alternative sources of livelihood such as engaging in business. This study shows that 66% of respondent are involved in business. Bead works, belt production and scandal production are the main business identified by respondent in this study. The study also shows that 8% of respondent are government employees, 7% are involved in crop production and 1% provide services such as tourist guards and house security.

3.3. Pattern of Extreme Climatic Events in Kajiado County

Time line data of extreme climatic events in Kajiado County from 1976-2014 is presented in Table 3. The report shows that drought is the main climatic event affecting Maasai pastoralist in Kajiado County. Maasai pastoralist reported that the frequency of drought and dry spell has been increasing the last 15years and the rains are becoming more erratic. Focus group discussants agreed that rainfall pattern has been changing drastically since the year 2000 till date. They reported that raining seasons are becoming shorter and when the rain comes, it falls heavily within few days causing flash floods and erosion. The pastoralist also reported that the frequency of drought in Kajiado county have reduced from 8-10years to 2-3years since the year 2000.

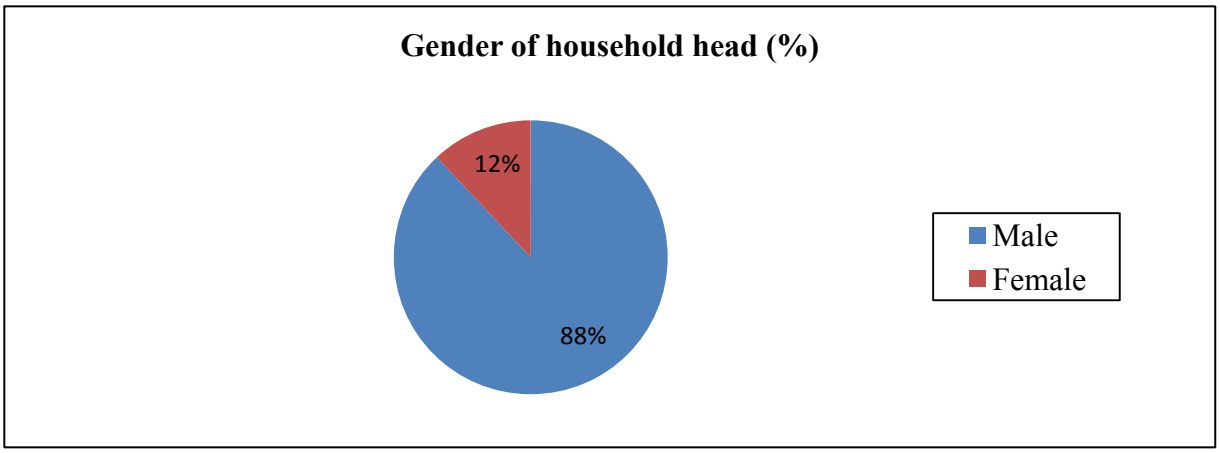

Figure 2. Gender distribution of household head

Table 2. Educational level of respondent

Gender	Informal Education	Primary Education	Secondary Education	Diploma	University	Others	Total
Female	50%	38%	13%	0%	0%	0%	100%
Male	31%	49%	13%	3%	2%	1%	100%
Average	40.5%	43.5%	13%	1.5%	1%	0.5%	100%

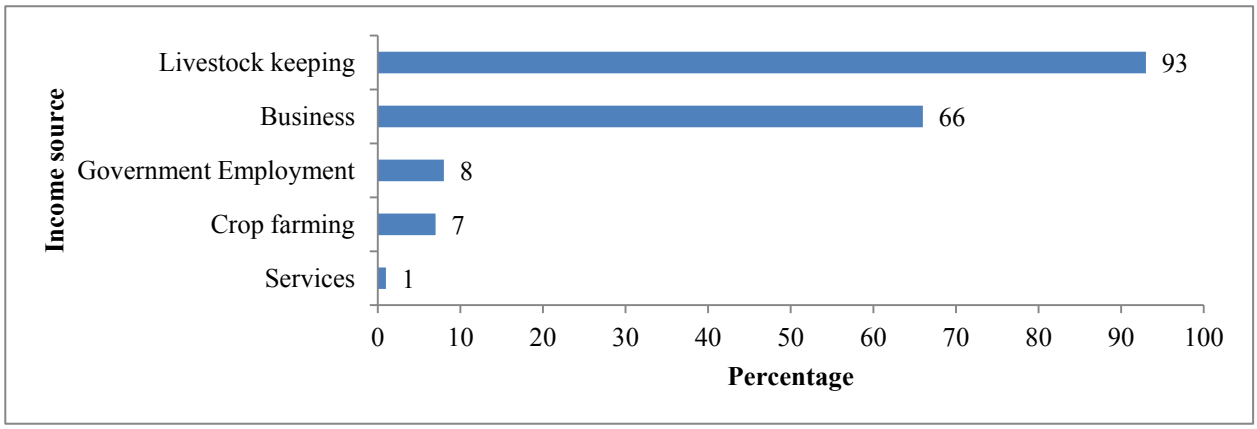

Figure 3. Source of livelihood of respondents

The participant of one of the FGD were in agreement with the following statement made by one of them

When I was young the rains were quite predictable and we all know the time for the long and short raining season. Now the rain comes earlier or late or even some times refuse to come at all. We now experience failed raining season (drought) at least once every two years in the area and this affecting the pastoralist system (FGD, Entayiankat, Kajiado East Sub County).

This study confirms the frequency of the drought problem that has been affecting southern rangelands and the pastoral communities. Several other studies [19,21,24] have reported increase in the frequency of drought in ASALs in Kenya and its impact on the livelihood of pastoralist living in the area. Increase in drought has lead severe loss of animals over the years and this has increased the rate of cattle stealing and communal clashes in the ASAL region of Kenya [1].

3.4. Drought Pattern in the Study Area

The result of standardized precipitation index (SPI) values for the long raining season (March-May) and the short raining season (October to December) for a period of 43years (1970 -2013) is presented in Table 4. A total of twenty (20) years have negative SPI values for the long rains, while twenty three (23) years have negative values for the short rains. The long raining season recorded extreme drought in three years 1973, 1984 and 2000 with SPI values of (-2.48, -2.77 and -2.82) respectively. Also moderately dry season was recorded in 1976 with a SPI value of -1.13. The short raining season has two years 1970 and 1981 of extreme drought with SPI values of (-2.33 and -2.18) respectively. It also recorded one year of severe drought in 1975 with a SPI value of -1.53 and five years 1972, 1973, 1976, 1980 and 2005 of moderate drought with SPI values of (-1.14, -1.06, -1.13, -1.27 and -1.36) respectively. The findings of this study agrees with Camberlin and Philippon, [3] who noted that the long raining seasons are more reliable than the short raining season in ASALs regions. The result shows that six years (1971, 1972, 1973, 1975, 1976 and 1979) had negative SPI values between (1970 and 1979) for the long rains and six years (1970, 1972, 1973, 1975, 1976 and 1979) had negative SPI values between (1970 and 1979) for the short raining season. Four years (1982, 1983, 1984 and 1978) of negative SPI values were recorded between 1980 and 1989 for the long rains and six years (1980, 1981, 1983, 1985, 1987 and 1988) of negative SPI values were recorded between 1980 and 1989 for the short rains. Result shows four years (1993, 1994, 1997 and 1999) of negative SPI values were recorded between 1990 and 1999 for the long rains, and also four years (1990, 1993, 1995, and 1996) of negative SPI values for the short rains between 1990 and 1999. The year 2000 to 2011 is the driest period reported in this study. Six (6) years (2000, 2004, 2007, 2008, 2009 and 2011) of negative SPI value were recorded for the long raining season and seven (7) years (2000, 2003, 2004, 2005 2007, 2008 and 2010) were recorded for the short raining season. Several studies [1,11,31,32] have reported reduction in rainfall amount especially during the short raining season in the ASALs of Kenya. This report also confirms the findings from the FGDs where discussants reported increase in drought events in the last 15years.

Result of annual drought severity from 1970 -2013 (Table 5) shows that a total of 21years has negative SPI values. The study area experienced severe and extreme drought in the year 1976 and 2000 with SPI values of -2.03 and -3.09 respectively; with the year 2000 being the driest year reported in this study. Six years (2000, 2003, 2004, 2007, 2008 and 2011) have negative SPI values between 2000 -2011. The increasing severity and frequency of drought occurrence in Kajiado County is an indication that the region is getting drier reflecting the observed climate change in the ASALs of Kenya.

Table 3. Occurrence of extreme events in Kajiado from 1975-2013

Year	Events	Local name of drought	Impact on people
2014	Drought		Death of livestock and starvation
2011	Drought		Loss of animals and migration of animals to national park and loitokitok
2009	Drought		Death of livestock and wild animals. People move their livestock as far as Tanzania
2005	Drought and famine	emperi	Death of livestock and wildlife. lack of grains for human
2000	Drought		Maasai were given yellow maize for food aid. Loss of animals
1997	Heavy rains (El nino)		Bumper harvest of maize. Livestock suffered from bloat
1994-1996	Drought	emperi	Livestock taken to Nairobi in search of pasture for the first time
1990-1991	Drought		Not enough grazing for livestock, Maasai women started diversifying sources of income
1978	Heavy rains		Sufficient pasture for animals and flood
1984	Drought	Engunememasi Kiroi	East Coast fever (Oldikana) outbreak. Maasai were given yellow maize for the first time as food aid. The drought was called the drought of the yellow maize
1980 -1981	Drought		People starved and livestock died
1976	Drought	Oloik	Starvation and death of animals

Source: Focus group discussions and personal interview with Maasai elders.

Table 4. Drought severity for the long rains (March to May) and short rains (October to December) in Kajiado County between 1970 and 2013

Long raining season (March to May)			Short raining season (October to November)		
Year	SPI	Drought Classification	Year	SPI	Drought Classification
1971	-0.40	Near normal	1970	-2.33	Extremely dry
1972	-0.19	Near normal	1972	-1.14	Moderately dry
1973	-2.48	Extremely dry	1973	-1.06	Moderately dry
1975	-0.02	Near normal	1975	-1.53	Severely dry
1976	-1.13	Moderately dry	1976	-1.13	Moderately dry
1979	-0.41	Near normal	1979	-0.61	Near normal
1982	-0.96	Near normal	1980	-1.27	Moderately dry
1983	-0.34	Near normal	1981	-2.18	Extremely dry
1984	-2.77	Extremely dry	1983	-0.77	Near normal
1987	-0.07	Near normal	1985	-0.45	Near normal
1993	-0.67	Near normal	1987	-0.50	Near normal
1994	-0.34	Near normal	1988	-0.53	Near normal
1997	-0.19	Near normal	1990	-0.04	Near normal
1999	-0.43	Near normal	1993	-0.38	Near normal
2000	-2.82	Extremely dry	1995	-0.40	Near normal
2004	-0.24	Near normal	1996	-0.45	Near normal
2007	-0.74	Near normal	2000	-0.3	Near normal
2008	-0.76	Near normal	2003	-0.02	Near normal
2009	-0.67	Near normal	2004	-0.09	Near normal
2011	-0.63	Near normal	2005	-1.36	Moderately dry
			2007	-0.8	Near normal
			2008	-0.1	Near normal
			2010	-0.03	Near normal

Source: Author compilation.

Table 5. Annual drought severity (January to December) in Kajiado County between 1970 and 2013

Year	SPI	Drought classification
1971	-0.44	Near normal
1972	-0.72	Near normal
1973	-1.81	Near normal
1975	-1.24	Moderately dry
1976	-2.03	Severely dry
1980	-0.42	Near normal
1981	-0.95	Near normal
1983	-0.05	Near normal
1984	-1.48	Moderately dry
1985	-0.27	Near normal
1986	-0.51	Near Normal
1987	-0.15	Near normal
1994	-0.16	Near Normal
1996	-0.18	Near Normal
1999	-0.8	Near normal
2000	-3.07	Extremely dry
2003	-0.13	Near Normal
2004	-0.37	Near Normal
2007	-0.35	Near Normal
2008	-0.69	Near Normal
2011	-0.44	Near Normal

Source: Author compilation.

3.5. Adaptation and Coping Strategies of Maasai Pastoralist to Climate Change and Variability

Maasai pastoralist communities in Kajiado County over the years have developed strategies of coping and adapting to climate change and it's extreme. However, respondents agreed that increase in frequency and magnitude of extreme climatic events is increasing their vulnerability to these extreme climatic events. This study revealed the different strategies used by Maasai pastoralist to adapt to climate change and its extremes.

Table 6 summarizes the adaptation and coping strategies and the percentage of household using the adaptation strategies in the study area. Migration in search of pasture (79%), Destocking (68%), buying of hay (60%), livelihood diversification (74%), table banking and self held group (55%) were some of the strategies identified by respondent. Other strategies identified by the households include Harvesting of wild fruit, slaughtering of weak animals, diversification of herds, sending children to school and rain harvesting.

3.6. Identified Best Adaptation Options in the Study Area

The Maasai pastoralist households were asked to rate the adaptation strategies identified based on their level of importance. They rated the adaptation strategies that will

significantly reduce their vulnerability to climate change and also areas where they will need assistance from external bodies such ad government organizations and NGOs. Table 7 shows the level of importance of adaptation strategies based on the rating of Maasai pastoralist. A five point rating scale was used to rate the level of importance of the adaptation strategies. The 5 point ordinal scale were graded either as 5= very important, 4= important, 3= moderate importance, 2= low importance, 1= no importance.

Rain harvesting and solving water problem was identified as the most important adaptation strategy in Kajiado County. Respondent identified water shortage as the biggest problem facing Kajiado County. Table 7 shows that 62.00% of respondent believed that solving water problem through water harvesting, building boreholes, dams and water pans is a very important adaptation strategy in Kajiado County. 25.4% reported that it's important, 10.8% reported that it is moderately important and 1.8% reported low importance. Lack of water for both human and animal use is a major challenge in Kajiado County. This challenge is further compounded by frequent drought that leads to drying up of water pans, wells and rivers. Rain harvesting, traveling long distance to fetch water and buying of water are some the adaptation strategy used by pastoralist. The importance of solving the water challenge was echoed by the FGDs with one the discussant stating:

Lack of water is one of the biggest challenges facing Kajiado County. We need the government and NGOs to assist in building borehole, dams and water pans for us and our livestock. This will stop the water borne diseases affecting people and also save our women and children the danger of traveling long distance in search of water.

Child education was also identified as one of the most important adaptation strategy among Maasai pastoralist. Maasai pastoralists in Kajiado County believe that child education is a long term adaptation strategy to climate change. They perceive education as a viable livelihood diversification strategy in a fast changing society that is making sustainability of pastoralism in the County uncertain. Table 7 shows that 45.6% of respondent reported that child education is a very important adaptation strategy, 35.8% believed it is important, 9.5% believed it is moderately important, 7.2% said it's of low importance and 1.9% said it is of no importance. Maasai pastoralists for decades saw education as an exit strategy and were not keen in educating their children. However, with increase urbanization, change in land use and increased climatic extremes, child education is now seen as the best way to prepare for an uncertain future. Previous studies by Opiyo et al., 2013 and Kagunyu 2014 also reported child education as a viable adaptation option in ASALs of Kenya.

Table 6. Adaptation and coping strategies to climate change and variability

S/N	Adaptation/coping strategy	% of household
1	Migration	79
2	Destocking	68
3	Buying hay	60
4	Paddock grazing	55
5	Diversify livelihood (employment, bead making, tourist guide)	74
6	Table banking and self help group	55
7	Irrigated farming using borehole	25
8	Selling of land	27
9	Rain harvesting	35
10	Sending children to school	63
11	Tree planting	39
12	Building dams	23
13	Greenhouse farming	8
14	Diversification of herds	58
15	Animal health training	54
16	Food aid	38
17	Slaughtering of weak animals	45
18	Harvesting of wild fruit	59

Source: Authors compilation.

Table 7. Level of Importance of Adaptation strategies to Maasai pastoralist households

Level of importance	% Respondent					
	Very important	important	moderately	Low	No	Mean
Rain harvesting/solving water problem	62.00	25.4	10.8	1.8	-	4.80
Child Education	45.6	35.8	9.5	7.2	1.9	4. 10
Improved infrastructure	42.6	36.8	10.4	5.6	4.6	4.05
Migration	32.4	35.8	15.0	8.2	8.6	3. 82
Promote table banking and cooperative organization	33.8	32.4	21.5	10.9	2.3	3.80
Livestock diversification	30.0	32.8	25.4	8.0	3.8	3. 76
Early warning system	30.4	30.6	26.8	7.9	4.3	3.72

Maasai pastoralist believed that improved infrastructure (better road network and availability of electricity) will improve their resilience to climate change and variability. 42.6% of respondent stated that improved infrastructure is a very important adaptation strategy and 36.8% believed it is important. GOK [7] reported that Kajiado County has only 300km tarmac road out of the 2,344.2km road available in the County; it also stated that about half of the available road network (1111.9km) are earth roads. Improved road network will improve access to major town to seek for alternative sources of income by the pastoralist. It will also increase access to major markets in the County. Only 39.8% of the households in Kajiado County have access to electricity and this are mainly concentrated in the urban areas [7]. Access to electricity especially in the rural areas will improve their access to information and early warning systems that will help in making fast decisions during climatic extremes. Respondent also reported that electricity will enhance livelihood diversification especially into electricity based livelihood.

Herd migration is one of the main adaptation strategies identified by pastoralist particularly in times of drought and dry spell. 32.4% of respondent reported that herd migration is a very important adaptation strategy and 35.8% reported it as an important adaptation strategy. Herd mobility enables opportunistic use of resources and help to minimize the effect of drought and dry spells [21]. Maasai pastoralist in Kajiado has for years developed migratory route in search of pasture, water and market for livestock. In times of extreme drought, pastoralists graze their animals in restricted national parks and sometimes cross the border to Tanzania in search of pasture and water. Focus group discussant reported that herd migration in Kajiado County is reducing due to increasing land sub division and sales; and increase in the chance of disease outbreak and death of animals during migration. FGD discussant suggested the creation of livestock migratory route in the County. This will allow pastoralist move their animals freely during drought and dry spells. Studies [5,15] revealed that seasonal decisions to migrate ensure that households maintain the productivity of their herds and security of their families. This form of mobility is pursued primarily for livelihood purposes and is very strategic to the survival of the pastoralist system [17].

Table banking is a group funding system where members of a particular group meet regularly to save money, repay loans and other contributions and also borrow money as long term or short term loans (FGD, Entayiankat). 33.8% of respondent reported that table banking and cooperative society are very important adaptation strategies during extreme climatic events. Table banking and cooperative societies is a fast way of securing loans without collateral and also minimal interest rate among rural dwellers. Maasai pastoralist women in Kajiado County use table banking to secure loans for livelihood diversification and paying for children school fees.

Table 7 shows that 30.0% respondents reported that livestock diversification is a very important adaptation strategy in the study area, 32.8% reported that it is important, 25.4% reported moderate importance, 8.0% reported low importance and 3.8% said it is of no importance. Livestock diversification is one of the key adaptation strategies that have enable pastoralist communities to survive harsh environmental conditions for centuries (Speranza, 2010). Diversification of livestock herds has both ecological and economic implications as different livestock species had different water and pasture requirements and reacted differently to droughts and diseases. Respondents reported that new breeds that are drought tolerance and consumes less pasture such as Saiwal cattle, dairy goats and black headed Maasai sheep are now been reared by Maasai pastoralist in the area. They reported that dairy goats consume less forage when compared to cattle and they also produce nutritious milk.

Early warning against extreme climatic conditions gives communities ample time to take decisions [1,18]. Result shows that 30.4% of respondents stated that early warning system is a very important adaptation strategy in the study area. Discussants at the FGD agree with the statement made by one of them that:

Timely and reliable climatic information would enable the Maasai household make informed decision on whether to increase his herd size or sell part of his animals. It also helps to make decisions on the specie of livestock to retain. It is also useful in making important agricultural decisions by agro-pastoralist.

However, discussant at the FDGs complained that climatic information does not get to the communities early. They also complain about the accuracy of climatic information from government sources.

4. Conclusion

This study showed that the impact of climate change and its extremes is being felt by Maasai pastoralist living in Kajiado County of Kenya. The increase in drought occurrence has severe impact on pastoralist livelihood, food security, human and animal health, vegetation, and child education in the study area. The Maasai pastoralists in Kajiado County have always responded to climate variability using various strategies that are discussed in this paper. However, the study showed that most of the adaptation strategies adopted by the pastoralist are largely autonomous adaptation and are unlikely to build resilience of pastoralist livelihoods and ecosystems to cope with the projected magnitude and scale of climate change in the 21st Century. Moreover, the vulnerability of the Maasai pastoralist is exacerbated by the interaction among 'multiple stresses' including poverty, land use change and a low adaptive capacity (Maito et al., 2013). Planned adaptation actions are therefore needed to respond to current and anticipated impacts of climate change and variability among pastoralist in the arid and semi-arid lands of Kenya.

Effective early warning system, seasonal climate forecasting and information dissemination can be an effective planned adaptation strategy against drought among Maasai pastoralist in Kajiado County. For early warning information to be effective and more than just a projected events, communities need to be endowed with a wider range of information and capacities upon which they can rely to mitigate imminent crises. A clear understanding of the knowledge and experience of communities can guide early warning information and services content in such a way that valuable information can be provided at the grassroots level. Early warning

information should include provision of seasonal climate and disease risk forecasts, timely information on the distribution of prices of key commodities across major markets and provision of information on the geospatial distribution of forage and water availability; it should also offer advice on effective and available risk mitigation strategies and how best to respond in the advent of a shock. The use of community radios to promote drought early warning system among pastoralist in Isiolo County in northern Kenya is a good example of community based early warning system. The vastness of land in most Maasai communities and poor infrastructure substantiates the use of community radio as an effective tool for effective early warning system in pastoralist communities.

In conclusion, the projected impact of climate change and variability in arid and semi-arid regions of Kenya requires planned adaptation strategies that will enhance the resilience of pastoralist to climate change and variability. Various stakeholders such as the government, communities, non-governmental organizations and the private sector all have important roles to play in enhancing the adaptive capacity of pastoralist to climate change and variability.

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