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ILIMI Model Of Improving Turkana Nomadic Pastoralists Of Ilemi Triangle Indigenous Knowledge On Drought Early Warning System, Turkana County, Kenya

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Abstract: ***For many decades now, drought in the Horn of Africa has had devastating impacts on the lives of many people, the ecosystem and livelihoods of the pastoralist communities. It has remained a global concern that requires urgent interventions. This study was conducted with a view to analyse the early warning system in Ilemi Triangle, Turkana County, Kenya and application of ilimi model to improve the warning system among the Turkana nomadic pastoral population. It draws an interesting experience on how the Turkana nomadic pastoralists in Ilemi Triangle continue to survive in such difficult environment that merely support livestock keeping and come only into limelight only in the year 2011 after Kenyan for Kenya initiative. The study adopted a mixed research design involving descriptive survey and evaluation and used Cochran equation formula to calculate study samples sizes of 424. Study population consisted of Heads of households, community leaders, managers of NGOs, chiefs, and county drought coordinators in Turkana count. Data was collected using household questionnaire, Key informant interviews, and focus group discussion. Data were analysed using SPSS for frequencies and proportions followed by Chi square test at p = 0.05. Socio-economic characteristic show household heads are mainly men in both area (88% in Loruth and 85% in Napak), community regarded marriage highly (83% in Loruth and 87% in Napak) and no formal education (98% in Loruth and 94.5% in Napak). The study found out that drought early warning was mainly detected traditionally observation of drying of water sources (29%, 62 for Napak and 30%, 64 in Loruth),and pasture (28%, 60 for Napak and 26%, 50 for Loruth), Information from traditional community leader's gods, tobacco and shoes observation (25%, 53 for Loruth and 20 %, 43 for Napak), traditional weather observations like birds movement, sky stars and intestines observations and change of animal behaviour and livestock condition , and reptiles behaviour (6% ,13 for Loruth and 3% ,7 for Napak) have dominated early warning methods. The study concluded that there are many unwarranted factors adversely affecting the indigenous knowledge systems. Elaborate supporting measures on early warning and preparedness have never been developed in Ilemi Triangle and most vulnerable population has continued to suffer .The study recommends for ILIMI model as solution to weak early warning system in Ilemi thus integration of indigenous household's perceptions and traditional weather intelligence and knowledge in to Modern weather monitoring data and ensure populations are well prepared to eventual droughts.***

Keywords: Drought, Early warning methods, Turkana community, nomadic pastoralist, Ilimi Model, Ilemi Triangle

ABBREVIATION

ASAL Arid and Semi-Arid Landscapes
AU Africa Union
CRED Centre for Research on Epidemiology of Diseases
GAM Global Acute Malnutrition
GHA Greater Horn of Africa
FAO Food Agricultural Organization
FARMD Forum for Agriculture Risk Management
FGD Focussed Group Discussion
ILIMI Indigenous and Localised Intelligent Knowledge with Modern Technology Information

ILRI International Livestock Research Institute
NDMA National Drought Management Authority
OCHA Office for Co-ordination of Humanitarian Affairs
UNDP United Nations Development Program
WHO World Health Organization

I. INTRODUCTION

The world is experiencing a surge of different disasters both in frequency and severity (WMO, 2016). One of such disaster is drought, which is one of the leading contributory causes of vulnerability in the pastoral communities of Sub-Saharan Africa counties according to Mayunga (2017). The vulnerable pastoralist's population according to WHO (2018) remain the most affected by disasters together with their local institutions, which provide the mainstay of disaster prevention, preparedness, and relief. The pastoralists vulnerability resulted from drought has drawn attention for the vision 2030 agenda on sustainable development goal number thirteen that discusses climate action and calls for urgent action to combat climate change and its impacts (UNESCO, 2017).

Drought is not a new phenomenon in Sub-Saharan African pastoral lands and drought itself has no definite definition according to Shilenje and Ojwang (2015). According to Mosley (2016), drought implies two or more consecutive years when rainfall that is less than 75 percent of the long-term average rainfall is received. Accordingly to Mayunga (2007), what is drought in one place may not be seen as drought in another place, even for the population coming from the same context of nomadic pastoralism. Quantitatively, CRED (2010) has provided that, Kenya has experienced about nineteen droughts from 1989 to 2010. All these droughts are experienced in Arid and Semi-Arid lands (ASAL) where Ilemi Triangle in Turkana County belongs.

Drought occurrences in the northern Kenyan corridor remain, therefore, an important issue among the nomadic pastoral communities. According to Lolemtum *et.al* (2017), these communities live in the marginal areas of the country and often experience variable rainfall, both in space and time, which results in low resource base, pasture disappearance and unpredictable levels of forage productivity. The northern corridor environment in Kenya offers limited opportunities for subsistence activities apart from livestock rearing that the pastoralists entirely depend on (Nicholson, 2014).

WMO (2016) classifies droughts as to being meteorological, agricultural, hydrological, and socioeconomic. Meteorological drought according to Opiyo (2014) concern the reduction in rainfall for a specified period, which is below an agreed statistical amount of the long-term average for the specified period while agricultural drought occurs when the moisture level in the soil is insufficient to maintain average crop yields. Hydrological drought on the hand occurs when water in natural and manmade reservoirs fall lower a certain threshold in a given period of time and finally socioeconomic is associated with the supply and demand of some economic good. This study focuses on the meteorological form of drought, as it is the most appropriate type of drought form that affects nomadic pastoral populations who are the study population.

As drought onset remains low and its cumulative impacts over a long period to nomad's livelihoods, drought according to Opiyo (2014) has persisted to be a major disaster that has contributed to a higher vulnerability requiring proper management. The frequency of droughts in ASAL regions according to Miriri (2018)have diminished the coping power of the population and allows no time to recover between droughts and, therefore, populations get more vulnerable to any shock of any nature and intensity. Other causes of vulnerability to drought according to Odhiambo (2013) include; ethnic conflicts along unmarked areas, poor implementation of timely disasters mitigation programs, climate change and aridity, weak drought early warning systems and erosion of indigenous coping strategies.

Turkana County is a sprawling arid land and has long been considered a difficult place to survive with an eighty-eight percent of the people in Turkana living below the poverty level Helgeson et.al (2013). Nevertheless, the Turkana nomadic pastoralist's people represent an interesting example of how pastoralists cope within such unforgiving arid environments and manage with a number of adversities that are profoundly affecting their livelihoods. The County was the hardest hit during the drought of the year 2011 leading to Kenya for Kenyan according to KRCS ((2013) because most of the food reserves had dried up with widespread food insecurity in the country with many parts of Turkana trapped in the impacts of droughts and losing livelihood. The year 2011-2012 drought and food crisis gave an opportunity to tap into local people's indigenous options, practices, and design a sustainable livelihood protection system but it never happened and instead, the government and humanitarian organizations continued to rely on supplying relief foods without exploring other options for sustainability (Ouma *et.al,* 2012). Nevertheless, despite the unforgiving environment, excessive defies in Ilemi Triangle belt and having repeated drought with an average of 186 mm per year according to the Mureithi (2012), the Turkana nomadic population have never left their livelihood option and keep on surviving in such harsh environments where humanitarian assistance is barely absent. Hence, to ensure survival, pastoralists cope with the ecological stresses, unpredictable and frequent droughts disaster.

However, as the Turkana nomadic pastoralists continue to practice a relative resilient mode of production of livelihood according to Huho *et.al* (2009), frequent drought have exhausted their drought prediction levels, coping strategies, and renders the communities susceptible to any form of disaster. They remain, therefore, unstable with a raised inherent vulnerability that makes their coping strategies unsustainable and unhelpful when drought happens. Thus, efficient management of droughts that will minimize vulnerability and mitigate impacts, rather than a mere response to their occurrence, is required to lessen the population's vulnerability and enhance sound resilience. This will require a proactive multispectral approach that will ensure an output of a resilient society; thus, it entails an indigenous coping and drought management practices that are mainstreamed into the regional, national, and county development plans. This then requires adequate information on the traditional indigenous practices (Mayunga, 2017).

Although these drought problems are increasingly apparent in many countries in Sub-Saharan Africa according to Opiyo (2014), there has not been a national priority and clearly defined long-term strategies for pastoral areas development that has remained marginalized and with frequent drought (Mureithi, 2012).This trend according to Lekapana (2013) is associated to lack of understanding of indigenous early warning practices that are required to produce a compact agenda that will provide a better framework on combating frequent drought in such isolated settings.

These Knowledge gaps jeopardizes the kind of the sustainable support the pastoralist ought to obtain to lessen vulnerability and improve their livelihoods, hence, has a very serious implication on pastoralist's economies and sustainability, continued survival in such hostile environment and reliance on livestock as pastoralist's livelihood option. The study was therefore conceived to determine the early warning strategies of the Turkana nomadic pastoralists of Ilemi Triangle in Northern Kenya after the extreme drought of the year 2011-2012.Understanding these will ensure an evidence-based framework of introducing and applying sustainable strategies and knowledge that is more specific, viable and adequate for pastoral population's livelihood development structure that strives to ensure resilience to frequent drought disasters.

During the recent widespread droughts in the Horn of Africa, in the year 2008- 2009 and 2010-2011, approximately 60-70% of livestock was lost according to Huho and Kosonei (2014) and about 3.2 million people were left in need of emergency assistance in arid and semi-arid regions of Kenya according to Opiyo(2014). This drought provided an opportunity to the government of Kenya to explore different strategies to safeguard pastoral populations and their livelihood from successive drought and ensure resilience; however, little lessons were learnt for Ilemi Triangle pastoralists because a subsequent extreme drought of the year 2011-2012 in Turkana County severely affected Ilemi Triangle more than any other areas of the County. This triggered the start of the Kenya for Kenyan initiative in the year 2011 (KRCS, 2013) that targeted emergency relief support to the Ilemi Triangle population with less focus on mitigation strategies and sustainability.

An already vulnerable pastoralist's and their livelihood that is not adequately informed and supported reduces the nomadic pastoralist survival chances that depend entirely on them and instead depend on frequent, permanent relief foods interventions and other unsustainable social protection schemes by governments and humanitarian organisations. This continued relief food provision without developing other sustainable long-term mitigation programs reinforces the cycle of dependency and vulnerability (Lekapana, 2013). Other adverse impacts associated with drought Ilemi Triangle are compounded by many other factors, including widespread poverty, violent conflicts, livestock disease outbreaks, land degradation, poor infrastructure and decades of marginalization by the national government.

The majority of people in northern Kenya live below the absolute poverty line. According to the KNBS (2013), 87.5% of the Turkana population lives in absolute poverty, and more than 50% heavily relying on food aid and safety net programmes from year to year. The population who are already poor in these isolated parts of the country keep on struggling to cope with the extra burden of increasingly unpredictable drought, which is triggered by climatic change with weak u understood early warning strategies.

Little evidence is available on how the Turkana pastoralists of Ilemi Triangle of the Northern Kenya safeguard themselves from the information sharing and networking .A few exceptions exist such as Mureithi (2012); Lekapana (2013); and Melle (2016) that have all concentrated on other areas of Turkana County and provided recommendations on disaster prevention, conflict management and vulnerability causes without mentioning Ilemi Triangle. There is therefore a knowledge gap.

The critical gap in response related to absence of knowledge had resulted to action deviation between what local populations apply and the action prescribed by the policymakers to mitigate drought impacts (Onyango, 2014). Hence, a created information gap that is necessary to inform changes required to ameliorate pastoralist's life, lessen their vulnerability and ensure resilience and survival.

Mutua (2011) suggests that nomadic population observe plants, solar system, wind and bird's movement, clouds patterns and behaviour of living organism's recognition as their early warning signs for impending drought. These indicators and pastoralists feeling support the traditional early warning system employed by the nomadic pastoralists, usually issued by elders to enable the nomadic population cope with anticipated drought event or a natural hazards (Ichara, 2012).

Moreover, Pearson (2012) has suggested that, most of the pastoral communities in Kenya have indigenous early warning systems and mechanisms of dealing with drought. These systems according to Mutua (2011) includes traditional indigenous weather forecast and climate prediction practices that are based on indicators that are established over generations through keen observation of livestock behaviour, birds, insects, the solar system, winds, clouds, and the feelings of the human body. These communities in ASALs recognized unique situations associated with the behaviour of the living organisms, and the locations and patterns of cloud, winds, the moon and stars (Mosley 2016).

According to Pearson (2012), these predictions based on these indicators and human feelings supported the early warnings issued by the elders to enable the community cope with the anticipated natural hazard. Observed historical trends allow for reasonable predications of future weather patterns. However, with the increased severity and frequency of drought over the last few decades this form of forecasting is getting less reliable than it was in the past Gupta, and Singh, 2011). However, Table 2.3 information is available with NDMA Turkana County on warning stages adapted to detect drought. However, the Turkana nomadic population will not be aware of such criterions if they are not well informed

Situation	Description
Normal:	Environmental, livestock and pastoralists welfare indicators show no unusual Fluctuations but remain within the expected seasonal ranges.

Alert:	Environmental and livestock stress indicators start to fluctuate outside the expected seasonal ranges within certain localized areas. An alert stage can also be signaled when unusually low asset status is reached within the district.
Alarm:	Environmental and livestock stress indicators continue to fluctuate outside the expected seasonal ranges and this situation extends to most parts of the district. Pastoral welfare indicators begin to fluctuate outside expected ranges. Reports of displaced population groups due to collapse of the pastoral system become more frequent.
Emergency	The environment and the pastoralist population are in a state of emergency. Displacement of herders and their families continues due to large-scale mortality of livestock and the further collapse of the pastoralist system. All indicator values including those of pastoralist welfare fall to very low or minimum levels.

Source: NDMA Turkana County (2016)

Table 2.3: Drought Warning Stages adapted for Turkana and used by Kenyan National drought management Authority (NDMA)

Although there are numerous literatures on pastoralists' drought early warning strategies, scanty information is available on the same for pastoralists of Ilemi Triangle and indicator for drought eminence in Ilemi Triangle region has not been researched and elaborated by any relevant study There is little connection and literature available of the participation between traditional early warning and the modern early warning information and this study will bridge this gap of exploring early warning in Ilemi Triangle. This study will provide an opportunity to understand the mechanisms of the early warning systems within the Turkana nomadic pastoral population of Ilemi Triangle. This gap of knowledge on the indigenous early warning system methodologies prompts an investigation into what exist that is utilized by the Ilemi Triangle nomadic population to detect drought and prepare them.

II. RESEARCH DESIGN AND METHODOLOGY

DESCRIPTION OF AREA OF STUDY

The study was conducted in Ilemi Triangle region of Turkana County, Kenya lying in the latitude 4°59'17. 39" N and longitude 35° 19'23. 40" E with a total area 14,000 km². Turkana County in the North West part of Kenya, with a nomadic pastoral population, covering an estimated area of 77,000km² and has a population estimated at 939,080 people according to Situma (2013). Ninety per cent (90%) of Turkana population lives in the remote rural areas that lacks infrastructure. Turkana County is bordered by Uganda to the west, South Sudan to the north, Ethiopia to the northeast, West Pokot County in Kenya to the south, Baringo and Samburu counties to the east (Figure 3.1). Approximately 80% of the Turkana land is classified as arid or very arid with only 3% of the County being suitable for limited rain fed crop production according to Otieno (2009). Therefore, the majority of the population are pastoralists.

Turkana County climate according to Mosley (2016) is characterized as warm or hot, with temperatures ranging between 24 to 40 degrees Celsius. It experiences very high temperatures during the day and moderate temperatures during the night all year round (Opiyo, 2014). This excessive heat accelerates depreciation of forage due to the high rate of evapotranspiration, drying up of surface water sources, failure of vegetation growth and pasture for livestock and heat stress on livestock. Rainfall is erratic and unpredictable both in timing and distribution. Most of the precipitation is run off through the myriad of seasonal streams and rivers that drain the highlands that surround Turkana County. In general, the rainy season is locally known as *"akiporo"* comprises long rains between April and June and short rains between October and December. January, February and September tend to be the driest periods locally known by the name "*akamu".*

Rainfall tends to be the highest in the western parts of the Turkana County and other areas of high elevation (NDMA 2018). According to Opiyo (2014), Turkana has been considered a County of burning desert of sand and stones that hardly a blade of grass anywhere, harsh and uninviting by any standards and an area with an immature ecosystem characterized by instability. The average of 216 mm drops of rain is usually received during long rains (NDMA 2018).

Turkana was selected for the study on the basis that it has been subjected to historical and repeated droughts episodes that have left the region vulnerable. Ilemi Triangle (Figure 3.1) in the far Northern part of Turkana County was preferred because it has been the most affected part of Turkana County by the year 2011 drought that came mainly into the limelight through famous Kenya for Kenyan initiative by the Kenya Red Cross society (KRC) and supported hunger stricken Turkana nomadic populations.

The two study sites in Ilemi were preferred because the nomadic population has lived in the areas for a longer period to easily identify own coping strategies with recurrent droughts and these population has never abandoned their livestock livelihood strategy to change to another means of survival. It was also based on the variability of socio-economic activities of livelihoods they do for a living, the distance of case study sites from each other (to provide ecological and livelihood differences), existence/non-existence of outside interventions to reduce community vulnerability to droughts like non-governmental organisations and their absence. Government support and non-governmental humanitarian organisations (NGO) interventions that have an influence at the community level vulnerability, mitigating drought impacts and security/access of the study site (this is because of frequent inter-ethnic and cross-border conflicts related to access to water and pasture natural resources (Kioko, 2013).

Ilemi Triangle region (Figure 3.1) is a triangular part in the extreme North of Turkana County, disputed among Kenya, South Sudan, and Ethiopia according to Melle (2016).

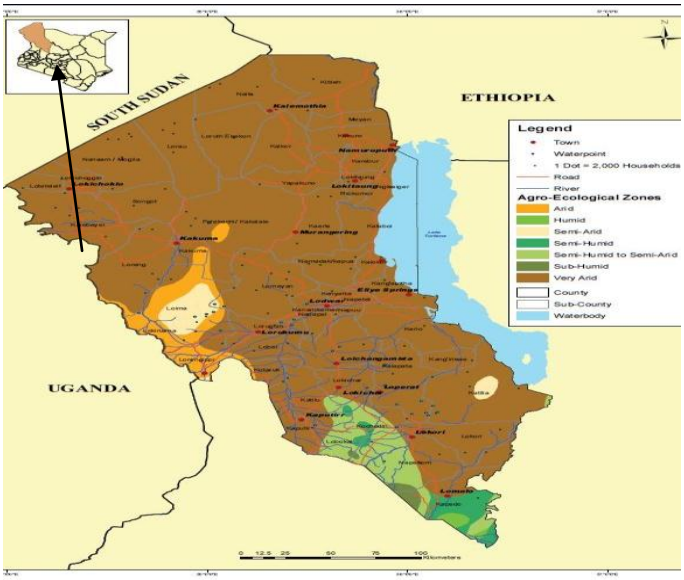
According to Haskins (2010), the Ilemi Triangle has remained a conflict zone between different highly weapon equipped mobile ethnic groups living in and around the Triangle because of the water, pasture resources it contains and drought impacts. The conflict and the dispute between the neighbouring groups have never been resolved since the colonial period as the three countries claim the ownership of the Ilemi Triangle.

However, Kenya has remained the de facto controller of this Triangle (Melle, 2016). The Ilemi Triangle region according to Obero (2013) has remained characterized by the poor road network, the inadequate commitment of the veterinary services, poor health infrastructure with successive drought episode and an inadequate livestock market. These conditions heighten the impacts of drought on pastoralist's populations living in this belt.

The study sites in Ilemi Triangle, Turkana County were Loruth in Kaaleng/ Kaikor ward on the west part of Ilemi Triangle and Napak in extreme North of Ilemi Triangle in the boarder of Ethiopia that practice primarily nomadic pastoralism. In Loruth, the households despite practicing nomadic pastoralism diversify livelihoods with charcoal, gum, Aloe and small business.

The Turkana County is mainly made up of pastoralist communities with deeply rooted traditional customs and value systems (GOK, 2017). Customs and traditions include frequent migration, believe on traditional leader's advices, livestock borrowing and cattle rustling that often expose the vulnerable members of the community like women, and children to armed conflicts with the neighbouring communities (Haskins, 2010). These regular conflicts do inhibit the Turkana pastoralists from accessing other important basic services like formal education, health care and other livelihood options. The Turkana County do experience high volatile levels of insecurity with frequent attacks from neighbouring countries and counties, such as the Pokot in Kenya, Karamojong from Uganda, Nyangatom and Dasanach from Ethiopia and Toposa from South Sudan.

Accordingly, Haskins (2010) has named the nomadic pastoral communities neighbouring each other inside Ilemi Triangle (Figure 3.2) to include Turkana of Northern Kenya, Jie, Dodos, and Karamojong of Uganda on the West of Turkana, Toposa of South Sudan and Nyangatom of Southern Ethiopia. All neighbouring ethnic groups inside this complex Ilemi Triangle region according to Owino (2016) form part of what is commonly known as "*Ateger"* who speak a similar language. These ethnic groups often migrate within Ilemi Triangle in search of pasture and water and have similar social-economic and cultural background. Their economy, therefore, revolves around livestock keeping according to Odhiambo (2013). This livestock includes: camels, cattle, sheep, goats, and donkeys. This complex region in the North West in Turkana County according to Melle (2016) has remained disputed since the colonial period. However, according to Melle (2016), Kenya has remained the de facto control of Ilemi Triangle though South Sudan has kept its contest unofficially. The principal cause of the contested ownership of Ilemi Triangle is the arbitrary delimitation of the Kenya and Sudan boundary according to Owino (2016).



Source: Researcher (2017)

Figure 3.1: Map of Turkana showing Water Points, the Physical features, and research area in Ilemi Triangle, Turkana County, Kenya

GOK (2010) puts the total demographic population for the two divisions to be about 57,647 people while the two study sites at 7,051people. This comprised of Loruth (3,808) and Napak (3,243) with 1,022 households in the two places GOK (2013) mentions that Turkana household size is of about 6.9 higher than the national household size of 4.4.Given the study population of the two sites being of about 7,051 people, this produced a total of 1,022 (552 for Loruth and 470 for Napak) households in the two study sites.

Kaikor was chosen as a pilot study site and the study was done in Napak, and Loruth areas as the two sites were in the news for being the most severely affected by a recent drought of the year 2011. The piloting in Kaikor did not only reinforced in testing the procedure but also provided the information about the response unpredictability and assisted in measuring the flow of information prior to carrying out the full study. Piloting also supported in evaluating each response aligned with the research question.

SAMPLING PROCEDURE, DATA COLLECTION INSTRUMENTS AND DATA ANALYSIS

The study population were pastoralists living in the villages (drought-prone areas of Ilemi Triangle), the key informants from the ministry of livestock and water, County officers for disaster management, the member of the County assembly of study sites, the community administrator (Chief), local community leader, sub-county administrator in Ilemi Triangle, Turkana metrological station officers, ward administrators, Security officers, Chief county executive dealing with disasters management and Turkana County disaster management director, Institutions including humanitarian Organizations working in Ilemi Triangle program managers to include Red Cross, NDMA, Lotus Kenya Development Organisation (LOKADO) and Turkana Pastoral Development organisation(TUPADO).

The study utilized multiple research designs involving both qualitative and quantitative approach using Correlational Survey, and evaluation designs. The researcher had chosen and utilized mixed designs for the reason that it addresses study questions and theoretical perspective at different levels that complement the strengths of a single design and overcome the weaknesses of a single design. Therefore, the mixed designs outweighed a single research design because they are easier to describe and are helpful in designing and validating study instruments according to Biddix (2016).

The quantitative method measured the determinants of the coping and mitigation strategies to drought disaster by the nomadic pastoralist by using numerical data and the researcher applied positivist epistemology approach that assumes that there is an external objective reality that can be measured without influence of the researcher (Naidoo and Wills, 2009). The descriptive research designs concerned with finding out "whom," and "where' of the variables while the qualitative approach utilized and applied to received data not captured quantitatively (Wagesho and Jain, 2013).

The multi-stage sampling method (Table 3.2) was used in selecting household respondents. The purpose of choosing this method was to avoid bias, saves cost, and ensuring an equal representative sample is selected and included in the study. This method of multistage random sampling according to Baraka and Litunya (2013) saves time, simple to use and lessens biases. A combination of stratified simple random sampling and purposive sampling techniques were used. The purposive sampling according to Shibutse et al., (2014) enables the researcher to sample out key participants who were responsible for their departments and head of the community or elders and who have stayed in the sampled areas longest. The random sample size of the households was determined using Cochran's formulae as presented and recommended by fisher *et al.* (1998).

$N= 1.96^2 \times 0.5 \times (1-0.5)/0.05^2$ 3.85 *0.25/0.0025 = 385.

The sample size formulas provided 385 households to be obtained and the researchers added 10% to the sample size to compensate for the persons that the researcher was unable to contact and further compensate for the non-response especially in the self-administered questionnaires. This gave a total of 423.5 samples (rounded to 424).The 424 were divided equally into 212 households heads for each study sites in Loruth and Napak.

The multi random sampling method was used in getting the samples for the study. Loruth and Napak area chief's records corresponded to the government population that showed a total of about 1,022 households living in two-study site. This population was divided into five groups or clusters. In each of the study area, two clusters were selected randomly for the study. This was due to homogenous nature of the Turkana nomadic pastoralist's population in the study site.

The sampling procedures used to get the 424 households were:

- ✓ Sampling stage one:

The five clusters in each location were given numbers 1-5. Two of the numbers were picked at random at each location since two clusters were used for the study.

- ✓ Sampling stage two:

All the households in the two clusters in each study area were picked and registered separately to form a sampling frame. Numbers were then assigned to households in two selected clusters in each study area. The numbers were then written onto separate pieces of paper and folded. All the folded papers were thereafter put in a bucket that was shaken thoroughly. The numbers were then simply and randomly drawn from the basket, one after another until the sample size was reached. A random sample of 106 households was picked at each of the two clusters in the study site.

A total of 212 households were studied from each study area. This made a total of 424 samples for the two study areas. All the sampled households representative interviewed were perceived to be the head of the household, a Turkana nomadic pastoralist adult and a permanent resident of the area and practice pastoralism. The participants were provided with full information about the research to receive their consent. Outside these inclusion criteria were excluded to minimize errors and other household picked from the bucket cluster. This was especially for the household that the adult was not present.

The Focus Group Discussion (FGD) and key informants were purposively selected. This selective or subjective sampling was based on the characteristics of the study population. No sampling frame was prepared for the key informants and focus group discussion participants. Key informants and focus group members were people perceived to have huge understanding and opinions about the topic under study. The main criteria for selecting the key informants in this study included the participant with extensive knowledge of the cultural practices related to drought in the past, longer length of stay in the study site and a leader of the organisation they are representing. For focus group discussion, ten participants were chosen at the equal measure in the five clusters of each study area i.e. two participants from each cluster. Gender equity was also a consideration in that one male and one female was selected.

The twenty four (24) sampled for the key informants comprised of one respondent from NDMA in Lodwar, 2 respondents from the County disaster department and line departments, 1 from each Community administrator (Chief) in Loruth and Napak, 1 Member of the County assembly each for Loruth and Napak, 2 from ministry of livestock and 2 from Ministry of Water, 1 from meteorological department, 2 NGOs representatives and 5 key informants from each of the 2 villages giving a total of 24 key informants. For focus group discussion members, ten for each study site were purposively selected and all the participants were provided with full information about the research to receive their consent.

The inclusion criteria for data collection were the participants only being the head of the household, adult (>18 years), a Turkana by ethnic group, permanent resident of the area and practice pastoralism. The FDG were for the leaders of various groups and community leaders while the interview guide was done only for the heads of institutions and departments or their deputies and or assistants when the head was not available. The participants were provided with full information about the research to receive his or her consent. Outside these inclusion brackets were excluded.

The data collection process involved in the operational procedures for both quantitative and qualitative approaches. The indigenous coping strategies were captured using both primary data collection methods. This was with the help of the household questionnaire, interview guides, key informant's interviews, focus group discussions and Observation checklist as study instruments. Two hundred questionnaires for each location. These instruments collected data on the household social demographic characteristics like education levels, age, gender, religion and other relevant characteristics; data on factors causing vulnerability to drought, how drought get detected by nomads, impacts of drought on nomadic population and data on community own drought coping strategies.

Key informant interviews were conducted with representatives of relevant departments and or institutions. Exposure of the interviewees and their respective level of education were considered in determining the interviews numbers. These self-administered interview guides on officials were closed ended questions. The purpose of opting to self-administer the interview guide questionnaire was to achieve a maximum and an increased response and reduce the time of processing. The explanation to the officials was provided first before providing the questionnaire. They were informed not only about the study objectives, an importance of their own opinion on survey results but also on confidentiality of the information they provide.

Focus group discussions were used to capture other qualitative information that is not captured in the questionnaire and affirm some of the information from a questionnaire, key informants, interviews, and observations. Two Focal Group Discussions (FGDs) from each study place had questions for discussions. The Focal Group Discussion consisted of local elders, chiefs and assistant chiefs, water point caretakers, food monitors, social workers, community health workers, community focal persons, Community opinions leaders, women group leaders, Youth group leaders and community volunteer's leaders. Their size was 8-12 members.

Observations checklist was used to collect data on general characteristics of the area, economic activities available, and activities by nomads, a general problem seen, solutions and options available and how nomadic pastoralists relate to outsiders. Photography was utilized to capture data observed. Observation sheets will be used to collect general and related information not captured in the other instruments.

Secondary data were received and reviewed from Ministry of livestock, Ministry of water, National Disaster Management Authority (NDMA) and meteorological department all located in Lodwar. This data was collected to compare, validate and strengthen the above collected primary data. Supplementary relevant literature in scientific and peer-reviewed journals in the Internet and virtual library were further reviewed.

To ensure validity of the study data instruments, the content was analysed by the expert judgments. The questionnaires, observation sheet, and participant information sheet were thoroughly checked by the Masinde Muliro University supervisors and improved, organized consistently with the research objective and expected data. Their feedback was put into consideration. The reliability was ensured by piloting the instruments in Kaikor village to ensure the instrument can be replicated, relied upon and free of errors.

No statistician was involved, and data was collected from the data instruments. This included interview guide, observation, questionnaire and focus group discussions that were edited, coded and arranged, tabulated and entered into an Excel spread sheet in a standard format to allow for analysis of both descriptive and inferential statistics where Statistical Package for Social Sciences (SPPS, version 21) computer software was used. Some information on some variables was collapsed because they were in excess of the study requirements.

For data analysis, inferential and descriptive statistics were employed for this study. For the demographic and socio-economic characteristics of the sample, descriptive statistics was utilized to analyses data such as Standard Deviation (SD), frequency and percentage, mean and median. Bivariate analyses (Chi-square tests) were used to examine the relationship between the independent variables like age, marital status, gender and income and the coping strategies. In the analysis, a Chi-square P-value of less than $p < 0.05$ (the significance level, 0.05) indicates a no statistically significant relationship between the measured variables. Pearson Correlation test will be undertaken for continuous variables (Porta, 2008) to assess the linear associations between different coping strategies and variables.

III. RESULTS AND DISCUSSIONS

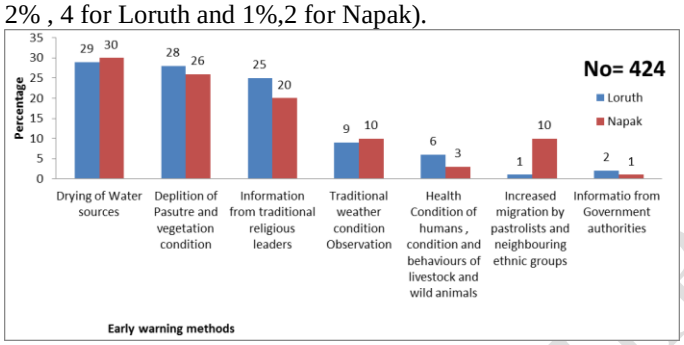
A. RESULTS

About ninety-one percent of Loruth respondents and fifty-four percent in Napak were female. More than seventy five percent of these respondents were married in both locations with more than ninety percent of them not having any basic education. More than sixty percent of the household types were not permanent in both places.

Characteristics	Categories	Loruth Number (N and %)	Napak Number (N and %)
Gender	Male	19(9)	97(46)
	Female	193(91)	115(54)
Age (in years)	18-50 years	198(93)	188(89)
	>51 years	14(7)	24(11)
Marital Status	Single	2(1)	9(4)
	Married	166(78)	175(83)
	Divorced	2(1)	9(4)
	Widowed	42(20)	19(9)
Are you the head	Yes	32(15)	46(22)
	No	180(85)	166(78)
Head of the household	Male headed	188(89)	181(85)
	Female Headed	24(11)	31(15)
Level of education	None	208(98)	202(94)
	Primary	4(2)	7(3)
	Secondary	0(0)	1(1)
	College and University	0(0)	2(2)
Type of household House hold	Temporary	149(70)	136(64)
	Permanent	63(30)	76(36)
	Traditionalist	198(93)	180(85)

religion	Christian	13(6)	31(14)
	Muslim	1(1)	1(1)
Source of water for Livestock	River/spring/stream	8(3)	105(50)
	Water pans and dams	14(7)	5(2)
	Rock catchment	0(0)	0(0)
	Piped water	0(0)	0(0)
	Wells and Boreholes	190(90)	102(48)

Figure 5.2 shows the main early warning methods of drought detection to include drying of water sources (29%, 62 for Napak and 30%, 64 in Loruth), depletion of pasture and vegetation condition (28%, 60 for Napak and 26%, 55 for Loruth), Information from traditional community leaders information from their gods, tobacco and shoes observation (25%, 53 for Loruth and 20 %, 43 for Napak), Traditional weather observations like birds movement, sky stars and intestines observations, and wind and temperatures rise (9%, 19 in Loruth and 10%,21 in Napak) , poor health conditions of livestock and animal behaviour (6% ,13 for Loruth and 3% ,7 for Napak) , increased migration (1% 2 for Loruth and 10%, 21 in Napak) and information from government authorities (2% , 4 for Loruth and 1%,2 for Napak).



Source: Researcher (2016)

Figure 3.1: Indigenous early warning methods in Ilemi Triangle, Turkana County in the Northern Kenya

The ten focus group discussion members in Loruth identified the following indigenous early warning methods to include observation of shoats intestines and tobacco, information from *'Emuron'* the traditional witch doctors, decreased water level from wells, spring, boreholes and water pans, change of soil colour, excess heat change, and diminishing pasture, increased distance to search water, strong dusty winds blow from east to west, change of livestock and reptiles behaviour, wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available and disappearance of leaves and fruits from trees. They were coded, scored and ranked in Table 3.2.

S/No	Identified impacts by 10 FGD members in Loruth	Total Score	Mean	Rank
1	Observation of shoats intestines and tobacco	190	19.0	1
2	Information from '*Emuron'* the traditional witch doctors	185	18.5	2
3	Decreased water level from wells, spring, boreholes and water pans and Increased distance to search water	178	17.8	3
4	Change of Soil color, excess heat change, and diminishing pasture and Strong dusty winds blow from East to West	165	16.5	4
5	Decreased number of traditional ceremonies like marriages and increased migration	138	13.8	5
6	Change of livestock behavior, white frogs color appearance, reptiles behavior of looking up and down	130	13.0	6
7	Wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available	80	8.0	7
8	Disappearance of leaves and fruits from trees	65	6.5	8

Source: Researcher (2017)

Table 3.2: Ranking of the Indigenous early warning methods by Loruth FGD, Ilemi Triangle, Turkana County in the Northern Kenya

The ten focus group discussion members in Napak identified the following indigenous early warning methods to include observation of shoats intestines and tobacco, information from *'Emuron'* the traditional witchdoctors, change of livestock, frogs, reptiles behaviour, increased distance to search water decreased water level from wells, spring, boreholes and water pans, strong dusty winds blow from east to west, change of soil colour, excess heat change, and diminishing pasture, increased distance to search water, wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available. They were coded, scored and ranked in the Table 3.3.

S/No.	Identified impacts by 10 FGD Members in Napak	Total Score	Mean	Rank
1	Observation of shoats intestines and tobacco	178	17.8	1
2	Information from '*Emuron*' the traditional witchdoctors	140	14.0	2
3	Change of livestock behavior, white frogs color appearance, reptiles behavior of looking up and down	138	13.8	3
4	Increased distance to search water, Decreased water level from wells, spring, boreholes and water pans	136	13.6	4
5	Strong dusty winds blow from East to West and Change of Soil color, excess heat change, and diminishing pasture	98	9.8	5
6	Decreased number of traditional ceremonies like marriages	72	7.2	6
7	Wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available	50	5.0	7
8	Disappearance of leaves and fruits from trees	30	3.0	8

Source: Researcher (2017)

Table 3.3: Ranking of the Indigenous early warning methods by Napak FGD, Ilemi Triangle, Turkana County in the Northern Kenya

Table 3.2 and 3.3 indicates the ranking of the Indigenous early warning methods by FGD in Loruth, and Napak in Ilemi Triangle, Turkana County Kenya. Observation of shoats intestines and tobacco, Information from '*Emuron* 'the traditional witch doctors, decreased water level from wells,

spring, boreholes, and water pans and change of livestock condition and behaviour, white frogs appearance, reptiles behaviour were ranked among the top early warning methods used in the two places by the FGD.

S/No	Factor identified in Loruth by 10 FGD members in Loruth	Napak Rank	Loruth Rank	D	D^2
1	Observation of shoats intestines and tobacco	1	1	0	0
2	Information from '*Emuron'* the traditional witch doctors	2	2	0	0
3	Decreased water level from wells, spring, boreholes and water pans and Increased distance to search water	3	4	1	1
4	Change of Soil color, excess heat change, and diminishing pasture and Strong dusty winds blow from East to West	4	5	1	1
5	Decreased number of traditional ceremonies like marriages	5	6	1	1
6	Change of livestock behavior, white frogs color appearance, reptiles behavior of looking up and down	6	3	1	1
7	Wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available	7	7	0	0
8	Disappearance of leaves and fruits from trees	8	8	0	0

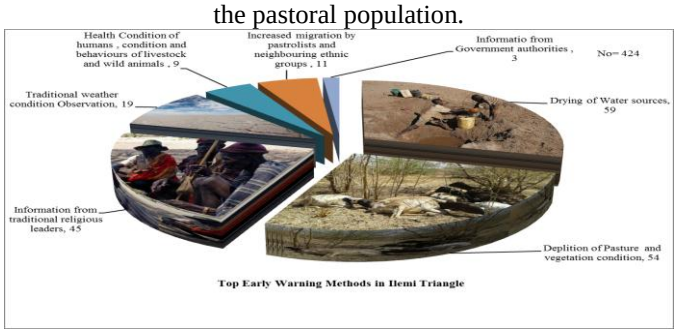
Source: Researcher (2017) $\sum D^2 = 1$

Table 3.4: Ranking Correlation between Napak and Loruth on the Early warning system methods

a. DRYING OF THE WATER SOURCES

The study showed that drying of water sources (29 %, (62) for Napak and 30%, (64) in Loruth) was one of the top early warning indications of the eminence of drought. When the river wells get dry up and get deep then drought is approaching.

Figure 3.3 shows that water remains the first notifiable resource for a drought indication and an important element in the pastoral population.



Source: Researcher (2017)

Figure 3.3: The top drought early warning indicators in Ilemi Triangle, Turkana County in the Northern Kenya

b. DEPLETION OF PASTURE AND CONDITION OF THE VEGETATION

Pasture presence remain the backbone of livestock livelihood and absence of pasture weakens this preferred pastoralist's livelihood option. Figure 5.2 indicates pasture depletion and vegetation remain among the top most recognisable element for early warning to drought among the pastoralists in Ilemi Triangle while Plate 5.1 taken during data collection period in Loruth, one of the study sites shows a complete absence of pasture. The findings showed that pastoralists in Ilemi Triangle observe pasture presence as an indication of the eminence of drought (28%, 60 for Napak and 26%, 55 for Loruth).

Source: Researcher (2016)

Plate 3.1: Depleted Pasture in Loruth, Ilemi Triangle, Turkana County of the Northern Kenya

c. INFORMATION FROM THE TRADITIONAL COMMUNITY LEADERS

Traditional community leaders information from their gods, tobacco and traditional shoe observation (25%, 53 for Napak and 20%, 43 for Napak),

The Focus group discussions in both areas articulated the importance of including traditional leaders in the drought early warning process affirmed the findings. They mentioned the importance of the witch doctor named "*Emuron"* in Turkana who provides instructions and information on drought, enemy eminence and on instructions on when to migrate. Therefore, they play a key role in the early warning and coping strategy to drought. These traditional witch doctors observe tobacco, rely on dreams from gods and use traditional shoes named "*Ngakaap*" to predict drought and instruct on migration.

The observation of intestines according to the key informants in Napak act as weather sign board for traditional practitioners in predicting meteorological conditions and informs them of eventualities. A traditional leader named *'Emuron lo aangamuk anajuom'* who uses their traditional shoes made of goatskin named *"Ngakapeta*'' to predict the weather conditions by shaking and throwing them on a flat surface. The traditional leaders shake the shoes several times while praying for their gods. When the shoes persistently continue to face the west part of their area when shaken, then it shows the wind and good things are coming and when they face all east then they have no sign of hope for rains. This informs them of how to cope.

d. TRADITIONAL WEATHER OBSERVATIONS

The findings indicates that traditional means like observations of bird's movement, sky and stars movement, moon shape and intestines observations, strong dusty wind,

excessive dryness of land and excessive temperatures rise (9%, 19 in Loruth and 10%, 21 in Napak) remain among the relied means of weather prediction in Ilemi Triangle.

The focus group discussions and key informants generally lamented that when birds named *'Elele'* in Turkana language migrate and soar very high in the sky it is an indicator that the rains are far (drought) and when they fly low it gives an indication that rains are approaching. Moreover, the singing of some such birds is said to be a good omen in so far as rainfall is concerned. In particular, if wild pigeon's birds named in Turkana "*Akuri na Emoru"* are heard singing, it is believed to be a very good sign of an approaching good rainy season.

Moreover, the Turkana nomadic pastoralists observe that the moon shape and stars to detect how the season will be as shown and the direction of where the stars moves is believed to be the direction where good pasture and water is available . Moreover, one old key informant in Napak illustrated that if a new moon rises and the crescent is directed to the North (left) it shows drought and if the Crescent is tilting right - this symbolizes a sign of wet season/rains and therefore the coming season is hoped to bring good fortunes.

Source: Researcher (2016)

Plate 3.2: Shoats grazing in Napak Dry Riverbed, Ilemi Triangle Turkana County, Kenya

Moreover, as there are no modern networks of the meteorological stations in Ilemi Triangle, any increased temperature named '*Eron'* gives an indication of drought. Any increase in temperature from the average temperature in Turkana gives an indication of drought and or a bad year that pastoralists have to prepare themselves either to migrate or apply other coping strategies.

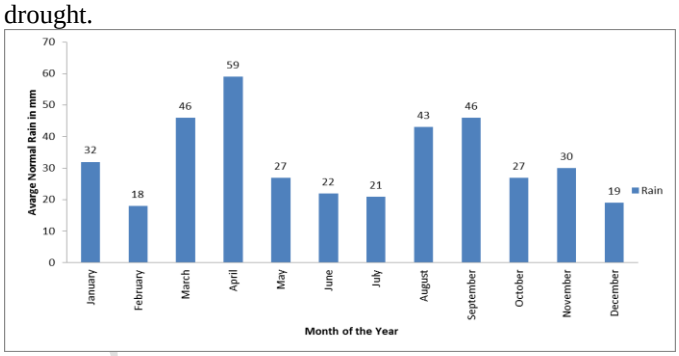
Table 3.6 shows normally expected temperatures in Turkana County and accordingly if temperatures go beyond the limits the nomads believe it is evidence that drought is coming. This is especially for higher temperatures according to the FGD of the two areas. NDMA (2018) has provided in Table3.6 the average normal amount of rainfall expected in Turkana County and if the amount of rain goes below the normal threshold, then, nomadic pastoralists experience problems.

Months	Temperature			Normal Precipitation
	Normal	Warmest	Coldest	
January	28.7°C	35.5°C	21.9°C	1
February	29.6°C	36.2°C	23.0°C	1
March	30.1°C	36.2°C	24.0°C	2
April	29.6°C	34.8°C	24.4°C	4
May	29.7°C	34.8°C	24.5°C	2
June	29.1°C	34.1°C	24.1°C	1
July	28.4°C	33.2°C	23.7°C	2
August	28.7°C	33.6°C	23.8°C	1
September	29.6°C	34.9°C	24.3°C	1
October	30.1°C	35.4°C	24.8°C	1
November	29.1°C	34.5°C	23.7°C	2
December	28.5°C	34.8°C	22.3°C	1

Source: Ingrid Støver Jensen and Anton Eliassen (2016) metrological information. Available; https://www.yr.no/place/Kenya/Turkana/Lodwar/statistics.html

Table 3.6: Temperature and precipitation per month in Turkana County in the Northern Kenya

Figure 3.4 show that Turkana County do receive long rains in the month of March and April and again between the month of August and September. The corresponds to the Turkana County Meteorological department opinion that Turkana County receives yearly long rains in the month of April to June, and short of this according to them is a sign of bad year with no rains thus disaster looming. It is expected that during the month of long rains, calving rates and milk yield increases and any short of this is a danger sign of drought.



Source: NDMA Turkana data (2017)

Figure 3.4: Normal average monthly rainfall for 2017 in Turkana County, in the Northern Kenya

However, key informants both from Napak and Loruth lamented that they do not follow this average monthly rain pattern and rely on traditional weather prediction patterns. Nevertheless, some rain drizzle seen received during dry season according to key informants in Napak indicates a sign of completed cattle rustling attacks by the neighbouring warring ethnic groups and that the dead people crying and their tears are coming out inform of rain and the stolen livestock are desperate to return from the cattle rustlers. This kind of rain according to key informant is named '*Ngakiyo a Ngitunga'* and it is not counted as normal rain, it is a form of danger that will motivate both migration to other areas and a start of organizing a retaliatory attack to the other ethnic groups. The authorities and peace initiative organisations can use this indicator to search for peace among the warring ethnic groups.

The computed SPPSS 21 Nonparametric Correlations for Mann Kendall's Tau between the monthly rainfall pattern in Turkana and monthly average temperatures (Table 3.6) shows the values of 0.226. The Positive (+) values indicate an increase in constituent concentrations over time and there is a positive association between the monthly average rainfall and average monthly temperatures. The correlation coefficient between rain and temperature is also r=1 that is positive showing the two variables is strongly related. They, therefore, go hand in hand in the detection of drought.

e. LIVESTOCK CONDITION AND BEHAVIOURS OF LIVESTOCK, WILD ANIMALS, REPTILES AND INSECTS

The findings indicated that poor health conditions of livestock and their behaviour (6%, (13) for Loruth and 3% (7) for Napak) remained among the top early warning signs in Ilemi Triangle. According to the key informants in Loruth and Napak, wild animals condition and livestock behaviour do include wild animals living close to human habitat and increased conflict between wild animals and human for water resources, increased water consumption behaviour by livestock to try to adapt if they will miss in the next dates, increased behaviour change of monitor lizards and big reptile named '*Anaknak'* in Turkana language especially in raising their heads more up believed in Turkana to be praying for rains and only lowering them down when rain season approaches and appearance of white frogs indicates drought is approaching.

The researcher observed an emaciated camel in Napak (Plate 3.3) during the data collection period from one of the livestock water point and the livestock emaciated condition makes them difficult to move.

Source: Researcher (2016)

Plate 3.3: Livestock condition in Napak area, Ilemi Triangle, Turkana County, Kenya

According to the Key informants in Napak, the daily or continuous night strange sounds and or noises named "*akiruko e emong a lodwarat"* in Turkana language made by the main household big bull according is believed of a bad omen coming and a danger approaching .The danger can be an enemy approaching; an eminent drought or an attack by neighbouring ethnic group that could happen anytime and the owner of the bull might be killed by neighbouring ethnic group enemies. This will automatically informs an immediate migration of the Turkana nomadic pastoralists to other areas.

When key informants from the two study sites were probed on which of the animals and livestock behaviour signals more danger for a looming drought. The ranking was done from the top most common and serious behaviour to the least as shown in Table 3.7

S/No	Livestock Condition, wild animals and Reptiles Behavior by 10 Key informants in Ilemi Triangle	Total Score	Mean	Rank
1	Increased water consumption behavior by livestock	179	17.9	1
2	Livestock becoming malnourished , lack of stamina and restricts movement	175	17.5	2
3	Daily or continuous night strange sounds and or noises named "*akiruko e emong a Lodwarat* "	168	16.8	3
4	Increased behavior change of monitor lizards and big reptile especially in raising their heads more up believed in Turkana to be praying for rains and only lowering them down when rain season approaches and appearance of white frogs indicates drought is approaching.	165	16.5	4
5	livestock behavior change and livestock refuses to obey herder instructions of refusing to follow a certain direction and folding tails	120	12.0	5
6	Livestock start to feed on dry bones and droppings of other livestock	85	8.5	6
7	Wild animals moving towards people habitation and increased conflicts between wild animals and people because of water and increased birds movement towards areas where is available	80	8.0	7
8	there is a reduced livestock product sell in the market and livestock body condition changes	65	6.5	8

Source: Researcher (2017)

Table 3.7: Ranking of the Livestock Condition, wild animals and Reptiles behaviour by FGD in Ilemi Triangle, Turkana County in the Northern Kenya

According to Key informant the top five animals and livestock behaviour signals that are more indicating the danger and a looming drought in the order of the top most common to include increased water consumption behaviour by livestock, livestock becoming malnourished, lack of stamina and restricts movement, daily or continuous night strange sounds and or noises named "*akiruko e emong a Lodwarat*" and increased behaviour change of monitor lizards and big reptile especially in raising and lowering their heads down and appearance of white frogs indicates drought is approaching, livestock behaviour change and livestock refuses to obey herder instructions of refusing to follow a certain direction.

Moreover, on the behaviour of livestock as an indicator of drought, one key informant in Loruth described this indicator and mentioned that

Though drought recurrence and its unpredictability has eroded our traditional knowledge to predict certain degree of drought, our livestock behaviour helps us to predict drought yearly and from experience as an elder of this village, Cattle precisely, provide us with a clear signals of an imminent disaster and we follow these signs to signify a specific hazard. Our cattle feeding habit changes tell us there is a problem and when they expel stool and excrete frequently while squatting than standing, fold tails and feed on dry bones then there are a problem and danger. In fact the year 2010 drought we predicted drought following the misery conditions of our cows that started grazing while lying started taking urine of other cows and making peculiar sounds at night but no government help was forthcoming until we heard of Kenya Red Cross coming to help.(Key informant interview, 26th July 2016, Loruth Village).

With regard to livestock, the key informants mentioned that drought occurrence is indicated by deterioration of body condition of livestock to include the sheep; goat, donkey and even camels (Figure 3.5) reduce body weight accompanied by protrusion of ribs, loss of hair in their skin. The situation is evident when lactating livestock produces almost no milk to fill the 300ml cup for shoats and or even to support the young suckling livestock who eventually succumb to such difficult condition. Livestock mortalities remain an important indicator of drought incidence. In severe and prolonged drought, livestock mortalities become evident. First, the young and aged sheep succumb to drought and then kids and mature sheep followed by goats. The prediction become true as the year 2010 drought was very severe with excessive livestock loss, no early warning information was provided to the population by the meteorological and NDMA department and Kenya Red cross came to provide relief food aid. In Napak one key informant mentioned that

In the drought of 2008 – 2009 and 2011, I saw it coming rapidly…I saw it from our religious leader tobacco and our special traditional shoes. The Tobacco informed us of danger coming and it never took long for the drought happened and the situation became miserable. (Key informant interview, 30th July 2016, Napak Village).

This exact prediction showed how strong relationship between the traditional method of weather prediction and modern method for the drought of the year 2009 and 2011 was. The researcher argues that even with repeated drought and the weakening of the drought knowledge of the pastoralist's, there was a strong relation in the prediction of the drought of 2008 -2009 by the traditional leaders to the eventual drought of 2008 -2010.This was never taken in because of absence of community engagement and coordination of weather information and it wholly missed and the community was left to bear the impacts of drought without early proper mitigation methods.

f. INCREASED PASTORALISTS MIGRATION

Human behaviour changes during drought and an increased inward migration by other ethnic groups is an indication of drought affecting them that is leading to their migration. The study findings showed that (1%, 2 for Loruth and 10%, 21 for Loruth). Increased sending of family members to the relatives is an also an indication of drought according to key informants.

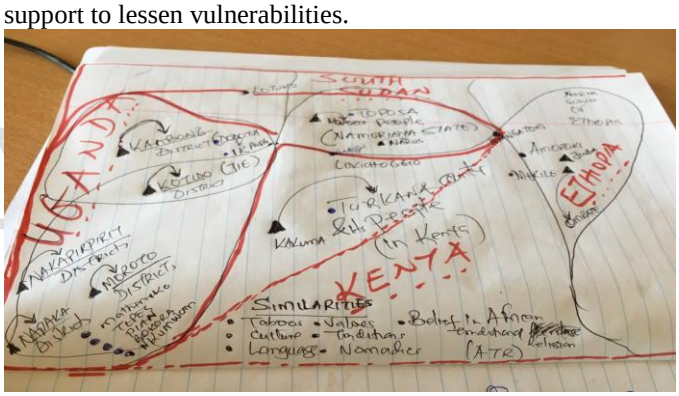
Key informants recalled past droughts from their own experiences and through stories from community elders. Drought occurrences in the last twenty years were easily remembered and freely discussed in the focus group discussion sessions, with middle-aged members also actively engage in the discussions

Source: Researcher (2016)

Plate 3.4: Observed migration of pastoralists in Napak, Ilemi triangle, Turkana County, Kenya during data collection period

Key informants concurred that in the past especially in the 1950s, 60s, and 70s the area was rich with varieties of vegetation, people were healthy and wealthy, and food shortage was unheard-of. They also recalled that water and pasture were in plenty and livestock suffering was minimal.

Turkana nomadic population like other ethnic groups in Ilemi Triangle (Plate 3.5) are known to follow a certain migratory pattern, the County government can link other services like education, and health to these areas they pass and ensure social amenities are available for this population to support to lessen vulnerabilities.



Source: Researcher, 2017

Plate 3.5: Sketch map of Ilemi Triangle with ethnic groups, Turkana County, Kenya

g. DROUGHT INFORMATION FROM BOTH THE STATE AND COUNTY GOVERNMENT AUTHORITY

This is one method the Ilemi Triangle population receive early warning information. It should have been the most effective if the system was working. In Ilemi Triangle (2%, 4 for Loruth and 1%, 2 for Napak), a smaller percentage of response mentioned that they receive early warning information from the government sources. The government sources include the chief, the administrators, the County commissioners and other government bodies like NDMA .This information is from meteorological station stationed in Lodwar town. There are no network of meteorological stations and weather field officers in Ilemi Triangle, thus a translation of poor coordination of weather information and absent modern weather technology.

The key informants have expressed concern of absence of modern equipped meteorological station in Ilemi Triangle and Turkana County as a whole. Turkana County only

meteorological available station is in Lodwar town and it is more analogue and misses much modern weather prediction apparatus to include the satellite. This modern meteorological station would support in providing accurate weather information to pastoralists on impending drought and enable nomads to immediately adjust. Moreover, there is a clear absence of active early warning system in Ilemi Triangle, poor collaboration, information sharing and poor weather coordination between traditional intelligent weather knowledge and modern technology.

Year	Local (Turkana) name	Local description	Approximate Livestock mortality rate
1925	Ekwakoit	Bad hunger	61%
1930	Abrikae	Drought and bad hunger.	70%
1942	Lolewa	Bad animal disease and all people were starving and excessive diarrhoea	80%
1943	Ekowom Loyang	Drought and famine.	70%
1947	Ata Nachoke	Animal disease and famine.	70%
1949	Ngilowi	Animal disease.	70%
1952	Lotira	Animal disease, drought and famine.	61 %
1953 –1954	Lokulit	Bad years, famine continued.	65%
1960	Namotor	Drought and famine	55 %
1966	Etop	Serious but short drought.	65%
1969 - 1971	Kimududu	Drought	54%
1972	Kibebek	Drought and famine.	75%
1973	Lolewa	Cholera epidemic, many deaths.	60%
1976	Ibore Akwaan	Small death of livestock after big rains	40%
1979	Atanayanaye, kiyotoAtangaa Loukoi,	Animal disease (CCPP, anthrax) and a lot of dead livestock	70%
1980-1981	Lopiar / Epocho Nyang	Drought and Animal disease (CCPP, anthrax), security problems, migration of Kwatela to Kaaleng and back to Kaikor	65%
1984	Kilejok, Kidirik	Minimal rain, animal raiding.	70%
1990-1992	Akalkal	Skins and bones of dead livestock everywhere	73 %
1993	Lokwakoyo	Severe Drought	74%
1994	Ngakalalio/Nanyeye	South Sudanese migrated to Ilemi after drought, serious but short	60%
1997	Etop	A very Serious but shorter drought.	80%
1998	Itaok ka Akimiet , Abunet Erupe a Munyes	Small drought as milk was available, minimal rain	50%
2000	Logara / Epompom	Drought with livestock death	63%
2001	Kidirik	Excessive migration because of drought	65%
2004	Kanyangiro	Drought that resulted to Migration to Kanyangiro in Uganda	60%
2005	Kimududu	Drought and bad hunger.	60%
2006	Lomoo	Named after animal disease PPR in Turkana	65%
2007 –2008	Ngasaja	Pastoralists migrating with flock of donkey with harness	70%
2009 - 2010	Abakuli , Epoo, Lokwarasmoe	Skins everywhere, many livestock death, dry pasture	75%
2011-2012	Ekusiya Deu /Ekaru a Red cross	Drought that led to Kenyan for Kenya initiative	85%
2015 - 2016	Namugielach	Drought that resulted to excessive death of livestock and lice infestation to both livestock and people	70%

Source: Researcher (2017)

Table 3.6: Drought Occurrences in Ilemi Triangle presented by the key respondents from Loruth and Napak since the year 1925

B. DISCUSSIONS OF THE FINDINGS

Following instructions from the traditional systems of traditional leaders and religious leaders according to Masinde and Bagola, (2012) study is vital for early warning information among nomads and it has helped them go through different droughts. In summary, the FGD rankings in Napak and Loruth were having correlation coefficient 0.99±0.0054.Thus it was statistically significant ($\rho < 0.05$). This implied that the FGD rankings in Napak and Loruth had a significant positive correlation. Thus, they were mainly the same. Thus, the communities of the two localities were experiencing the same events hence the same perceptions.

The study findings agree with Mutua (2011) findings that mentioned that absence of rains, drying out, drying of surface water collection points like water pans and wells plus a misty and high speed dusty windy storms symbolize drought. Water is a critical element and a determinant of pastoral production systems in the ASALs and the Turkana pastoralists like other pastoralists follow water sources for their livestock and always dwell near water points. An absence of water commodity ensures these pastoralists migrate and these makes they exposed to other volatile neighbouring ethnic groups in Ilemi Triangle. This study corresponds to studies by Ichara (2012) that showed that pastoralists first thing they notice as a sign of drought is pasture and will inform them to migrate or not. The suggestions given by FGD that during drought, all pasture is wiped away and livestock become miserable agree with the study done by Opiyo et al., (2012) in North-western Kenya that mention that pasture depletion in nomadic pastoral environment is an indication drought is imminent.

Reduction in number of traditional ceremonies like marriages, respect of order from traditional religious groups form active part of early warning in Turkana and any lack of respect for traditional leaders is reciprocated by calamities like drought according to Mureithi (2012). Moreover, Knowledge about past disasters and climate in Ilemi Triangle are the accumulated experiences that have been handed down to generations through oral traditions and the traditional leaders have this knowledge library. They are relied upon by the communities.

This study findings corresponds to study by Makwara (2013) on exploring the Linkages between the Indigenous Knowledge Systems and Modern Weather Forecasting and

mentioned that elderly male community leaders formulate hypotheses about seasonal rainfall by observing natural phenomena, such as the appearance of certain birds, mating of certain animals and flowering of certain plants, while cultural and ritual specialists draw predictions from divination, visions or dreams.

According to the focus point discussions and key informants, during the dry season, the traditional religious leaders do a lot to try predicting the weather. This is done through observation of tobacco, sky observation, observation of small livestock intestines colour and playing with traditional shoes according to Lekapana (2013). These practices are done alternatively and different traditional leaders have own preferences. Tobacco is put on a flat service and the specialized traditional religious leaders recite some words to their gods to provide them with information and feedbacks. The same is done with traditional shoes named "Ngakapeta" and" and intestines observation. The shoat intestines colour when looking dark indicates heavy clouds for forthcoming rain while clear intestines show hunger and a danger that is looming according to the key informants from Loruth.

It is expected that the gods of traditional religious leaders provide them with enough information on drought eminence, rain information and if the enemy is approaching or not. Nomadic pastoralists follow these traditional religious leaders' instructions (Mutua, 2011) and therefore, these traditional leaders play a key role in early warning of the nomadic population. However, with the absence of modern early warning monitoring tools and hardly a network of the meteorological station in Ilemi Triangle, nomadic pastoralists have to rely on these close leaders for any information on weather. According to Lekapana (2013), the government has not invested in recognising the traditional religious leader's knowledge in the early warning system and it has clearly been left out and has not been recognized at all.

In addition, involvements of the local communities' people-cantered early warning systems rely on the direct participation of those most likely to be exposed to hazards (Dube, 2018). Without the involvement of local authorities and communities at risk, government and institutional interventions and responses to hazard events are likely to be inadequate. A local, 'bottom-up' approach to early warning, with the active participation of local communities, enables a multi-dimensional response to problems and needs. In this way, local communities and traditional structures can contribute to the reduction of vulnerability and to the strengthening of local capacities according to Cannon (2004). Moreover, with an absence and lack of integration of modern early warning network in Ilemi Triangle, lack of extension officers, absence of drought information amid non-inclusion of nomadic pastoralists in the management and coordination of drought information in Ilemi Triangle makes the nomads to consider any drought management initiatives as foreign.

Traditional leaders and the pastoral institutions therefore, are essential in drought mitigations according to Opiyo (2014). They play a key role in implementation of traditional coping strategies and in inter-community conflict resolutions. Drought policies that affect pastoralists should recognise the importance of traditional institutions of pastoral communities and integrate their livelihood strategies into policy implementation plans and activities (Mureithi, 2012).

This findings corresponds to the study findings by Mutua (2011) and Mosley (2016) that found out that movement of stars to a certain direction, colour of moon changing from brown and dark according to the Turkana pastoralists symbolizes a bad omen and or drought while when the new moon rises, the shape of the moon in the tilting position like asymmetrical shape symbolizes no rain that month.

Furthermore, the change of wind direction is used in the study area to detect drought and according to Lekapana (2013), when the wind is moving from East to West consistently for more than three months according to shows the drought is occurring. Nevertheless, the Northern winds and winds from the West winds in Loruth bring good tidings and rain for livestock (Mureithi, 2012). Plate 5.2 indicates how dry and clear sky the Ilemi Triangle environment is and it's a traditional indication of drought. Lack of rain in the expected month shows hard times and a sign of drought according to KMS (2010). Nevertheless, there is a serious wearing of traditional observation as an indigenous knowledge on predicting drought because of recurrent drought in Ilemi triangle, Turkana County has further affected nomads coping strategies and the government should play a role in early warning information.

FGDs and Key informants suggested that if livestock folds the tails more than twice, starting to feed on dry bones and droppings of other livestock and when livestock refuses to obey herder instructions of making them follow a certain direction provided by the herdsman when gathering them and instead livestock runway scuttling in opposite direction, this is a bad omen and denotes a terrible upcoming drought that could clear the whole livestock and it will definitely inform immediate migration. These findings corresponds to study findings by Gupta and Singh (2011) who discussed that such bad omen in nomadic pastoralists enables them to immediately migrate to evade imminent danger.

Appearances of white frogs and reptiles' behaviour are traditionally believed to be a sign of danger and drought is approaching according to the key informant in Loruth village. This finding corresponds to Mutua (2011) findings that indicated that wild animals do migrate close to human habitation when drought strikes and this increased conflicts between human and wild animals show excessive drought in hibernation areas of these wild animals in Ilemi Triangle.

Observed emaciation is as a result of absence of pasture. According to Lekapana (2013), livestock emaciation due absence of pasture is evident in drought stricken areas and it is then important to provide relief pasture to safeguard such livestock from death. The livestock condition in pastoral populations informs drought level and malnutrition of livestock according to the key informants that drought is severe; they become lethargic and lose vigour to walk for longer distance even to have water and pasture. This lack of stamina restricts livestock movement especially sheep, the young and the aged livestock to shades, denying them an opportunity to feed on few available pastures. This eventually will accelerate their death (Ichara, 2012).

Findings corresponds to Mutua (2011) and Opiyo (2014) studies that concluded that when drought is approaching,

livestock behave strangely and become highly infested by animal pests especially ticks and lice; herders witness an abnormal increase of shoats calving twins; there is an outbreak of livestock diseases even from migrating neighbours, young goat kid suckling while lying down or crouching and or an even putting a one foreleg around the head. Moreover, an explicit description of livestock behaviour in nomadic pastoralism lifestyle plays a key role in the continuous survival of nomadic population according to Lekapana (2013).

The findings correspond with Mureithi (2012) study's findings that suggested that when drought approaches, people and livestock behaviour change, there is a reduced livestock product sell in the market and livestock body condition changes, livestock market prices do change immediately and pastoralists to increase the cost of livestock and their products. One other most important animal indicator is the behaviour of insects according to Opiyo (2014 and Makwara (2013). These insects behaviour have a great influence on weather decisions. Accordingly, when a lot of crickets are observed on the ground, a poor rainy season is expected. By contrast, when sun spiders are visible in the area, they signal the imminent arrival of a wet spell and a sign of good hope for livestock according to Mawere (2010).

Moreover, the number of traditional ceremonies and raids reduces. Accordingly to Melle (2016), raids' do increase in number to gain more livestock to compensate the lost livestock during drought or do restocking. This increased conflict shows stress for resources and or the neighbouring ethnic group have been impacted badly by drought impacts. However, raids or cattle rustling does happen mostly in the wet season and not during drought because livestock gets weaker or are in poor health during drought and can die easily during raids.

This corresponded to the drought incident that happened in Turkana County in the year 2011 and the most affected was Ilemi Triangle To check if they use past experience in predicting drought, three different key informants (an elder of about 80yrs) in Napak and Loruth were able to name different drought season (Table 3.3) since the year 1925. The increasing severity and frequency of drought occurrence is an indication that the region is getting drier reflecting the observed changes in arid north-western Kenya. This observation concurs with Thornton and Gerber (2010) who notes that the climatic condition of northern Kenya is getting drier. Additionally, failure to have the expected amount of rainfall according to OCHA (2010) have led to several droughts in Kenya during the last 25 years mainly 1975, 1977, 1978, 1984, 1992, 1997, 2005 and lately 2008; 2009.

Moreover, the behaviour of people was also considered indicators of a looming or occurring drought. One man summed this up in a focus group session in Loruth who mentioned that women go and gather fruits, roots, berries and tubers from trees around the dry rivers to be used as food for the family during drought. Men and women have resorted to collecting firewood, send more family members to Kakuma to work in the refugee camp and to the relatives in big towns like Lodwar to eat, making charcoal and transporting to Kaikor to sell or exchange for cereals, maize, and other foodstuffs. This usually does not occur during good seasons. Men will learn to do a lot of visits to relatives to borrow foods and women go back to their parents to look for food (Mutua, 2011).

These findings resemble the study findings by Mureithi (2012) who reported that inward migration of neighbouring ethnic group is a big indication that drought is hitting hard the neighbouring. Accordingly, resources used by pastoralists have heavily been affected by instability created by migrating ethnic groups conflicts related to water and pasture resources according to IFRC (2014). Otherwise, if drought is approaching many of these pastoralists move (Plate 5.4) close to each other and conflicts results (Opiyo, 2014). This is a major feature in the Ilemi Triangle due to drought.

The study agree on importance of sharing weather information and according to Opiyo (2014), information is power and by ensuring that the local communities have access to a tailor-made information on impending droughts is one way of giving them power to protect themselves from their negative effects of drought. Therefore, the huge gap in information sharing remains a threat on how Ilemi Triangle pastoralists cope to drought. Moreover, drought indigenous knowledge and its intelligence are under serious threat from events such as climate variations, frequency and severity of drought and modernisation according to Melle (2016).

Blending this traditional Knowledge with the scientific forecasts can mitigate some of this. Conversely, incorporating indigenous forecasts into the seasonal climate forecasts will improve its relevance and acceptability, hence boosting its utilisation among the nomads (Lekapana, 2013). This is because an effective drought early warning system (DEWS) has a high potential of making a greater contribution towards tackling the cycle of droughts (Oxfam, 2011). This is by way of providing timely, relevant and comprehensible information on impending droughts that could be used to mitigate droughts' effects and therefore reduce their negative impacts on the fauna and flora.

However, successful DEWS rely on weather forecasting systems in place and the network of meteorological stations are not available in Ilemi Triangle. This research calls for an immediate implementation of the modern meteorological stations networks across Turkana County and especially in Ilemi Triangle and integration of modern and traditional indigenous methods of early warning to reduce population vulnerability on drought.

The relation between indigenous EWS and conventional methods has been that they both relied upon by their users and assist populations to make decisive decisions to cope with drought impacts. As the scientific and modern weather apparatus are missing in Ilemi Triangle and or even when indigenous methods are built upon experimental learning and on accumulated knowledge passed orally from generation to generation and rarely recorded in a written forma; they play a key role in modern world and an important knowledge for decision making for communities. The study advocates for improving traditional weather early warning methods by assessing the desirable properties of indigenous knowledge indicators to include their reliability, robustness, and relevance through monitoring and verification with observations. The effectiveness of the traditional methods has been reduced by anthropogenic influences according to Opiyo (2014) and the

climate changes have reduced the predictability level, thus, need for use of modern weather methods.

Table 3.6 indicated that the drought of the year 1942, 1997, 2010 -2011 and the year 2011-2012 had many livestock lost due to mortality related to severity of drought. All these years, Ilemi Triangle according to key informants have never had any modern method of predicting weather and only relied on the traditional methods of intelligence. This calls for the state and County government to work on a long term plan of allowing coordination and participation of local population into weather management, erect modern meteorological station in Ilemi and work on polices that strengthen pastoral livelihood and development of pastoral traditional institutions in Arid and Semi-Arid areas in Kenya according to Opiyo (2014).

Moreover, the conditions of vegetation according to Mosley (2016) provide signals of a looming drought. Respondents mentioned that gradual disappearance of grass and shrubs, change of their colour from greenish to brown, coupled with continuous grazing leave bare grounds and stumps of grass and shrubs clearly indicate 'bad years'. Secondly, when mature trees such as '*esekon, etiir, edung, engol, and Ebei* 'lose leaves and fail to flower and produce fruits and berries then, this is a clear signal of a severe drought looming.

To address the problems of weak early warning system in Ilemi Triangle, this study proposes and advocates for an incorporated model named '*ilimi*' that bridges, integrates Indigenous Knowledge Systems into modern weather monitoring structure and promptly communicating weather predictions. This Ilimi in Ilemi Triangle will deliver systematic drought early warning system (DEWS) in nomadic pastoral setting. This information will be composed of indigenous drought knowledge base, enhanced and integrated drought monitoring with modern knowledge and prediction levels and finally delivering early and proactive dissemination of drought information.

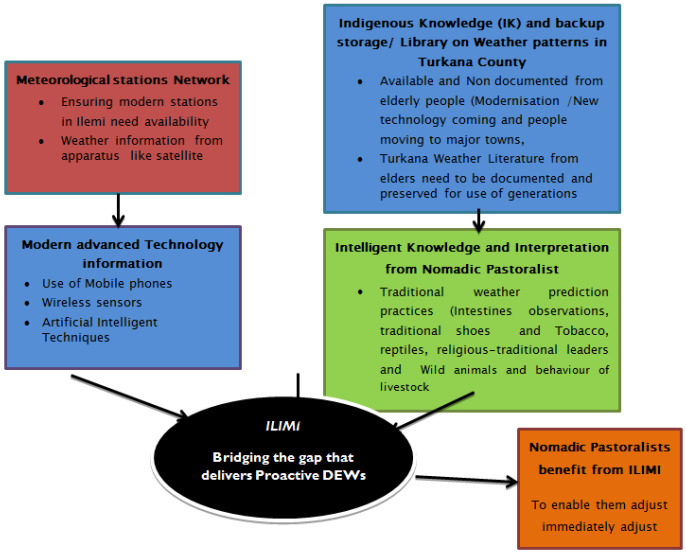
ILIMI acronym for Indigenous and Localised Intelligent Knowledge with Modern Technology Information is a bridge that integrates scientific drought forecasting approach into the indigenous drought forecasting approach known by the population to boost predictability levels. The modern weather apparatus in Lodwar should be able to support nomads with drought early warning information and the information must be shared. ILIMI was conceptualised from a Turkana word *'ilimilimi'* a name used by the Turkana people of the Northern Kenya to indicate some raindrops, and marks an end of drought and a beginning of rain season thus a bridge between two seasons. Ilimi model ensures pastoralists get adequately supported and prepared before the next cycle of drought begins.

The Turkana nomadic pastoralists migrate with their livestock to the areas that have rained also known as '*Akop na ilimi Akiru'*. This thesis supports building, conceptualisation, deployment and evaluation of *ILIMI* model and initiative within pastoral population framework because the bridge provides the much-needed link between the scientific and indigenous drought forecasting approaches and ensures the pastoralists are well prepared to drought.

Nevertheless, the study acknowledges that predicting droughts alone cannot eradicate droughts in Ilemi Triangle; access to relevant and accurate information on impending droughts in timely fashion and comprehensible formats however could go a long way in assisting all the stakeholders plan for and mitigate effects of the droughts according to Opiyo (2014). This precisely is the contribution of *Ilimi*. The presence of weather sensors in *ilimi* will enable capturing of the micro weather data and hence, improved prediction accuracy. Indigenous knowledge on the other hand helps in cultivating relevance (both culturally and locally), acceptability and sense of ownership of the forecasts among the Turkana nomadic pastoralists. Moreover, the systematic capture and storage of Turkana indigenous knowledge (IK) on weather that requires implementation is phenomenal step towards the much-needed conservation of the endangered IK.

The main contribution of this research is a framework for drought prediction that creates the missing link (bridge) between the scientific and indigenous drought forecasting systems

Looking on application of *Ilimi* model in Ilemi Triangle, the state and County government should immediately apply this model to stress on implementing a mechanism of retaining indigenous weather information library that will act as a knowledge base for reference and built indigenous practices. According to Gupta and Singh (2011), the knowledge and appropriate technology transfer from the modern technology information from the apparatus will be important to equip the pastoralists with information on drought and livelihood management within their own local environment and social structure. This will increase capacity to cope and lessen drought impacts according to Lekapana (2013).



Source: Researcher (2017)

Figure 3.5: Ilimi Model to deliver effective DEWs in Ilemi Triangle, Turkana County, Kenya

IV. CONCLUSIONS

The study findings showed that the main early warning methods used in Ilemi Triangle are all Indigenous Intelligent Knowledge without any present Modern Technology

Information like satellite and radars in Ilemi Triangle. The traditional early warning methods identified by the study included drying of water sources, depletion of pasture, information from traditional community leaders, Traditional means like observations of bird's movement, sky stars and intestines observations, animal and human behaviour change and wind and temperatures rise. The traditional knowledge, precise predictions of droughts and intelligence are getting weakened and affected adversely by unpredicted climate and absent weather information sharing.

V. RECOMMENDATION

The integration of indigenous household's perceptions and traditional weather intelligence and knowledge in to Modern weather monitoring data is urgently required in Ilemi Triangle. The scientific meteorological stations and network must be installed and the Integration is necessary for better planning and targeting interventions. Thus, applications of Ilimi model that calls for a comprehensive and proactive communication and coordination of weather predication information flow to pastoralists in their own sites.

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