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# An Evaluation of Constraints in Climate Change Indigenous Coping and Adaptation Strategies for Sustainable Agro-Pastoral Based Livelihoods in Baringo County, Kenya

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***Abstract:*** *The frequency and intensity of climate change events have overwhelmed the coping and adaptation capacity of communities resident in the arid and semi-lands of Kenya. This is evidenced by the continued over reliance on external food aid. The objective of this study was to assess constraints in climate change indigenous coping and adaptation strategies for sustainable agro-pastoral based livelihoods in Baringo County, Kenya. The study postulated that incorporation of indigenous knowledge can add value to the development of sustainable climate change mitigation and adaptation strategies. A social survey research design was adopt for this study. The target population was all the households in the study area. A completely randomized cluster sampling approach was used for data collection. Data collection instruments included questionnaires; focus group discussions; key informant interviews; personal observation and secondary data review. The data collected was analysed through descriptive and inferential statistics; Pearson's Chi-square; and Correlation analysis. We therefore conclude that neither the indigenous knowledge nor the exogenous knowledge is yet fully utilized in the development process as each has inherent constraints that limit their adoption; and that conventional approaches have been perceived as more advanced and therefore have overlooked the potential in local experiences and practices. We recommend that indigenous knowledge needs to be captured, documented, preserved and transferred as well. To upscale any adaptation initiatives, there is need to improve indigenous knowledge information exchange between local communities; Community based Organizations; Non-Governmental Organizations; planners and academia. The use of the Integrated Knowledge Intervention Model (IKIM) conceptualized by the author is also recommended.*

***Key Words:*** *Adaptation, Constraints, indigenous coping, indigenous knowledge*

## I. Introduction

Africa is one of the most vulnerable continents to climate change which is manifested in the short term by climate variability a situation aggravated by the interaction of multiple stresses in the form of weather uncertainties (unpredictable seasons), persistent climatic abnormalities (drought and floods), rampant environmental degradation and eminent food insecurity occurring at various levels, and low adaptive capacity to the impacts of these climatic related events (Boko et al., 2007). The IPCC (2007) reports that communities who live in Arid and Semi-arid Lands, and whose livelihoods are highly dependent on natural resources are among the most vulnerable to climate change. Baringo County falls in this category. However indigenous communities have continued to survive through climatic events over time by use of their indigenous coping and adaptation strategies.

This notwithstanding there exist a significant manifestation of the marginalization of indigenous peoples from the climate change policy and decision-making. This is manifested in the paucity of references in the global climate change discourse to the existing indigenous knowledge on climate change. Such international discourse has often failed to consider the valuable insights on direct and indirect impacts, as well as mitigation and adaptation approaches, held by indigenous peoples worldwide. This is well described in the Intergovernmental Panel on Climate Change report (IPPC, 2007). The IPCC Assessment report of 2007, states that indigenous knowledge is an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change. This was affirmed at the 32nd Session of the IPCC in 2010, in which it was expressed that indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable (Raygorodetsky, 2011). However, Raygorodetsky (2011) observes that previous IPCC assessments were unable to access traditional knowledge information because, for the most part, this type of information either appears in grey literature outside of peer-reviewed academic forums, or remains in oral form, thereby falling outside the scope of the IPCC and other policy formulation processes. The factors that may constrain the use of the indigenous coping and adaptation strategies are therefore unknown and need to be investigated.

## II. Statement Of The Problem

Human societies all across the globe have developed rich sets of experiences and explanations relating to the environments they live in. These knowledge systems are today referred to as indigenous or local knowledge among other terms. They encompass the sophisticated arrays of information, understandings and interpretations that guide human societies around the globe in their innumerable interactions with the natural milieu: in agriculture and animal husbandry; hunting, fishing and gathering; struggles against disease and injury; naming and explanation of natural phenomena; and strategies to cope with fluctuating environments especially climate change. Indigenous communities through use of this knowledge have developed local mechanisms of survival. Despite the existence of these indigenous coping and adaptation strategies, predictions are that climate change will increasingly continue to negatively impact on people world over especially those living in the ASALs of Africa. To address these issues and concerns there is need for a comprehensive assessment of the factors that may constrain the agro-pastoralists from using their indigenous coping and adaptation strategies. The generated information could lead to complementary use of both indigenous and scientific knowledge in the policy and interventions formulation process.

**Objectives of the Study**

The objective of this study was to examine factors that may constrain the effectiveness of both the indigenous and scientific coping and adaptation strategies.

## III. Research Methodology

**Study area**

The study was carried out within the Baringo County. Baringo is one of the 47 Counties in Kenya (GoK, 2010). The County lies between Latitudes $0^{\circ}$ 12' and $1^{\circ}$ 36'N and Longitudes $35^{\circ}$ 36' and $36^{\circ}$ 30'E. It borders Turkana County to the North, Samburu and Laikipia Counties to the East; Nakuru to the South; and Keiyo, Marakwet and West Pokot Counties to the West. The study will however concentrate on the Eastern semi-arid areas of Marigat Sub-County, (Marigat and Mochongoi Divisions), described in this study as Lower Midland Zone (LM) and Inner Lowland Zone (IL) (shown shaded in figure 4). The sub-county County covers 1423$Km^2$ of which about 139.5$Km^2$ is covered by water surface. Lake Baringo covers an area of 130$Km^2$ and Lake Bogoria 9.5$Km^2$. The Sub-County lies between Latitudes $0^{\circ}$ 12' and $0^{\circ}$ 38'N and Longitudes $35^{\circ}$ 50' and $36^{\circ}$ 18'E (GoK, 2013).

**Topography and climate**

The major topographical features in the Sub-County are river valleys and plains, the Tugen Hills, the floor of the Rift Valley and the Northern plateau. In the Eastern part of the Sub-County near Lakes Bogoria and Baringo is the Loboi plain covered mainly by the lacustrine salt-impregnated silt deposits.

The Tugen Hills in the South Western part of the County form a conspicuous topographical feature. The altitude varies from 1000 m to 2600 m above sea level. The Hills occur in a North-South direction and mainly consist of volcanic rocks. The Hills have steep slopes dissected by gullies. On the Eastern and Western parts of the Hills there are the escarpments and the rivers flowing down these Hills pass through very deep gorges.

The County has different agro-ecological zones necessitating different agricultural activities (GoK, 2013). The troughs of the Rift which have a North-South alignment are occupied by the Lakes Bogoria and Baringo. Most of the Sub-County is either too steep (Tugen Hills) or too plain (Eastern parts around Lake Baringo). The lowlands or plains are very dry.

**Rainfall**

Baringo County is one of the arid and semi-arid Counties in the country with much of the County receiving low to average annual rainfall. However, within the County there are some high potential areas neighbouring the Hills and the highlands that receive high rainfall. The County experiences two seasons of rainfall; the long rains start from the end of March to the beginning of July, and the short rains from the end of September to November. The rainfall is about 50% reliable. It varies from 1000-1500mm in the highlands to 500-600mm in the lowlands in the North-Eastern part of the County. The rainfall distribution pattern means that major cropping activities are concentrated in the highland areas which have adequate rainfall. These areas are found in Kabartonjo, Tenges, Sacho and Kabarnet Divisions. The major farming activities include dairying, growing of maize, groundnuts, cotton and coffee. The remainder of the County is mainly rangelands with the rearing of goats, sheep, cattle, camels and bee-keeping forming the major livestock activities (GoK, 2013).

**Temperatures**

The mean annual maximum temperature in the County lies between 25°C and 30°C in the Southern part. In the Northern part, the mean annual maximum temperature is about 30°C and occasionally rises to over 35°C. The hottest months are from January to March. The mean annual minimum temperature varies from 16° to 18°C but can drop to as low as 10°C in the Tugen Hills. The main factor influencing the variation in temperature is the altitude. In the highland of the Tugen Hills with an altitude of 2600 m, the temperatures are much lower than in the lowlands of Marigat, Kerio Valley and Nginyang where the altitude ranges between 762m and 1000m above sea level (GoK, 2013).

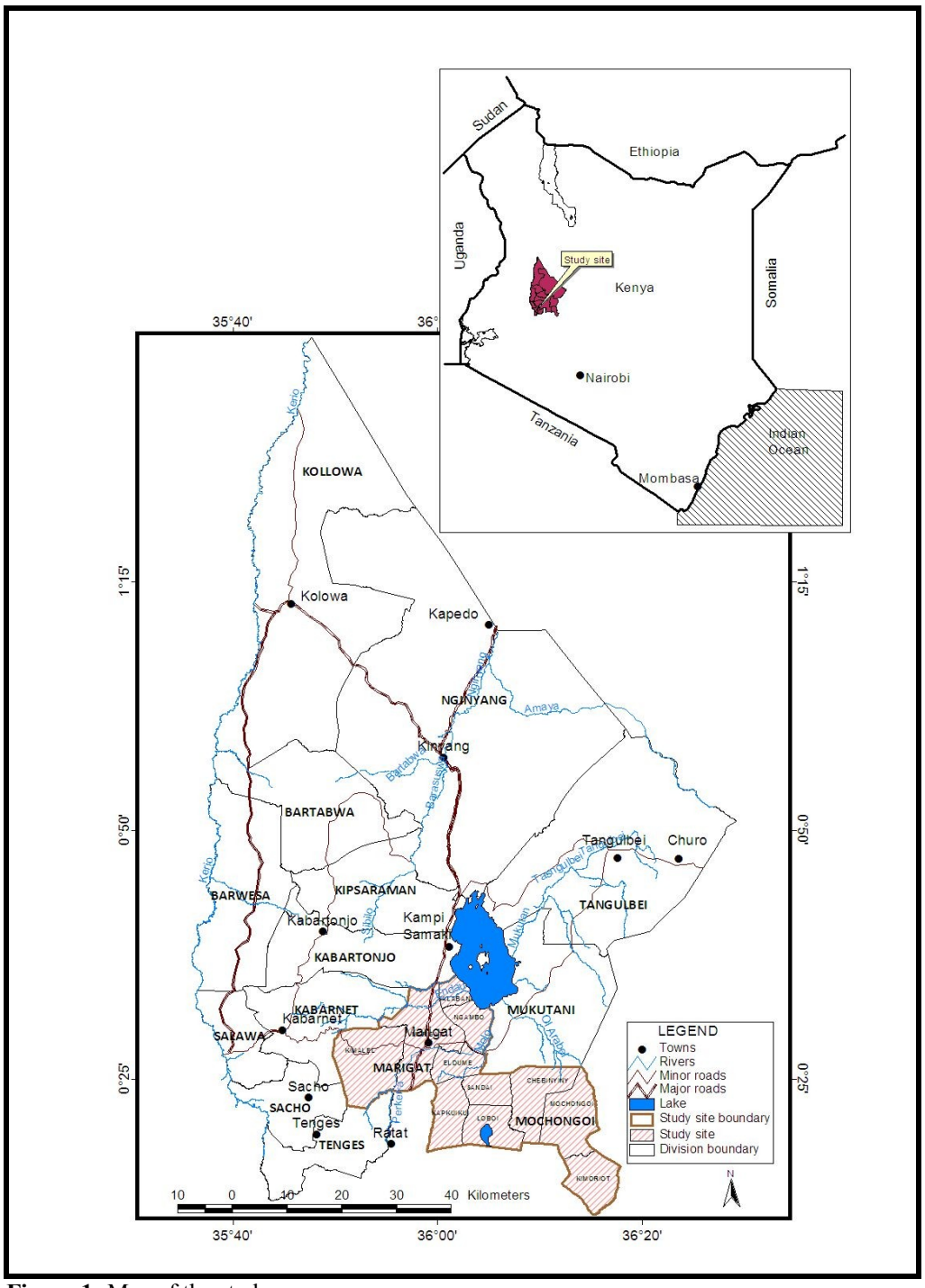


**Figure 1:** Map of the study area
The study area is shown checked on the map.

## IV. Research Design

This study adopted a cross sectional survey design. Using this design, a sample of the population was selected, and from these individuals, data was collected to help answer the research questions. This design was selected for the advantage that the information about independent and dependent variables that was gathered represents what goes on at only one point in time (Olsen and George, 2004). Data collection tools included secondary data review, Focused Group Discussions (FGDs), Participatory Rural Appraisals (PRAs), questionnaires, key informant interviews and personal observations (Figure 2).

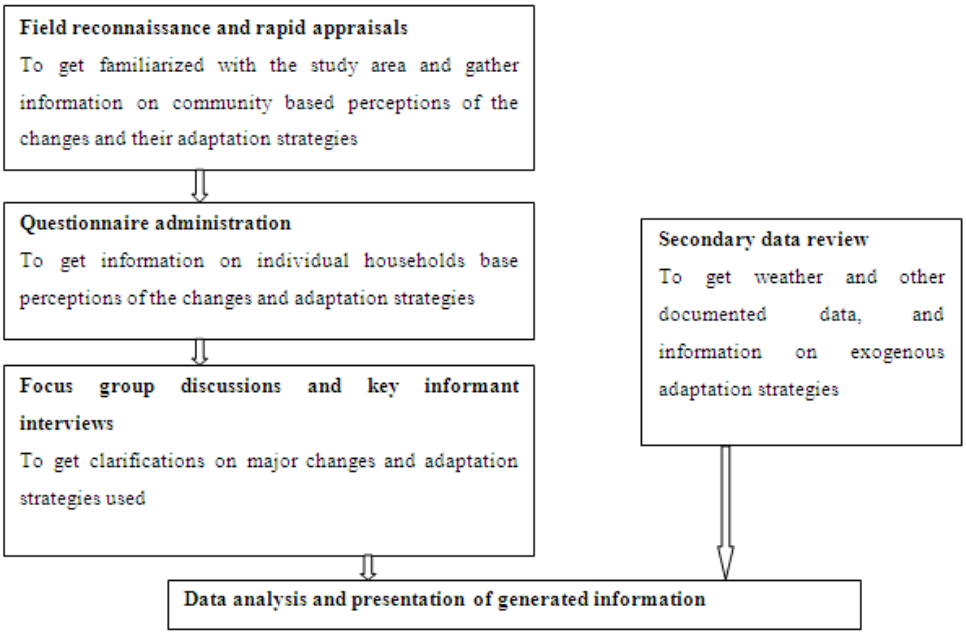


**Figure 2:** Research Design Framework

## V. Results and Discussions

**Constraints to indigenous coping and adaptation strategies**

It was anticipated that over time the community may have faced some constraints that may lead to either increase or reduction in use of the indigenous coping strategies to climate change. An open question was floated to the respondents on the possible constraints. The following were expressed as the drivers of change: change in land tenure; education; emergence of new and more resistant diseases; formal and informal employment on-farm and off-farm; reduction in pastures; drought; change in life style; availability of modern medicine; insecurity; involvement in formal business; rural urban migration; Christianity; floods and increase in population (Figure 3). Four factors which had a percentage of less than 1% are not discussed.

The significant factors that act as constraints to continued use of the indigenous coping strategies are shown in Figure 3 and discussed.

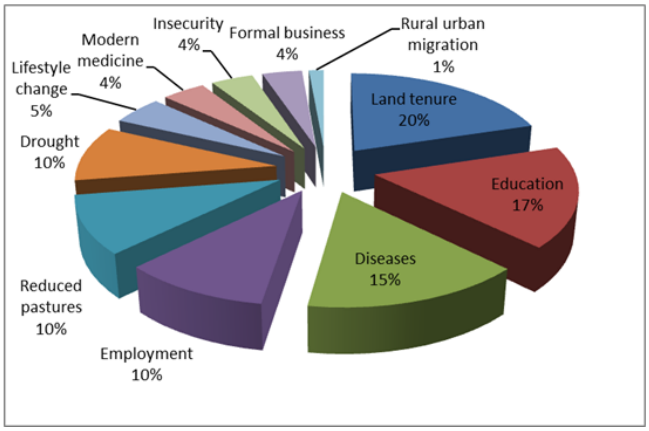


**Figure 3:** Constraints to Indigenous Coping Strategies
**Source:** Author's survey

**a. Land tenure**

Land tenure system was perceived by the respondents as the major factor affecting the continued use of indigenous coping strategies to climate change contributing 20% of the discontinuity (Figure 3). Land tenure is essential for long term land management planning, which is important for mitigating climate change (FAO, 2013). Farmers are more likely to invest in improving their land through soil protection measures, planting trees and improving pastures if they have secure tenure and can benefit from their investments. In the early years of focus of this study, land in the study area was predominantly communally owned. The communal type of land ownership allowed the elders to make decisions on how the land was to be used by the community especially as regards grazing patterns. This allowed for areas to be set aside for wet and dry season grazing. In recent years land tenure has tended towards freehold ownership. Demarcation of former forested high elevation areas of Mochongoi, Kimoriot and Arabal, which used to serve as dry season grazing areas; and the opening up of several irrigation projects in the low elevation areas which used to serve as wet season grazing areas were given as examples. This kind of ownership does not allow for communal decision making. This has therefore put a limitation to the relocation strategy.

Further, the change in land tenure system does not guarantee everybody in owning land. Rural landlessness is often the best predictor of poverty and hunger – the poorest are usually landless or land-poor. Women are one of the groups that often have fewer and weaker rights to land because of biases in formal law, in customs and in the division of labour in society (FAO, 2013). Improved access may allow a family to produce animal and crop products for both household food consumption and marketing, thus helping to ensure livelihoods.

Central to climate change adaptation is resilience, which is defined as the ability to recover from shocks and adjust to changing circumstances. Sustainable assets like access to land and natural resources help to increase the resilience of the poor. It is perceived that secure access to land often gives a valuable safety net as a source of shelter, food and income in times of hardship (FAO, 2013). However, in the study area, the secure land tenure system coupled with frequent recurrence of droughts has translated into reduction of availability of pasture and water resources for livestock as perceived by. Consequently, competition for the two resources has resulted in conflicts leading to loss of human lives. Insecurity was mentioned by the respondents as contributing 4%, (Figure 3), as a constraint to use of traditional coping strategies to climate changes.

Pasture – This factor was said to have affected the use of the indigenous coping strategies by about 10% (Figure 3). The study revealed that there was decline of pastures. This supports the view by Critchly (1984) that in Baringo, periodic droughts, flooding and overgrazing will continue to negatively affect the quality of the pastures available in Baringo. This is exacerbated by inflow of livestock from neighbouring districts during the dry season. All this puts pressure on the fragile eco-system.

The results are in agreement with the Intergovernmental Panel on Climate Change report (2007). The report says that at the plot level, and without considering changes in the frequency of extreme events, moderate warming (i.e., in the first half of this century) may benefit crop and pasture yields in temperate regions, while it would decrease yields in semiarid and tropical regions. Increased frequency of heat stress, droughts, and floods negatively affect crop yields and livestock beyond the impacts of mean climate change, creating the possibility for surprises, with impacts that are larger, and occurring earlier, than predicted using changes in mean variables alone (IPCC, 2007).

Water - In the study area, several rivers occur, but most are ephemeral except for Molo and Perkerra, which are permanent. With the characteristic insufficient rainfall, water shortage is prevalent throughout the Sub-County. Lack of vegetation cover in most areas is said to cause even light rains to assume flood and storm characteristics as the water rushes down unprotected slopes. This is especially so in the high areas of Mochongoi and Kimoriot.

During prolonged droughts lack of adequate water and pasture in the marginal and dry areas of the sub-county, has accelerated loss of livestock. The incidence of water borne diseases is also high (PricewaterhouseCoopers, 2005). The scarcity, and therefore the need to access the two important resources, (pasture and water); dictates some form of movement by livestock owners. However any form of movement translates to trespass which is resisted by the land owners. This in most cases lead to conflicts over the limited resources destruction of property. In the wake of the conflicts other vices such as livestock theft and loss of life emerge. Ashley and Carney (2004) and Olago et al, (2009) observed that in the Lake Baringo basin, El Nino events appear to have resulted in 5–7 year cycles of rainfall variability that bring about lake level fluctuations of one (1) to three (3) meters.

**b. Education**

Education was found to contribute 17% loss in use of indigenous coping strategies to climate change (Figure 3) (second only to land tenure). This implies that education is playing negatively to indigenous knowledge. This may mean that there is still a widely held view that anything associated with culture and

hereditary values is backward. This was also echoed during the focus group discussions that vast number of educated youth feel embarrassed to associate themselves with their own cultural background.

Burford et al. (2003) say that education incorporates all the processes of raising up young people to adulthood, and drawing out or developing their potential to contribute to society, that are traditionally found in rural communities. Taken this way, then it is time to recognise and acknowledge the limitations formal education imposes on a community's development, as well as its devastating effects on the natural environment. This should not be interpreted as meaning that literacy, numeracy and the acquisition of new languages are unnecessary as no society can exist in isolation. What appears to be currently missing is a system of teaching and learning that combines the indigenous knowledge and formal education.

In their responses, the respondents closely linked education effect to the person who did herding of livestock. Traditionally, they said this was a role played by young boys and youth males, as table 1 portrays. Over time this is changed as the herding class has gone to school. Note that 28.5% of the herding is done by fathers, and it was felt by 23.6% of the respondents that any member of the family can now do the herding (Table 1). The education factor was also said to be contributing to other factors such as employment, rural urban migration, venturing in business, and change of life styles (discussed in d below). It was clear that with education, youthful members of the community no longer consider agro-pastoralism a prestigious activity worthy of their personal presence.

**Table 1:** Livestock Herding

| | **Herder** | **Frequency** | **Valid Percent** | **Cumulative Percent** |
|---|---|---|---|---|
| | Father | 105 | 28.5 | 28.5 |
| | Mother | 20 | 5.4 | 34.0 |
| | Son | 139 | 37.8 | 71.7 |
| | Daughter | 8 | 2.2 | 73.9 |
| | Hired labour | 7 | 1.9 | 75.8 |
| | Any of the above | 87 | 23.6 | 99.5 |
| | Other | 2 | .5 | 100.0 |
| **Total** | | **368** | **100** | |

**N**=368

**Source:** Author's Survey

**c. Emerging diseases**

According to the respondents, new livestock, human and crop diseases have come into play. Example of such diseases included yellow fever (livestock); cholera and HIV/AIDs (Human); and Lethal necrosis (maize). These and some earlier known diseases also have proved to be resistant to the traditional herbal medicines. The emerging diseases factor was associated with 15% losses in holding to indigenous coping strategies (Figure 4). This finding is in agreement with Epstein (2001) and IPCC (2001) who state that climate change poses a threat to the control of pest and disease invasions. These "pests and diseases" include insects, plant diseases, and invasive weeds. As climate variables continue to change in an area, new pests and diseases may become able to invade previously uninhabitable areas like Marigat Sub-County. Climate factors that aid in pest and disease invasions are mostly temperature related and include increasing average temperatures, warmer minimum temperatures, changes in precipitation patterns, and water shortages. Additionally, extreme weather events such as drought and floods create conditions conducive to 'clusters' of insect-, rodent- and water-borne diseases.

| Disease | Population at Risk (millions) | Prevalence or Incidence of Infection | Present Distribution | Possible Change of Distribution due to Climate Change (1) |
|---|---|---|---|---|
| Malaria | 2,400 | 300-500 million | Tropics/Subtropics | +++ |
| Schistosomiasis | 600 | 200 million | Tropics/Subtropics | ++ |
| Lymphatic filariasis | 1,094 | 117 million | Tropics/Subtropics | + |
| African trypanosomiasis | 55 | 250,000-300,000 new cases/year | Tropical Africa | + |

| | | | | |
|---|---|---|---|---|
| Onchocerciasis | 123 | 17.5 million | Africa/Latin America | ++ |
| Dengue | 2,500 | 50 million/year | Tropics/Subtropics | ++ |
| Yellow fever | 450 | <5,000 cases/year | Africa/Latin America/ East and Southeast Asia | ++ |

+= Likely; ++ = very likely; +++ = highly likely; ? = unknown.

**Figure 4:** Estimated impacts of climate change on tropical vector-borne diseases
**Source:** Adapted and modified from IPCC, 2001.

As discussed earlier, traditional medicine utilises plants and animals to make natural remedies. Due to the ongoing climate changes being observed across the globe, certain plant and animal species are lost which lead to changed ecosystems, and an overall poorer natural environment. This will then affect what plants people can use around them. Essentially, this means that the environment plays a huge role in shaping traditional knowledge and subsequently the indigenous coping strategies. Thus as expressed by the respondents, loss sources of traditional medicine and presence of modern medicine has led to loss of capacity to cope traditionally. The presence of modern medicine was associated with a 4% loss in keeping to indigenous coping strategies (Figure 12). This is in agreement with AUN (2014) who on studying 12 ethnic groups from Nepal biologists found that plant availability in the local environment has a stronger influence on the make-up of a culture's medicinal floras. This means that the environment plays a huge role in shaping traditional medicine knowledge.

**d. Employment**

This factor was perceived as contributing 10% decline in use of the indigenous coping strategies to climate change. Other related factors are rural-urban migration, (1%); doing formal business, (4%); and change in lifestyle, (5%) (Figure 3). Burford et al. (2003) observed that the growing trend towards urbanisation is encouraging thousands to abandon their indigenous knowledge, in the belief that new knowledge and new opportunities are to be found in town. Yet the realities of mass unemployment, the high costs of urban life and of further education, and the growing pandemic of AIDS testify that this is not the case. Many end up homeless, jobless and penniless, with neither the traditional skills that sustained their ancestors nor the specialised and expensive skills required for employment in a modern town. The inevitable result is poverty (Burford et al., 2003).

**e. Invasive species**

From personal observation, the encroachment of the grazing land by such invasive species such as Prosopis juliflora (Mathenge) was expected to reduce accessibility of forage leading to reduction of effective grazing areas. The effect of this species was investigated and the following is a brief. Prosopis was introduced into Baringo district through the efforts of the "Fuel wood/afforestation extension in Baringo" project, a joint FAO/Government of Kenya initiative. This project originated from prior consultations that identified Baringo district as an area needing rehabilitation from over-grazing and over-exploitation of its semi-arid woodlands. The Baringo Fuel wood/Afforestation Extension project became operational in February 1982. It was implemented in two phases, phase I from 1983-85 and phase II from 1987-90, with a brief interruption in 1987 when FAO temporarily withdrew project management support. More than thirty years after the introduction of Prosopis into the drylands of Kenya, there is now increasing concern and debate about the negative impacts of the species on the lives, livelihoods and ecological integrity, as well as the possibilities for its control and perhaps total eradication (Zeila, 2008).

Prosopis was associated with various advantages. It plays a leading role in the afforestation of arid lands. Its capability of growing on degraded land under arid conditions has made it especially suitable for this purpose. Prosopis produces good quality fuel of high quality calorific value, which burns well even when freshly cut. It also produces high quality charcoal, and its heartwood is strong and durable. As is happening in Moyale, (Tolera and Abebe 2007) the agro-pastoralists are resorting to the sale of charcoal, firewood and poles as an alternative means of livelihood. However, in disguise they area also harvesting other trees illegally and widespread extraction of these natural resources may have an adverse long-term effect on the environment and compromise their livelihoods. Its branches are widely used as fencing posts, while its pods which are high in protein and sugars may be important fodder for livestock, and / or food for humans. Prosopis juliflora has also been used to shelter agricultural crops from wind and to reduce the movement of soil and sand. Its leaves

contain various chemicals known to affect palatability to livestock, but also suppress the germination and growth of crops, weeds and other trees (Zeila, 2008).

Despite the above mentioned advantages, communities living in the drylands have registered their complaints that centre on the adverse effects of the species' powerful and poisonous thorns, its aggressive colonisation of useful habitats such as pasturelands and farmlands, its negative effect on animal health (which consume excessive amounts of seed pods), The pods have been reported to result in facial contortions, impacted rumen and constipation among livestock. These ill effects may sometimes result in death. Other unforeseen uses include the use of the impenetrable thickets as hideouts by cattle rustlers (Zeila, 2008). Thickets of Prosopis have become established in dry season grazing reserves (wetlands), croplands and along river courses.

## VI. Conclusions And Recommendation

**Constraints to indigenous and scientific coping/adaptation strategies**

Various constraints were found to be impeding the use of either the indigenous or the exogenous strategies. We therefore conclude that neither the indigenous knowledge nor the exogenous knowledge is yet fully utilized in the development process as each has inherent constraints that limit their adoption and that conventional approaches have been perceived as more advanced and therefore have overlooked the potential in local experiences and practices.

The study thus recommended that indigenous knowledge needs to be captured, documented, preserved and transferred as well. To upscale any adaptation initiatives, there is a need to improve indigenous knowledge information exchange between local communities; Community based Organizations (CBOs); Non-Governmental Organizations (NGOs); planners and academia. The use of the Integrated Knowledge Intervention Model (IKIM) conceptualized by the author is recommended (Figure 5).

The model can be explained as follows:

**Indigenous and Exogenous Knowledge –** These are the two channels of knowledge on which intervention decision are based. Indigenous knowledge (IK) in this model means the local knowledge that is unique to a given culture or community. It is seen as the basis for local-level decision making. Exogenous knowledge (EK) means scientific knowledge, that is, knowledge generated by universities, research institutions and private firms. Or "indigenous knowledge" used by other communities external to the local community on which interventions are intended.

**Information Gathering –** This is meant to be specific to the issue at hand. It can take the form of primary or secondary information gathering. This would help to determine whether any information exists in documented form or not. Primary information gathering would either generate and form the basis for documentation of hitherto undocumented IK or enrich inadequately studied IK area. It would also help to identify how the local community addressed such an issue. Secondary information gathering would on the other hand assist in determining how such an issue was addressed by others either scientifically or using "indigenous knowledge".

Challenges and Strengths - At this stage the gathered information is analysed for what worked well and challenges identified.

**Research –** The challenges are subjected to research on how they can be turned into strengths.

**Strengths –** The strengths under the IK, EK and those determined after working on the challenges are blended to come up what could work well under the complementarity of all the strengths.

**Formulation to Upscaling -** After this strategies and programmes to address the issue at hand are formulated. If the designed interventions work well, then they can be promoted and up scaled, and if not the challenges within the strategy can subjected to further research.

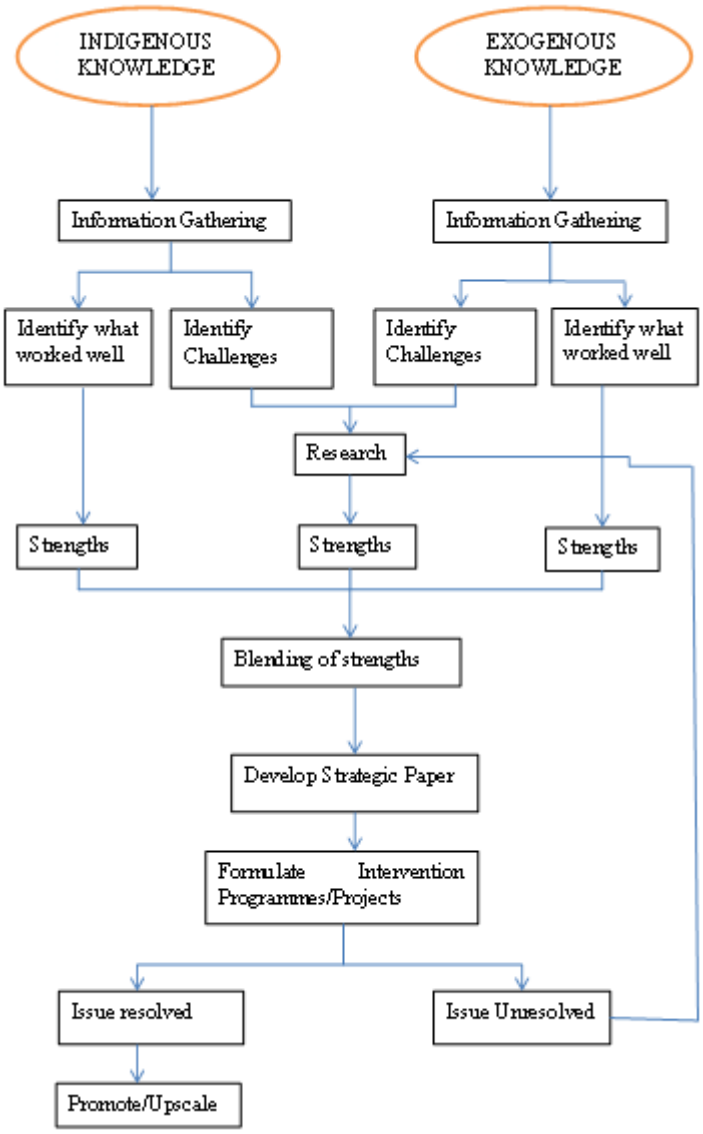


**Figure 5:** Integrated Knowledge Intervention Model (IKIM)
**Source:** Conceptualized by Author (2014)

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