IMPACTS OF CLIMATE CHANGE ON THE LIVELIHOODS OF LOITA MAASAI PASTORAL COMMUNITY AND RELATED INDIGENOUS KNOWLEDGE ON ADAPTATION AND MITIGATION

By

Henri ole Saitabau
Directorate of Research and Collections (DRC)
NATIONAL MUSEUMS OF KENYA
P.O Box 40658-00100 Nairobi-Kenya
Email: hsaita2000@gmail.com, hsaitabau@museums.or.ke

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Introduction
Since time immemorial, the Loita Maasai have had rich indigenous knowledge about their environment and how to monitor and predict climate and seasonal cycles through observation of behavioral characteristics of biological components, cosmology and other traditional, socio-cultural methods. They still use the same knowledge to model weather events and livelihood management. However, unpredictable weather variations have become so phenomenal that drought that used to occur every ten years is now occurring every two years or less and the trend continues to worsen. Annual rainfall is more erratic and figures continue to decline while people experience warmer dry months.

Climate change is severely affecting the weather patterns thus raising concerns for livelihoods, socio-economic and environmental sustainability. Owing to changes in seasonal cycles, the Loita Maasai pastoralists in recent years have experienced the full impact of prolonged droughts leading to drying of water sources, poor crop yields and livestock losses, all resulting in food insecurity.

This increased vulnerability has thus put the community to high risks of natural disasters. The use of traditional warning systems to monitor weather variations is becoming difficult, owing to unprecedented environmental changes, although this can also partly be blamed on erosion of indigenous knowledge.

Work carried out in Loita in 2010 has shown that during drought (as was the case 2007-2009), community adaptation strategies and mitigation measures are suspended, resulting in increased environmental degradation and loss of biodiversity. This paper seeks to identify the various forms of pastoral livelihoods that are now vulnerable as a result of climate change. It also seeks to identify some of the community-derived priority strategies that the Loita Maasai of Kenya and Tanzania can use to improve resilience and adaptations, citing various mitigation measures that use local indigenous knowledge. The paper also shows how climate change has impacted on the cultural heritage especially ceremonial cycles as well as cultural sites where such cultural ceremonies are undertaken and also includes adaptive measures proposed by the community.
The culture of the Maasai

The maasai call culture ‘Olkuaak’, all that one does being a maasai. Economic, social and political existence in Maasai can be determined by culture, for example building of a house and house built is determined by culture. Others include division of labor, the use of tools etc. All these belong to system of activities that are in turn put of many more systems of social organization, internal order and protection. System of thought, language, communication, speech and symbols. All these and many others form a people culture. Within culture, people establish and act out their relationship with themselves and surrounding environment. In this reference, culture hence is home that provide belonging and identity.

The maasai culture had the tools to accommodate local and historical contingencies and thus reshape itself without thereby becoming a culture of change. It is a culture of homogeneity which spells constant harmony.

Loita Maasai of Kenya

The maasai have in times past and within their own geographical settings developed a distinctive manner of life, economically, socio-politically and culturally, but did not do so within their confines. Their history is like most histories bound up with many other histories, not only African ones but also those of the East Africa, the north and the west (J. Voshaar, 1998). The Maasai are a nilo Hamitic people divided into social territorial sections known as !loshon (Plural). Each !o!osh!o is occupied by a single Maasai sub-tribe. The Maasai straddles Kenya and Tanzania, where 14-22 sub-tribes live. The Loita Maasai sub-tribe lives on 2000m high plateaus in the southern parts of the Narok district and which extend into the northern regions of the Ngorongoro district in Tanzania (P.maundu et al, 2001).
The Loita Maasai have tenaciously clung to their culture and have always been aggressive towards outside influences which may have negative effects to their culture. They are a people with an independent way of thinking, faithful to their kinship, and they maintain a very high regard for their own culture (p.maundu et al, 2001). The community is traversed by the Kenya – Tanzania international boundary.

**Geography of Loita:**
Loita is an extensive area ranging from L. magadi and nguruman escapement in the east to siana springs and Maasai Mara plains in the west. It extends across the Kenya-Tanzania boundary down to L Natron to Ngorongoro escapement. The Loita hills form the natural barrier in the north. Two distinct ecological features characterize Loita region, the upland dry forest (Naimina Enkiyio) and the lowland savanna grassland (Legilisho .kiyiapi, 1998).
Rainfall Temperature and Humidity
There is a gradual climate variation in Loita characterized by semi-arid savanna condition with a mean annual between 600-700 mm rising progressively to 1270 mm in parts of the forest area.

Temperature fluctuates according to altitude ranging from 20ºc to 22ºc in the rangeland and 17.7ºc to 20ºc in the forest area. Temperature can fall below 10ºc in the forest during the coldest month of the year. The mean monthly relative humidity varies between 86% in May and 69% in October. This variation is between 58% in February (LegilishoKiyiapi, 1998).

The annual evaporation is approximately 1000mm and 1425 mm compared with rainfall patterns that of evaporation fluctuates less through the year.

Altitude and Topography
Loita area is dominated by three main topographic formations; Low lying Loita plains to the west with less resistant schist and Grass and rock system. On the plains, altitude ranges between 1700-1900m, moving on the easterly direction. Towards the forest is a gently undulated terrain with highly dissected series of rocky crest and ridges separated by deep valleys.

By far the most pronounced landscapes are Loita hills that are an extensive network of variations of hills and ridges system rising gently to the west and falling sharply considerably peak to peak variation in altitude.

There is generally a north-south gradient which the north parts of the forest being on the higher altitude than the south peak of 2600m a. s. l whilst low point mainly 2000m a s l. in the north gradient.
Soils
Soils in Loita are dominated by the nature of the parent materials and terrain’s dominating on the savanna rangelands moderately to poorly drained black cotton clay soil which are highly susceptible to water logging. On the rocky highly dissected hill slopes are rather shallow and somewhat excessive drained soils.

Vegetation
Vegetation can be broadly classified into the following categories

Grassland- Consist mainly of the grass species with a few annual and short perennial and occasionally short Acacia species with the grass as the main undergrowth. It’s common in the undulating plains of the western parts of Loita. This forms the main grazing grounds for Loita pastoralists.

Evergreen bush land- Is the natural vegetation of Loita plains but little undisturbed vegetation remains. In Loita the vegetation is characterized by clumps of shrubs and trees from just a few meters to some 50 diameter. Shrubs commonly reach to the height 2.5 to 4m but occasionally trees up to 7m are found. Most of the bush land species are
commonly encountered at Ilkerin area although this is degraded forest areas.

**Forest**- Is generally a dry upland forest of *Olea, Juniperus and podocarpus* dominated sp change with altitude, soil type, drainage and humidity.

**Demographics**
The total land area of 1748 km², with the population estimated at 22,000 and 2270 households. This translates the population density of 1.3 households/km², which is considerably potential. At present, Loita division is sparsely populated and it is reasonable to assume exploitation of natural resources by the community at sustainable level.

**CLIMATE CHANGE**
Climate scenarios produced by the intergovernmental panel on climate change (IPCC 1990a) indicate that carbon dioxide concentration in the atmosphere will double by the year 2050. This will course a temperature between 1.5ºc-4.5ºc and sea level rise of about 0.3-0.5 m (J.S Ogola et al, 1997). Anticipated changes pose a serious threat to ecosystems and associated socio-economic and cultural system.

Changes in ecosystems will change the albedo and hydrological characteristics of an area thereby affecting the local energy and water balance.

An important point in understanding species response to climate change is that weather is variable and extreme events like drought, frost, floods, cold, hot spell and associated fires and pests outbreaks may have more effects on species distribution than average climate. Animals can adapt their behaviors during drought and heat waves by timing their activities to cooler parts of the day restricting their movements to conserve energy and water or migrating to more favorable areas. Increased frequency or persistence of these conditions can significantly influence animal health or survival either directly or indirectly through loss of habitats food and water. Vulnerability to climate change will be high for floral and faunal communities for which adaptability options are limited for example montane and coastal communities (IPCC, 1990b). All these as well directly and indirectly affect the livelihood of indigenous communities in fragile ecosystems.
Climate change and mitigation measures

Governments are committed to minimizing adverse social, economic and environmental impacts resulting from the implementation of measures taken to mitigate or adapt to climate change impacts. While mitigation measures are important to prevent further impacts from climate change, such measures offers both opportunities and concerns to indigenous communities.

Indigenous people are used to large proportions of land surface per head of the population; there is a strong correlation between the location of indigenous territories and areas with highest biodiversity and natural resource conservation. As a result they have the potential to be key players in designing and implementing mitigation measures such as carbon sequestration, forests protection, renewable energy production, conservation and rehabilitation degraded agricultural and pastoral lands.

Mitigation activities require appropriate institutional structures and involvement of indigenous communities in such tremendous challenges. There is need to strengthen national and local systems to measure reports and verify climate change impacts and manage financial systems in a way that is accessible by indigenous people.

BIODIVERSITY AND ECONOMIC CHANGES IN KENYA

Kenya is endowed with great diversity of plants and animals genetic resources. It is estimated that there are between 8000-9000 plants species in Kenya of which over 2000 are shrubs and trees. The forest cover is 3.4% of total land of which 85% are indigenous forests.

Kenya has unique species of wild animals including a variety of bird’s species and other small animals. It also boasts with great climate and ecological variations that contributes to the diversity of both plants and animals genetic resources.

The economic fortunes of Kenya depends to a large extend on the availability and management of plants genetic resources and wildlife resources. Forest are major source of energy in rural areas in Kenya, they also support most of the country’s fauna which are the foundation of tourism and contributes to climate variation and rainfall. However changes in socio-economic activities are coursing irreversible degradation of biodiversity.
Such changes are attributed to rapidly growing population and changing models of social production.

**Indigenous people and their environment**

Indigenous people strongly resist being defined; they assert their inherent rights to define who they are. This right is recognized by the ILO convention 169 concerning indigenous people and tribal people in independent territories (ILO. 1989).

As a general orientation, indigenous people are distinct with their own language, culture and territories that have lived in the country since time prior to its formation to current national state. More than 300 million people in the world are indigenous people. Indigenous people are culturally distinct. And live lives that vary from considerably from locality to another.

Of estimated 6000 cultures, over 4000 are indigenous meaning indigenous people make up between 70-80% of the world’s cultural diversity (IUCN. 1997). Cultural diversity is a fundamental attribute of human livelihood because it changes creation and re-creation, interpretation and re-
interpretation all being the fabric of everyday experiences (Carrithers. 1992). This is particularly apparent with indigenous people whose lives are intimately bound up with their environment which not only provides for them but also provide spiritual inspirations of life. Their cultural diversity is grounded in their territories and localities drawing together their social and natural worlds.

When looking at the global distribution of indigenous people, there is a marked correlation between areas of biological diversity and cultural diversity particularly in significant areas like South America, Africa and south East Asia (IUCN, op.cit.31). The diversity present in the natural indigenous people’s world, adds to the complexity and distinct variety of different interpretations and activities, not only for each people but also to communities.

**The Loita maasai and their environment**

For many years, the maasai depended on their environment for survival. Today their livelihood still revolves around their environment as attested to by their intimate knowledge on environmental matters acquired as a child growing up. There are activities through which the maasai learn as they interact with the surrounding for example, plants and plants uses, medicinal plants, water resource, saline environments, fodder plants, food plants etc. they are acquired as children look after the animals, warriors spending time in the forest, women and young girls learn during excursions to collect firewood, medicinal plants and collecting materials for construction and as elders constructs kraals.

Taboos prohibited the use of wildlife; he who eats or hunts wildlife is perceived as *Oltorroboti*, the hunter. The land hence boasts an exceptionally high density of wildlife, as well is a wildlife dispersal area for Maasai Mara game reserve and Serengeti national park. As a result to this, there are various challenges faced by the maasai pastoralists which include, zoonotic diseases, overgrazing, human wildlife conflicts among others.

Subject to grazing, the forest provides dry spell grazing grounds therefore it is an important source of security. It cushions the community so well that when other areas of maasai land reports massive livestock deaths, this is rare in Loita. Similarly the law laying savanna ecosystems provides a perfect grazing ground during the wet season; hence the Loita maasai equally value all ecosystems within their land. Traditionally herding involves a well-organized seasonal movement based on transhumant nomadism from
Ilpurkeli lowlands to Isupuki highlands. Animals are kept for economic and cultural values. Extraction of resources from the forest is regulated by the elders and the chief oloiboni, plays a significant role in decision making regarding extraction of forest resources in large quantities. Other resources such as medicinal plants, firewood, fencing, food plants etc appear to be plentiful and can be obtained freely.

AN OVERVIEW OF IMPACTS OF CLIMATE CHANGE ON INDIGENOUS PEOPLE

The continued existence of indigenous people is intertwined with the success of their fragile environment and resources. Many indigenous communities depend on their environment for survival majorly on food, medicine and fuel but these habitats are fast disappearing and small communities are suffering the hardship while indigenous cultures and traditions including language are facing major challenges in their continued existence.

The effects of climate change varies according to specific locations and ecosystems and indigenous communities are interpreting and responding to the changes in very creative and sustainable ways drawing on their traditional knowledge of their environment and natural resources and other indigenous technologies to find solutions. Indigenous people from dry land areas are also reporting accelerated climate change, making their livelihood situations vulnerable

Impacts of climate change on indigenous people need to be viewed in the context of their status as local communities can sometimes magnify existing problems and reduce resilience. Climate change can as well bring new prospects to indigenous people such as innovation, economic opportunities in clean energy generation through wind and solar energy or provide access to new food sources.

In accordance with the continental scale regions used by the IPCC as well as the socio-cultural regions used by the UN permanent forum on indigenous issues: Africa, Arctic Asia, Caribbean’s, Northern America, Latin America
and the pacific, these are areas that indigenous people inhabit across the globe and are reporting severe effects of climate efforts and approaches to adopt and mitigating climate change as they react to these changes and overarching observation about climate scenarios within their environments.

**The case of Africa**

According to the regional climate projection of the fourth assessment report of the IPCC 4AR southern Africa is likely to decrease in much of the winter rainfall region and western margins. There is also likely to be an increase in annual mean in East Africa, and generally warming throughout the continent. Although the vast of majority of Africa people can considered to be indigenous in the literal sense, in practical identity this is claimed by mainly those ethnic groups whose economy and culture fall outside the dominant national systems by a variety of historical and environmental circumstances. They are reliant on sustainable use of natural resources and their cultures are closely linked to the distinctive environmental conditions under which they have survived.

Indigenous African communities have long experience in developing local adaptation strategies to cope with extreme weather events such as drought. But current changes in climate and the subsequent impacts on water availability, food production pastoral activities and human health are severely straining the coping capacity of many indigenous communities in Africa.

Deteriorating food security with communities living dry land areas is a major concern; hence water management is critical in the context of rain fed water dependency for food production.

As the traditional resource base for pastoral communities diminishes, traditional practices of pastoral farming are threatened with associated indigenous knowledge.

Land alienation and loss of biodiversity are putting the livelihoods of pastoral communities and hunters and gatherers at risk. There is an array of significant challenges experienced by indigenous Africans which includes; food insecurity, displacement, famine, droughts, floods, receding water resources, loss of culture, eroding of indigenous knowledge, health impacts and land loss. The potential adaptation is highly constrained by limitations of migration and mobility, destruction of biodiversity and long term land destruction due to human activities and drought.
The effects of climate change in Africa are intertwined with human rights issues and most of the policy responses identified to support indigenous people adaptations and mitigations efforts focus on implementing human rights framework. Other strategies used includes engaging indigenous knowledge; creating institutions and policies that empower indigenous people especially women and promoting peaceful co-existence by designing programs that allow different kinds of land use.

**Indigenous knowledge observation of change in climate**

Much of the existing climate change literature reflects the western science approach which is based on systematic observation to monitor changes in climate and to provide forecasting services and to plan adaptation options. However systematic observation and data availability are limited in many fragile ecosystems which most of the world indigenous people are living (G. Kirsty, 2010). Climate change is impacting on the local communities and indigenous people because they live on ecosystems that are already suffering of other stressors as the consequence of historical, social, political and economic rejection and exclusion.

In recent years, there has been an increase realization that the observation and assessment of indigenous groups provide valuable local level information, offer local verification of global models and are currently providing the basis for local communities driven adaptations strategies that are way past the planning stage and are already being implemented and tested.

Local observation of direct effects of climate change by indigenous people corroborate scientific prediction and effects include temperature, precipitation changes, environmental change, changes in wildlife, pest and vector diseases, increasing soil erosion, landslides, rise in sea levels, extreme weather events, increasing aridity and drought, floods patterns and increase melting of ice in capped mountains and sea ice. Most indigenous people are not strange to climate change and weather induced vulnerability. They have generations of experience and coping with climate change, however anthropogenic climate change concerns are more recent.

Indigenous communities have experts who are capable and have knowledge to undertake and maintain systematic long-term climate observation and
analysis of this climate information. These experts are elders, seers and craftsmen who rely on centuries of traditional knowledge and oral history to monitor and model weather changes. The indigenous people depend on diverse resources from ecosystems and biodiversity to observe climate change. Many indigenous communities around the world have already reported some adverse impacts from changing climatic condition within their ecosystems on which they depend on. Such reports include warming weather, disappearing of snow in mountains which are visible indicators, changes in distribution of plants and animals leading to disappearance of essential food sources and of particular concern are the impacts on species that have special cultural significance to communities (G. Kirsty, 2010).

Extreme weather events therefore highlights the importance of indigenous weather prediction knowledge as timely warning of impending events and one of the best strategies for mitigating impacts of such events.

**INDIGENOUS KNOWLEDGE OF THE LOITA MAASAI IN CLIMATE MODELING**

Indigenous Knowledge among the Loita Maasai is acquired through experiences where young children grow up in traditional environments and interacting with natural environment until their old age, apprenticeship where young men and women spent time with the elders to learn the various I.K systems of their community and initiations rites. It’s also passed on from one generation to the next.
The Maasai entirely depend on their surroundings for survival. This rich store of knowledge about ethnobiology experienced through cordial interaction with biodiversity has enabled them observe behavioral activities of organisms and learn how to understand weather variations, thereby develop coping mechanisms and responding climate change.

There are several environmental components that are considered meteorological guides in determining expected weather conditions. They can also relate past extreme weather events with current climatic condition to understand the severity of seasonal change and determine community vulnerability.

Today a lot has changed due to impact of climate change to normal seasonal cycles which has distorted traditional systems of weather forecasting and monitoring practices.

Various parameters observed can be categorized into two groups; Traditional Ecological Knowledge (TEK) and Ethno science.
How environmental components help in predicting weather variations. And subsequent adaptation strategies

Traditional Ecological Knowledge (TEK)
This is demonstrated in Behavior of certain mammals, plants phenology, behavior of certain insects, behavior of certain birds and the winds movement, these characteristics are traits that the maasai read to understand weather variations and environmental changes.

![Environmental components that demonstrate traditional ecological knowledge in weather prediction](image)

Ethno science
This is a science based on indigenous knowledge and it is demonstrated through; the traditional calendar, astrology of the Loita maasai, role of Oloiboni and other community decision makers, reading of Entrails
The entrails reader looking at the intestines to foretell the future

Entrail Reading
This is a art of observing the entrails or intestines of a slaughtered animal. The art is common among the pastoral communities. For the case of the Loita maasai, entral reading is associated with a single family (Enkang ole Mpiroi). The entrologist (crafted term to describe the art) observe the entrails and foretell future events. They also use a pair of sandles to foretell the future by rubbing the sandles together hence throw them to the ground and finally foretell events depending on the direction the sandle face and how they will lie on the ground.

The role of Oloiboni
The Iloibonok are deviners who can predict calamities and future events and provide remedies. There are several of them but there is one chief laibon. Laibons are consulted for advice during major community events, weather changes and sometimes are consulted in matters of diseases and subsequently prescribe treatment of ailments. They thus have social and spiritual control and command great respect in the community. The healing ceremony is usually solemn and the laibons uses a guard, herbs and a collection of paraphernalia for healing, cleansing and blessing.
The Oloiboni and his son, the spiritual leader of the Loita maasai community

Early Warning Systems (EWS)

Some IK is fairly accurate since local people are able to prepare culturally and economically for weather changes but much has been distorted. Reliability of IK is however under threat due to effects of climate change including ecological components that tell early warnings.

Early warning tellers among the Loita Maasai people particularly on prolong droughts and famine just to mention a few includes;

(a). Appearance of red ants in the water point in the lowland areas. This tells famine locally known as Eng’oloto. Also the same ants invest homesteads around the washing areas inside the Maasai huts. These are signals of famine among the Maasai community.

(b). Scavenging bird especially the vultures (Ilmotonyi ng’iroin) seen roaming the grasslands tell severe drought and massive livestock death is looming.
The local people therefore respond to this indicator by migrating away to areas where water and pastures can sustain their livestock for a longer period of time during such adversities. Other traditional early warning systems used by the Maasai included dropping of Water levels in permanent rivers, poor harvests, out break of certain livestock diseases, laibons, entrails readers and seers predictions, noises made by certain insects, birds and animals, drying of certain plant species and migration of birds and other animals, insects etc.

**THE MAASAI TRADITIONAL CALENDER (ILAPAITIN).**

The maasai names the months through related ecological condition and weather pattern. They have the month’s equivalent to the normal calendar but do not systematically follow each other all the times since it is the climatic condition that tells a particular month, though this has not been well documented. Some moths may share names as named by different sub-tribes of the maasai and it is sometimes complex to count them sequentially therefore altering the naming consistency. The maasai categorise months as follows; Months of the wet season which includes, Oladalu (January), yerat (December), Oyeni oing’ok (May), Olodoyiorie Nkokwa (April). Moths of the cold season, Oloilepunie nkokwa (July), Kuju orok (June), Moru sasin (February), Oloiborr arre (arch). And the months of the dry season, Kushin (September), Ilgisan (November) Pushuka (August) and Ntungus (October).

The table below shows the months in the maasai calendar and relative equivalence in the English calendar.
<table>
<thead>
<tr>
<th>Months in the English calendar (equivalent)</th>
<th>Months in Maasai</th>
<th>Meaning</th>
<th>Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>December</td>
<td>Yerat</td>
<td>Riverines</td>
<td>It is the months of scarcity when slight rains might fall and course scattered pools of water in the valleys. After sometimes grasses along the valleys and riverine becomes green</td>
</tr>
<tr>
<td>April</td>
<td>Olodoyiorie</td>
<td>Decending of plough (Nkowa)</td>
<td>Avery wet month; in the night small clusters of stars known as plough (Nkowa) is visible and the same time descend naming the month</td>
</tr>
<tr>
<td>May</td>
<td>Oyeni oing’ok</td>
<td>Tying the bulls</td>
<td>Bulls particularly juvenile bulls become fierce and aggressive fighting the big bulls and sometimes drive cattle home during the day, hence have to be tied or separated from the hard</td>
</tr>
<tr>
<td><strong>Mid-year season (July)</strong></td>
<td>Oloirujuruj</td>
<td>Cold and drizzling</td>
<td>Is a very cold month characterized by drizzling</td>
</tr>
<tr>
<td>June</td>
<td>Kuju orok/Oloilepunyie nkokwa</td>
<td>Black Hair</td>
<td>The whole country is beautiful green and the pasture lands are linked to a hairy caterpillar.</td>
</tr>
<tr>
<td>February</td>
<td>Moru sasin</td>
<td></td>
<td>There might be hail if it rains but the hailstones are very small.</td>
</tr>
<tr>
<td>March</td>
<td>Oloiborr are</td>
<td>White waters</td>
<td>Pools of water becomes clear and</td>
</tr>
</tbody>
</table>
appears white as viewed from a distance

<table>
<thead>
<tr>
<th>September</th>
<th>Kushin</th>
<th>Little black and white birds which feed in the midst of cattle appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>Ntungus</td>
<td>Drought</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The land is very dry and there is massive drought which may lead to loss of livestock due to lack of pastures and water</td>
</tr>
<tr>
<td>November</td>
<td>Ilgisan</td>
<td>There is rainfall in the highlands</td>
</tr>
<tr>
<td>August</td>
<td>Pushuka</td>
<td>Certain birds appear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lots of postures and food.</td>
</tr>
<tr>
<td>June</td>
<td>Kuju orok Oloilepunyie Nkokwa</td>
<td>Black Hair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The whole country is beautiful green and the pasture lands are linked to a hairy caterpillar.</td>
</tr>
</tbody>
</table>

According to the maasai traditional calendar, each month has thirty days divided into two (fifteen bright moon days and fifteen dark moon days). The eighth day of each half moon is known as the exchange day from brightness to darkness, meaning it is the middle of the month. There is no clear sequence as to which month follows which, though the people know that there are twelve months. It is in agreement that the month corresponds with the English calendar as described above but today certain months varies seasonally in certain time of the year and sometime absolute the opposite of what is traditionally is expected. This can be attributed to climate change and environmental changes.

**LIVING WITH DROUGHT**

Drought in ASAL areas of Kenya is of national concern. In northern Kenya, 3 million pastoralists are hit by severe drought which as been increasing in severity and frequency. Maasai pastoralists in southern Kenya are as well bearing the heat of climate change related adversities.
**Impact of climate change and pastoral livelihoods**

Most of the local people in ASAL areas don’t attribute adverse climatic conditions to over utilization of natural resources, human destruction to forests and green house gases. This is because climate observation is less developed in Africa and technical expertise and scientific understanding is also very poor. Local communities are marginalized by government’s development agendas and lack of information about climate change. In this regard therefore many pastoralists suffer the consequences of socio economic and cultural devastation.

Seasonal cycles also changes in short term basis to determine climate variation in ecosystem for example wet season, dry season, cold season and famine. Seasonal cycles unpredictability has ever since caused suffering to indigenous communities as they experience floods in times of normal rains, El ninos, laninas, and poor cropping due to erratic rain patterns that are unreliable, and severe droughts.

![Both floods and drought bring diversations to the maasai livelihood](image)

Such consequences results to unsustainable livelihood and high levels of vulnerability including poor resilience and adaptation mechanisms. This increases poverty index and dependence on relief aid

Traditional indicators used to determine the severity of weather conditions are also disrupted making them unreliable in predicting seasonal changes. Climate change has also impacted on ecological components used to monitor seasonal variations, for example disappearance of certain insects, plant and animals species that were important in modeling weather and emergence of invasive plants and insect’s species for example *Prosopy juliflora* and fleas.

The most affected Loita Maasai a livelihood includes, nomadism, food situation, cultural practices (ceremonial cycles), cultural sites, land use patterns and natural resource use and access (natural salt lick, water points etc).
A few decades ago such warning systems were effective, reliable and minimum changes within the environment occurred which was reasonably acceptable. Today and the recent past, a lot has changed because of population growth, need for modernization and other factors attributed to climate change has accelerated dramatic levels of environmental degradation, habitat destruction endangering existence of macro and micro-organisms, destabilization of existing early warning systems, ecological imbalance and atmospheric pollution which were significant elements in climate modeling and seasonal change prediction and monitoring systems.

Climate change has also impacted on the traditional livestock breeding systems, which has resulted to livestock depletion. Cultural ceremonial patterns are also distorted because there are practices that are conducted in specific seasons for example (eunoto), warriors graduation ceremony to junior elders, which comes only when land is green after warrior hood hence prolonged drought distorts the ceremonial cycle. Severe weather conditions also necessitate spiritual cleansing prayers in pursuit to remedy adverse effect of unpredictable seasonal variations, which is a rare practice.

There are also various land use planning and management patterns that are as well distorted by the same i.e. pastures management, water conservation and utilization, management of saline environments and migration trends. Erratic seasonal cycles thereby affects such patterns and practices making them unsustainable and unreliable.
Apparently, the Maasai are highly vulnerable to effects of climate change because their temporary forms of settlements which may have already place them to greater risks of natural disasters such as floods, long-term droughts and famine etc.

Finally it is of great importance to assess human-ecosystem vulnerability and understand how mitigation measures and decision made by vulnerable communities’ affects the environment and options available in future to challenge climate variability are sustainable.

**How Climate Change Affects the Economy of the Loita Maasai Pastoralists**

Erratic climate variations have impacted on indigenous pastoralist’s way of life. For many years the Maasai have solely depended on livestock production for survival until a few decades ago when pastoralism became unsustainable due to climate change, as a result economic strategies which ensure pastoralists survival through adversities are therefore distorted. Continued reliance to the same will increase poverty, marginalization and dependence on aid. In this case, climate change has severely affected the community in various ways for example; Severe drought has killed large numbers of their livestock, malnutrition due to lack of balanced diets, Outbreak of diseases which are attributed to adverse weather conditions, landslides and cut off communication which retards development in the area and climate change has also distorted traditional ceremonial cycle since there are certain ceremonies that are held on specific times only.

**COMMUNITY PRIORITIZED CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES**

In order to challenge climate change and seasonal variability, the Maasai people, adaptability to related conditions has been highly prioritized by diversifying economic strategies to ensure survival. Today the Loita Maasai live with harsh and very demanding environment. As a result that evolved a variety of adaptation mechanisms to include the following;

- Transhumant nomadism
- Traditional range management practices (Ilookeri)
- Maintaining the local Maasai indigenous strain of livestock which can survive prolonged dry conditions
- Village based micro enterprises (house hold businesses)
✓ Subsistence agriculture to deal with food insecurity and dietary diversification to improve nutrition.

✓ Venture into small business enterprises based on livestock marketing

✓ Engaging on formal employment and manual labour to increase family per capita income.

✓ Keeping of specific and manageable herds of livestock in accordance to availability of pastures and water in times of hardship to take advantage of heterogeneous nature of their environment.

✓ The Loita Maasai are also taking advantage of selling artifacts to tourists making expeditions in their land them, earning subsidies to boost house hold economies.

There are also various traditional methods used by the Maasai to mitigate climate change which included;

Agro-pastoralism, where they grow cereal crops to supplement their diets. This form of agriculture is carried out at a subsistent level, a practice they have adapted from the neighboring agricultural communities like the Batemi from Tanzania and the Kikuyu from Kenya.

Keeping low female dominated herds, since female animals especially cows are susceptible to severe dry condition. Traditionally male animals are much stronger and can be able to trek for long distance in search of pastures and waters.

Early weaning of calves during persistent drought because, cows cannot produce enough milk and food availability is scarce. During this time, the cows are weak and need to travel long distance in search for water and pastures. People will migrate to the forest (Naimina Enkiyio forest) where there is sufficient water and pastures, some time this migration happens as a result of the Oloiboni directives to performing sacrifices to mitigate drought.

Reducing cattle herds and increasing sheep and goats flocks; during such hard times, cattle may not be able to withstand longer drought, in most cases pastoralists loose a lot of cattle. It has been realized that lower stock (sheep and goats) are more resilient to harder and drier conditions. The maasai therefore tend to destock cattle and increase sheep and goats number to reduce the chances of loosing their livestock.
Zonation of the forest into grazing blocks. This practice has been practiced by the Loita maasai since time immemorial, this has ensured sustainable forest utilization, equitable resources sharing and biodiversity conservation. In this regard, every village area has a forest block to graze their animals during the dry spell. This is geared to manage conflicts and ensure environmental conservation.

Feeding livestock using tree branches in the situation where grass has completely dried and cleared. Feeding livestock using such selected plants species is meant to provide the animals with more calories to withstand hunger, such species are *Olea europoea, Pappea capensis, Teclea simplicifolia and Grewia similis*. Controlled livestock breeding is also of paramount importance in the traditional way of adapting to drought condition since pregnant animals will be so heavy to rise incase they can’t stand by themselves.

In order to organize cultural ceremonies, the Loita Maasai have designed a mechanism to coordinate cultural practices in the recent past, they reduced ceremonial gaps, from normal between 4-5 years to 2-3 years and also the life cycle. This is to cope with climate change and still meet cultural demands. The community also proposed a cultural mapping exercise in the area to protect ceremonial site from human encroachment and climate change adversities.

**CHALLENGES IN INDIGENOUS CLIMATE CHANGE AND SEASONAL CYCLES PREDICTION**

There is a diverse range of challenges facing indigenous knowledge systems of the Loita Maasai in predicting and modeling climate change and seasonal cycles

**Education**

Today, many families in Loita send there children to schools at a very early age. Children spent their entire childhood and youth hood in formal education and urban centers where they go looking for employment after school. As a result of this, they don’t get chance to undergo indigenous knowledge educations which make a big population of the younger generation drop outs of cultural education and undermining consistent transmission of IK education through generations while many
knowledgeable community elder are passing on with the indigenous knowledge. There are efforts being put to ensure that young people are attending traditional/cultural education through ceremonies as a measure to maintaining and transmitting IK systems among the Loita Maasai.

**Religion (mainly Christianity)**

Religion has found way into the Loita Maasai people. The massage being preached has directly impacted on the IK system and culture of the people; many converted community members perceive cultural practices as ungodly, primitive and backward practices this has also affected local people understanding of climate change. This factor therefore is threatening the existence and transmission of indigenous knowledge practice in the verge of extinction. Besides threatening the culture and the indigenous knowledge of the Loita maasai, it is also impacting negatively in the Laibon (*Inkidongi*) system which is the spiritual arm of the maasai culture.

**Socio-economics and Land use changes**

Many pastoralists in the region have adapted farming as a new strategy to cope with local food shortage during critical times. Today the traditional lifestyle of the Loita Maasai is spontaneously shifting to agro pastoralism which has gained prominence through agricultural extension programs in the area. Land is still owned communally and pastoralism is the center core of the economy among many families. With the rate of agricultural activities growing in Loita, pastoralism will soon loose its potential and traditional knowledge on climate change will be lost.

Eco-tourism is also gaining potential because the culture and natural environment is very aesthetic with a high diversity of wildlife roaming naturally hence attracting tourist in the area, this is yet to be realized many in the community.

Loita division is a declared an adjudication area and at the advanced stages for land demarcation which will change land tenure system in the largely communal holding to private ownership. The changing of land ownership will also impact on major factors that are observed in climate modeling.
Population growth

Many people are settling on lands that are set aside for grazing during critical times, cultural sites and other fragile ecosystems causing severe environmental damage. This limits nomadic activities and access to important natural resource and slowly accelerating conflicts. As a result of population growth, climate change becomes unmanageable at the rural levels which have ultimately led to unprecedented suffering of people, livestock and wildlife.

Socio-cultural challenges

Cultural/traditional ceremonies normally held in certain times of the season for example *Eunoto* and *Olamal loo nkituak* are held during the wet season when water, milk and plants like *Periplocca linearifolia*, *Olea africana* and *Lantana trifolia* are available. In dry condition such materials are not available hence ceremony has to be postponed. Unprecedented Prolong droughts and famine; distorted such ceremonial cycles thus the community looses its socio- economic and cultural direction.

This is therefore to say that, most of the maasai cultural activities are done when the environment of green and human and livestock have enough food. It is also believed that Gods presence is felt when there is plenty, and all components of the environment are happy. Drought give the opposite since this period of time does not support any activities. This is the time of hardship where the people feels Gods is far away. This theory is attested during prayers and various forms of sacrifices such as Ilasari, songs and prayers.
Section of the Ceremonial village (emonyatta) whose cycle is distorted by adverse weather conditions

**Conclusion**

Global land and marine surface temperatures records in the time series from 1850-2005 shows an increasing trend of global average surface temperatures (Brohan et al. 2006). Twelve of the thirteen warmest years occurred between 1995 and 2007, 2000 being the warmest decade compared to 1990s. According to the IPCC fourth assessment report (IPCC 2007) increase concentration of anthropogenic GHG is very likely the cause of warming in the 20th century. With current development trends and climate change mitigation policies, global GHG emissions will continue to grow for several decades. Climate models predict an average warming of 0.2° per decade up scenario to the mid 2020 for a range of emission scenarios (IPCC 2007).

Predicting future climate change is necessary for assessing impacts on the vulnerability of environmental, economic and social systems for the reason future climate patterns are simulated using estimate of plausible future socio-economic conditions and associated GHG emission.
There is nothing new about challenges of living with variable and changing climate. Indigenous people have millennia of experience of adapting and coping as well as mitigating climate change by applying their environmental information to plan and manage their livelihood on the impacts from extreme weather conditions.

The main threatening climate change impact is human induced, such kind of climate change have far reaching challenges with faster and broader impacts due to indigenous people’s relationship with their environment, they have been observing and reporting the impacts of weather changes for several decades. Indigenous people are trying to cope with adaptation to these changes using their indigenous knowledge with varying degrees of success bearing in mind the dynamic capacities and influences driven by a variety of factors ranging from availability of resource, recognition of rights, entitlement, human resources, governance etc.

In the context of climate change impacts to indigenous livelihoods and related indigenous knowledge on adaptation and mitigation, research with local knowledge and communities are proving and important source of climate history and baseline data are already playing a valuable role in providing local scale expertise in formulating research questions and hypotheses and also monitoring impacts and implementing adaptive responses at local level.
## ANNEX

### Annex 1. Maasai names and meaning

<table>
<thead>
<tr>
<th>Maasai name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olosho/Iloshon</td>
<td>Community, communities or territories occupied by individual communities or maasai sub-tribes</td>
</tr>
<tr>
<td>Magadi</td>
<td>Soda or sodium carbonate (Na2CO3)</td>
</tr>
<tr>
<td>Ngurman</td>
<td>Gardens or an escapement along the southern end of loita forest</td>
</tr>
<tr>
<td>Naimina Enkiyio</td>
<td>Lost child. Also the name given to Loita forest (Forest of the Lost child)</td>
</tr>
<tr>
<td>Ilkerin</td>
<td>An area/Location in Loita division where the The Ilkerin –Loita development project is situated</td>
</tr>
<tr>
<td>Oloiboni/Iloibonok</td>
<td>Foreseeer/foretellers</td>
</tr>
<tr>
<td>Enkang</td>
<td>Kraal/homestead</td>
</tr>
<tr>
<td>Eng’oloto</td>
<td>Hardship</td>
</tr>
<tr>
<td>Ilmotonyi ng’iroin</td>
<td>Nubian vultuers</td>
</tr>
<tr>
<td>Olmotonyi</td>
<td>Vulture</td>
</tr>
<tr>
<td>Ng’iro</td>
<td>Brown colour</td>
</tr>
<tr>
<td>Ilapaitin</td>
<td>Months</td>
</tr>
<tr>
<td>Nkokwa</td>
<td>Milky way</td>
</tr>
<tr>
<td>Eunoto</td>
<td>A ceremony where warriors graduate into junior elders</td>
</tr>
<tr>
<td>Emanyatta</td>
<td>Ceremonial village</td>
</tr>
<tr>
<td>Ilookeri</td>
<td>Land set aside for lower stock to graze. Not very far from villages vicinities</td>
</tr>
<tr>
<td>Batemi</td>
<td>A bantu tribe which neighbours the Loita maasai in Tanzania</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>A bantu community from central kenya</td>
</tr>
<tr>
<td>Inkidongi</td>
<td>A clan of the maasai with capacity to foretell the future</td>
</tr>
<tr>
<td>Olamal</td>
<td>A ceremonial gathering</td>
</tr>
<tr>
<td>Olamal loo nkituak</td>
<td>A women ceremonial gathering</td>
</tr>
</tbody>
</table>
## Annex 2. List of plants species

<table>
<thead>
<tr>
<th>Botanical names</th>
<th>Family name</th>
<th>Local names</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Olea europea</em></td>
<td>Oleaceae</td>
<td>Oloirien</td>
</tr>
<tr>
<td><em>Juniperus procera</em></td>
<td>Cappresaceae</td>
<td>Oltarakwai</td>
</tr>
<tr>
<td><em>Podocarpus latifolia</em></td>
<td>Podocarpaceae</td>
<td>Olpirpirri</td>
</tr>
<tr>
<td><em>Prosopy juliflora</em></td>
<td>Fabaceae</td>
<td>Mathenge</td>
</tr>
<tr>
<td><em>Pappea capensis</em></td>
<td>Santalaceae</td>
<td>Oltimigomi</td>
</tr>
<tr>
<td><em>Teclea simplicifolia</em></td>
<td>Rutaceae</td>
<td>Olgilai</td>
</tr>
<tr>
<td><em>Grewia similis</em></td>
<td>Tiliaceae</td>
<td>Olnyaligwai</td>
</tr>
<tr>
<td><em>Periploca linearifolia</em></td>
<td>Aasclepiadaceae</td>
<td>Osinandei</td>
</tr>
</tbody>
</table>
References


