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Climate Change Adaptation Strategies Adopted for Sustainable Livelihoods by the Pastoral Community in Narok County

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Abstract

Climate change is a global phenomenon that has posed complex challenges today. It is reported to impact negatively on both the economy and livelihoods of the population especially in the arid and semi-arid regions of Sub-Saharan Africa. Narok County in Kenya is one of the regions that has experienced extreme weather events characterised by changes in the rainfall patterns and increased frequency and intensity of droughts over the past 50 years (GOK, 2010). These immense climatic conditions have threatened pastoral livelihoods in the County despite pastoralism having a great potential in contributing to household welfare. Despite this, no comprehensive studies have been conducted in the area on how the community can be involved in adaptation measures aimed at minimizing the effects of climate related shocks. The aim of this study was to assess and document efficient and effective adaptation strategies to climate change that are used by the pastoral community in Narok County in order to sustain their livelihoods. The author used descriptive survey design to achieve this objective while employing face to face interviews to collect primary data. The sample size comprised of 415 pastoral households identified through a multistage cluster sampling and simple random sampling techniques. The collected data was analysed using statistical package for social sciences (SPSS) computer program and results were presented in using tables and bar graphs. Findings showed that the main adaptation strategies used by the pastoral community include; crop cultivation, livestock diversification, destocking, water harvesting, soil conservation, tree planting, and irrigation farming, among others. Consequently, policies that incorporate indigenous knowledge, promote community-led adaptation, effective and appropriate dissemination of climate-related information at the local level and those that provide access to relevant institutions should be formulated in order to enhance the resilience of pastoral communities to impacts of climate change.

Keywords: Climate Change, Adaptation Strategies, Pastoral Community, Sustainable Livelihoods

INTRODUCTION

The impacts of climate change are currently being experienced globally. The delays in the climate system and the unprecedented increase in the level of greenhouse gases in the atmosphere today means that further climate change is now unavoidable and therefore the need to adapt to the impacts is equally imperative. Poor communities who face the challenge of adapting to climate change through a process of building adaptive capacity and reducing vulnerability are mainly living in Arid and semi- arid lands (ASALs). In Kenya, ASALs make up an overall percentage of 84 of the total land and hold 20 per cent of the country's

population (Idris, 2011). According to a study conducted by Bobadoye *et al*. (2016), ASALs are the worst hit by climate change among other natural hazards with its largest effect being felt in small-holder agriculture, cattle rearing and tourism that are dominant sources of livelihoods in these regions. This has consequently resulted to adverse economic strain and food insecurity making it difficult for pastoral communities to survive.

According to Mwebeza (2009), East Africa is one region that is expected to suffer worst impacts of climate change which include frequent severe droughts and more unpredictable heavy rainfall events in some places which in turn will cause human, economic, and environmental as well as biodiversity impacts. Closely related issues are observed in Kenya's Agricultural sector which indicates that climate change has already taken a toll on agriculture due to water scarcity, decline in soil fertility, soil erosion and landslides and increased incidence of pests and diseases.

Orindi *et al.* (2007), opined that climate change will have far reaching negative effects on the already perilous food security situation especially for the pastoral communities in Kenya. Notably, the pastoral communities are affected by the impacts of climate change despite having other challenges that hinder their way of life and restrains their potential to adjust to changes in their external environment. Oxfam (2008), groups these challenges into four main categories to include: climate change, political and economic marginalization, inappropriate development policies, and increasing resource competition. For instance, in Laikipia East sub-county, drought is ranked highest in severity among other climate change challenges and it is followed by livestock diseases, human diseases and conflicts over resources (Kirimi *et al*., 2013). Rainfall data and household surveys from Mandera and Turkana confirm that with climate change, droughts are more frequent and severe and therefore, pastures are not able to regenerate, and rangelands remain bare even when erratic rainfall is recorded (Ogindo *et al.,* 2009). Acoording to GoK (2010) documented report of a workshop held in Nakuru on the impacts of climate change in the rift valley revealed that in Samburu County the impacts include; increased water scarcity caused by low rainfall and short-lived water pans, increases in daytime temperatures and decreases in night time temperatures.

Nevertheless, Idris (2011) argues that pastoral communities are capable of assessing and managing risks that are caused by the vulnerability they encounter in the ASALs from harsh climatic conditions successfully. In the quest to remain food secure, the pastoral community in Narok County, over the years has built a list of activities to adopt towards reducing the effects of climate change on their environment, through trial and error, and partly through exchange of information with other people. Despite pastoral practice having a great potential in contributing to household income, it has however, been adversely affected by climate change related shocks possibly as a result of limited knowledge about particular changes in climate. This has made the practice to be accorded little attention in terms of its role in alleviating household poverty and food security. Whereas the entire practice of pastoralism in Kenya claims that income is a driving factor to adaptation to climate change, little past work has addressed coping strategies adopted by pastoralists in enhancing sustainable livelihoods. This paper therefore attempts to provide insights and add to existing knowledge on climate change adaptation strategies used by pastoral community in Narok County to sustain their livelihoods.

Natural variability and human interactions have been blamed for increased emmision of greenhouse gases that reflect mean variation of climate elements. Increase in levels of green house gases has caused

increased levels of global temperatures and subsequently resulted in climate change, (IPCC, 2001).The global average surface temperatures has increased over the 20th century by about 0.6^0C and it is expected to increase in the next century faster than any that has occurred in the past 10,000 years ago (McMichael, 1996). The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) emphasized that global warming is mostly due to man-made emissions of greenhouse gases (GHGs) from human activities. There is consensus among many scientists that the anthropogenic cause of increment of greenhouse gases (GHGs) in the atmosphere is the main cause of the climate change incidences experienced. According to Kamal (2011), GHGs are mainly contributed by land use changes such as deforestation particularly in developing countries, and the burning of fossil fuels specifically in developed countries.

Vulnerability of Pastoral Livelihoods to Climate Change Impacts

Pastoral societies inhabit arid and semi-arid environments where the living conditions are harsh and challenging. In these regions, pastoralism serves as the bedrock of the peoples' livelihoods and culture. Various studies have concluded that with the natural drier characteristics in ASALs these areas are particularly more vulnerable to climate change impacts comparatively to others. Berhanu and Beyene (2015) contended that climate change is supposed to increase the likelihood increase in the incidence of droughts and floods in most ASALs in Sub-Saharan Africa. Masika (2002) affirms that climate change is already accelerating the hazards that affect human livelihoods, settlements and infrastructure in ASALs, and thus dwindling the resilience of livelihood systems in the face of increasing uncertainty and frequent disasters.

The economy of ASALs will not be spared with the changes in climate since the increase in overall water stress that will be caused by projected temperature increase and drier conditions t will notably alter vegetation cover as well as put further stress on water resources. Dube & Phiri (2013) noted that the condition of grazing lands in Southern Zimbabwe deteriorated very quickly over the years due to the continuous seasons of drought that had made some of the pastures fail to recover. On the same note, vegetation does not reach flowering period in north western Somali land due consecutive droughts and seasonal rains, thus leading to reduced biomass that exposes land to more soil erosion (Hartmann *et al.,* 2009). This is also in line with the study by Silvestri (2012), which was done in 7 rural districts in Kenya, that reported that some livestock feeds that were available 10 years ago are no longer available while some new feed resources have been introduced in particular: mathenge (*Prosopis juliflora*) and, napier grass (*Pennisetum purpureum*) because of increased dry conditions. The report also attributed the loss of livestock and consequently reduction of herd size in the last 10 years to the changes in the feed resources in the 7 districts.

According to Fischlin *et al*. (2007), dry soils caused by rise in temperature and decrease in rainfall will be responsible for vegetation flammability and shift in species composition. Additionally, an extended drought can result in the mortality of perennial plants and the switch to an annual dominated flora (Hein, 2006). Such situations according to Iona (2011) jeopardize herd growth as there is insufficient time for herds to recover following a shock thus furthering the vulnerability of pastoralist livelihoods. Although direct effects of climate change on the animals are likely to be small as long as temperature increases do not exceed 3°C, Hoffmann (2010), argues that these changes will directly cause physiological stress and thermoregulatory control in animals as well as nutrition disease stress. Community conflicts, loss of lives and livelihoods as well as migration among other problems

will consequently result (GoK, 2010). Hence livestock production is expected to be affected by changes in feed quality and availability, water availability and increased rates of disease and heat stress. In Baringo, Lelanguyah (2013) found out that destruction of crops, displacement of people and death of animals are some of the major effects of climate change on the livelihoods of the local people. Such effects led to loss of income sources for most of the local pastoralists as well as loss of residence. The end result is the increase dependency ratio where the affected population eventually seek for food and shelter from the homes of close relatives and friends.

Climate-induced changes therefore reduce the pastoral resource flows that are critical for livelihood sustainability, by directly affecting their yields and changing ecosystem distributions and species ranges (Oxfam, 2008). Rembold *et al*. (2014), in their research on food security found out that the aftermath of 2014 prolonged drought in Makueni and Narok counties were low cattle prices which went lower than the long-term average by -10.53% and -8.57% respectively and this had a huge impact on pastoralists who normally have to sell cattle in order to afford food. Such impacts will result in dwindling of pastoral livelihoods, especially through declining food security and problems with the survival of many livelihood activities such as livestock raising, fishing and the use of forest products as well as crop production (McDowell & Hess, 2012; Hertel & Rosch, 2010). The high rise of cases of poverty in the country may therefore be explained by the prevailing conditions of climate change and the out dated adaptive measures employed by the affected communities. This argument may be supported by the changes in livelihood systems evidenced by a shift from pastoralism to agro-pastoralism which is indicated in most County Integrated Development Plans (CIDPs) of the ASAL Counties including Narok (GoK, 2013). The changes in livelihood strategies are instigated by the ever-changing climatic conditions that pose dynamic and unpredictable weather conditions.

Adaptation Strategies among Pastoral Communities

Little *et al.* (2001) point out that most pastoral adaptation to climate change are associated with the social and cultural practices of the community which usually form a sequence of responses to the situations of droughts. Galvin *et al.* (2001) notes that the crucial strategy of reducing the vulnerability to drought among most pastoralists is herd mobility where the herders move with the livestock to target spatially different prime pastures and water. African Union (2010) envisages that the goal of this "strategic mobility" is to enhance production by keeping the livestock on a diet that is higher in nutritional value than the average value of the range. It is also noted that this strategic mobility offers the highest returns when properly managed and is thus a potential and environmentally compatible agricultural activity in the dry lands (Steinfield *et al.,* 2006). Most of the East African pastoral households are vulnerable to poverty and do experience difficulty in adapting to climate change. This according to IPCC (2001) is largely because of their inability to implement adaptation strategies and it is likely that the nature of the climate variability that they are familiar with, will itself change, adding new variability to the system.

For a long period of time, communities living in harsh climatic regions where climate variability has been the norm of the day have taken remedial measures to overcome such conditions. The Pastoral community of North Africa live in an expansive area of nearly 3,053,200 km² that has faced severe and frequent droughts which dates back into several. (Nyong *et al.* 2007; Hulme *et al.* 2001). The magnitude and intensity of these droughts, are further described by Hulme *et al.* (2001) to have been on the increase with devastating consequences over the last 100 years. The pastoral communities in this region have

been able to apply their indigenous knowledge systems, to come up with and implement extensive mitigation and adaptation strategies that have enabled them cope with the past climate variability and change. In Ethiopia local knowledge has proved to be vital in mitigating the impacts of climate change as illustrated by a complete success of local sorghum with higher variance of traits that proved to be less susceptible to the frequent droughts compared to the modern varieties. The later proved to succeed when weather and other conditions were favourable (Hertel & Rosch, 2010).

Some of the indigenous adaptation strategies used by the Sahelian communities include use of alternative fodder in times of droughts, mixed composition of herd species to survive climate extremes, and slaughtering of weak livestock for food during periods of drought (IIRR *et al*., 2004). Nyong *et al*. (2007) further note that pastoralists and agro-pastoralists in the region, usually shift to goat and sheep keeping from cattle keeping during drought periods because the goats and sheep require less feeds than the later. They also practice nomadic mobility from the dry Northern areas to the wetter Southern areas of the Sahel to reduce pressure on low carrying capacity grazing areas. This system of seasonal movement illustrates the use of indigenous type of ranching management system by a pastoral community to cope with extreme climate events. However, Silvestri *et al.* (2012) in their study presents a different scenario by comparing adaptation capacities between pastoralists and agro-pastoralists which indicated that most pastoralists declared they had nothing in response to climate shocks compared to agro-pastoralists in semi-arid, temperate and humid sites. This could be due to the fact that pastoral households being in the arid areas are already dealing with tougher climate conditions and are therefore less likely to respond to climate shocks unlike their counterparts in semi-arid regions. There is however, data paucity on the specific indigenous practices that can boost pastoralists' resilience to climate change.

Saranta (2013) describes the roles played by some strategies adopted by Maasai pastoralists to enable them survive under climatic risks associated with their environments. Their movement with animals was meant to enable animals got access to fresh pastures and minerals, water while minimizing on overgrazing of home pasture resources. Keeping different anal species under the same management was to reduce among other roles, the risk of total loss when risks such as diseases strike. However, these strategies required more labor and at the same time they may not be viable to the current scenarios brought about by climate change. Furthermore, Orindi, *et. al.* (2007), found herd dispersion which involves spreading one's animals to several localities to be more instrumental in counteracting local risks of theft and disease faced by these communities than the climate extreme events. They also noted that pastoralist maximized their herd by keeping as many female animals as possible that ensured steady products for their families. The large herd was geared towards survival; reducing risks and recovery after ordinary droughts but this may not serve the case with the extreme weather events of climate change. This study therefore, aimed at establishing a set of specific adaptation strategies to climate change conditions already experienced by the local community.

Community-Based Adaptation in Pastoral Areas of Kenya

Community-based activity is conceptualized in terms of integration of the community's value system as expressed in their beliefs, attitudes and practices in the perspective of environment. It is a holistic, multi-dimensional, transdisciplinary and place-based approach that focuses on the interrelations between socio-economic, cultural, political and environmental stressors to which communities are exposed. (Ayers & Forsyth, 2009). It is one such

approach that according to Vincent *et al*. (2010) will manage climate change while accelerating socio-economic progress given that it is based on cultural strategies and mechanisms that are appropriate in enhancing viable coping mechanism and thus contribute to sustainable means of livelihoods at community level. Local people should be in the forefront in the process of adaptation since climate change impacts, appropriate responses, and, to some extent, adaptive capacity, are location–specific. Westerlink (1996) contends that when community-based activity gives local people a sense of ownership and a feeling of empowerment which motivates them to play a role in its success. The management of the Kaya forest in Kenyan coast is one such initiative of the local community that has led to sustainability of the forest (GoK, 2013). Kenya launched its National climate change action plan (NCCAP), in March 2013 and it is intended to address issues of climate change among a wide range of sectors, including Agriculture, livestock and pastoralism, water resources, forestry and energy. Though the action plan is yet to be implemented and it seems to have left out the local community from the list of stakeholders, the local community should not be seen as a threat towards the environment and development.

Community-based tool in adaptation process strengthens the local coping abilities of a community while promoting their skills of creativity (Wolfenson, 1996). Furthermore, involvement of the community is one of the surest ways to build long-term capacity that maintains project gains once the original activity is complete (Suich, 2013). Despite this, there have been challenges that surround the community-based climate change adaptation program. These include: failure of the community involved to benefit directly (Fabricius & Collins, 2007), poor governance and leadership (Bohensky & Lynam, 2005), lack of technical and financial support (Balint & Mashinya, 2006), inequitable distribution of benefits as well as inadequate flow of fund for community level activities and neglect of indigenous knowledge (Suich, 2013). Schwartz *et al*. (2011) also point to a number of variables that shape the ability of community members to participate in CBA strategies to include age, wealth, ethnicity, social status or gender. Consequently, it is imperative to understand the contexts as well as the local dynamics and community indicators of vulnerability that will have a bearing on CBA before assessing the extent to which these CBA strategies are able to deal with climate change impacts on livelihoods.

Several studies have shown that pastoralists have adapted to climate change in order to try and salvage their means of survival from negative impacts of climate change. (Deressa *et al*., 2009; Deressa *et al.*, 2010; Gbetibouo, 2009; Hassan & Nhemachena, 2008). Furthermore, they even identify the adaptation strategies that are commonly used to include; changing farming practices (such as plant drought resistant varieties, have more livestock, building cattle shelters) diversifying livelihood options (get off farm work, start business) and forming social networks (cooperatives, community horticultural projects). There is however, no documented knowledge of the specific role played by Maasai patoral community both at community and household on how to cope with specific events of climate change.

METHODOLOGY

This paper presents findings of a study that was conducted within the pastoral hotspots of Narok County using both primary and secondary data. The County falls between latitudes 0^0 50' and 2^0 05' South and longitudes 35^0 58' and 36^0 05' East and extends for about 17,944 km^2 in terms of the total area. It is bordered by several counties which include: Nakuru in the North, Bomet, Nyamira and Kisii in the North West, Kajiado in the East and Migori in the West. The County's topography forms a highland in west that is covered by Mau forest and it rises up to an altitude of 3,100 m above the

sea level while the lowland in the south has an average altitude of 460 m above sea level. While the highlands favour intensive agricultural production because of rich volcanic soils, the lowland area with poor soils and unreliable rainfall is inhabited by the nomadic pastoralists. The county's dominant soils are fairly shallow soils which if not properly managed can be easily eroded (RoK, 2009). The temperature ranges between 8ºC and 28ºC while the rainfall has double maxima ranges between 500 mm and 1,800 mm per annum. Some of the low-lying parts of the county experience floods during the heavy rainy seasons forcing some farmers constructed dams in some areas so as to prevent soil erosion and conserve some of the run off for agricultural purposes.

In the arid and semi-arid parts of Narok the presence of shallow and less fertile soil in the central and southern plains support grasslands, scattered trees and scrubs (RoK, 2009). Acacia and other scrubs, being the dominant vegetation species present in the parts of the County due to high temperatures, have developed certain physiological features that prevent excessive loss of water from the plant. The County thus grapples with the challenges of water shortages since the area is prone to long periodic droughts for the better part of the year with most rivers also drying up during the dry season hence access to surface water for domestic and livestock consumption continues to be a problem. The current water sources for both domestic and livestock use as enumerated in Narok Development Plan 2008- 2012 (GoK 2008), include rivers, water pans, shallow wells, boreholes and springs. However, these water sources are mostly contaminated with a wide variety of microorganisms and chemicals that cause typhoid, diarrhea diseases, cholera, intestinal worms, trachoma, schistosoma and other notoriously virulent diseases. Reliance is therefore on rain water harvesting and water selling vendors.

This study adopted a descriptive survey design which enabled presentation of variables under investigation and their effects with respects to the adoption of the adaptation strategies among the pastoral community of Narok County. Purposive sampling was employed in selection of key respondents who included head of the Ministry of Livestock, Environment and Agriculture as well as other relevant stakeholders who are promoting the adaptation strategies to ICC in Narok County. For administration of questionnaires, the study purpossively and randomly targeted the pastoralists' households in the County and therefore a multi-stage cluster sampling technique was also used to select three sub-counties which are pastoral hotspots namely; Narok East, Narok South and Narok West. The pastoralists living in the area were chosen because of their varied cultures and cultural practices that influenced adaptation strategies. Those chosen had also lived in this area for a long period of time and therefore were in a position to understand issues related to climate change over time and space. Table 1 presents a summary of the attributes of the target population.

Table 1: Population of Study Area

Sub County	Population	Male	Female	Households	Area (Sq. Km)
Narok East	82,956	42,380	40,576	17,559	2,059.50
Narok South	181,905	91,309	90,596	35,124	4,959.20
Narok West	135,939	67,641	68,298	27,288	5,452.70
Total	400,800	201,330	199,470	79,971	12,471.40

Source: KNBS (2015)

A total of 6 key informants participated in the study. The key informants were purposively drawn from the Narok County offices of Ministry of Livestock, Narok

County Agricultural Sector Development Programme (ASDP), National Drought Management Authority (NDMA), County Meteorological Department, Regional Pastoral Livelihood Resilient Project (RPLRP) and Kenya National Bureau of Statistics (KNBS) office. Krejcie sampling formula (1970) was then used to compute the sample of households from the 79,971 households that constitute pastoralists sub-counties in the County (KNBS, 2015). The formula is presented as follows:

$$n = \frac{(x^2 Npq)}{((d^2(N-1)+(x^2 pq))} \qquad (1)$$

Where *n* is the desired sample size; N is the target population; *p* is the population proportion (0.5); d is the degree of accuracy reflected by the amount of error that can be tolerated in fluctuation of a size about a population and corresponds to the significance level with a standard error of the proportion at the corresponding confidence level (95%); χ^2 is the table chi square value for one degree of freedom relative to the desired level of confidence (χ^2 =3.841 at 95% confidence level); and *q* is 1-*p*. The sample served as adequate representation of the population which the researcher studied. Using this formula, a total of 382 households was then arrived at as the sample of the study. The sample size of households in each of the sub-counties was computed proportionately as presented in Table 2.

Table 2: Sampling Frame and its Distribution

Sub-County	Household Population	Proportionate Sample
Narok East	17,559	17,559/79,971 x 382 = 84
Narok South	35,124	35,124/79,971 x 382 =168
Narok West	27,288	27,288/79,971 x 382 =130
Total	79,971	382

Besides, an additional 33 households (8.6% of sample), 8 households in Narok East, 14 households in Narok South and 11 households in Narok West, were proportionately sampled to reduce sampling error, render sampling approach representative of general study area population and take care of any incomplete collected questionnaires. Therefore, a total of 415 pastoral households were targeted to be randomly identified and interviewed putting into consideration their geographical spread as shown in Table 3.

Table 3: Sampling Frame per Sub-Counties

Sub-County	Household population	Targeted sample	Actual Sample
Narok East	17,559	84 + 8 = 92	67
Narok South	35,124	168+14=182	160
Narok West	27,288	130+11=141	188
Total	79,971	415	415

Data collection was done through questionnaire, key informant interview, document analysis, focus group discussions and observation. Analysis of the collected data was done using descriptive statistics which involve calculation of frequencies, percentages and means using SPSS computer program. The chi- square test was used to test the significant difference on some cross-tabulated categorical dependent variables. Results were presented using tables and charts.

RESULTS

Pastoralists were interviewed regarding their experiences of climate change impacts and their responses to these impacts (adaptation strategies). Results (see Table 4)

showed that adaptation strategies adopted were regional specific, with changes into crop cultivation, and diversification of livestock types being the most preferred strategies at household level among the Maasai pastoral community.

This was evident by 56.7% of the respondents from Narok West and 37.5% from Narok South who reported to have used these strategies to counter the impacts of climate change. In addition, the results further indicated that the strategies adopted by the pastoralists varied significantly across the three regions as shown by Pearson Chi Square of 141.789 and a p-value of 0.000. Relatively few respondents (1%) reported to have used irrigation, used non-farming activities or cultivated artificial pastures.

Table 4: Adaptation Strategies Adopted at Household Level

Indicators/Variables			Sub-Counties			
Responses	Frequency	%	Narok West	Narok East	Narok South	*Chi2(P-Value*
Adaptation strategies			(%)	(%)	(%)	
Did nothing	25	6	55.6	0	44.4	
Change into crop cultivation	55	13	9.2	27.3	63.5	
Constructed water harvesting schemes	48	12	45.8	14.5	39.7	
Diversification of Livestock types and Varieties	40	10	22.6	62.5	14.9	
Cultivation of artificial pastures	9	2	56.4	11.2	32.4	
Migration	41	10	55.9	0	44.1	
Irrigation and cultivating pastures	6	1	34.5	0	65.5	141.789 (0.000)***
Reducing the number of livestock	7	2	43	28.7	28.3	
Diversification of non-farming activities	6	1	0	16.8	83.2	
Implementation of soil conservation and land paddocking	37	9	56.9	24.1	19	
Change into crop cultivation and diversification of livestock types	120	29	56.7	5.8	37.5	
Paddocking and irrigation	21	5	76.1	0	23.9	
Total	415	100	188	67	160	

*** (p<0.01), ** (p<0.05), *(p<0.10)

On the other hand, the study sought to establish the adaptation strategies that pastoralists had adopted at community level. The results (Table 5) indicated that 29.9% of the respondents had resorted to leasing out their land to private conservancies, coupled with land paddocking as well as reduction of their livestock size. This was a combination of strategies that could best suit their capability and hence meeting of the expected benefits from the selected strategies. The implementation of the soil conservation schemes, and the use of irrigation schemes were the least adopted strategies at the community level (Table 6). In addition, the results (Pearson Chi Square

of 154.299 and a p-value of 0.000), further revealed that the strategies adopted by the pastoralist varies significantly across the three regions of the study area.

Table 5: Adaptation Strategies Adopted at Community Level

Indicators/Variables			Sub-Counties			
community level strategies	frequency	%	Narok West (%)	Narok East (%)	Narok South (%)	*Chi2(P-Value*
Change into crop cultivation	74	18	2.8	33.8	63.4	
Constructed water harvesting schemes	79	19	44.3	29.1	26.6	
Implementation of soil conservation schemes	2	0.5	100	0	0	
Diversification of Livestock types and Varieties	9	2	23	67	10	
Paddocking of land	5	1	60.2	0	39.8	
Irrigation	2	0.5	0	100	0	
Reducing the number of livestock	4	1	23.5	25.1	51.4	154.229 (0.000)***
Diversification of non-farming activities	3	1	0	33.5	66.5	
Implementation of soil conservation, paddocking and livestock diversification	11	3	63.2	27.4	9.4	
Lease out land to private conservancies, Paddocking and reduce livestock size	124	30	61.3	4.1	34.6	
Change to crop cultivation, construct water harvesting schemes	23	6	69.5	0	30.5	
Lease out land to private conservation, and change to crop cultivation	5	1	0	0	100	
Total	415	100	188	67	160	

*** (p<0.01), ** (p<0.05), *(p<0.10)

Finally, 6% of the respondents at household's level and 7.2% at community level reported that they had done nothing in response to climate change impacts in all the three sub counties. This could be attributed to high poverty levels of households and their lack of coping mechanisms for the new scenarios caused by impacts of climate change, or they could have had an adaptation strategy in place and hence the effect of the impact of climate change was minimal.

Additionally, the study aimed at determining the specific adaptation strategies that the pastoral community had adopted to counter specific climate change indicators such as drought, flood, and extreme high temperatures. The results are presented in the subsequent figures (Figure 1,2 and 3). From figures 1 and 2, it was clear that a big number of the respondents had not adopted any strategy at all to calamities of floods (62%) and extreme temperatures (25%), respectively. In addition, 20% of the respondents reported to have built terraces and gabions against floods while 34% had adapted to high temperature by planting trees.

The results further showed that the pastoralists were using migration to the neighbouring forests or highlands to counter the challenge of high temperatures especially in all the sub-counties (Figure 2 and 3).

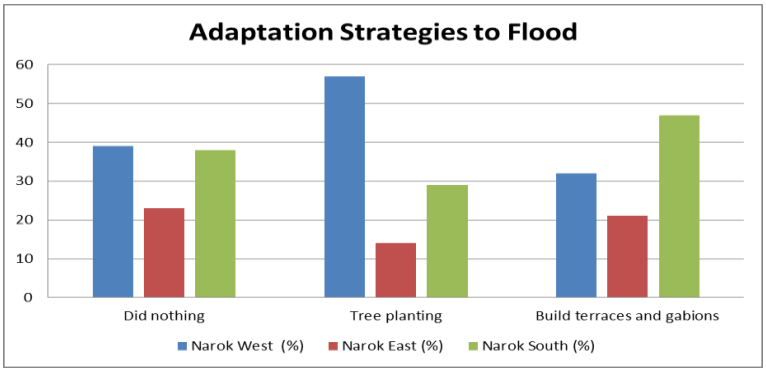

Figure 1: Adaptation Strategies to Impacts Caused by Floods in the Three Sub-Counties.

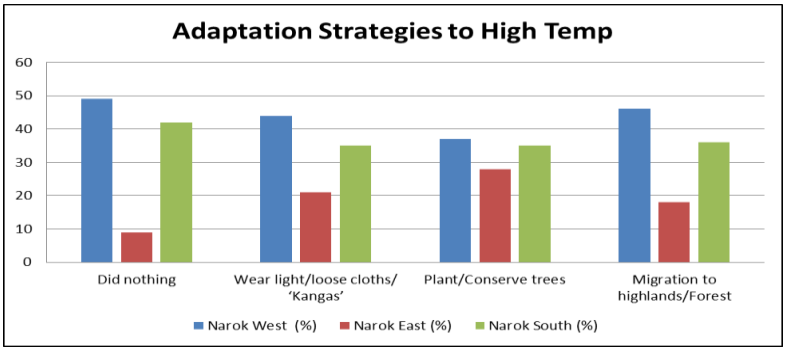

Figure 2: Adaptation Strategies to Impacts Caused by High Temperatures.

The pastoral community had defined adaptation strategies to the impacts of drought as presented in Figure 3.

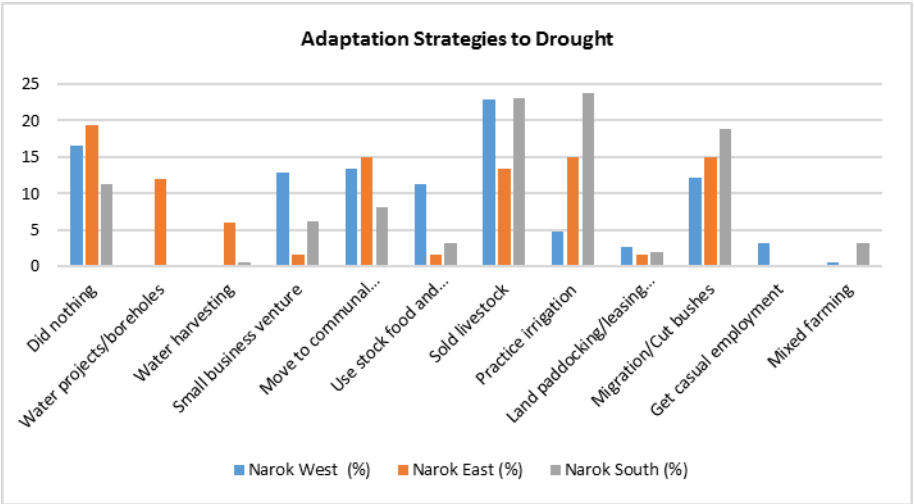

Figure 2: Adaptation Strategies to Impacts Caused by Drought in the Three Sub-Counties.

The results in the table 6 therefore summarizes the major strategies that have been used by pastoralists both at household and community level to adapt to impacts caused by prolonged drought, floods and increased temperatures.

Table 6: Adaptation Strategies to Specific Climate Change Indicators

Climate Change Indicator	Specific Adaptation Strategy
Adaptation strategies to drought	-Drilled boreholes and harvested water -Ventured into small businesses -Sourced for grazing areas from conservancies and communal lands -Kept resistant breeds of cows -Used stocked food and bought more from neighbouring counties -Sold Livestock -Practiced irrigation -Practiced mixed farming -Land paddocking -Migration to far place for pasture and water -Sought for casual jobs
Adaptation to high temperatures	-Planted and conserve trees -Wore loose clothes/'kangas' -Migrated to forest and highlands
Adaptation to lack of pasture	-Sold livestock -Took insurance for livestock -Mixed farming -Herd mobility to other counties e.g. Nakuru and Nairobi -Made use of artificial pastures
Adaptation to floods	-Planted trees -Constructed terraces and gabions -Performed drainage channels -Early vaccination of livestock

DISCUSSION

The objective of the study was to asses and document the adaptation strategies that were used by the Maasai pastoralists both at household and community level, which enable them to sustain their livelihoods. Results indicated that respondents had adopted different adaptation strategies to different specific challenges of climate change. At the household level, adaptation strategies adopted were regional specific, with changes into crop cultivation and diversification of livestock types being the most preferred strategies. Drought tolerant crops like cassava, soya beans, beans, maize, sweat potatoes and bananas had been introduced in some specific areas like Mosiro, Maji Moto and Nkinije but these were mostly in a small scale and under irrigation. It was also noted that the pastoralists had attempted to diversify their livestock types to keep breeds that could have high yield in terms of meat and milk like Sahiwals, Borana, and East African Zebufor cattle and dorper, galla and East African goats. The challenge they encountered with these new breeds as reported by one of the key informants was that they were less hardy than the indigenous breeds.

The foregoing result concurred with that of Campos *et al*. (2014) who noted that diversification of productive activities in different landscapes was a key response to climate change. This is because different livelihood units are not dependent on a single landscape unit and its resources and environmental services. This was also in line with the findings of Deressa *et al.* (2009) who pointed out that the most common adaptation strategies in the Nile Basin included the use of different crop varieties, planting trees, soil conservation,

changing planting dates and irrigation although these were limited by lack of access to land, information, and credit. In addition, Ndamani and Watanabe (2015) reported that farmers were using drought-tolerant and early maturing varieties and also changing planting date to adapt to dry spells, droughts and floods situations.

In addition, selling of livestock during adverse conditions was also used by pastoralists as an adaptation strategy to reduce the number of herds that could be affected by the conditions (see Plate 1). This result implied that pastoralists did sell their livestock during extreme weather events because animals were unable to resist the long dry periods due to the shortage/absence of feed/pastures and water. However, this would not allow them to get good prices and hence a drawback to their household income. Similar findings had also been reported by Feleke *et al*. (2016) who found out that the most commonly used adaptation strategy was marketing during forage shock in Ethiopia by sheep and goat farmers. On the other hand, pastoral households could also be more reluctant to sell livestock because those with large herd sizes and greater mobility had been shown to have increased resilience to drought (Little *et al*., 2001).

Plate 1: Animals brought for sale at Nkoilale market.

Reduction of livestock among the Maasai community did not necessarily mean cutting on the number of herds owned by an individual household head but this could also mean distribution of some of the animals to relatives who were leaving in better agro-ecological zones or moving them to far places to salvage the problem of water and pasture shortages. Respondents did indicate that they moved their animals to far off places even as far as Tanzania, Nairobi, Machakos and Nakuru in search of water and pasture to abate the impacts of the biting dry spell. In one FGD it was reported that traditionally migration was a very critical strategy that ensured survival of livestock during stress periods occasioned by climate variability among Maasai pastoralists. It was used to save a core stock of breeding animals that together would be capable of reconstituting the herd after a drought, making the nucleus of their breeding herd as their main capital base. This concurred with the sentiments presented by Saranta (2013), that migration was one of the strategies adopted by Maasai pastoralists to ensure that animals got fresh pastures and minerals; accessed water supplies; avoided overgrazing resources, human competitors and disease-carrying insects. However, as much as the strategy had provided a solution in saving the pastoral livestock ever since time immemorial, the dry seasons have now become unpredictable and more prolonged,

forcing them to start migrating much earlier and even longer than before.

More so, key informants from both the County livestock department and RPLRP lamented that herd migration posed a challenge to disease control by making it difficult to track all the animals and vaccinate them against emerging disease outbreak once they were away and even when they came back and yet at the same time they could not be quarantined because of lack of pasture and water. Study results further illustrate that few households were cultivating subsistence crops under irrigation while others were cultivating artificial pastures as other adaptation strategies. Three main irrigation projects found in the region included; Mosiro, Naroosura and Mjimoto irrigation schemes which were all funded by the African Development Bank in collaboration with the Kenyan Government. Mosiro irrigation scheme being the largest occupied over 750 acres under irrigation of horticultural crops which included onion, tomatoes, French beans and watermelons among others. It had over 520 registered members who benefitted in terms of food and income. In another area some individual farmers were making use of small streams and dams like in Maji Moto stream to irrigate their own farms where they cultivated few food crops for subsistence (See Plate 2).

Plate 2: Irrigated agriculture at Maji Moto.

Livestock feed supplementation included feeding the livestock on harvested fodder such as rhodes, napier grass, fodder sorghum and maize crop residues. Sustainable Land Management project which was a 5-year project between 2011 and 2016, funded by United Nations Development Program (UNDP) had played a role in training the pastoralists in various topics such as; pasture and fodder development, growing of drought resistant crops and sustainable natural resource management among others. During the FGDs it was indicated that some households had already started supplementing animal feeds using these cultivated pastures which were either harvested from their farms or bought from nearby towns. Hence, during seasons of prolonged drought the weak animals that could not be migrated to other parts were kept near the homesteads and fed with supplementary feeds.

However, although feed supplementation looked an important strategy for alleviating the impacts of climate change in this region, only a few economically stable pastoralists could afford this approach. It therefore called for a way of providing subsidized costs of the supplements so as to make it affordable to majority of the Maasai pastoralists. These findings corroborated with those of Bryan *et al*. (2013) and Deressa *et al*. (2009) who noted that despite many households in Kenya and Ethiopia respectively, having responded to climate change through the adjustments of their farming practices, few were able to make morecostly investments, such as agroforestry or irrigation, although they desired to invest in such measures. On the contrary, Rakotobe *et al*. (2016) were of the

opinion that farmers could still cope with the little they had as noted from the farmers who adjusted to effects the cyclones by replanting crop fields, rebuilding homes with local materials, reducing consumption of staple foods, harvesting wild foods and finding temporary work to buy food.

On the other hand, the study results on the adaptation strategies that pastoralist had adopted at community level indicated that they had resorted to leasing out their land to private conservancies who in turn used it for wildlife conservation. Land paddocking being a new phenomenon among the Maasai pastoralists was perceived by the respondents as a form of adaptation to the climate change impacts that would allow them practice paddock grazing as opposed to communal grazing which they had practiced for a long time. Paddock grazing, they said, gave room for pasture in the paddocked areas to regenerate and therefore ensured constant availability of pasture even during very dry seasons. This new practice according to Focus Group Discussions would help control the movement of livestock while playing a great role in controlling spread of disease. However, most pastoralists kept very large herd of livestock which implied that by confining them in these lands which were already dry would degrade them further hence leading to soil erosion. Plate 3 illustrates a paddocked land at Nkoilale.

Plate 4: Author next to a paddocked grazing land at Nkoilalel.

Pastoral communities are in fact more vulnerable to climate change and climate shocks given the meagre options available for coping and adaptation in ASALs. However, a point to note in this is that some adaptation strategies had already been adopted at the household level in the study area since some pastoralist had chosen to cultivate crops together with livestock production while others had diversified their animal breed and were also engaged in diversification of livelihoods such as off-farm businesses. Additionally, the implementation of the soil conservation schemes, water harvesting systems and the use of irrigation seemed to be the least adopted strategies at the community level, perhaps because of the huge financial costs incurred in these activities. Similar results have been documented in other parts of Kenya where the farmers practice varied adaptation strategies to cope with impacts of climate change like tree planting, reduction in the number of herds, supplementing livestock feeds, application of fertilizers in their farms application, conservation of both soil and water resources (Nkurumwa et al., 2010; Gicheru *et al.,* 2012; Bryan *et al.,* 2013).

Results further revealed that the pastoral community had adopted specific adaptation

strategies to specific climate change indicators like drought, flood, and extreme high temperatures. The results indicated that majority of the pastoralists were adopting less strategies to floods and extreme temperatures but were widely responding to droughts by using various adaptation strategies that minimized the impact associated with droughts. These findings concur with the results of Bryan *et al.* (2009) who noted that majority of farmers' households in Ethiopia and South Africa did not adopt any strategy to combat the impacts of climate change. Yet for Silvestri *et al*. (2012), failure to adapt to climate change by farmers in ASALs could have been due to the fact that households in the arid areas were already dealing with more difficult climate conditions and were therefore less likely to respond to climate shocks.

During drought the pastoralist sold off their livestock, while during high temperatures, they planted/conserved trees, migrated to highlands and forests while in case of frequent floods seasons, they built terraces and gabions and also conserved trees. These findings were also in agreement with that of Bryan *et al*. (2013) who documented that farmers from arid regions were moving animals, presumably to regions with lower temperature and more rainfall to support grazing, as the key adaptation strategy, followed by changing the crop variety (but not planting date) and changing livestock feed. During focus group discussions with local leaders, it was alluded that the most commonly used adaptation strategies among the pastoralist include; intergration of crop farming into their livestock keeping practice, seeking off-farm income sources, such as jobs, trade, food-for-work, and charcoal burning among others. The same results were also cited by other studies like Kabubo & Mariara (2008); Roncoli *et al*. (2010); Nkurumwa *et al*. (2010); Gicheru *et al.* (2012); Silvestri *et al.* (2012); and Kirimi *et al.* (2013) which have studied the adaptation strategies to climate change in Kenya. The study confirmed that the Maasai pastoral community had defined their own ways of adapting to ICC both at household and community level which were governed by indigenous knowledge systems. They also had specific adaptation strategies for specific climate change indicators based on their past practices of adapting to previous ASAL conditions. Egbe *et al.* (2014) had suggested that integration of indigenous knowledge system into climate change policies could lead to an effective capacity building and adaptive strategies that were cost effective.

CONCLUSION

This paper has presented some of the adaptation strategies that to have been used by pastorolists in Narok County in response to the impacts of climate change in the region. As indicated in the study findings, the main adaptation strategies reported in the study included; crop cultivation, livestock diversification, destocking, water harvesting, soil conservation, tree planting and irrigation of farms. These are the main adaptation strategies that have reduced the negative impacts of climate change and enabled sustainability of pastoral livelihood. On the other hand, it was indicated that pastoralists had leased out land to private conservancies, paddocked their land, reduced the size of livestock, and constructed water harvesting schemes as adaptation strategies at community level. Specific adaptation strategies were adopted for specific climate change parameters. In order to adapt to frequent incidents of floods, pastoralists planted trees and constructed terraces and gabions as adaptation methods. For increasing temperatures, they were engaged in tree planting and migration to highland and forests. In addition, during drought periods pastoralists moved to communal land and conservancies to graze their livestock, practiced irrigation and sold off their livestock as a way of sustaining their livelihoods while managing the associated negative effects of climate change.

RECOMMENDATIONS

The author recommends policies that are aimed at promoting community-led adaptation strategies and especially among the pastoralists since these will enhance adoption of more viable measures by the affected community. The decision to adapt is strongly dependent on the characteristics of the pastoralists themselves and thus policy interventions that seek to enhance these characteristics will have impact on adaptation. Furthermore, policies formulated should promote access to socio-economic facilities such as capital and water as well as information by the pastoralists because they influence their positive adoption of adaptation strategies to climate change. It therefore requires the governments concerned to invest in large scale irrigation schemes along the pastoral strip so as to enable survival of pastoral livelihoods while buffering them against dependence on food aid during seasons of extreme climate events. It will also prompt them to practice mixed farming as a way of livelihood diversification and as an adaptation strategy in itself. Policies that also aim at creating off-farm employment and other income opportunities in the pastoral areas are essentially needed to provide options for pastoral areas that will salvage their livelihoods from the problems brought about by climate change. Finally, there is need for policies that enable pastoral households to change their livestock management practices through creation of awareness as well as financial empowerment so as to increase their resilience to future climate change and variability.

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