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INFLUENCE OF CLIMATE CHANGE MITIGATION STRATEGIES ON RURAL LIVELIHOODS.A CRITICAL LITERATURE REVIEW.

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ABSTRACT

Purpose: Climate change may reduce the availability of these local natural resources, limiting the options of rural households that depend on Natural resources for consumption or trade. The general objective of the study was to examine influence of climate change mitigation strategies on rural livelihoods

Methodology: The paper used a desk study review methodology where relevant empirical literature was reviewed to identify main themes and to extract knowledge gaps.

Findings*:* The study found out that local communities are aware of the climatic changes taking place in their locality and have taken steps to discuss climate change issues within their neighborhood, through local leadership Chief Barazas and reports by environment stakeholders. The researcher also established that different adaptation strategies are encouraged by different organizations.

Recommendations: The study recommends that scaling up and diversifying funding allocations for climate change response by both government and NGOs. This will ensure vibrant climate that climate change response activities that are at the same time enhancing rural livelihoods. Channeling of funds through grass root organizations like youth groups and women organizations will provide support of most preferred local adaptation strategies like change in crop patterns, agro-forestry and cross breeding of livestock.

Keywords: *influence, climate change, mitigation strategies, rural livelihoods*

1.0 INTRODUCTION

Background of the Study

Climate change has become one of the environmental threat across the world with the witnessing of the increased global air, oceanic temperatures, wide spread melting of snow and ice and rising sea levels (IPCC, 2007). This affects less industrialized regions impacting on livelihoods of the rural households which tend to rely heavily on climate sensitive resources such as water supplies and agricultural land; climate sensitive activities such as arable farming and livestock husbandry; and natural resources such as fuel wood and wild herbs (PRB, 2007). Climate change may reduce the availability of these local natural resources, limiting the options of rural households that depend

on Natural resources for consumption or trade. Lands becomes less fertile, fewer reeds for basketry and less fuel wood for cooking. There is need for creating awareness to rural communities on the climate changes.

Local knowledge entails practices that could have been adopted from other areas and incorporated into the societies' practices over a long period of time whereas indigenous knowledge refers to the information that is unique to a certain group of people and has been used and perfected over a long period of time. Therefore, local and indigenous knowledge with reference to climate change adaptation is the means that a community uses their unique cultural practices that have been perfected over time through observation and experience and combine it with knowledge from other regions that work in their local situation. This knowledge is then used to generate coping and adaptation mechanisms to the impacts of climate change. It is important for communities affected by current climatic variability to adapt to the long term impacts of climate change to maintain their food security and their livelihoods and to ensure that their environment is not irreversibly damaged by the impacts of climate change. Community adaptation involves behavioral shifts and is not only about coping with the consequences of climate change impacts. It involves changing their activities and livelihoods to suit prevailing climate conditions.

This is not a new ideology as communities have adjusted their behavior over time as a response to the weather variability especially in Sub-Saharan Africa. For example, Ngigi (2009) noted that communities adapt at the farm level, whereby families switch their crops to suit prevailing weather conditions and take up such measures as irrigation to counter the effects of inadequate rainfall. Brooks (2003); Smit (2006) concur that adaptation entails a level of adjustment on the community's part. Adaptation is defined as the adjustment that takes place in both human and natural systems as a response to actual or expected climatic stimuli and/or their effects so as to regulate the potential harm or to take advantage of the opportunities that may be of benefit (IPCC, 2001). Adaptation is further defined as a system's behavioral and characteristic adjustment that enhances its ability to cope with external stress (Brooks, 2003).

On the other hand, Smit et al., (2006) defines adaptation as adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts. Based on timing, adaptation can be anticipatory or reactive, and depending on the degree of spontaneity, adaptation practices can be autonomous or planned (Fankhauser, 1999). Easterling (1996) notes that planned adaptation measures are characteristically consciously made policy options or response strategies which are multi-sectoral in nature and they are aimed at altering the adaptive capacity of the agricultural system or facilitating specific adaptations. For example, farmers make deliberate crop selection and distribution strategies across different agro-climatic zones, substitution of new crops for old ones and resource substitution induced by scarcity. The multi-sectoral nature of planned adaptation strategies ensures that diverse sectors of the ecosystem are included as opposed to autonomous adaptation which caters to adaptation in a specific sector of the environment and/or natural resource. Autonomous adaptation strategies do not adequately cater for the needs of the community with the changing climate; planning for adaptation offers a wider scope in catering to the needs of the community and it anticipates the impacts of climate change

and provides possible adaptation strategies to the projected impacts. It may involve building of infrastructure and capacity building to ensure that the adaptation process is effective and efficient. Adaptation should therefore not be limited to reactive responses and should be planned for to prevent climate change impacting them negatively and on a larger scale

In Africa, farmers in warmer and drier Sahelian regions have already curtailed their cropping season (IPCC, 2007). Yields from rain-fed agriculture are expected to fall as much as below 50 percent in some poor African countries. According to the same IPCC report, fisheries will likely to decline. This is expected to affect the rural livelihoods of Latin America too. Climate change is noted to be spurred by anthropogenic activities such as Green- house Gas emissions through burning of fossil fuel and transportation representing 3.9% of the world's total (IEA, 1999). Deforestation alone account for major part of Africa GHG emissions and compared to industrialized countries of Europe and North America. Much of the Africa's focus on climate change has been on the vulnerability of the region due to low human capacity to adapt to anticipated increased extreme events, resulting from widespread poverty, heavy reliance on the rain fed agriculture, inadequate technological and economic resources and insufficient safety nets and educational progresses (IPCC, 2011; Sokona and denton, 2001; Tsachakert, 2007).

African nations have responded to the need to address climate change and thus some have already become signatories of united nation framework Convention for Climate Change (UNFCCC). Climate change is viewed as a threat to rural livelihood and this has the capacity to undo many years of development in Africa. In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate and this is evident from countrywide temperature increases and rainfall irregularity and intensification (COP 16 Report, 2010) .These affect resources critical for economic development, for instance 1999/2000 La'nina drought, which left approximately 4.7 million Kenyans facing starvation (NCCRS, 2010).

In early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trend is both minimum through night and early morning and maximum at day time. This depicts a general warning. Annual rainfall event indicates that 24 hour rainfall amount experienced today is lower than those of 1960s (NCCRS, 2010). This changing temperatures and rainfall patterns have profound impact on Kenya Socio-economic sectors most of which are climate sensitive. These key sectors include; agriculture, rangelands which are backbone of Kenya's pastoralists, wildlife and tourism sector, forestry, water resources, aquatic and marine resources, health as well as physical and social infrastructure. Climate change is already ravaging Kenya and evident by increase in incidences such as flooding, spread of disease like Malaria and erratic rainfall patterns. Global greenhouse Gas (GHG) emissions are continuing unabated and this is seen to worsen the impact of climate change if it is not addressed. If Kenya takes no action to minimize the impact of current and future climate change, the cost of potential damage to economy would be enormous. According to a recent study, direct cost of climate change in Kenya will potentially amount to between one to two billion US Dollars annually by the year 2030 and considerably greater if indirect costs are included. Climate change impacts portend an increasingly

worsening and worrying situation in the future if Global and national efforts are not enhanced to reverse atmospheric GHG emissions which accelerate global warming.

1.2 Statement of the Problem

Climate change is increasingly taking center stage of discussions as one of the great challenges facing humanity of this century in both developed and developing countries. In Kenya, this is already intensifying at an alarming rate evident from countrywide increase in temperature and rainfall irregularity and intensification. An example is La'Nina drought 1999/2000 which left approximately 4.7 million Kenyans facing starvation. In addition, increased average temperature has led to spread of vector borne diseases like Malaria to areas where disease is not known to be endemic (NCCR, 2010). Several international instruments have been put in place to aid the process of addressing this phenomenon (Promara, Mau Assessment report, 2010). These instruments include IPCC, UNFCCC and Kyoto protocol. Several climate change negotiations have been conducted with the latest one being Conference of parties (CoP 17) held at Durban, in South Africa in the Year 2011. Like for the case of Kenya, instruments include; The Recently adopted National Land Policy, Environmental management and coordination Act, Vision 2030, the Kenyan Constitution (2010), Wildlife conservation and management Act and Local Government Act. According to Shiwarti (2007) and Somorin (2010), the effect of climate change on rural livelihood is intensifying, resulting to death, among other in human copying mechanism. This has been witnessed from decline in agricultural production, increased nomadic by pastoral communities in search of pasture, unpredictable rainfall pattern and reduced water supply in the area. This has attracted the attention of both location and international conservation specialists/organizations to inject their funds on restoring Mau forest alongside conservation of Mara River so as to boost agricultural production along Mau Forest. The current study will bring into light the role of influence of climate change mitigation strategies on rural livelihoods

1.3 Objectives of the Study

The general objective of the study was to examine influence of climate change mitigation strategies on rural livelihoods

1.4 Justification and Significance of the Study

This study will come up with findings which will be expected to help development agencies, scholars, learning institutions to improve on teaching content, the government of Kenya among other stakeholders in formulating policies and programmers towards responding to climate change as well as enhancing rural livelihoods of community. The study would be beneficial to scholars as it would contribute to plugging knowledge gap in line with how climate change mitigation strategies influence on rural livelihoods

2.0 LITERATURE REVIEW

2.1 Literature review

2.1.1 Adaptation to Water Stress

Impact on water resources has been noted to be a likely problem of climate change. Inadequate water will lead to drought and desertification whereas too much water leads to flooding (FAO, 2007). Desertification is considered to be one of the most threatening processes to livelihoods of the poor (MA 2005) with more than 300 million Africans living in drought or drought-prone areas; a number likely to be increased in Africa and on a global scale due to climate change (IPCC, 2007). A new report projects that by 2030, 47% of the world population will be living in areas of high water stress, especially in Africa, with 24 to 700 million people expected to be displaced because of water scarcity (UNESCO, 2009). This is noted to have more impact in Africa, with adaptation costs in the sub-Saharan urban water sector estimated at between 10 and 20 per cent of current overseas development assistance to the region (Muller, 2007). Adaptation options for water shortage range from water use controls to the building of reservoirs and diversion of rivers into drought prone areas (Obersteiner, 2006). Reduced vulnerability to drought, particularly ASAL regions, requires improved soil and water management (Falkenmark and Rockstrom, 2008; Stringer, 2008). The regulation of water flows in dry land regions have been strongly linked to the proportion of land covered by forest, grassland, and wetland, and maintaining vegetation cover can assist in adaptation to drought (Falkenmark and Rockstrom, 2008). Upland watersheds play a vital role in water regulation. Run-off from mountainous areas in SIDS is often the major supply of water (Mata and Budhooram), and in the Phillipines, watersheds are a critical part of the national economy (Lasco et al, 2008). Often these watersheds are degraded, and their rehabilitation is one adaptation option (MacKinnon, 2007). Planting trees on slope fields, mini-terracing for soil and moisture conservation, and improved pasture management can also complement actions such as building of small-scale infrastructure in water resources management (World Bank, 2008). Natural resource management has been included in the NAPA of the Niger, where water stress is the major issue, and the reduction of pressure on freshwater resources is receiving attention in Brazil where the use of pesticides has impacted water quality in many areas (Hedger and Cacouris, 2008). Soil erosion measures such as conservation tillage can be coupled with rain water harvesting and are activities that can be undertaken by communities (Paavola, 2008).

2.12 Adaptation to flooding

Watersheds can reduce flooding and sedimentation whilst improving water quality downstream. A study of upland forests in a watershed in Madagascar has estimated their flood protection value at $126,700, and peat bog in Sri Lanka that buffers floodwaters from rivers have an estimated annual value of more than $5 million (Emerton and Bos, 2004; Sudmeier –Rieux, 2006). In the Morogoro region of Tanzania, reduced river flow and increased flooding has been attributed to deforestation in the mountains, and it has been suggested that effective governance of soil, forests and water resources are needed as adaptation measures, along with improved social capacity (Paavola, 2008). Ecuador and Argentina have integrated forests and wetlands into their 'living with floods' strategies (World Bank), and reforestation is recognized as an important option for

adaptation in the watersheds of the Phillipines (Lasco et al., 2008). Viet Nam includes measures such as integrated management of watersheds in its disaster reduction planning, along with forest management, and soil and water conservation (Sudmeier-Rieux, 2006). Large-scale a forestation projects in China have been carried out with the aim of reducing flooding and increasing water conservation, and countries of Central America are collaborating to protect watersheds and forest (Abramovitz et al, 2006). Ecosystem management is also an effective adaptation strategy at the river basin scale and can be an alternative to the development of dams, which have a high environmental impact. (Mata and Budhooram, 2007). In developed countries, cost effective flood reduction strategies that allow re-growth of vegetation alongside rivers and establish vegetation buffers along streams, combined with the reduced development of infrastructure, and are being promoted in some areas (Nelson et al, 2008). Some evidence that this can be an effective strategy has been provided in a modeling scenario exercise, which suggested that a combination of wetland restoration and hard defenses provides optimal flood protection (Berry et al, 2008). Riparian floodplains can also help to reduce the levels of water pollution following extreme events (CCSP, 2008). In Europe, the conservation or restoration of river floodplains has been included in a number of flood reduction strategies (Zaunberger, et al, 2009), although there are many new river management plans that do not include such measures (Krysanova et al, 2008).

2.1.3 Adaptation in Agriculture

Food production is climate dependent economic activity. Climate change is already affecting agriculture in developing countries and this is anticipated to worsen if no action is put in place (IPCC, 2007), with significant impacts on crop yields and the productivity of grazing lands and livestock expected, through changes in temperature, precipitation, water availability, salinity, and the abundance of pollinators , pests and diseases (Rosenzweig and Tubiello, 2007). Impacts vary across regions and require a number of different adaptation strategies (Berry et al, 2008). Agricultural production is the main economic activity for rural communities of vulnerable regions such as Africa and India (Chatterjee, et al, 2005; Osbahr et al, 2008). In some countries in Africa, yields from rainfed agriculture could be reduced by up to 50 per cent by 2020 (IPCC, 2007). In Central and South Asia, crop yields could fall by as much as 30 per cent by 2050 as a result of climate change; India alone could lose 18 per cent of its rain-fed cereal production (Lobell et al, 2008). For agriculture in the world's dry lands, the challenges are especially large due to unpredicted changes in hydrological cycles characterized by both increased droughts and increased risks of flooding (Falkenmark and Rockstorm, 2008). Depending on the region and the available resources, options for adaptation range from relatively inexpensive changes, such as shifting planting dates or switching to an existing crop variety, to much more costly measures including the development of new crop varieties, increasing chemical and other inputs and irrigation systems (Rosenzweig and Tubiello, 2007). The options for adaptation in agriculture include: changes in the locations of cultivation (opening new areas for cultivation); changes to the crops cultivated, including substitution by new crops, new varieties and crop diversification; and changes to agricultural practice, including irrigation and soil management regimes and the use of agricultural inputs. Biodiversity plays an especially strong role in supporting the latter two.

2.1.4 Forest Adaptations

Climate change discussions focus on mitigation, rather than adaptations (Guariguata et al, 2008). Although there is a wealth of literature on the ecosystem services provided by forest and the links to livelihoods, little is explicitly related to climate change adaptation. Much of the literature that does exist is related to management of temperate forest (Locatelli et al, 2008). However, the role of forests in societal adaptation is becoming increasingly recognized (Eliasch, 2008), and has led to the development of initiatives such as the Congo Basin Forest and Climate Change Adaptation (COFCCA) project. Solidifying the links between forests and adaptation will be important to reduce damaging management practices that could lead to mal-adaptation in the longer term (Nkem et al, 2007). Forests can contribute to adaptation in the following three main ways; through structural defense against wind and soil erosion, through water regulation, and through the provision of timber and non-timber forest products (NTFPs) (Ogden and Innes, 2007; Innes and Hickey, 2006; UN, 2008; WRI, 2008; McEvoy, Lindley and Handley, 2006; Paavola, 2008; Eriksen et al, 2006), as has been discussed in previous sections. On a local scale, forests can provide shade and reduce exposure to heat; for example, a study in Kenya found that improved microclimate and catchment properties of a hilltop area were closely linked to good biodiversity status of the forest (Eriksen et al, 2006). Conversely, deforestation is a driving force for loss of ecosystem services and land degradation (Cangir and Boyraz, 2008). Forest dwellers and those that rely on forest resources are often the poorest members of society and have low adaptive capacity (FAO, 2007; Ravindranath, 2007). Where access to NTFPs become marginalized, vulnerability of the poorest people increases (Eriksen et al, 2005; Paavola, 2008). Both natural and plantation forests can provide ‘safety nets’ during periods of food shortage, and can provide an important contribution to food security (Kalame et al, 2009; Nkem et al, 2007). Community involvement in a forestation projects, for example, can diversify incomes and improve social capacity, reducing the vulnerability to climate change impacts (Guariguata et al, 2008; Spittlehouse, 2005). Forests can be particularly important during extreme events. In addition to the provision of ‘safety nets’, it has been suggested that forest cover can reduce landslide erosion by a factor of 4-5 compared with sites that lack substantial tree root strength, and reduce flooding (ProAct Network, 2008; ISDR, 2004). In a study of North Pakistan, it was estimated that 56% of all landslides were due to land degradation from deforestation and grazing, and that protective forests would be a cost effective action to reduce disaster risk (Sudmeier –Rieux et al, 2007). In the Amazon, forest has a major role in the regional hydrological regime (Correia et al, 2008). Forest loss could push some sub regions into a permanently drier climate regime, increasing vulnerability of societies to drought conditions (Malhi et al, 2008; Betts, 2007). Recent research has suggested that there is potential for large scale die-back of the Amazon rain forest through a combination of degradation and drought (Nepstads et al., 2008; Philips et al 2008), although it is thought that in-tact forests will be more resilient to climate change impacts (Bush et al, 2008; Malhi et al. 2008; Gullison et al, 2007). Forest management and conservation practices may help to decrease the 19 vulnerability of those who depend on forest services for their livelihoods, while at the same time maintaining the mitigation capacity of forests (Guariguata et al, 2008; IUCN, 2008). Adaptation in the forest sector (for both natural and plantation forest) can either enhance

resistance and resilience of existing forests to climate change, or facilitate adaptation to new conditions (Locatelli et al 2008). Other adaptation options include diversification of the forest economy and the forecasting of potential pest impacts (Ogden and Innes 2007; La Porta et al 2008). Climate change is rarely factored into forest planning (Nitschke and Innes, 2008), possibly due to the uncertainties surrounding the vulnerability of forests to climate change (Chapin et al., 2007; Millar, Stephenson and Stephens, 2007). A mixture of adaptation measures will be required, depending upon whether the goal is to manage for a specific ecosystem service, or for resilience in general (Locadelli et al, 2008). Although a number of adaptation measures have been proposed (Locatelli et al; 2008; Guariguata et al., 2008; Millar ,2008;Noss, 2001;Ogden and Innes, 2007), most of the management practices suggested to date have been generic and based on temperate case studies (Kalame et al, 2009). Adaptation to climate change is a relatively new field, and the literature available in this area is limited. Very few adaptation strategies have actually been implemented, but those that have tend to rely on technological and engineering measures. The limited evidence to date suggests that although technological and structural adaptation measures will be required, biodiversity will also play a vital role in adaptation to climate change (Campell et al., 2008). In addition, climate change impacts can be exacerbated by management practices, such as the development of seawalls, flood management and fire management that do not consider other sectors such as biodiversity conservation and water resource management; this results in mal-adaptation in the longer term (World Bank, 2008; Hulme, 2005). Furthermore, the use of technology and infrastructure can 'lock in adaptation' to a specific impact, whereas the incorporation of 'soft' adaptation measures, including land use planning, natural resource management, and building social adaptive capacity, can allow for flexible responses (Kirshen et al, 2008). Integration is required not just between biodiversity-based adaptation and technological measures, but also across different adaptation sectors, and will require significant institutional support

2.2 Empirical Review

Achola, (2013) conducted a study to determine sustainable climate change adaptation strategies for the Taita Hills in Kenya and assess their potential for integration with ecosystem based adaptation. It uses a mixed methodology that involves literature review, participatory methods and household surveys. As a result it emerges that adaptation to climate variability and change in the Taita Hills, takes on both an anticipatory and reactive approach. The household survey indicates that 68% of the farmers have taken up climate change adaptation strategies. The study shows that the unpredictability of the long and short rainy seasons, the poor rainfall distribution within the seasons and inadequate rainfall during the growing season constitute their perception of climate change. However, with regards to farm water management as an adaptation strategy only 51% of the households have initiated farm water management measures. Furthermore, socioeconomic parameters such as farm sizes and dependency ratio render the households vulnerable to climate change. Finally, the Taita people possess sufficient indigenous knowledge for climate change adaptation that can be utilized together with EBA approaches for an integrated approach to climate change adaptation. The smallholder farmers' in the Taita Hills possess sufficient knowledge on climate change adaptation. The study recommends the diversification of livelihoods by the

smallholder farmers' in the Taita Hills, the inclusion of the smallholder farmers in decision making regarding climate change adaptation practices, implementation of policies that have been validated through research and improvement of agricultural extension services to the smallholder farmers.

Ndiema, (2013) conducted a study to examines the impact of climate change on fishery- based livelihoods around Lake Naivasha. Lake Naivasha has been the main source of livelihood for people living around it although in the recent years, effects of climate change have been experienced. It has been argued by fishing communities around Lake Naivasha that economic activities and food security, to a greater extent, has been adversely affected by changes in weather patterns. This is experienced in form of declining fish quantities and ever changing water patterns. The study endeavoured to examine, the fishing community perception on climate change, examined the impact of climate change on Lake Naivasha fish quantity and finally examined how communities are adopting to climate change. The research study employed a descriptive survey design which is concerned with generalized statistics that result when data is obtained from the respondents. The researcher used questionnaires, focus group discussions, interviews and observation to collect data. With a target population of 150 simple random sampling was used to collect data from respondents in these categories namely; Fishermen, Boat owners, Transporters and Fish mongers totaling to 90 respondents. Data analysis was done using Statistical Package of Social Sciences (SPSS). Both qualitative and quantitative data analysis was used to analyze the data. The findings were presented through descriptive statistics by use of frequencies, tables, graphs and pie-charts. The analysis was on the impact of climate change on fishery-based livelihoods around Lake Naivasha. After the study it came out clearly that more than half of respondents had knowledge on climate change and its effects. The findings showed that communities suffer from escalating lose from climate change. These included reduced income, bad debts and low job opportunities for fishing crew. They blamed the declining fish catch on climate change. Fish quantities have declined due to climate change. Although communities are trying to adapt to climate changes through various means including fish farming and afforestation, many of them lack enough capital for installation of various adaptation strategies. The study findings clearly indicated that climate change has had a great impact to the fishing communities surrounding the lake. The study recommends that there is need for a clear policy on climate change adaptation by both County and Central Governments. Protection of the catchment areas and protecting the riparian habitat (the papyrus) where fish breeds should be enhanced. Based on recommendations the study proposes that similar studies should be carried out to focus more on climate change adaptation strategies.

James ,(2017) examined the link between climate change, resource scarcity and violent conflict in Turkana County and suggested possible conflict resolutions in terms of climate change governance in order to enhance adaptation and coping mechanisms among the Turkana people. The objectives of the study were to establish the impacts of climate change on resource scarcity in the Horn of Africa, determine the effects of resource scarcity on violent conflict particularly in Turkana and to critically assess the role of climate governance in resolving violent conflict in this region. The study relied on Homer Dixon's Environmental Resource Scarcity Theory to explain the links between climate change, resource scarcity and violent conflict. The theory assumes that resource

scarcity is a product of environmental hazards that lead to insufficient supply, too much demand or an unequal distribution of a resource that forces some sector of a society into a condition of deprivation and violence. The scarcities are as a result of population growth, economic development, pollution and climate change. The study employed both secondary and primary data through making use of expert interviews with individuals who hold theoretical and practical knowledge on quantifiable environmental problems, notably environmental scarcity - farmland, water, grassland, and fish to establish their influence to conflict in Turkana County. The study targeted fifteen key informants distributed across climate research, security, and academia and non-governmental organizations. Interviews and discussions were transcribed and qualitatively analysed to draw explanatory patterns and generalize the assumptions that underpin this case study. The key issues as mentioned above were the causal links of climate change, environmental resource scarcity and violent conflict. Further the research looked at ways to resolve violent conflict through climate change governance strategies.

Obed, (2017) conducted a study to evaluate traditional coping strategies and propose appropriate adaptation strategies for the study area in the face of the changing climate. To this end, the study evaluated historical and projected climate trends, and how the variability and change affected coastal farming communities. It also evaluated how coastal farming communities were coping with the climate change and variability, and whether or not the existing coping strategies were effective in the face of a changing climate. Observed climate data from the Kenya Meteorological Department were subjected to standard statistical analysis to generate the historical climate for the Kenyan coast. Future climate scenarios were developed using the Coordinated Regional climate Downscaling Experiment (CORDEX RCA) climate model outputs (driven by eight global climate models (GCM)) and used to inform the projected climate outlook over the study area. Results showed a negative but significant trend in precipitation and a positive trend for both minimum and maximum temperature in historical data. Projected climate showed a positive trend in rainfall for the period 2015 to 2045 for both the Representative Concentration Pathway (RCP) 4.5 and the RCP 8.5. Through semi-structured questionnaires, focus group discussions and interviews, socio-economic characteristics of farming communities and ongoing coping/adaptation strategies to impacts of climate change were assessed. Results from the survey indicated that the effects of climate change on farming communities at the Kenyan coast were generally similar irrespective of the locality. Local communities employ both indigenous and modern strategies to cope with climatic change impacts with the support of the state, the county governments and non-state actors through knowledge provision. However, there was limited uptake and implementation of adaptation measures in the study area. The study generated useful information that could inform the adoption of appropriate and sustainable climate change and variability adaptation options in the study area. Further, an integrated climate change adaptation framework that could be adopted in the study area was generated from this study. It is recommended that the local administration adopts the framework for effective climate change adaptation and enhanced local and regional socio-economic development.

2.3 Research gaps

Geographical gap is a knowledge gap that considers, the untapped potential or missing/limited research literature, in the geographical area that has not yet been explored or is under-explored. For instance Ndiema, (2013) conducted a study to examines the impact of climate change on fishery- based livelihoods around Lake Naivasha. Lake Naivasha has been the main source of livelihood for people living around it although in the recent years, effects of climate change have been experienced. The study findings clearly indicated that climate change has had a great impact to the fishing communities surrounding the lake. The study recommends that there is need for a clear policy on climate change adaptation by both County and Central Governments. James ,(2017) examined the link between climate change, resource scarcity and violent conflict in Turkana County and suggested possible conflict resolutions in terms of climate change governance in order to enhance adaptation and coping mechanisms among the Turkana people. The key issues as mentioned above were the causal links of climate change, environmental resource scarcity and violent conflict. The studies presented a geographical gap as Ndiema study was conducted around Lake Naivasha while James study was conducted in Turkana County in Kenya while our current study focused on influence of climate change mitigation strategies on rural livelihoods.

Methodological gap is the gap that is presented as a result in limitations in the methods and techniques used in the research (explains the situation as it is, avoids bias, positivism, etc.) Achola, (2013) conducted a study to determine sustainable climate change adaptation strategies for the Taita Hills in Kenya and assess their potential for integration with ecosystem based adaptation. It uses a mixed methodology that involves literature review, participatory methods and household surveys. The study recommends the diversification of livelihoods by the smallholder farmers' in the Taita Hills, the inclusion of the smallholder farmers in decision making regarding climate change adaptation practices, implementation of policies that have been validated through research and improvement of agricultural extension services to the smallholder farmer. The studies presented a methodological gap as it used mixed methodology that involves literature review, participatory methods and household surveys while our current study adopted a desktop literature review method

Conceptual gap arises because of some difference between the user's mental model of the application and how the application actually works. Obed, (2017) conducted a study to evaluate traditional coping strategies and propose appropriate adaptation strategies for the study area in the face of the changing climate. Meteorological Department were subjected to standard statistical analysis to generate the historical climate for the Kenyan coast. Future climate scenarios were developed using the Coordinated Regional climate Downscaling Experiment (CORDEX RCA) climate model outputs (driven by eight global climate models (GCM)) and used to inform the projected climate outlook over the study area. Results from the survey indicated that the effects of climate change on farming communities at the Kenyan coast were generally similar irrespective of the locality. The study focused on traditional coping strategies and propose appropriate adaptation strategies, while the current study examined influence of climate change mitigation strategies on rural livelihoods.

3.0 METHODOLOGY

The study adopted a desktop literature review method (desk study). This involved an in-depth review of studies related to influence of climate change mitigation strategies on rural livelihoods. Three sorting stages were implemented on the subject under study in order to determine the viability of the subject for research. This is the first stage that comprised the initial identification of all articles that were based on influence of climate change mitigation strategies on rural livelihoods from various data bases. The search was done generally by searching the articles in the article title, abstract, keywords. A second search involved fully available publications on the subject on the influence of climate change mitigation strategies on rural livelihoods. The third step involved the selection of fully accessible publications. Reduction of the literature to only fully accessible publications yielded specificity and allowed the researcher to focus on the articles that related to the influence of climate change mitigation strategies on rural livelihoods which was split into top key words. After an in-depth search into the top key words (influence, climate change mitigation strategies, rural livelihoods), the researcher arrived at 4 articles that were suitable for analysis. The 4 articles were findings from Achola, (2013) who conducted a study to determine sustainable climate change adaptation strategies for the Taita Hills in Kenya and assess their potential for integration with ecosystem based adaptation. It uses a mixed methodology that involves literature review, participatory methods and household surveys. The study recommends the diversification of livelihoods by the smallholder farmers' in the Taita Hills, the inclusion of the smallholder farmers in decision making regarding climate change adaptation practices, implementation of policies that have been validated through research and improvement of agricultural extension services to the smallholder farmers.

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4.0 SUMMARY, CONCLUSION AND POLICY IMPLICATION FOR FURTHER STUDY

4.1 Summary

Climate change has remained an environmental concern in international relations especially in nation states consolidating long term solutions on adaptation and mitigation policies. As states deliberate on developing comprehensive international environmental policies with emerging issues such as emission reduction caps, carbon trading and credit ratings affects the state's decision to comply with international environmental laws and regulations. International climate change agreements have been the bedrock from which national governments draw its national policies on ways of curbing the effects of climate change by developing stringent laws and policies to ensure emission reduction of the harmful gases such as carbon dioxide.

4.2 Conclusion

The study concludes that local communities are aware of the climatic changes taking place in their locality and have taken steps to discuss climate change issues within their neighborhood, through local leadership Chief Barazas and reports by environment stakeholders. The researcher also established that different adaptation strategies are encouraged by different organizations. These included change of crop patterns. The other strategies included rotational planting, switching of planning dates, adoption of hardy variety of crops, mixed farming; avoid excessive use of chemical fertilizer, use of organic manure and intercropping. This concurs with the study carried out by a Abramovitz et al, (2006) which found that measures of climate change adaptation to agriculture changes during stress and this include; changes in location of cultivations, substitution by new crops, and crop diversification.

4.2 Recommendations

The study suggested that scaling up and diversifying funding allocations for Climate Change response by both government and NGOs. This will ensure vibrant climate that climate change response activities that are at the same time enhancing rural livelihoods. Channeling of funds through grass root organizations like youth groups and women organizations will provide support of most preferred local adaptation strategies like change in crop patterns, agro-forestry and cross breeding of livestock. Local approaches like community discussions through chief Barazas and neighbors as this will help create awareness among community members. Community level tailor-made trainings on climate change issues and climate change reports and information from organizations with the mandate to manage the environment like Kenya Forest Service need to be disseminated at the local level. Community members with incomplete secondary education and below should be targeted and motivated to participate in climate change trainings which should take into account relevant climate change aspects and use of community devolved funds

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