IOSR Journal Of Humanities And Social Science (IOSR-JHSS)
Volume 23, Issue 12, Ver. 1 (December. 2018) 28-38
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

The Trends of Rainfall and Temperature in the Past 45 Years From 1971 to 2018 As Evidence of Climate Change in Lake 94 Baringo County, Kenya

Otieno Caroline Marygorety Akinyi[1], Dr. Hamidu A. Shungu(PhD)[2], Dr. Reguli B. Mushy(PhD)[3],

[1]*Lecturer/Research Fellow, African Women's Studies Centre,*
University of Nairobi, P.O. Box 30197, Nairobi, Kenya.
[2]*Lecturer, Faculty of Arts and Social Sciences,*
Open University of Tanzania, P.O. Box 23409, Dar es Salaam, Tanzania.
[3]*Lecturer, Faculty of Arts and Social Sciences,*
Open University of Tanzania, P.O. Box 23409, Dar es Salaam, Tanzania.
Corresponding Author: Otieno Caroline Marygorety Akinyi

Abstract: Climate change is the catch-all term for the shift in worldwide weather phenomena associated with an increase in global average temperature. The study sought to examine the trends of rainfall and temperatures in the past 45 years from 1971 to 2018 as evidence of climate change in Lake 94 Baringo County, Kenya since the Ilchamus community have been exposed to effects of climate change both on terrestrial and aquatic environments to a great magnitude that has alleviated socio-economic and environment concerns. The study used descriptive design, adopting purposive sampling to carry out case study and focus group discussion. Key finding was the formation of Lake 94 in 1994 and frequent drought followed by flooding. The Ilchamus community should be trained on disaster management.

Key words: climate change, terrestrial, aquatic, environment, disaster management, Lake 94

Date of Submission: 26-11-2018 Date of acceptance: 07-12-2018

I. INTRODUCTION

Background to the research problem

Climate change is the defining human development issue of our generation (UNDP, 2008). The way the world deals with it today will have a direct bearing on the human development prospects of a large section of humanity. Failure will consign the poorest 40% of the world's population of 2.6 billion people to a future of diminished opportunity (ibid). There is a broad international agreement that human induced climate change is a reality and that it is caused by the emissions of greenhouse gases into the atmosphere (Mainlay and Tan, 2012). To date, climate change has largely been treated as a scientific problem to be diagnosed, understood and modeled by climate scientists. Mainlay and Tan, (2012) goes further to explain that, current plans to address climate change involve the development or reform of policies and action plans and are largely viewed as a technical exercise. In addition, solutions are being sought through the introduction of economic incentives (e.g. carbon trading schemes and carbon taxes) to push behavioural change and investment in technological innovation. However, there is growing recognition that finding appropriate responses to climate change requires a much broader understanding and approach (Mainlay and Tan, 2012).

Statement of the problem

The Ilchamus community living in Legumgum sub-location of Baringo County has been exposed to effects of climate change both on terrestrial and aquatic environments to a great magnitude that attracts socio-economic and environmental concerns.

General objective of the study

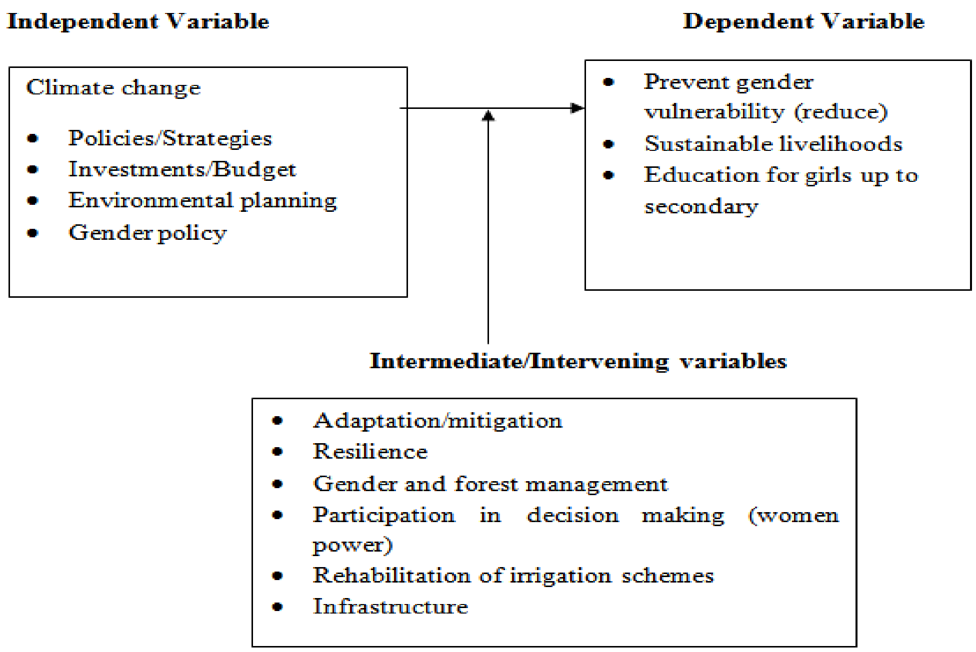
The general objective of this study was to examine the trends of rainfall and temperature in the past 45 years from 1971 to 2016 as evidence of climate change in Lake 94 Baringo.

Scope of the study

The study covered the whole of Legumgum sub location that surrounds Lake 94 in Baringo County. The study was carried out for a period of six months beginning June –December 2016.

Conceptual Framework

This study adopted a conceptual framework that analysed climate change variables and the adaptive strategies that were employed to mitigate climate changes. In general, conceptual frame is more often perceived as an analytical tool with several variations and contexts. It can be applied in different categories of work where an overall picture is needed. It played a key role in making conceptual distinctions and organizes ideas.



Definition of climate change

Climate change is the catch-all term for the shift in worldwide weather phenomena associated with an increase in global average temperature. It's real and temperatures have been going up around the world for many decades being referred to as global warming; climate change is the term currently favoured by science communicators as it explicitly includes not only earth's increasing global average temperature, but also the climate effects caused by this increase as witnessed in Legumgum area, Baringo County.

Climate change is considered one of the undesirable consequences of man's unsustainable development practices by Bruntland report. This concern was taken up by the World Meteorological Organization and United Nations Environmental Programmes that established intergovernmental panels on climate change to provide abroad and balanced information about climate change (IPCC, 2009). Climate change was also identified by the millennium ecosystem assessment as one of the five main direct drivers causing ecosystem decline across the globe. The change has significant impacts on the ecosystems, their services and on human wellbeing. Ecosystems likely to be influence include water, food production, provisioning services and natural disaster risk management. The availability of these ecosystems services is affected by precipitation pattern changes and temperature increases. Effects of changes in the services on human wellbeing can impacts on security, basic material for life and health. In systems exposed to increasing resource demands, unsustainable management and pollution, exposure to climate change constitutes additional pressures (Report of Kenya Government, 2009).

Causes of climate change

The causes for changes in climate can be many, and the consequences of each of them can last for longer or shorter time periods (Blenckner, 2005). On a geological perspective, the drift of the continents has caused changes on the global climate that follows a geological time scale, that is, hundreds of thousands of years. On the other hand, volcano outbreaks that are also related to the continents' drift can change the climate on a shorter time scale by throwing ashes into the atmosphere (ibid). The ashes shade the solar radiation by increasing the albedo of the upper atmosphere and cool down the atmosphere below. Climate changes caused by volcano outbreaks can last from a few days to a few years depending on the intensity of the outbreak, the amount of ashes liberated, and the altitude reached by the ashes (Blenckner, 2005). Climate change can be attributed to increase in greenhouse gas (GHG) emissions through human activities that have resulted in additional warming of the earth's surface, with several anticipated disastrous impacts.

This is coupled up with sea level rise and global warming that would continue to increase over centuries because of the inertia of the earth systems (Nyong, 2007). Man has accelerated the climate change by deforestation whereby they clear large areas of forests which could act as carbon sink for excess carbon dioxide [CO_2] in the atmosphere. Large agricultural rice paddies are other sources of methane gas that acts as greenhouse gas. Transportation system generates substantial amount of sulphur dioxide, carbon monoxide and carbon dioxide, which contribute to greenhouse effects in the atmosphere that led to climate change effects globally. Manufacturing industries in developed countries uses substantial energy in their operations like fossil fuel (coal, oil) that generates a large amount of carbon dioxide in the atmosphere (Nyong, 2007).

Observed and Predicted Climate Changes

Climate change and vulnerability is a phenomenon that has in the recent past attracted not only the attention of environmental experts but also the rest of the society. For decades, it has been observed that climate has continuously been changing, Solomon, *et al.* (2007). In New York, climate change predictions indicate that precipitation from storms is likely to dramatically increase. The 1% annual chance storm event or "100-year storm" is expected to increase by 0.2 inches of rainfall and is likely to become more frequent, and larger storms will be experienced more often. Intense mid-latitude, cold-season storms, including north Easters, are projected to become more frequent and take a more northerly track, Giorgi, & Lionello, (2008).

The climate model simulations under a range of possible emissions scenarios suggest that for Africa, in all seasons the median temperature increase lies between 3°C and 4°C, roughly 1.5 times the global mean response, Kharin, *et al.* (2007). Half of the models project warming within about 0.5°C of these median values, Christensen et al. (2007). Maximum and minimum predictions of change are given together with the 25, 50 and 75 quartile values from the 21 GCMs Kjellstro¨ *et al.* (2011). Whilst all models agree that it will become warmer, the degree of warming predicted is quite variable.

Climate change observed over the past several decades is consistently associated with changes in a number of components of the hydrological cycle and hydrological systems such as: changing precipitation patterns, widespread melting of snow and ice; increasing atmospheric water vapour; increasing evaporation; and changes in soil moisture and runoff. There is significant natural variability on inter-annual to decadal time-scales – in all components of the hydrological cycle, often masking long-term trends, Sheffield, & Wood, (2008). There is still substantial uncertainty in trends of hydrological variables because of large regional differences, and because of limitations in the spatial and temporal coverage of monitoring networks. At present, documenting inter-annual variations and trends in precipitation over the oceans remains a challenge.

Present day weather and climate play a fundamental role in the day to day running of society. Seasonal phenomena may be advantageous and depended upon for sectors such as farming or tourism, Mirza, (2003). Other events, especially extreme ones, can sometimes have serious negative impacts posing risks to life and infrastructure and significant cost to the economy. Understanding the frequency and magnitude of these phenomena, when they pose risks or when they can be advantageous and for which sectors of society, can significantly improve societal resilience. In a changing climate it is highly valuable to understand possible future changes in both potentially hazardous events and those reoccurring seasonal events that are depended upon by sectors such as agriculture and tourism Field, Barros, Stocker, & Dahe (2012). However, in order to put potential future changes in context, the present day must first be well understood both in terms of common seasonal phenomena and extremes.

Climate Trends in Africa

The fluctuating climate of Africa is governed by marine and continental interactions that impact economic development, especially through agriculture and water resources Rockström, *et al.* (2012). Observed surface air temperatures have shown an accelerating warming trend since 1960, reaching +0.03 °C/year.

Consequently, there has been an increase in the number of warm spells. Funk, Michaelsen & Marshall, (2012) indicate that in East Africa, the observed temperature trends are relatively flat. The trends in precipitation over Africa are less coherent, with large spatial and temporal variability. According to Jury, (2013), multi-decadal variability prevails in the Sahel while central Africa has seen a small decline in rainfall.

In southern Africa, long term trends are weak but inter-annual rainfall variability has increased since 1970, Fauchereau, *et al.* (2003). The intra-decadal oscillations are recognized to be influenced by the Pacific El Niño Southern Oscillation (ENSO) and by interactions with Atlantic and Indian Ocean climates. Alongside the influence of global ocean variability, several studies have highlighted the importance of land cover and dynamic feedbacks on climate. An increase in vegetation cover has been linked to a cooling in the order of 1°C in tropical Africa. Deforestation and atmospheric dust loadings play a role in African climate change16-20 and generate uncertainty in radiative forcing of coupled general circulation model simulations.

Generally, one-third of people in Africa live in an arid climatic regime vulnerable to fluctuations and the consequent health impacts. This has made understanding and predicting trends in climate a challenge that scientists face. While seasonal forecasting has helped mitigate drought cycles in South Africa, crop yields have declined in other nations. The marine environment has experienced climatic stresses that have contributed to changes in fishery resources. The knowledge of multi-decadal climate forcing has matured, and trends have been documented in the context of our understanding of anthropogenic influences. The effects of increasing greenhouse gas concentrations are manifest at regional scales, which for southern Africa include desertification.

Year-to-year climate variability is modulated by ENSO, amongst other factors, and so the regional climate may exhibit an 'extended summer or winter, Annamalai, Hamilton, & Sperber, (2007). Global climate observations coupled numerical models are constantly improving. The regular explorations into the past and projected trends of regional climate are instructive, to determine the magnitude and extent of climate signals. This helps address the concern on the rate and pattern of climate change found over southern African as well as the consistency of the past and future trends.

Climate Trends and Projections in Kenya

Regional climate simulation for the East Africa region has thus far been confined to one model and one emission scenario, a situation that has made the results to be very uncertain. To improve the certainty, it would need multiple regional models and emission scenarios, a modelling effort which amounts to more work. Future regional downscaling of the global climate projections for Kenya should be extended to other IPCC GCMs to gain a better sense of the uncertainty associated with the regional climate model projections.

The regional climate projections indicate that the role of sharp mountain range slopes, such as the Great Rift Valley in Kenya, can greatly affect local climate. The IPCC GCMs are based on a large grid resolution ($200x200km^2$) and do not include modifications for altitude. GCM projections are valuable for projections on the large scale as long as they are interpreted with caution, particularly when large contrasts in altitude exist over short distances like in Kenya.

Results from recent work from stations in Kenya and Tanzania, indicate that since 1905, and even recently, the trend of daily maximum temperature is not significantly different from zero. However, daily minimum temperature results suggest an accelerating temperature rise, (Christy, Norris, and McNider, 2009).

According to Hansen, & Indeje, (2004) the observed, gridded, gauge data sets observed over the period 1901-2000 or over 1951-2000, showed that there are no homogenous, wetter or drier climates in East Africa. In the Short rains, there is a discernible pattern of northern Kenya becoming wetter while southern Kenya and Tanzania is becoming drier in the 1951-200. Although these patterns are not strong enough to be regarded as not due to chance, they are not statistically significant.

According to Githui, & Bauwens, (2009), the average temperatures in Kenya are projected to likely to increase in the range of 1-3^0C by the 2050s according to downscaled results from eight climate models using the climate change explorer tool, and maximum temperatures show similar changes, and the greatest warming generally occurs from July to September.

Furthermore, Droogers, Butterfield, & Dyszynski, (2009) indicated that it is possible to use the climate change explorer and downscaled climate projections to explore climate projections at the station level in Kenya. For instance, by taking the station of Wajir in northern Kenya as an example, it is possible to start to dig in detail into where there is model agreement, and where is more uncertainty over projected changes. Exploring the uncertainty in the climate models can enable us to start making informed decisions.

Climate change and floods

Rural communities have often settled on floodplains because they offer favorable conditions for settlement, economic development and assets for sustainable livelihood support. According to World Health Organization (WHO) report on the meeting held in 2002, at its headquarter, that the main causes/sources of floods at the global level are storm surges, El niño/La niña events, and other extremes of climate variability, land terrain, poor drainage systems and regulation of dams. On the other hand, the report outlines that the impacts of floods can include effects on population displacement including loss of life and diseases (malaria, diarrhoea, other waterborne diseases, etc.), Infrastructure destruction, including land transport systems (roads and bridges), buildings and power supply, and farms and disruption of crop production. Starvation can be a consequence (WHO, 2002). Adaptation strategies are therefore vital to reduce the effects of climate variability.

Climate change and droughts

Although drought affects pastoralists and crop farmers, its impacts on pastoralists is higher. This is because they constitute the majority in arid regions hence making them much vulnerable (Orindi *et al.*, 2007).

The intensity of drought seems to be increasing over the years as a result of the changing climate, according to Orindi *et al*. (2007), the 2000/2001 and 2006 droughts were the worst in at least 60 years (since 1940's), and several rainy seasons failed between these two extreme years. The severities of these droughts were however not established hence no exact figures on the losses resulting from the droughts were given. It was therefore important to establish the mortality cases of both humans and livestock that resulted from the droughts as well as other economic effects to the pastoralists. Local communities have developed different coping strategies for drought (Meza-Morales, 2010). For crop farmers the strategies include reduction of sown surface and crops prioritization, irrigation management (accumulate, recycle and water right shifts), drill and deepening wells, use of public resources. While for pastoralists coping strategies are nomadic summer pastures, selling cattle, storage of fodder, seek an alternative source of income (e.g. mining activity and agricultural temporary work) (ibid).

Drought and flood incidences

As in the rest of the tropical regions, droughts and floods are common phenomena in Kenya. The two are triggered by the same factors and can be either mild or disastrous. They are more common in the arid and semi-arid regions. Floods drown people and destroy property, but are also important because they irrigate crops, provide water, and replenish the soil. Droughts, on the other hand, cause plants to die, which means less food, but they are also major contributors to forest fires, which clear out old dead undergrowth, making room for new life (Lelenguyah, et al., 2013).

Droughts A chronology of drought incidences in the Rift Valley region of Kenya and some of their related impacts show that severe droughts, with serious impacts to both man and animals occurred in 1928, 1933-34, 1939, 1942-44, 1952-55, 1960-61, 1965, 1984-85, 1987, 1992-94, 1999-2000 and 2005-06. Memories of the more recent droughts are still fresh in the minds of most Kenyans. Maximum drought intensity (length or duration of a drought) varies within the district, ranging from 16 – 20 months in the driest areas to 4 – 7 months in the wettest areas (Lelenguyah et al., 2013; UNDP, Undated).

Floods, like droughts, are also recurrent in Kenya and are characterized by variable spatial-temporal patterns. Floods are usually associated with abnormally wet weather in a region when the amount of rainfall received exceeds the long-term average. Like droughts, floods tend to be more frequent in the arid, semi-arid parts of Kenya where, the term El Niño is synonymous to floods. The El Niño episode of 1997/1998 caused serious flooding and extensive destruction of property, infrastructure and life in many parts of the country. It triggered unprecedented interest and awareness in issues germane to excessive rainfall among Kenyans. However, this awareness does not seem to have been translated into some preparedness, and subsequent floods have been received with the same level of astonishment (Ngaira, 2008).

Formation of fluvial lakes due to climate change

Fluvial lakes are very shallow. Although they constitute almost 10% of all lake surface area, they hold only about 0.3% of the volume. Sediments transported by rivers may accumulate, for example, in river bends, and create a form of dam, or running water may excavate depressions.

Meandering rivers may take a new course through a river bend and then a lake, oxbow lake, may be created. A river system with an oxbow lake often includes many such small lakes. Fluvial lakes may also be created near the coast, when longshore coastal currents deposit sediments that block river outflows. The fluvial lakes can be created due to processes acting over a longtime, or as a consequence of very extreme events (Blenckner, 2005).

The Maasai, Ogiek and Turkana live within the Rift Valley Province of Kenya. They all have long historical connection and have retained their socio-cultural links with the lands and environments that they depend on for their livelihoods. Traditionally, the Maasai and Turkana were pastoralists, while the Ogiek in the Mau Forest, practiced hunting, fruit gathering and bee keeping (Boko et al., 2007). The Mau Forest has gradually been depleted and deteriorated through logging and influx of settlers, with the Ogiek describing the power saw as their "enemy number one (ibid).

The Government is currently taking action for the protection of the Mau Forest and has indicated that it will affirm Ogiek land rights within the forest and cooperate with them in the management of the forest resources. In the context of deforestation and forest degradation, the Ogiek now indicate farming as their most important livelihood element. Livestock is the backbone of the Maasai and Turkana pastoralist livelihood and defines much of their culture and economy.

The Maasai community targeted in this study depends directly on Lake Naivasha, which also feeds off the Mau Forest Complex (ibid). The lake has in recent years suffered substantial degradation as a result of competing land uses, especially arising from the establishment of large horticultural farms. Thus, traditional livestock keeping practices have come under immense pressure, particularly due to the curtailment of livestock mobility.

Lake Turkana, along with the Rivers Turkwel and Kerio, is the life-blood of the Turkana region. The Turkana combine pastoralism with fishing in the lake and cultivate the river plains, when occasional flooding deposits sediment. However, the area is prone to long periods of drought during which the rivers dry up, and families have to travel long distances to access water (ibid). The government has promoted irrigated agriculture to deal with the increasingly frequent droughts. Recent oil discovery and hydropower developments raise expectations for diversification of livelihoods, but also raise concerns for the land rights and livelihoods of communities that are dependent on the water resources of Lake Turkana (Boko *et al.*, 2007).

Methodology

The study adopted descriptive research using case study and key informants to gather information. The study was carried out in the semi-arid rangeland of Logumgum sub-location of Baringo County, Kenya. This area is located between latitude 00°26'- 00°32'N and longitude 36°00'- 36°09' E and an average altitude of 900m above the sea level. It is located within agro-climatic zone IV and V (Wasonga, *et al*., 2011). Logumgum is one of the sub location in Marigat sub-county in the larger Baringo County. It is made up of 10 (ten) villages which include; Logumgum, Sororwa, Silango, Losamburmburu, Loitip, Sirata, Eldebes, Retoti, Lorok and Tasekwam. The sub location covers an area of 1,677.45sq.km (District Development Office, 2011). Administratively, the sub location is being administered from Sirat market centre as shown in Figure 3.1

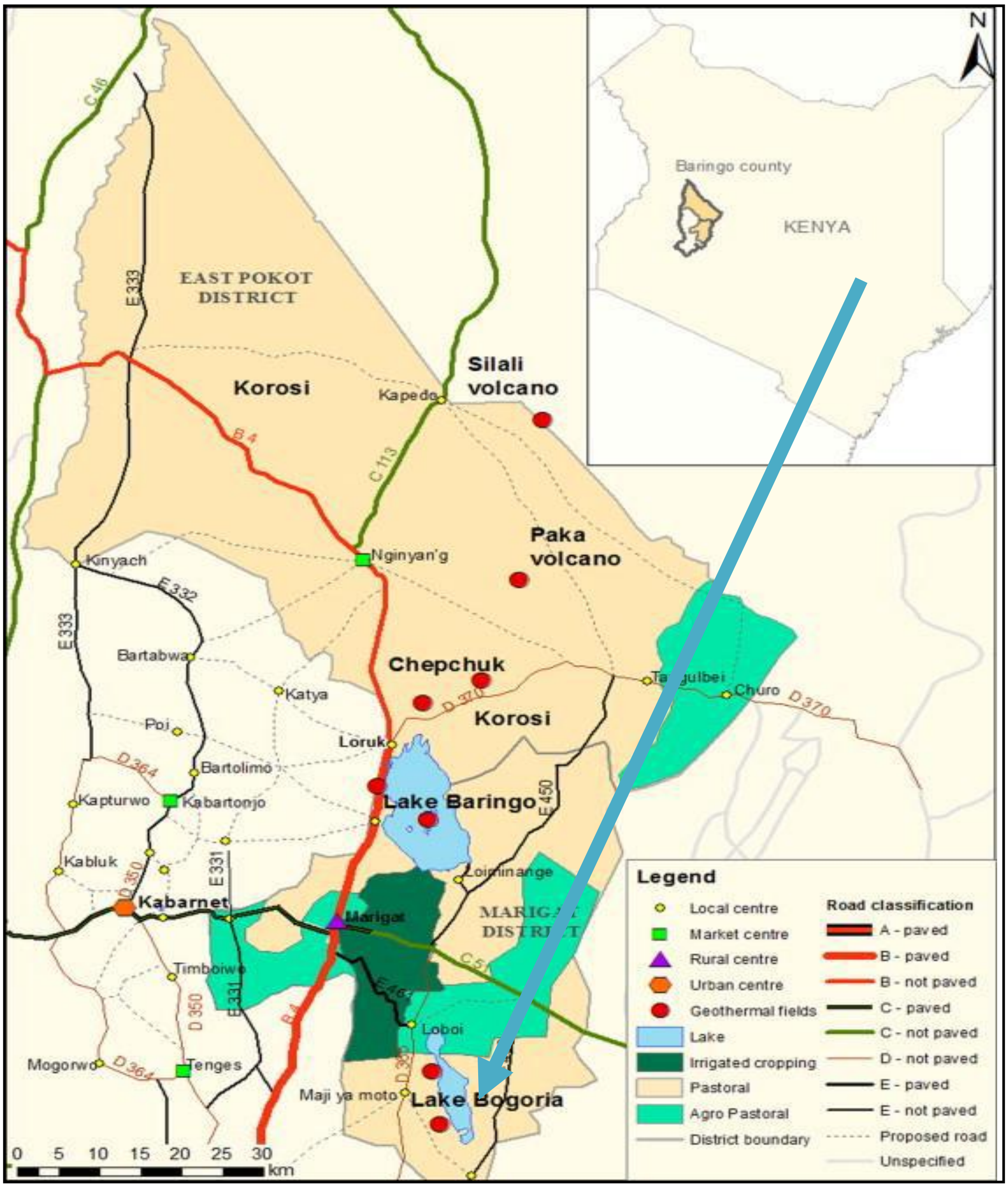


Figure 3.1: Map of Baringo County showing the study area (Highlighted in dark blue) (Lelenguyah 2013)

Study findings

Background information of the Ilchamus community and Lake 94

The lake is situated in Logumgum sub location, Kiserian location, Marigat Sub County in Baringo County. The location is made up of ten villages; namely Logumgum, Sororwa, Silango, Losamburmburu, Loitip, Sirata, Eldebes, Retoti, Lorok, Tasekwam. The site was formerly called *Kichirtit* in Ilchamus language meaning a swampy place before the formation of the lake. The name Lake 94 was coined by the locals because, that is the year people woke up and found a large water mass at the site which was not there before.

The ecological and historical information on Lake 94

The study found out from the respondents, that around 1979, the area become swampy and tall grass grew in it. This turned the place into a grazing land during drought. From 1992, the area experienced long spell of drought which went up to 1994. This made livestock farmers to cut branches of big trees like *Ficus sycommorus* which grow along the river banks to feed their livestock. The remaining logs were not removed from the river channel. On 26/4/1994, a torrential rain was experienced in the area. This resulted into the flooding of River Molo. The flood carried along the big logs that were left on its channel to Lake Baringo.

At the estuary the river deposited the logs which became a barrier to other debris carried along the water body. This deposition ended up changing the course of the river to the current site of Lake 94. Further explanation by the respondents confirmed that this diversion was exacerbated by hippopotamus and crocodile. The hippos contributed to the diversion by eroding the river banks while stepping out of the river at night to go and graze on the wetland fields while the crocodile dug the river banks to hide their eggs for hatching.

Perkerra River also contributed to the increase of water into the lake. The amount of water went up in the swamp ending up with the formation of the lake, which came to be known as Lake 94. Other respondents explain that there was a stream called Leseyai which passed in the area and was a great indicator that the place was to become a lake due to fault line formed.

A majority of the respondents believe that the formation of the lake was predicted around 1992, by an old man (name unknown) who said that the digging of the canals for irrigation will result into water collecting in one area. During its life time, the lake has dried up twice due to severe drought in 2000 and 2009.

The area is also very hot; therefore, evaporation is also accelerating the reduction of water from the lake. Secondary Ecological succession was observed on the areas where the lake was receding. Terrestrial (dry land) is composed of the indigenous species of plants like *Balanitis aegypticus*, and *Acasia* species among others. The immediate zone is composed of invasive species like herbs, *Prosopis juliflora* and many others. Plants and trees that have not adapted to aquatic environment have dried off. Water zone was observed to have aquatic plants like tyhpa, water lilies and water hyacinth. The colour of water is brown, an indication of soil pollution and the floating plants were indications of eutrophication due to enrichment of the water body with nutrient like Nitrate, Phosphorous. Animals like ostrich, white egret and other scavenger birds were observed in the immediate zone between dry terrestrial land and water body.

The formation of the lake has brought invasive species of plants namely; water hyacinth and water lilies (known in traditional language as *Kirongit, Larau, Sabongow lamara* respectively). Some of these plants are consumed as vegetable while on the other hand these invasive plant species affect the gender roles in the community by interfering with livestock rearing and fish population in the lake as reported by 54% of respondents as shown in Table 4.5.

Table 4.5: Respondents' View on the Impact of formation of Lake 94

Items	Frequency	Percentage
Brought about invasive plant species	71	54
Human-Wildlife conflict	79	60

The data in Table 4.5 show that human- wild life conflict due to the formation of Lake 94 has increased as crocodiles kill livestock's (sheep and goat) and attack people who go to the lake to fetch water or fish while hippos destroys crops grown for human consumption and even attack cattle when they graze on typha, sage grass, reeds and papyrus inside the lake during drought as reported by 60% of respondents. The other notable ecological changes that have been experienced in the area include the diversion of river Perkerra from its original course. This has resulted into the drying of river bed thereby causing the drying up and eventual death of *Ficus sycomorus* trees which were growing along the river bank.

The formation of Lake 94 and its effects

According to the respondents, on 26/4/1994, a torrent rain was experienced in the area. This resulted into the flooding of river Molo which originates from the eastern part of Mau forest in Nakuru County. The flood carried along with it big logs that were left on its channel to Lake Baringo which led to the formation of Lake 94, a fluvial lake, as described in 4.4.

Blenckner, (2005), explain that fluvial lakes are very shallow, although they constitute almost 10% of all lake surface area, they hold only about 0.3% of the volume. The authors explain that Sediments transported by rivers may accumulate, for example, in river bends, and create a form of dam, or running water may excavate depressions. Meandering rivers may also take a new course through a river bend and then a lake ending up with the formation of the oxbow lake. A river system with an oxbow lake often includes many such small lakes like Lake 94.

The fluvial lakes can also be created due to processes acting over a longtime, or as a consequence of very extreme weather events (ibid). This fits the respondent's explanation of how Lake 94 got formed. Using the narrative given by the respondents, the lake can be described as a fluvial lake formed due to sediments transported, deposited or accumulated by river Molo and Perkerra, as a consequence of very extreme climatic events, which occurred in 1994, where torrential rainfall pounded the area causing a massive flood that resulted into the formation of the lake. This is supported by the fact attributed to Onywere *et al*. (2014), who reported that, the increased recharge of Lake Baringo was mainly from Molo and Perkerra Rivers, now both reaching the lake directly through surface recharge and bringing in a large amount of sediment loads.

The Ilchamus like the Maasai, Ogiek and Turkana live within the Rift Valley Province of Kenya now Baringo county since 2010. They all have long historical connection and have retained their socio-cultural links with the lands and environments that they depend on for their livelihoods.

Traditionally, the Maasai and Turkana were pastoralists, the same way the Ilchamus were in the olden days according to Boko *et al*. (2007). This defined much of their culture and economy. The Maasai community depends directly on Lake Naivasha, which also feeds off the Mau Forest Complex, which eventually releases some of its water into river Molo that drains into Lake Baringo by Extension feeds also Lake 94 (ibid).

Lake Naivasha in recent years has suffered substantial degradation as a result of competing land uses, especially arising from the establishment of large horticultural farms. Thus, traditional livestock keeping practices have come under immense pressure, particularly due to the curtailment of livestock mobility. The same scenario has not spared the Ilchamus and the Lake 94. The site fall close to Perkerra irrigation scheme in Baringo. The irrigation scheme and the areas covered by Lake 94 have taken up most of the land that was previously used as dry season grazing fields for livestock's according to the respondents. This has curtailed livestock numbers and mobility among the community. The impact has a bearing on the gender equality in the area. The other notable ecological changes that have been experience in the area include the diversion of river Perkerra along its original course. This has resulted into the drying of river bed thereby causing the drying up and eventual death of *Ficus sycomorus* trees as shown in figure 7.5.

Figure: *Ficus sycomorus* trees drying up along the riparian zone of former course of river Perkerra (Akinyi &Oruko, 2016).

The drying of these trees can be explained by the following scientific facts. The tree falls into the categories of C_3 plants that require a lot of water for growth. When the river course changed the ground water supply was interfered with. The trees could not survive the dry environment therefore they got dried up as observed. Since they were key species in the ecosystems, their death has affected the riparian zone of the river and by extension this has affected the gender in the area.

According to respondents, beneath this big trees used to grow some herbs which the Ilchamus used as traditional medicinal herbs and vegetables during dry periods. These dried up. The tree was also used to host the beehives for the community; therefore its extinct within the zone is a disaster to the Ilchamus community. The introduced species of *Prosopis juliflora* which is not a social plants very few herbs are also not able to grow underneath it. It does not help the bees as well. The end result is the negative impacts both socially and economically on the livelihood of the Ilchamus community.

Climatic variations factors and ecological succession around Lake 94

Since its formation, the lake has dried up twice due to severe drought in 2000 and 2009. The average annual temperature of the area is about 27^0Celsius. The period between January and March is the hottest with temperature rising to over 40^0C according to Kimani *et al*. (2014). This climatic variability significantly affects the water levels in Lake 94 as it hastens evaporation and evapo-transpiration of moistures from water surface and floating aquatic plants in water during photosynthetic process.

This problem is exacerbated further by water abstraction for irrigation by horticultural local farmers in the sub location. This affected both gender in the area that relies on farming as their source of food and income. The Rift Valley lakes have had a history of fluctuations which have been recorded since 1860 (Richardson, 1966).

The current lake level rise and formation of new ones represents an opportunity for scientist to study *in-situ* ecological changes taking place as a result of the increased water volumes and the flooding of the riparian areas of the lakes from the raised water levels and how they relate to gender issues as proposed by Onywere *et al*. (2014).Secondary Ecological succession was observed on the areas where the lake was receding as shown in figures 7.6.

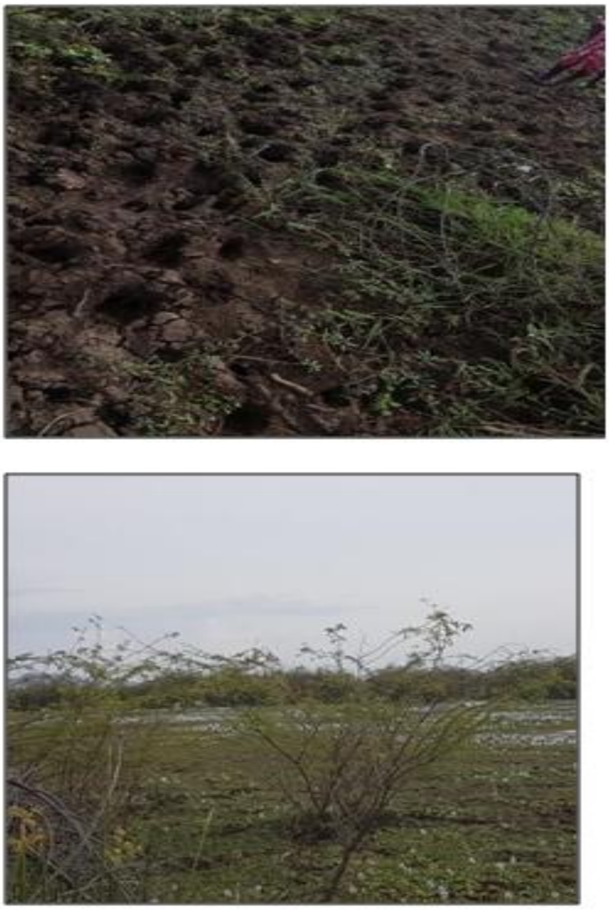


Figure 7.6: Secondary ecological succession observed around Lake 94 (Akinyi & Oruko, 2016)

Terrestrial (dry land) is composed of the indigenous species of plants like *Balanitis aegypticus*, and *Acasia* species among others. The immediate zone is composed of invasive species like herbs, *Prosopis juliflora* and many others. Plants and trees that are not adapted to aquatic environment dried off when they were submerged by water. Water zone was observed to have aquatic plants like tyhpa, papyrus, sage grass, water lilies and water hyacinth. Some of these aquatic plants are being consumed by the area residents as vegetables and food as reported by the respondents and sampled by the author.The colour of water in the lake was observed to be brown in colour an indication of soil pollution from surface run off probably from the catchments areas. The growth of emergent/floating plants in the lake were indications of eutrophication effect which is due to the enrichment of the water body with nutrient like Nitrate and Phosphorous from non-point sources of pollution from within and without the surroundings of Lake 94.

It is speculated that farmers are applying excess amount of fertilizers in their farms along the rivers basin and upstream, which are not taken up by plants. These excess nutrients end up being washed by rain water into the Lake 94where they cause eutrophication effects. This promotes algal growth resulting into a mat of bloom which lowers the water quality and in some cases lead to death of aquatic species ending up with reduced biodiversity.

Loss of biodiversity in an ecosystem has a negative effect on gender, when they rely on environment for existence as is the case in Logumgum sub location. The growth of water hyacinth in the lake has reduced drastically the population of fish as the respondents reported that the catch has gone low in recent past. This has affected the family income and nutrition base which was supplementing the loss of milk in the diet. The long term effect is likely to be felt by the community in years to come, mostly by women and children.

II. CONCLUSION

In conclusion, it was observed from the assessment that the rainfall is less frequent in the areas surrounding Lake 94. The study found out that the areas experienced extreme droughts which were succeeded by extreme floods that eventually led to the formation of Lake 94 in the year 1994, adjacent to Lake Baringo. The lake was established to have been formed due to fluvial deposition.

The name 94 was given to the lake because it is the year the lake was formed as well as it is a neutral name that neither belongs to the Tugen, Ilchamus or Pokot though it is in Logumgum area. The Ilchamus community living in Logumgum sub location, Kiserian location within Marigat Sub county Baringo County where Lake 94 is located were found to be aware of climate change, which they attribute to change in rainfall pattern, frequent droughts and floods.

III. RECOMMENDATIONS

The Ilchamus community indigenous knowledge on climate change prediction and mitigation should be documented for future references. Training on disaster management among the vulnerable members of community should be carried out especially to women and children. The climate change information should also be packaged in a format that is easily accessible by the members of the Ilchamus community. Alternative source of income other than burning and sale of charcoal should be introduced since this further worsened the situation even though it is a mitigation strategy to tame the spread of '*mathenge'* plant in the area.

REFERENCES

[1]. Annamalai, H., Hamilton, K., & Sperber, K. R. (2007). The South Asian summer monsoon and its relationship with ENSO in the IPCC AR4 simulations. Journal of Climate, 20(6), 1071-1092. doi:10.1175/JCLI4035.1

[2]. Blenckner, T. (2005). A conceptual model of climate-related effects on lake ecosystems. Hydrobiologia, 533(1-3), 1-14. doi:10.1007/s10750-004-1463-4

[3]. Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., . . . Yanda, P. (2007). Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden , & C. E. Hanson, IPCC Fourth Assessment Report: Climate Change 2007 (pp. 433-467). Cambridge UK: Cambridge University Press.

[4]. Christensen, J. H., & Christensen, O. B. (2007). A summary of the PRUDENCE model projections of changes in. Climatic Change, 81, 7-30. doi:10.1007/s10584-006-9210-7

[5]. Christy, J. R., Norris, W. B., & McNider, R. T. (2009, June). Surface Temperature Variations in East Africa and Possible Causes. Journal of Climate, 22, 3342-3356. doi:10.1175/2008JCLI2726.1 District Development Office. (2011). District Annual Monitoring and Evaluation Report. Marigat District.

[6]. Droogers, P., Butterfield, R., & Dyszynsk, J. (2009, September). Climate Change and Hydropower, Impact and Adaptation Costs: Case Study Kenya. FutureWater Report 85.

[7]. Fauchereau, N., Trzaska, S., Rouault, M., & Richard, Y. (2003, June). Rainfall Variability and Changes in Southern Africa during the 20th Century in the Global Warming Context. Natural Hazards, 29(2), 133-159. doi:10.1023/A:102363092

[8]. Field, C. B., Barros, V., Stocker, T. F., & Dahe, Q. (Eds.). (2012). Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. Special Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

[9]. Funk, C. M., & Marshall, M. T. (2012). Mapping Recent Decadal Climate Variations in Precipitation and Temperature across Eastern Africa. In Remote Sensing of Drought: Innovative Monitoring Approaches (p. 331).

[10]. Giorgi, F., & Lionello, P. (2008). Climate change projections for the Mediterranean region. Global and Planetary Chnage, 63(2-3), 90-104. doi:10.1016/j.gloplacha.2007.09.005

[11]. Gitau, W., Mutua, F., Bauwens, W., & Githui, F. (2009). Climate change impact on SWAT simulated streamflow in western Kenya. International Journal of Climatology, 1823-1834. doi:10.1002/joc.1828

[12]. Hansen, J. W., & Indeje, M. (2004, September). Linking dynamic seasonal climate forecasts with crop simulation for maize yield prediction in semi-arid Kenya. Agricultural and Forest Meteorology, 125(1-2), 143-157. doi:10.1016/j.agrformet.2004.02.006

[13]. IPCC. (2009). Climate change, mitigation of climate change. Summary for policy makers. Working group 111 Contributions to the IPCC, 4th Assessment Report. Cambridge United Kingdom: Cambridge University Press.

[14]. Jury, M. R. (2013). Climate trends in southern Africa. Southern Africa Journal of Science(109(1-2)), 1-11.

[15]. Kharin, V. V., Zwiers, F. W., Zhang, X., & Hegerl, G. C. (2007). Changes in Temperature and Precipitation Extremes in the IPCC Ensemble of Global. Joournal of Climate, 20, 1419-1444.

[16]. Kjellstrom, E., Nikulin, G., Hansson, U., Strandberg, G., & Ullerstig, A. (n.d.). 21st century changes in the European climate: uncertainties derived from an ensemble of regional climate model simulations. Tellus A, 63(1), 24-40. doi:10.1111/j.1600-0870.2010.00475.x

[17]. Kotikot, S. M., & Onywere , S. M. (2014). Application of GIS and remote sensing techniques in frost risk mapping for mitigating agricultural losses in the Aberdare ecosystem, Kenya. Geocarto International , 30(1), 104-121. doi:10.1080/10106049.2014.965758

[18]. Lelenguyah, G. L., Kabochi, S. K., & Biwot, J. C. (2016). Pastoralists' Perception on the Trend of Various Climatic, Social and Environmental Variables in Baringo County, Kenya. Journal of Ecological Anthropology, 18(1).

[19]. Mainlay, J., & Tan, S. F. (2012). Mainstreaming Gender and Climate Change in Nepal. IIED Climate Change Working Paper No. 2. London: IIED.

[20]. Meza, M., & Laura, E. (2010). Drought risk management: Pilot study on vulnerability and local coping strategies. Options Méditerranéennes, 95, 175-185.

[21]. Ngaira, J. K. (2018, April). Challenges of water resource management and food production in a changing climate in Kenya. Journal of Geography and Regional Planning, 2(4), 97-103.

[22]. Nyong, A., Adesima, F., & Elasha, B. O. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. Springer Science & Business Media.

[23]. Orindi, V. A., Nyong, A., & Herrero, M. (2007). Pastoral Livelihood Adaptation to Drought and Institutional Interventions in Kenya. UNDP Human Development Report Office Occasional Paper 2007/54. Nairobi (Kenya). UNDP.

[24]. Richardson, J. L. (1966, January). Changes in level of Lake Naivasha, Kenya, during postglacial times. Nature, 209(5020), 290-291.

[25]. Rockström, J., Steffen, W. L., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., . . . Schellnhuber, H. J. (2012). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. Ecology and Society, 14(2), 32.

[26]. Sheffield, J., & Wood, E. F. (2008). Global Trends and Variability in Soil Moisture and Drought Characteristics, 1950–2000,. Journal of Climate, 21, 432-458. doi:10.1175/2007JCLI1822.1

[27]. Solomon, S., Qin, D., Manning, M., Averyt, K., & Marquis, M. (2007). Climate Change 2007 - The Physical Science Basis. Working Group I contribution to the fourth assessment report of the IPCC, 4.

[28]. UNDP. (2009). Resource Guide on Gender and Climate Change. New York: United Nations Development Programme.

[29]. WHO. (2002). Floods: climate change and adaptation strategies for human health. Report on a WHO meeting . London: WHO Regional Office for Europe

Otieno Caroline Marygorety Akinyi. ’’ The Trends Of Rainfall And Temperature In The Past 45 Years From 1971 To 2018 As Evidence Of Climate Change In Lake 94 Baringo County, Kenya” IOSR Journal Of Humanities And Social Science (IOSR-JHSS). vol. 23 no. 12, 2018, pp. 28-38.