DROUGHT MONITORING CENTRE-NAIROBI

Pilot Application Project

Traditional indicators used for climate monitoring and prediction by some rural communities in Kenya

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A CONTRIBUTION TO THE HARMONIZATION OF TRADITIONAL AND MODERN SCIENTIFIC METHODS OF CLIMATE PREDICTION IN KENYA

PREFACE

Climate variability, and in particular rainfall, has a large influence on the lives of the communities of many people in the traditional setup of Kenya who depend on rain-fed subsistence agriculture for their livelihood. Weather and climate has determined the way of life and the operation of the rural communities for many generations. Before the advent of modern scientific methods of forecasting, the traditional communities in Kenya were able to observe the behaviour of some animals, birds, insects and plants and use these to forecast the weather for the coming season.

Traditional forecasters recognized that some plants, birds, insects and animals are more sensitive to the changes in the atmospheric conditions than others including human beings. This knowledge have been accumulated and handed down to generations through oral traditions. The traditional methods of forecasting and the experience gained from observing the nature has made the headsmen to recognize that the indicators can often signify the beginning of good or bad weather and warn the villagers in good time. They have mastered the positions of stars, the sun and associated shadows and the moon, the wind strength and direction and the cloud position and movement and the lightning patterns Some clans have in fact developed and archived all the traditional indicators useful for their communities.

The traditional forecasters, sometimes referred to as “rainmakers” in some communities, are a highly respected group of people and continue to be held in high esteem by their respective communities. Some communities are even known to pay the traditional headsmen either using their produce or a portion of their animals. It was noted that when it comes to the issue of climate forecasting, the headsmen are given much more hearing by the local communities more than the district Meteorologists.

This project has tried to document some of the traditional indicators used by some communities in Kenya. It has been noted that these traditional indicators have high scientific value that could be integrated with the local climate information. This project has also enabled close interaction between the local meteorological community and the clan heads in providing climate information to the local people. Infact it was revealed that some of the clan heads use the climate information provided by the Meteorological Department through radio and TV broadcasts to enhance the information they provide to their members.

It has therefore been agreed that DMCN and KMD should work together to document he scientific value of the climate information being provided by the traditional experts and to educate them on the limits of the information that they provide to the communities.

I would like to thank the Director of KMD, Dr. Joseph Mukabana for the role he has played in this project and also not forgetting to thank NOAA/OGP for providing the necessary funds in support of this project.

Prof. L. A. Ogallo
DMCN Project Coordinator

FORWARD

Traditional climate monitoring and prediction methods continue to contribute significantly to the management of the various climates related activities in Kenya. Most of the rural communities continue to have strong belief and confidence in the traditional forecasts and rainmaking. The major cause in this strong belief is lack of understanding of the modern scientific weather and climate information and products and the mistrust that exists between the traditional forecasters and the climate scientists. The glaring gap between the traditional forecaster and the modern climate scientist and the recognition of the importance of weather and climate information for the enhancement of food security in Kenya, prompted the need to study the traditional forecasting methods with the aim of determining their scientific value and initiate collaboration with the traditional forecasters

The traditional forecasters can form a vital focal point for the dissemination of climate information and products to the rural communities using appropriate language easily understood by the communities.

The integration of the traditional information and local rainfall indicators can provide vital information for understanding climate variability in areas where meteorological stations do not exist.

This report contains the findings by the investigators on the traditional methods of rainfall forecasting including suggestions from two workshops held in Kathonzweni and Kisumu, respectively. This project came up with useful findings that will help to extend the study to other areas and also help to enhance our understanding of the scientific value of traditional methods. The project was intended to build a partnership between the climate scientists and traditional rainfall forecasters and rainmakers in Kenya with the objective of improving the dissemination and application of climate outlooks in the country.

The information available in this report creates a beginning point for understanding the traditional methods used not only for predicting seasonal rains, but also for managing associated disasters. Since this was only a pilot study, more studies need to be carried out in more communities to improve our understanding of the methods and incorporate the traditional ways into our modern scientific methods.

We thank the National Oceanic Atmospheric Administration office of Global Programmes (NOAA/OGP), USA, for providing the resources used in this study. Thanks are also due to the Drought Monitoring Center Nairobi (DMCN) for promoting pilot projects that go towards enhancing the use of weather and climate information in everyday planning of socio-economic activities by the general citizenry, policy makers and industry.

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EXECUTIVE SUMMARY

The climate has always remained the key to the settlement and development of humankind. Since time immemorial, life has revolved around the type of climate of an area. In the tropics, where the weather is warm and humid, the type of dressing did not require heavy clothes unlike in the high latitudes where heavy dressing was required due to the prevailing cold conditions. The communities had to learn to cope with climate variability. They had their monitoring methods, which were passed from generation to generation. The predicting indicators included the nature around them such as plants, birds, animals, insects, stars, the moon, winds, clouds, lightning patterns and temperature amongst many others.

Through careful and consistent monitoring of the climate, humankind continued to live with climate related natural hazards. The slow technological developments in Africa sustained these methods and are still extensively used in most parts of the continent including Kenya. The methods are still given prominence, making it difficult to promote the use of climate outlooks generated by the Drought Monitoring Centre, Nairobi (DMCN) and the Kenya Meteorological Department (KMD). The traditional forecasters are still the major source of weather and climate information for farm management in the rural areas.

The major objective of this project was to determine the indicators used in parts of Kenya and make an attempt to establish their scientific interpretations. The current pilot project involved studies of Luo, Abasuba, Abaluya and the Akamba communities. The Luos and Abasuba of Nyanza Province experience two major rainfall seasons during the months of March – May (long rains) and October to December (short rains). The most reliable season is March – May. For the Abaluyhas of western Province, the rainfall is received almost throughout the year with peak rainfall in March – May, June – August and October – December. The Akamba community of Eastern Kenya experience two major rainfall seasons in the year, one during March – May and the other in the period October – December. The most reliable season is October – December.

The communities have mastered the traditional indicators, which include plants, animals, insects, birds, stars, the moon, the wind the temperature, clouds and lightning patterns. Amongst the Abasubas and Luos the strength and direction of the wind, the frequency of a westerly driven swarm of insects (Sam), the position and direction of the movement of rain clouds and the conditions of some plants form a major indicator of seasonal rainfall performance. The frequency of water sprouts (twister) over Lake Victoria is also a major indicator of seasonal rainfall performance. For the Abaluyha community studied in this phase of the project, the major involvement is with the" rain making".

The Kanganyi clan of Bunyore in Vihiga district has an association with a traditional office whose major concern is to make rain for the community. They are respected members of the clan. Before they "make the rain," they study the wind, cloud patterns, conditions of some plant species and the behaviour of some snake species. The Abasuba communities of Guasi and Mfangano still believe in traditional "rainmaking." Similarly the Abaluhya and Luo communities also still believe in traditional rainmaking.

The Akamba community monitors the wind, position of the sun and the associated shadows, plants, insects (bees in particular) and animals to predict the seasonal rainfall performance and onset. The major season of interest is October – December rainfall season, which is the most reliable in the area and is monitored in anticipation of much of food production.

The result indicated that the traditional methods are still widely used amongst the communities and had some relationships with the modern scientific methods. The results also indicated that the indicators are local and vary from community to community and location to location especially as regards the prominence of an indicator. This variation calls for more studies to map out the indicators used by each community and their scientific interpretations.

There is also a need to monitor the potential indicators so as to establish the scientific interpretations and their potential in predicting weather/climate. It is important to note that the indicators helped the community to mitigate disasters by using traditional methods of preserving food and farm practices. The farm practices included growing drought resistant plants. The communities were very interested in working with the modern climate scientists and requested for more workshops to enhance the collaboration.

1.0 INTRODUCTION

Climate variability has a large influence on the lives of the communities in Kenya. The climate elements with the largest influence are rainfall and temperature. Rainfall is, however, the single most important element for the activities of the many of the Kenyan communities who depend on rain-ed subsistence agriculture for their livelihood.

The human being has lived with and experienced climate related disasters throughout the time of his existence. Climate might have been more cruel and hostile in the past millions of years than it is today. Many animals must have perished during that time but man lives by culture rather than instinct in order to remain alive.

Kenya has two major rainfall seasons experienced in a year with one occurring in March-May (long rains) and the other in October- December (short rains) (EAMD, 1962). However, the western Highlands and Coastal areas receive significant rainfall during the period June – August. The failure of a rainfall seasons, as was experienced in 1984, 1999 and 2000, has adverse impacts on the communities in Kenya and at certain times leads to large loses of lives. The excess rainfall, as was experienced in 1961 and 1997/98, also affects the well being of the communities and at times leads to loss of life and damage to property and infrastructure. This significance of rainfall made the communities in Kenya, as was over other parts of Africa, to develop their own traditional methods to monitor, predict and even "make rainfall."

Before the advent of modern scientific methods, the communities in Kenya They must have realized that some animals, birds, insects and plants had the capacity to monitor and detect the changes in the atmospheric conditions and learnt their behaviours as a way of predicting the future climate. The level of human cultural development corresponds to his suffering when a disaster strikes. More people, living in high towers perished when earthquakes occurred than did those of a population with low level of cultural development. Equally, populations with low-level technological cultured development learnt much from the behaviour of plants, animals and insects with high body sensitivity and instincts. They also mastered the positions of stars, the sun and associated shadows and the moon, the wind strength and direction and the cloud position and movement and the lightning patterns. The knowledge about past disasters and climate in Africa are the accumulated experiences that have been handed down to generations through oral traditions.

The "rainmakers" were highly, respected and continue to be held in high esteem, respected people by their respective communities. It is important to understand how they could monitor and predict rainstorms, windstorms, earthquakes, lightning, drought or seasonal rains. The traditional cognitive act is that rain could be perceived, cold or strong wind could be felt, movement of clouds could be seen while thunder and lightning could be heard and seen, respectively. Older members could feel the changes in atmospheric conditions before the eyes and ears could detect anything. Traditionally humankind must have realized that plants, animals, birds and insects are also affected and could feel changes in atmospheric conditions much earlier. Traditional forecasters recognized that some plants, birds, insects and animals are more sensitive to the changes in the atmospheric conditions than others including human beings. They began to depend on their early behaviour and movements. They also recognized that in every season, some trees shade off their leaves and they marked these trees and periods.

They further mastered the position and organization of the strength and direction of wind, the position of the sun and the associated shadows, the patterns of lightning, the conditions of swamps, temperatures as felt by the body and position and movement of clouds. It was through these cognitive acts that marked the sources of traditional knowledge and experience we are beginning to record in Kenya. Sometimes, curiosity and long time observation of what happens around us is what we normally call experience because nature has the habit of repeating itself.

The main objective of the study is to record traditional weather/ and climate monitoring and prediction indicators and establish the scientific interpretation to harmonize them with the modern scientific methods. The study also aims at learning the terminologies used by the traditional forecasters so as to improve the dissemination of seasonal climate outlooks to their respective communities. The study recognized that the rural communities, who continue to rely heavily on traditional methods and climate outlooks may only understand and interpret the terminologies used by the traditional forecasters.

2.0 METHODS USED IN THE STUDY

The methods used in the study include individual interviews, workshops and statistical analyses. The video recording of sessions and interviews was also utilized in information gathering. The ages of people interviewed and participated in the workshops ranged between 40 and 90 years. This age group included the elders of communities who are charged with the responsibility to signal all farming activities for their communities. Themes and probing questions were prepared in advance and the participants were guided in the discussion. The discussions were very interesting and stimulating than was expected, and elders discovered that they had useful knowledge that would be interesting to the people using modern scientific methods.

3.0 CLIMATE AND OVERVIEW OF NATURAL DISASTERS AFFECTING THE COMMUNITY

The communities studied in this pilot project are involved in farming and fishing. The communities grow a few crops and keep animals. Both activities, farming and fishing, are affected by weather and climate. The most common weather and climate related hazards affecting the communities are floods, drought, strong winds, lightning and frost. The temperature of the lake water influences fish movement and the communities along the Lake Victoria shore have mastered to monitor the water temperature by putting their legs in the Lake in the morning and at night. Others also use the temperature of drinking water kept in the pots as away of monitoring the overall atmospheric temperature. The communities use the Lake as a source of fresh water, for sanitation fish and as a means of transport. A number of times the communities face climate related hazards, which at times become disasters. Boats frequently capsize in the lake and Lives are lost. Due to the influence of weather/ and climate on life supporting activities, the communities have mastered some indicators to enable them live with the weather and climate related hazards. The failure of a rainfall season has adverse impact, which include hunger and starvation.

Excess rainfall is associated with over swelling of rivers Kuja, Migori, Yala, Miriu, and Nzoia, among others, which overflow their banks causing damage to neighbouring villages and flooding in low lying areas such as Kano plains near Kisumu and Budalangi in Busia. The strong winds are associated with loss of life and damage to property and destruction to infrastructure. Figure 1 a gives sample of a destruction associated with strong winds.

Fig.1a. a banana plantation destroyed by a twister (tornado) in Kajulu (Kisumu) in January 2003.

Fig.1b: A Fruit tree destroyed by a twister (tornado) (Nyakoi) in Kajulu (Kisumu) in January 2003.

The Luos, Abasuba and Abaluhya live in the Lake Victoria Basin and the surrounding highlands. The low altitude areas of the Lake Victoria Basin experience two major rainfall seasons, March – May (Long rains) and October – December (Short rains). The "long rains" are the most reliable in the low altitude areas of the basin. The neighboring highlands have rainfall almost throughout the year with the peaks in March – May, June – August and October – December.

Due to the importance of weather and climate to the communities around the Lake, the communities had to develop traditional methods for monitoring and predicting weather and climate. The sailors had to master the winds over the Lake. These communities also believed in "rain making" and capability to influence lightning as an inherited and spiritually provided talent.

The weather and climate-related hazards frequently affecting the Akamba community are droughts and floods. The study addressed the Akamba of Kathonzweni Division, which is in Makueni District bordering Athi River and Yatta Plateau on the eastern side of the country. Its elevation of the ranges Yatta or Nyika plateau from 790 m to 1120 m and the mean annual rainfall is 600-700 mm with a bimodal distribution.

The Short rains (October-December) are more reliable and account for 49% of the annual total compared to the Long rains (March-May) which are unreliable and account for 37% of the annual total. Rains during the Short Dry season (January-February) account for 10% of the total and are critical for the success of biennial crops (e.g. pigeon peas, cowpeas, and pumpkins). The mean annual average temperature is in the range 21.6-24^{o}C.

The soils are of the Yatta or Nyika plateau developed from undifferentiated Basement System rocks (ferralo-chromic/orthic/ferric Acrisols, with Luvisols and Ferralsols). They are composed of well drained, moderately deep to deep, dark red to dark reddish brown, friable to firm, sandy clay to clay with topsoil of loamy sand to sandy loam in most places. The division is in ecological zone LM5, a livestock millet zone. Crops grown are short duration maize cultivars, beans, green grams, sorghum, cowpeas, pigeon peas and millet. The livestock carrying capacity is 2.8-5 ha/LU on mixed short grass savannah or bushland, where buffel grass (cenchrus ciliaris) and horsetail grass (chloris roxburghiana) are predominant.

The environment is generally harsh and farmers are naturally inclined to take keen interest in rainfall behaviour, considering that most of the agricultural production takes place during the more reliable Short rains. Thus, farmers have more than a passing interest on indicators that would help them to increase their preparedness for the rains. Like the Luo, Abaluya and Abasuba of Lake Victoria basin, the Akamba communities have mastered indicators to monitor and predict rainfall.

Due to some differences in the indicators used by the respective communities, the indicators are discussed for each community

4.0 TRADITIONAL RAINFALL INDICATORS USED BY COMMUNITIES IN KENYA

In this study, the communities considered are the Luo, Abasuba and the Abaluhya

4.1 Traditional indicators among the Luos, of Kisumu District

Among the Luo community, the rainfall indicators used include plants, animals, insects, wind, clouds, temperature, stars, the moon, and wetlands (thidhya). The indicators and their signs are listed below.

4.1.1 Plant indicators

A number of plants are used as indicators. They are listed below.

- Manera (*Terminalia brownii*) is a tree, which normally grows very big and shades the leaves to signal dry conditions.
- Ngowo (Ficus sur) drops its leaves twice a year.
- Waa (Tamarindus indica) also drops/ shades its leaves twice a year
- Yago (Kigelia africana) drops/ shades off its leaves thrice a year
- Ober (Albizia coriaria) shades its leaves once a year
- Saye (Acacia gerrardii) shades its leaves twice a year

- Bongu (*Ficus ovata*) shades its leaves twice a year
- Opok (*Terminalia mollis*) shades its leaves once a year
- Amboro shades its leaves twice a year
- Juelu shades its leaves twice a year.
- Olemb-ajwa and Olemb-ochok bloom their flowers twice a year
- Ruga shades its leaves once a year.
- Ochuoga (shades off its leaves twice a year showing both long and short rain seasons)
- Siala shades its leaves thrice a year, but others maintained that Siala shades its leave only twice a year.

Fig.2: The tree used by Nganyi rainmakers to monitor rainfall.

The shading of leaves is an indication of water stress associated with dry conditions. The trees shade the leaves to reduce evapotranspiration and would put on the leaves when the rains approach. Some plants used to monitor seasons include:

- Maup pap (Zephranthus) is a "field flower plant" the Amaryllis family that appears a week or two before the rains storm is an indicator of rain – but both may disappear for long as the number of years of dry season may last. These blossoms and plants appear white when there is plenty of rains and pinkish during a duration of rainfall deficiency.
- Awuor-awuor is one or two lived clover, which share the name with the insect usually found in the shade buried under the dust also called "Awuor-awuor". This plant though grows under the tree shades, will dry up by a one-day cold wind, suggesting a weather change.
- Otonglo seasonal plants are available during wet/ rainy seasons and Ayila/ Aila plants are very abundant during the long rains/ wet season, and are also common along the riverside or hilly bushes. The Ayila plants are only in abundance during the long rainy seasons and appear for a short time during short rainy season.
- Ruga - falling of white flowers.
- Yuoma (Erythrina excelsa)
- Orembe – when it starts shading off red flowers, the planting season would commence because the wet/ rainy season is just about to start.
- Oluoro chieng' (a shrub) as the name suggests occurred only during wet/ rainy season and dry up quickly during dry season.
- Awayo eaten by children grazing is also seen only during rainy season
- Maup-pap (Rhamphicarpa) commonly found in Angugo plain and between Ong'oche and Othoch-rakuom and between Nyatike and Ong'er comes up with the slightest sign of rain.
- Anyim, the seed may stay in the soil for years when the rainfall is not sufficient for it to grow.
- Nyaite agwen (four leaved clover) or Nyaite abich (five leaved clover) are seasonal Cloves.
- Obwanda is another seasonal vegetable that are never seen during dry season, sometimes even during short rain season.
- Ochol and Ondati are trees known for their slow growth.
- Nyabend-winy grows only in wet bushy places. It requires a lot of shades; can disappear when the bushy places also disappear.
- Nyalwet-kwach is a shrub, usually used as medicinal plant, but is disappearing first because of burning of forests. Kasigo-jaleny-thee (is a plant which share the name with oil pot) and Odo-do are also sensitive to dry weather and dry up early even before the rain disappears completely.
- Nyabend-pi (blue lotus or water lily) is interesting in that unless the season has changed and rain has come it will never blossom despite the fact that it grows in the water.

4.1.2 Animals

Certain seasonal cries of birds were believed to be communicating messages of changes in weather/climate. This birds include the Hundhwe (*Robin chat*), Kalanini and especially Kow-wach the night bird which has a sharp long cry. Both Kalanini and Kow-wach usually disappear for several months and only reappear when a season begins. It was also confirmed that some birds change their cry every season.

The absence of frogs and toads indicates dry season and during the dry season frogs seldom croak. – When frogs stopped croaking during the rainy season even when it was still raining. It was also an indication for the disappearance of rain. The African elders and "rain makers" would begin to inform the people of the impending dry season. The frogs stopped "playing around" and begun digging themselves deep into the mud when the soil was still wet.

The presence of snakes and other reptiles and at times wild animals around houses and homestead in search of water and food showed the prevalence and continuity of a dry spell.

During the rainy season, daily rainfalls were predicted by the changing songs and cries of the Robin chat – *Cossypha caffra* or Semirufa (Hundhwe). The presence of Aluo Aluo (a long necked bird) that could be seen once in a while during the rainy season, showed a reduction in rains; thus its presence indicated changes in weather showing that the end of the season was soon to be experienced. The following are birds which were mentioned as indicators of wet / rainy season.

- Opija (*Hirundo abyssinica* and *Hinindo smithic*) are common swallows with circular movements in the sky when rain is forming and when wind is blowing it towards the settlement or homestead.
- Agak (*Corrus albicoelis*)
- Ogungo (ibis)
- Nyabalakwasi and Koga are birds which fly very high above the clouds, therefore could feel moisture from a distance – they acted like the "African aerial" to detect rainy season was approaching.
- Tel tel and Ondiek ti ochiem were said to ask questions like "Why don't you plant?| or "Dak ti ukom? which means the rains were now there for the preparation for planting/ weeding.
- Ang'etho (a bird which looks like an eagle) was heard crying around the rivers, it showed that the rains were soon starting. Its cry was like an alarm to be ready for rains.
- - The presence of the Okok bird in the fields also indicated that soon the rainy season was ready, thus showing the rains would continue.
- Kalanini (koth chew-chwee) bird reminded people that rains were near and they should start preparing for it.
- Magungugungu birds when seen hovering and flying over the area would indicate planting season/ rains were in process. The other birds used as indicator of seasons include:
- Nyakwadha birds
- Kerende birds
- Gwer gwer birds
- Oteko (dek tin) birds
- Mire
- Tutu-ted akwacha

4.1.3 Insect indicators

- The presence of Aguyo (butterfly) presence in large numbers created controversy; some members argued that their presence act as an indicator for drought continuity whereas others argued the opposite.
- Safari Ants also acting as an indicator of seasonal change created controversy; some elders argue that Safari ants and termites curry food and store it just before heavy rains start, while others argued that ants would carry food and store before the onset of dry season.
- Chwer Ngwen (termites) showed the reduction of rainfall and the approach of drought.

There are five types of army ants (Ngini-ngini) that are used as indicators. They include:

- Katalang' – black large poisonous ants
- Tho-morno – red large ants
- Omonyio – medium size ants rather harmless
- Ong'ino – small red ants
- Ong'ind kombe kombe – the large dark red tree ants.

These ants' movements are good indicator of wet/ rainy season approaching and when transporting food or their eggs is a clear indication of the closeness to a rainy season. However, there are controversies on the particular season the ants transport their food and eggs.

- The presence of Agoro ants signals a sign of continuous rain season.
- The appearance of Oyala ants sometimes shows no rains on that particular night; however, rains are still falling
- The appearance of Onyoso ants showed continuity in rains.
- When Kungu (Armyworms) appear, people long for rain, which would normally make them grow quickly.

All the above are known insects associated with rains or wet season. When dry season approaches only ants and butterflies are seen frequently.

4.1.4 Wind, Clouds and Temperature

Mzee Tobias Otieno asserts that the direction of strong winds noticed in Achuth hills blowing strongly from Maasai hills towards the Lake during afternoon further indicated dry period were to follow. The entire group members agreed, "A lot of wind with dust covering the air shows a dry spell was to continue coupled with hunger".

The direction and strength of wind is used by the communities to mark the beginning of rains and possible performance. The whirlwind(Kalausi-in Nyanza) is a clear indicator of approaching wet season. However, strong easterly winds (Komadhi) marks dry spell and in years when it sustains itself beyond March the communities in the Lake Victoria basin expect a poor March-May rainfall season.

4.1.5 Stars and the moon

Some elders mentioned the movement of stars in relation to weather and the change of the seasons. The constellation (yugni) was identified as yugni-machwo (orion) and yugni mammon (the sisters). They represent the male constellation and the female constellation. They are several in numbers. The female stars are usually many but we can see only 7 of them; they move from the East to the West followed by the male yugni (six stars). Their appearance from the East showed a decline in rains thus showing the start of the drought. It appears from the discussions that female constellations indicate the season of cultivation and appearance of male constellation was associated with the beginning of dry season or harvesting. A particular star called "Rip" when seen showed a dry spell/ drought could follow or come soon. The position of April, milk-way at a particular season is remembered by elders. They say Arip (milky-way) appears to be crossing the sky from North to South. Some elders suggested that Arip keeps on changing its position every three months, suggested some elders.

4.2 Traditional rainfall indicators among Abasuba of Mfangano, Rusinga and Gwasi

The Abasuba community is settled on Islands (Mfangano and Rusinga) in Lake Victoria and the highlands next to the Lake (Gwasi). Their seasonal weather and climate indicators include plants, animals, insects, wind, clouds and temperatures among others. The presence of low clouds or fog in the morning in (Migingo Island) in Lake Victoria and the Huma hills in Rachuonyo District on the shores of the Lake indicated that it would rain sometimes in the course of the month or weeks. Other indicator includes the formation and movement of clouds on specific hills and in specifies direction.

4.2.1 Plants

The plants used by the Abasuba community have large similarities to those discussed under the Luo community. They only differ in the naming. Hence, the trees covered under the Luo community indicators are also used by the Abasuba and shall not be repeated here.

4.2.2 Animals

The birds called Magungu in Suba language form one single major indicator. They mark the closeness to rainfall onset and signal for speeding up land preparations. These birds pass from south to North during the period February/March. They fly very high without much effort. They seem to float in the air. The birds might be associated with the movement of the Inter-Tropical Convergence Zone (ITCZ). The Lake Victoria basin falls in the area of deep convection, which might explain the cause for high flights. Another indicator commonly used among the communities is the frogs and toads, whose appearances indicate the improvement of the moisture in the atmosphere and the closeness of the rainfall onset.

A black eagle called in the local language Koga is the best indicator of changing weather because it can go higher in the sky than any bird". Like plants, the Abasuba also uses a number of animals used by the Luo community.

4.2.3 Insects

The appearance of a swarm of insects (Isami in the Suba language) moving from the West to East is a major indicator of rainfall onset and performance. The frequency and the density of Isami indicate whether the season will be good or not. The year when the isami is late and less frequent is associated with late onset and rainfall deficiency. The high frequency and density is associated with a good season. Studies have indicated that deep westerlies are associated with good rains in western Kenya (Mukabana and Pielke,1993; Anyamba,1983; Okoola, 1996). The other authors who have looked at the influence of wind on rainfall in the region include Agumba (1985) and Camberlin (1997).

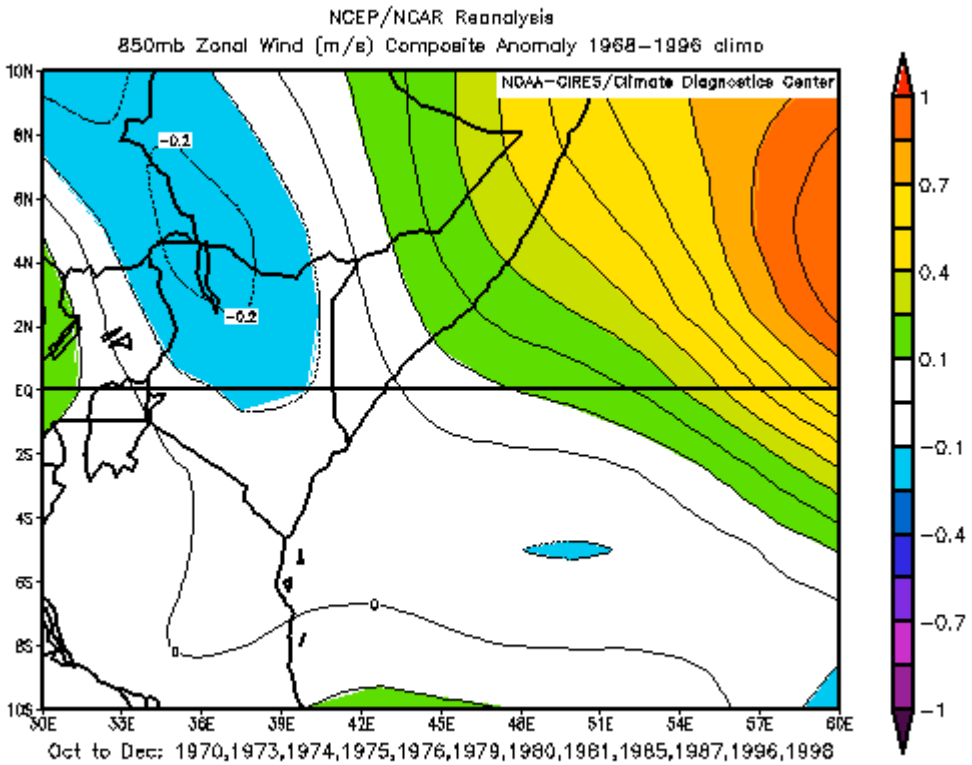

Fig: 3a. Zonal wind composite anomaly for the dry October-November – December (OND) years in Kenya as listed.

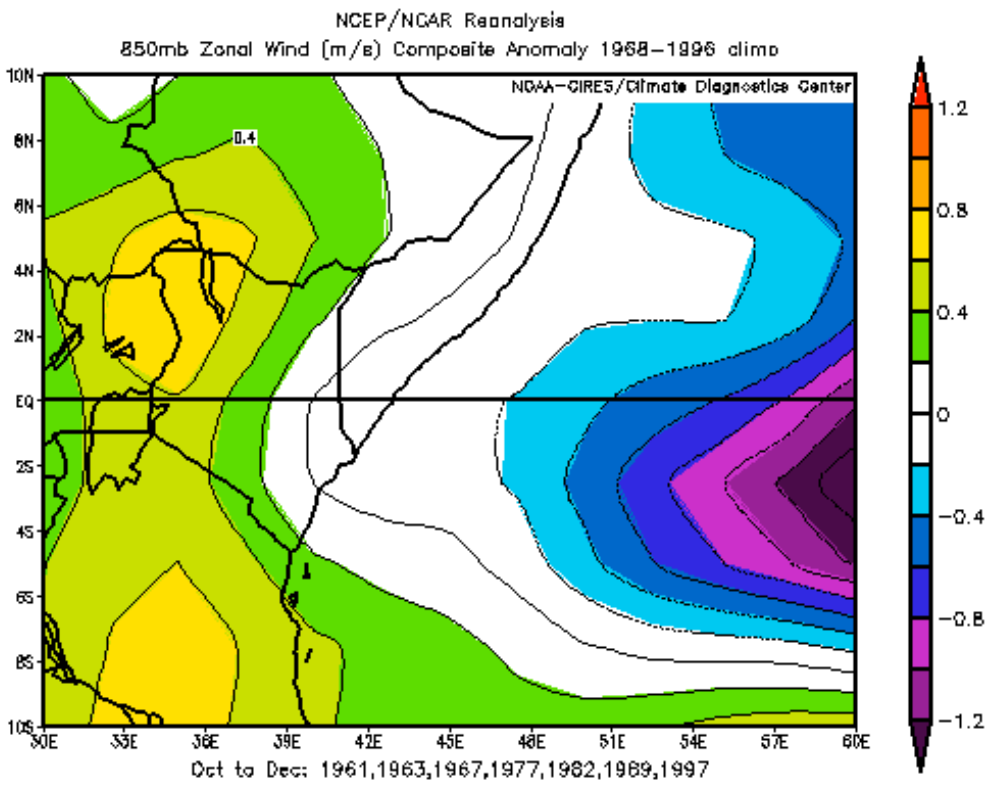

Fig: 3b850HPa Zonal wind composite anomaly for the wet October-November- December (OND) years in Kenya as listed.

The frequent and dense westerlies are indications of a well development moist airmass from the Congo Basin, which has a high influence on the rainfall of western Kenya and the Lake Victoria Basin.

The spider is another indicator of seasons. It is associated with the occurrence of Isami. They fix their webs across the wind to trap isami (the insects). Frequent spider webs are an indication of a good season. Similar approach is used in Mozambique to determine the strength of the monsoons by the traditional forecasters (through personal communication). The distinct patterns of zonal wind anomalies associated with dry (fig.3a) and wet (fig.3b) spells continue to confirm why the traditional forecasters and "rain makers" use wind direction and strength as a rainfall indicator. Further studies need to be carried out to address the potential of wind as a rainfall indicator.

The Abasuba communities also use red ants (Masanduku), which only appear when the moisture level of the atmosphere is improved. They mark the closeness of the rainfall onset.

4.2.4 Winds, Clouds and temperature

The mainstay of Abasuba is fishing. Being frequent sailors, they have mastered the winds and cloud movements. They also use their traditional methods to monitor the Lake water temperature. The cold Lake Victoria temperatures are known to signal dry conditions. The Abasuba Suba know so well that if the easterly wind (Ekomanzi) continues beyond mid-March into April, there would be a likelihood of rainfall deficiency in the March-May rainfall season. The same signal is used for October- December rainfall season. Figure 3 provides a clear distinction in the wind anomalies associated with wet and dry conditions in Kenya for OND rainfall season.

They also know that the formation and movement of clouds are significant to monitor and predict rainfall occurrence and performance. There are specific locations, which if frequented by clouds and lightning would signal a good rainfall season. The other indicator of rainfall performance is the frequency of water sprouts on Lake Victoria. The rainfall is expected to be abundant in years when the frequency of the water sprouts is high.

The unusual heavy rainy seasons are expected to be followed with a rainfall deficient season or drought. It is this time that elders give advice to the people to plant drought resistant plants such as budho (Pumpkin), Boo (Cow peas), Omuogo (Cassava), Sweet potatoes, Millet and sorghum. The elders mentioned that it was very important to plant the above-mentioned food crops as "food security" comes the dry season. The extreme rise in temperatures, continuous clear blue sky with little or no cloud cover at all would indicate prolonged dry period.

4.3 Traditional Indicators Among The Akamba of Kathonzweni Division of Makueni District

4.3.1 General

Farmers in this community mentioned a pool of twenty (20) rainfall indicators (Table 5) used at different stages of the rainfall season. Plant indicators make 60% of the pool and mainly indicate the rains are about to start, thereby giving farmers opportunity to plan farm activities, especially farm preparations and planting. Figure 1 – 3 shows some plants used to monitor and predict rain.

Animals form 15% of the indicators and seem to apply when the rainfall season is in progress. The noise they make tell farmers about the nature of the rains already in progress. For example, the sharp cries of the millipede indicate the rains in progress are likely to fail. Twenty percent (20%) of the indicators are scientific (meteorological to astronomical) in nature, even though the logic employed in interpreting their meaning may not be strictly scientific. An interesting indicator is Muoni River (Table 1, No. 10). This local river was claimed to indicate rainfall failure if it flooded before the start of rains. This river originates in highlands located on the western side of the low-lying study area. This pattern is likely to indicate that enhancing of convergence over the western side of the area would result in rainfall failure in the low lands. Since the area is in the easterly wind region enhanced convergence to the west would enhance the easterly winds, which would accelerate and create low-level divergences and swallow cloud development.

As can be seen in Table 1, some indicators e.g. *adansonia digitata* and *asparagus africana* are used only for the "Short Rains" season, while others (e.g. *acacia mellifera*) are used during the "Long Rains" season and yet others are used for both seasons, e.g. *acacia tortillis* and the cluster of 6 stars.

The indicators are listed in Table 1 below together with their associated indicator characteristics. Unfortunately, some indicators are given in either common or vernacular names due to lack of scientific identification.

It came out from the workshop that farmers from Kathonzweni have several indicators for rainfall onset and the quality of the rainfall season.

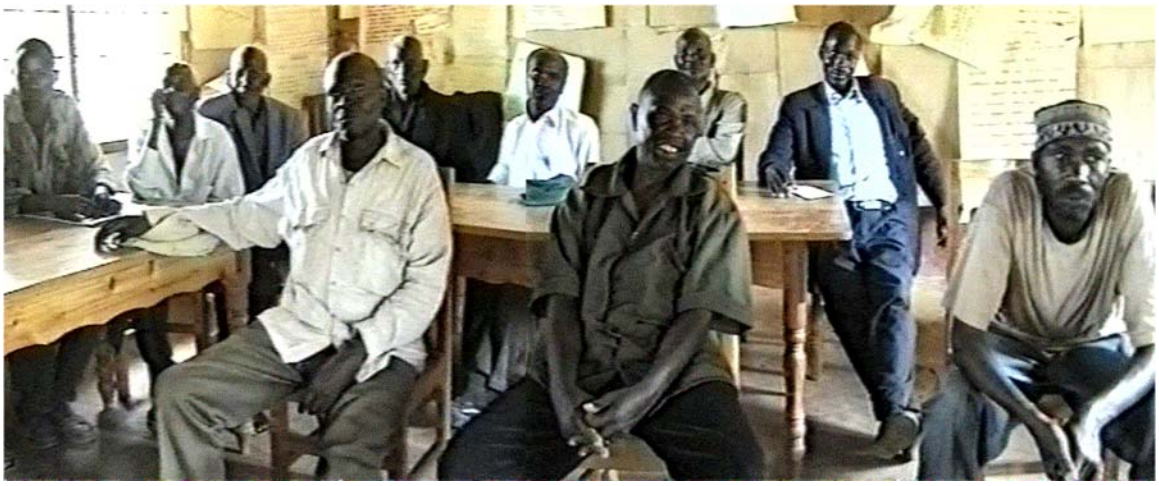

Fig.4: A section of participants at Kathonzweni (Makuweini) workshop during a discussion on the traditional indicators among the Akamba community.

No less than 5 different types of indicators are used by farmers in Kathonzweni. It is regretted that some names for the indicators are given in local vernacular (Kikamba) for want of appropriate common English or botanical names. The following were the indicators used:

- Trees
- Position of the setting sun
- Passage of Bees
- Certain birds
- Minzai (a flying insect)
- Clouds and Lightning
- Hill shadows
- Heat/Temperature
- Frogs
- Wind
- Streams/Rivers
- Livestock excitement
- Dust devils
- Star clusters (kiemea)

The indicators may further be categorized into five broad groups as follows:

- Plant indicators (trees).
- Meteorological indicators (sunset, clouds, lightning, heat/temperature, wind, dust devils)
- Animal indicators (insects: bees; minzai; birds; frogs; livestock excitement)
- Astronomical indicators (hill shadows, star clusters)
- Hydrological indicators (streams/rivers)

The farmers believed that the indicators had given the correct signals for the nature of rainfall they were receiving. However, the validity of this statement can only be established if the farmers are interviewed before the rains because memories fade fast and are usually replaced by current experiences if there are no records to fall back to. Up to the day of the meeting, the two birds, Ivutavuti and Kanyange (Table 1, indicator nos. 4 &18, respectively) were reportedly giving correct signals indicating the rains were not over (Ivutavuti, no.4) and the rains would be good (Kanyange, no. 18). No cries of the millipede had been heard to suggest rainfall failure.

4.4.2 Indicators for the Long Rains Season of 2003

The participants stated that they had already seen and were still seeing indicators that the forthcoming "Long Rains" of March – April – May (or MAM) were near. The indicators mentioned were the following:

Heat/Temperature: The intense heat being experienced up to the time of the meeting was a clear indication that the rains were near. On the day of the meeting, it was so hot some of the participants stated that the day would not end before it rained. Sure enough, there was a short but intense downpour in mid afternoon during the meeting!

Lighting: Lightning had already been sighted at Ngundi Mwita on the Yatta plateau.

Precursor rains (Ngalule): Normally, there are precursor rains which come during the Short dry season (Jan-Feb) and mark the end of the "Short Rains" growing season. They are characterised by lodging of crops. If they are late in coming, they become precursors of the "Long Rains" and if they are heavy, most farmers start planting for the "Long Rains" season.

These rains had not come and the expectations were for good "Long Rains" since they would not have been weakened by the precursor rains.

Winds: Winds had backed to a North Easterly direction. The early backing of wind is considered an indication that the rains would be good.

5.0 TRADITIONAL RAIN MAKING

"Rainmaking is still" prevalent among some communities of Kenya. In this study, some rainmakers were involved. In this study, discussions were held with the Nganyi Rain Makers Association and the individual rainmakers in Suba District.

5.1 The Traditional "Rain making" among the Abaluhya of Bunyore in Vihiga District

The notable rainmakers in Bunyore are the Nganyi family. Members of the Nganyi clan are renowned rainmakers among the Abaluya and the Luo communities. The capability to make rain is inherited in the family. The group Nganyi elders indicated that they can make rain, stop rain and even use rain to punish those who have no respect for them. They have an exclusive forest a shrine where a huge snake, used as an indicator of moisture levels in the atmosphere, lives. The shrine has particular tall trees, which are used to monitor and predict rain. The Nganyi rainmakers have mastered the winds and associate good and bad rainfall seasons with particular wind direction.

Fig.5: Prof. Laban A Ogallo-DMCN Project Coordinator(Third from left) and Dr Joseph R Mukabana, Director KMD(Sixth from left) during a visit to the forest shrine of the Nganyi rainmakers.

The Nganyi elders indicated that prayers to their ancestors precede the rainmaking process. Sometimes during the rainmaking, the wind calms and changes direction to a source favorable for rainfall occurrence in the area. The rainmakers use nature to monitor and choose an appropriate time to make rain. A visit to the shrine of Nganyi and discussions with elders who are the heads of the rainmakers association, revealed that the tradition is still very popular in the community

The rain making facilities included:

- Sacred trees
- 3 stones
- Special rain herbs
- A hole
- A chicken
- A sheep
- A pot
- Water
- A goat
- Reeds

To make rain, the Nganyi group would:

- Wake up early in the morning and go to the secluded Nganyi forests (sacred shrines) and sit under traditional trees and begin praying by invoking their ancestral rainmakers facing the Nganyi hills.
- Place three stones under the tree after prayers
- Collect the herbs.
- Place a pot in the hole and put a chicken or sheep/goat meat together with the herbs (which they ceremonies with invoking their ancestors and later eat)
- Use special reeds to blow into the concoction in the pot.
- Send either a virgin girl to the river that would draw the water for making rain, walk home naked while carrying water in a pot without a supporting ring. The girl should be below puberty age and should never look back as she is carrying the water to the shrine lest she is struck by a bad omen. This girl would later be rewarded by being given a chicken or goat.
- Put this water into a ceremonial pot.
- Use reed pipe to suckle and blow the water inside the pot.
- Pray from 2.00 – 3.00 p.m. and be checking inside the pot for changes in colors of the bubbles. The following colours of water bubbles from the pot shall be a indicator for the intensity of the rains:

⇒ Red – they forecast there will be a problem
⇒ White – Normal Rains
⇒ Black – Abnormal rains.

The shrines are preserved and no wood can be cut or collected from the place. The belief is that the wood from the shrine can bring a bad omen to the family and community. This contributes to environment conservation.

5.2 Traditional Rain Making Among the Abasuba Community.

In Suba District, we interviewed people involved in rainmaking. They included Mama Dorcas, Mr. Barack Thango Mino and Mr. Adiel.

5.2.1 Rain maker - Mama Dorcas

Mama Dorcas was born in 1928. She inherited the power of "rain making" from her parents who died when she was a very young girl. She also has the power of healing and preventing bad omen. When the area experiences some dry season, she has to be contacted and persuaded so that she can talk to the ancestral spirits for good luck to come. After talking and applying some herbs (concoction) she has to wait for some days (about two weeks) and during this period the only sign or indicator experienced is a very warm night and sweating. After all this waiting there must be some rainfall. She also claims to have the power of stopping rainfall at any given time. She can just uproot whatever she planted and the rain stops right away. She also has the power to stop lightning.

Fig.6a: Mama Dorcas from a side view.

Fig.6b: Mama Dorcas in a rain making regalia from a back View.

In order for her to make rains or control lighting strikes a group of elders must gather together and pay her some price (normally a cow or money) Her medicine is then applied in the area where the meeting is held. To make rain sometimes involves planting a specific plant (herb). The herbs have to be placed in a place where the old men in that area agreed. When doing this all the women and children in that area must avoid being in that place. The procedure is as follows:

She comes with the medicine (concoction) and she has to send someone to fetch water using a pot or plastic container. When the individual is going to fetch water, she/he is not allowed to look back until she/he reaches the lake/well. After fetching the water he/she is not allowed to look back until he/she reaches the shrine. After delivering the water to the shrine, the rainmaker has to apply the medicines before the crowd that is composed of the most respected old men in the community. When doing this, a very holy calf must be slaughtered for the group to celebrate without cooking ugali (a form of bread resulting from a mixture of water and maize/millet flour).

The goat meat has to be roasted and eaten there without any piece being carried home. Application of the herbs has to be done by the rainmaker herself. When she is applying the herbs someone must have a hollow pine. Normally, they use a hollow reed to blow that water until they see some bubbles with some signs of the rainbow. At this point, the rainmaker has to talk loud to the spirit of the ancestors and the same time continue to apply the herbs, which include green leaves of a particular plant and a black concoction.

After doing, this everyone is supposed to go back home with the hope of seeing rain within three days.

Within those three days the rainmaker experiences a very warm night and sweat breaks out on her body the whole night. When the sun rises, she feels no sweat and this has to repeat itself for three consecutive days until it rains on the third day.

Mama Dorcas also indicated that she could stop lightening. In order to accomplish this fit, Individuals must offer some money for their homes not to be struck by lightning. This she does by planting a preventive medicine in the middle of that home and some on top of every house including granaries. After this exercise there is assurance that no lightening would not strike that home including all living things in the home

5.2.2. The Rainmaker - Mr. Barack Thango Mino

Another Rainmaker interviewed is Mr. Barack Thango Mino. He was born in 1918. He was the third born in the family. He inherited the power to make rain from his father who was well known in the area. He said that his father got this power from the Lake Victoria. The father was a farmer and when he was going to the lake he heard a voice coming from the Lake. When he looked he saw a floating calabash and as he approached the calabash, he heard another voice telling/encouraging him to pick it. He picked up the calabash and took it home. The very night the strange calabash started talking and the father felt hot the whole night. The next day he invited traditional medicine men to his home who revealed to him the power in that calabash. When he picked up the calabash, some black concoction spilled and placed him in the middle of the calabash.

Mr. Mino claimed he had the power to bring rain even if there were no signs of rain. In order to do this, he must be offered some cash that range from ten thousand (KSh. 10,000) to twenty thousand (KSh.20,000) plus a bull. After this offer, he applies the medicine using the same methods used by Dorcas . This includes sending someone to fetch water using a pot from the house of the old man and the person carrying the pot is not allowed to look back from the house to the lake/well and the same after collecting water where he/she is not allowed to look back until he/she reaches the (shrine) where the rainmakers is offering his sacrifices. This is usually done on top of a hill. Here, the traditional rainmaker has to talk clearly with the spirits of the ancestors while having a very good sight/view of the area where they need rainfall.

During the time he is talking to the ancestral spirits someone has to be blowing the pot with a pipe to bring bubbles. Some rainbow must appear in the bubbles. Placed in the pot some medicines, put there by this rainmaker. In his case, no cow has to be slaughtered. Mr. Thango sprinkles the medicine/herbs in the surrounding area using the inherited calabash. After doing all this, all the elders go back to their homes expecting a very heavy down pour. Mr. Thango has to experience a very hot night and the following morning he feels nothing. This has to go on for some days before it rains and immediately it does the rainmaker must be paid the price they agreed on with the old men (elders) including the bull. After this the rains continued pouring until the whole area gets a heavy harvest. Mr. Thango said that he also has the capacity to stop rainfall. He may stop the rain if the payment agreed is not honored. When he predicts a dry season, he has to talk to the elders of the community about it so that they can look for ways of appeasing the ancestral spirits who give him the unique powers.

It can also happen when the rainmaker feels that something is wrong in the community. He can offer some herbs and plant them in a particular area so that when it is raining in some areas this place will not experience any rainfall. The area elders confirmed this.

When this happens the community has to call a meeting to discuss where this bad omen comes from.

When the meeting is called everybody has to attend, including women, so that solutions can be found. The area Chief or his Assistant, depending on the affected areas, can sometimes call the meeting. People have to testify before the elders. It may be they have wronged, the rainmaker or not. If they find that the rainmaker has been wronged they settle the issue. They will then persuade the rainmaker and urge him to forgive the one who wronged him.

Mr. hango also has the power of preventing lightning which some times strikes homes, people and animals leaving them dead. He can offer this to individuals who pay him some money for that kind of. The charges range from five hundred to two thousand shillings. It depends on how many things (living) you may want to from this bad omen.

This he does by applying some black concoction from the gate of that home to the houses in that home including the sleeping places goats, cows, sheep and chicken

After that he has to plant another powerful herb in the middle of the home and at the gate where all the livestock pass when they are going to graze.

After this kind of powerful application, they do not expect lighting to strike anything in that home.

5.2.3 The rainmaker - Mr. Adiel

Mr. Adiel was born in 1907. He was the first-born in a family of ten; four boys and six daughters. He also indicated that he inherited this power from his father who had powers of bringing and preventing rainfall in the area from years back until now.

He says that his powers must be respected at all cost. A lamb has to be slaughtered every beginning of the year to appease the powers throughout the year. When the area experiences some dry season for some months he has to be contacted and even paid money or a calf. Sometimes a ploughing bull, as they call it, is given to him so that luck can come back to the community. By doing this, he comes with all his powers which he claimed are not to be kept in the house for reasons well known to himself, which he refused to divulge at any cost claiming they were his secret weapons.

the first thing he does is to talk to the elders of that area. After that, he needs to have a container (preferably a pot), plastic container plus some traditional brew called busaa.

This beer made from fermented millet or finger millet must be poured in that container. He then mixes it with his herbs plus some black concoction. He starts talking to the ancestral spirits in a shrine called (KAR MISANGO shrine where only some selected elders are invited to witness everything including blowing of the mix in the container that is made up of fermented finger millet or millet. He prefers finger millet but will use millet if the finger millet is not available.

The mixture of millet and dark concoctions is blown using a reed. When he blows that pot someone must be ready with medicine called MANYASI in a calabash. When some bubbles form from the blowing, he has to spread the mixture all over that shrine. This person is supposed to know all the stages from the beginning to the end and if he does not and the indicator is the one to coach him.

After all these sacrifices the rainmaker including the elders at that shrine must slaughter a sheep which they have to eat right at the shrine and travel back home without looking behind.

And if everything was performed in the right manner, those who went to the shrine must experience a very hot and sweaty night. That is the indication of a very heavy down pour, which is to be expected within three or four days. If this does not happen, the traditional rainmaker must repeat his sacrifice until the area experiences some rainfall. After the first sign of rainfall, he must be paid all his remaining balances, which includes a bull.

After that the whole area may experience rainfall until they get a bumper harvest as he claimed. Mr. Adiel says that sometimes his own area experiences a very dry season and he cannot use his powers unless he is paid something. This is when he can rescue his own community.

He says sometimes, he is invited to go as far as Kisii to perform his powers of rainmaking. This people pay him a good sum of money and they feel satisfied because they get enough rainfall. He has also the capacity to prevent lightening strikes if requested.

When lightening strikes a home, a person, a cow or any other living thing in a particular compound the owner must call him. Before they skin a stricken animal, he must apply his herbs so that this animal can be skinned and eaten.

But if they eat this animal without him applying his medicine on the meat then this bad omen will follow everyone in that family and before they die they will witness this bad omen repeating itself in that family, he said. He applies his powers by using the ancestral spirits and the same time spreading the concoction around the fence of that home.

He also claimed he can prevent the lightening from striking a house using the same methods with the different herbs (medicines)

To stop rainfall, he uses a small dry stick, which he said was powerful. He can place it outside and the rain stops immediately until he is paid something to appease the ancestors. Without this, the area, or a given area for that matter, will not experience any rainfall until they give out offerings that must include a small calf and some money.

If Mr. Adiel the rainmaker has an exchange of bitter words with someone within the community he can plant that medicine so that the area experiences a very dry season.

If debtors do not pay his dues, he may apply his concoction that the community, does not see a drop of rainfall unless he gets his payment.

6.0 APPLICATION OF WEATHER AND CLIMATE INFORMATION

Participants in Kathonzweni and Kisumu Workshops' respectively, were asked whether they received meteorological forecasts/reports through the radio or print media. They acknowledged that they receive the forecasts over the radio but sometimes found them inaccurate. They attributed this inaccuracy to the relative location of the reference stations used. As regards Kathonzweni, Makindu is usually mentioned in the forecasts as the reference station for the lowland region between Machakos and Voi. The station does not seem to represent the climate of Kathonzweni.

They felt that any weather forecast for Makindu is unlikely to affect them since Makindu is due south and any phenomena forecast for Makindu is likely to drift away from their location towards Kajiado District. They suggested that the forecasts should be down scaled sufficiently so that they received forecasts for their specific area. They felt they were on the wrong side of the Mbui Nzau hill near Kibwezi, which they felt lee-shadowed them. Similarly, for Lake Victoria basin, stations used are Kisii, Kisumu and Kakamega, which do not represent the climate of the low altitude areas of the basin. There is need for more stations to make their representation.

A number of politicians and community leaders would have liked their communities to be involved in the study but it was not possible to involve everyone in this phase due to the limited resources available. In Kisumu, the District Commissioner, who came from pastoral community, was impressed with the study that he described as a useful step since most communities still depended on the traditional method.

The following is a list of plants used as traditional rainfall indicators among the Kamba in Kathonzweni Division, Makueni District.

Table 1: Plant traditional indicators of rainfall for Kathonzweni Division, Makueni District.

No.	Vernacular (Kikamba) name	Botanical name	Indicator sign	Rainfall predicted	Rainfall start
1	Kikamba	*Adansonia digitata*	Trees in full bloom	Short rains	2-3 weeks away
2	Muaa	*Acacia tortillas*	Flowers (shed by rains) • Blooming after flowers •• Blooming without flowers	Rains before Long rains •Long rains ••Short rains	1-2 weeks away •1 week away • • 2 weeks away
3	Kikuyu	*Ficus sycomorus*	Full bloom	Long rains & Short rains	1-2 weeks away
4	Itula	*Commiphora*	Full bloom	Long rains & Short rains	1-2 weeks away
5	Muthiia	*Acacia Mellifera*	Flowering and blooming Flowers shed by rains	Long rains Short rains	2 weeks away
6	Ngala atumia		Appearance of fruits	Short rains	<2wks away
7	Uusya	*Asparagus africana*	Burst of flowers followed by fruits	Short rains	1 week away
8	Itaamwaka	*Boophone disticha*	Pink flower drop. Rains decay fallen flower	Short rains	No more than 2 weeks away.
9	Mukau	*Mellia Volkensii*	Blooms, flowers and small fruit appear. Rains come when some flowers still on plant	Short rains	
10	Kiuwa nzuki	*Combretum apic*	Blooms and flower buds appear. Flowers dropped by rains.	Short rains	1-2 weeks away.
11	Kititiu	-	Blooms and flower buds appear. Flowers dropped by rains.	Short rains	1-2 weeks away.
12	Muvingo	*Dalbergia Melanoxylon*	Flower buds appear, blooming starts. Rains drop flowers.	Short rains	1-2 weeks away.
13	Kiumo	*Ficus Thonningiii*	Full bloom	Short rains	1-2 weeks away
14	Kyumbu	_	Full bloom	Short rains	1-2 weeks away
15	Kikelenzu	-	Change in colour of leaves after full bloom. Colour changes from pink to colour of mango tree.	Short rains	1-3 days away

Table 2: Non Plant Traditional indicators of rainfall for Kathonzweni Division, Makueni District

No.	Vernacular (KiKamba) name	Botanical/English name	Indicator sign	Rainfall predicted	Rainfall start
BIRDS					
1	Katheka Kaia	-	Cry Indicates rains are good and will continue. Rainfall will be enough to fill ponds/ lakes with water.	Short & Long rains	Rains already in progress.
2	Ivutavutilya	-	Cry Indicates the coming rains will be good.	Short rains	Cry starts in September, rains come in October.
3	Malwe/Ngala Misyi	-	Cry (Eats bees).	Short & Long rains	2 weeks away
4	Ilumi	-	Cry	Short & Long rains	2 weeks away
INSECTS					
5	Nzuki	Bees	Northerly passage •Southerly passage	Short rains •Short rains	1 month, good rains expected 1 month, bad rains expected
6	Minzai	-	Appearance/ random flight. •If wavy, undulating motion almost touching the ground as if it is planting	Short & Long rains •Short & Long rain	Rains very near, •Rains same day.
ANIMALS					
7	Syoa	White dry-land frogs	Crocking	Short rains	Rains very near
8	Kituli kya indo	Livestock	Frenzy excited commotion	Short rains	Rains very near
No.	Vernacular (Kikamba) name	Botanical/English name	Indicator sign	Rainfall predicted	Rainfall start
OTHER INDICATORS: METEOROLOGICAL/ASTRONOMICAL					
9	Uthuilo wa sua	Sunset position	Sun sets over a specific spot, e.g. between two hills.	Short rains	<1 week away
10	Matu	Clouds	Clouds thicken at horizon and wind veers or backs to N. East. This indicates good rains on the way. Lateness in thickening of clouds and veering of wind portends poor rains. The thicker the clouds the heavier the rains	Short rains & Long rains	Very near
11	Utisi	Lightning	When two streams of lightning, one from East and the other from West meet at Ngundi Mwita on the horizon, coming rains are good. If they meet high in the sky, rains fail.	Short rains & Long rains	-
12	Syuu sya iima	Hill shadows	Shadow of a hill is cast at a specific spot by the setting sun (e.g. on a rock on the opposite the hill), the rains fall immediately. If this does not happen, rains are late and bad. Not commonly used in Kathonzweni but was an indicator for immigrants at their places of origin.	Short rains & Long rains	Immediate
No.	Vernacular (Kikamba name	Botanical/English name	Indicator sign	Rainfall predicted	Rainfall start
13	Uvyuvu/Ivyuvi	Heat/Temperature	Hot under shade coupled with high humidity. If condition extends over large area, rains are very near and expected to be good.	Short rains & Long rains	Very near
14	Kilingi	Dust devils	Appearance and intensity. Intensity increases as rainfall start approaches. More pronounced for Short rains.	Short rains & Long rains	Intensity dependent
15	Kiemea	Star clusters	Appearance in East for Short rains and in the West for Long rains. When the cluster appears bright surrounded by a halo, rains are expected to be good. When clusters are dull, rains fail or are poor.	Short rains & Long rains	Very near
16	Wiu wa mbusi	Stream bed wetness	Water level in dry riverbeds rises in middle of drought. Visible wetness spreads on the stream/river floor as rainfall start approaches.	Short rains & Long rains	Rains get nearer as the wetness spreads

Table 3: Ranking of plant indicators of rainfall

No.	**Indicator (Kikamba name)**	Botanical name	**%score**	**Rank**
1	Muaa	*Acacia tortilis*	80	1
2	Kiamba	*Adansonia digitata*	8	2
3	Kikuyu	*Ficus sycomorus*	4	3
4	Itula	*Commiphora baluensis*	4	3
5	Muthiia	*Acacia mellifera*	4	3
6	Ngala atumia	-	0	4
7	Uusya	*Asparagus africana*	0	4
8	Itaamwaka	*Boophone disticha*	0	4
9	Mukau	*Mellia volkensii*	0	4
10	Kiua nzuki	-	0	4
11	Kititiu	-	0	4
12	Muvingo	*Dolbergia Melanoxylon*	0	4
13	Kiumo	*Ficus Thonningii*	0	4
14	Kyumbu	-	0	4
15	Kikelenzu	-	0	4

Table 4. Ranking of non plant indicators of rainfall

No.	**Indicator (English name)**	**% score**	**Rank**
1	Lightning (at Ngundi Mwita)	29.2	1
2	Insects (excluding bees)	20.8	2
3	Cluster of stars	20.8	2
4	Sunset location	8.3	3
5	Bees	8.3	3
6	Winds	8.3	3
7	Birds	4.2	4
8	Clouds	0	5
9	Hill shadows	0	5
10	Heat/Temperature	0	5
11	Frogs	0	5
12	Stream/River wetness	0	5
13	Livestock excitement	0	5
14	Dust devils	0	5

7.0 RECOMMENDATIONS AND WAYFORWARD

It was observed from the study that:

- Traditional indicators are still widely used in Kenya as modes of rainfall forecasting and land use management.
- The indicators are mostly local and are well understood in the communities and are easily discussed.
- The specific indicators vary from community to community and location to location.
- The indicators have a scientific bearing, which is not understood.
- The communities believe in rainmaking and the power to stop lightning and rain.
- Large gaps exist in regard to availability and application of the scientific forecasts issued from the KMD and DMCN, given the fact that meteorological information are limited to urban population and a few enlightened rural communities, who make little use of such information.
- The frequently used traditional indicators included Plants, Birds, Insects (bees, butterfly, red ants, termites (ngwen), Stars (sun, milk way), Hill shadows, Moon, Winds (direction, strength and time of starting and ending), Clouds (position and movement), Lightning (location and patterns), Springs and swamps, Amphibians (frogs and toads), Whirl wind (Dust devils) and Water spout.

It was, therefore, recommended that:

- The identified indicators should be monitored in the current location of studies for a period of at least one-year to provide information on the performance and scientific interpretations.
- Similar studies should be carried out at more locations to map out important indicators that can contribute to scientific methods of forecasting and improve on the skill and application of forecasts.
- Traditional indicators should be documented for the benefit of future generations.
- Meteorology and traditional norms of socialization, beliefs, skills, climate indicators and knowledge should be included in the school curriculum.
- The traditional indicators should be protected to help us adapt to the environment in which we live.
- The climate scientists, botanists, zoologists and traditional-weather experts should work closely in understanding and documenting traditional indicators.
- The study should be extended to cover more parts of the country since the indicators vary from place to place depending on cultures.
- The cultural knowledge gained through long experience and observations should be utilizalised to improve the skill of seasonal climate outlook.

8.0 CONCLUSION

Traditional forecasting methods are still very popular in Kenya. They are still the most used methods for farm management and food production. The traditional forecasters and rainmakers are still respected people, are held in high esteem by their communities where they live, and their advice is always taken seriously. The study raised a lot of interest, enthusiasm and hope. Various national leaders stressed the interest to include more communities to collect and document the information on a practice on which the majority has depended for many generations.

The scientific interpretation of the indicators and the involvement of the traditional forecasters would help in bridging the gap between the modern and traditional methods of forecasting for the benefit of the rural communities, who form the largest percentage of the population of the country. Working closely with the traditional forecasters help merge the traditional and scientific methods of forecasting and would also improve the trust and would enable hasten the distribution of climate outlooks.

This project has enhanced the confidence of the rural communities, involved in the study, in the modern scientific methods of climate prediction. They are very willing to work with the DMCN and KMD to enhance the skill and dissemination of the climate outlooks. They are also willing to work with the climate scientists to provide scientific interpretation of the indicators.

The project has brought into focus very useful aspects for disaster management. The indigenous knowledge is a very useful climate information for areas where climate records are non-existent.

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APPENDIX 1: LIST OF PARTICIPANTS AND CONTRIBUTERS.

Machakos-Kathonzweni Workshop.

	NAME	VILLAGE	SUB-LOCATION	DATE OF BIRTH
1	JAMES M. MANYILI	KASAMBANI	KAVINGONI	1942
2	WAMBUA MUTIO	ITUKA	ITUKA	1928
3	MUTUKU KILANGO	ITUKA	ITUKA	1925
4	MUTUKU MWATU	ITUKA	ITUKA	1928
5	NATHAN MUTUNGA KILAKA	MATHEMBA	THAVU	1920
6	DAVID MWEI	ITUKA	ITUKA	1926
7	PETER NGEWA NZEKE	IKAASU	ITUKA	1942
8	NDULULU NDAMBUKI	NOMANI	KAVINGONI	1949
9	PILIGITER NZIOKA	KATHAMBONI	THAVU	1920
10	POSTINA KILONZO	KATHONZWENI	ITUKA	1923
11	DAVID M. MANGEA	KATHAMBONI	THAVU	1949
12	NDETO KILAKI	KASAMBANI	KAVINGONI	1936
13	KYANGUKU MULAA	NGOMENI	KAVINGONI	1909
14	KISAVI MALII	KILULUINI	KAVINGONI	1929
15	WAMBUA KYALO	KILULUINI	KAVINGONI	1943
16	MUNYAO WAMBUA	KATHAMBONI	THAVU	1980
17	SAMMY B. MUNYAO	MATHEMBA	THAVU	1958
18	NICHOLAS M. MWAILU	KASAMBANI	KAVINGONI	1947
19	BONIFACE MINOVE	MUAANI	THAVU	1952
20	PETER MATUMU	KITHAMBANGII	THAVU	1956
21	JOHN M. MUSYOKI	KASAMBANI	KAVINGONI	1932
22	DANIEL M. MUOKI	KASAMBANI	KAVINGONI	1942
23	MUASYA NYILE	KASAMBANI	KAVINGONI	1957
24	JOSEPH K. MBOTE	ASST. CHIEF YEKANGA	THAVU	1957
25	CHRISTOPHER MUTHOKA	AGRI. DIV. CROPS OFFICER	KATHONZWENI	1957
26	VERONICAH KUTU	ITUKA	ITUKA	1926
27	WILLIAM NYAKWADA	PRINCIPAL INVESTIGATOR	-	-
28	DR. D.K. MUSEMBI	INVESTIGATOR	-	-
29	JOHN KIMINZA			1958
30	MICHAEL NDENGELE	DIV. EXTENSION OFFICER		1965

APPENDIX 2 - LIST OF PARTICIPANTS, KISUMU WORKSHOP

1	Evans Luke Oluchiri	P.O. Box 25 LUANDA
2.	Michael N. Musuya	P.O. Box 373, VIHIGA Or P.O. Box 1738 KISUMU
3.	Akech Paschaliah O.	P.O. Box 4432 KISUMU
	Bernard Owuor	Education Officer P.O. Box 1914 KISUMU
4.	Thomas Osore Omulako	P.O. Box 150 LUANDA
5.	Tabitha Ogwai	P.O. Box 1958 KISUMU
6.	Obedi Osore Awiti	P.O. Box 150 LUANDA
7.	Rose A. Awuor	P.O. Box 1220 KISUMU
8.	Naftali Okonda Eyole	P.O. Box 150 LUANDA
9.	Walter Otieno Okumu	C/o Buyala Primary School P.O. Box 52 MUSANDA VIA BUTERE
10.	Albert A. Mulongo	P.O. Box 5199 KISUMU OR P.O. Box 35, BUMALA BUSIA
11.	Paul Siaya Awora	P.O. Box 356, NGIYA Or P.O. Box 2756 KISUMU
12.	Julius Otieno Apiyo	P.O. Box 44 KISUMU
13.	T.E.C. Obare	P.O. Box 980 KISUMU
14.	Jayne A.A. Wadenya – Okumu	Okmart Investments P.O. Box 6069 KISUMU
15.	Mrs. Margaret Okeyo	Ndori Primary School P.O. Box 68 KISUMU
16.	Mrs. Mary Aoko	Ndori Primary School P.O. Box 68 KISUMU
17.	Mama Dontila Auma	P.O. Box 1129 KISUMU
18.	Josiah Alitsi Akoyo	P.O. Box 1958 KISUMU
19.	Felix M. Otieno Okeyo	P.O. 2377 KISUMU
20.	Onyango Maria	Maseno University P.O. Box 333 MASENO
21.	Cellestine A. Owino	P.O. Box 1738 KISUMU
22.	Patricia J. Ochieng	Maseno University P.O. Box 333 MASENO
23	Peres Sibuda	P.O. Box 144 BUMALA
24.	Rev. Fr. Alfred C. Atemo Ogada	P.O. Box 50 KISUMU
25	Mr. Otieno Karani	Mayor (KISUMU)
26.	Prof. A.B.C. Ocholla – Ayayo	P.O. Box 30197 NAIROBI
27.	Joseph R. Mukabana	Meteorological Department P.O. Box 30259 NAIROBI
28.	Stella Aura	Meteorological Department P.O. Box 30259 NAIROBI
29	David K. Musembi	KARI Kiboko P.O. Box 12 MAKINDU

APPENDIX 3 - PEOPLE INTERVIEWED

Nyanza-Migori, Kisumu, Suba

1. Mzee Meshack Dawa, 86 years – Kamagambo Location
2. Mzee Samson Akello, 75 years – Kanyamkago/ Karachuonyo Locations
3. Mzee Gideon Were Opiyo, 60 years – Kawere Sub-location, Kanyamkago Location
4. Mzee Peter Karan, 83 years – Maragoli, Bware Sub-location – Kanyamkago Location
5. Mzee Obwon ogira, 80 years – Kano/ Nyakach
6. Mzee Walter Akello, 85 years – Kano/ Kanyamkago
7. Mzee Fares Awuonda, 78 years – Ramogi/ Suna
8. Mzee Walter Olwalo, 80 years – Kanyamkago
9. Mzee Pastor Tobias Otieno, 74 years – Gem/ Kanyamkago
10. Mzee Harisson Achungo, 70 years – Nyakach/ Suna
11. Mzee C. Odongo Wandago, 73 years – Achuth/ Kanyamkago
12. Mzee James Okuoga, 78 years – Kano/ Kanyamkago
13. Mzee Kepha Owino, 63 years – Gem/ Kanyamkago
14. Mzee Leunadis Okombo - Suba
15. Mzee Odhiambo Nyakonia - Mfangano/Suba
16. Mama Dorcas - Gwasi/Suba
17. Barak Thango Omino - Gwasi/Suba
18. Mzee Adiel - Gwasi/Suba