

ADAPTATION MEASURES TO THE IMPACTS OF CLIMATE CHANGE
IN TANZANIA: CASE OF MAASAI PASTORALISTS IN KETUMBEINE
WARD-LONGIDO DISTRICT

¹Francis Njau, ²Canute Hyandye, ³Lota J.Olais

^{1,2,3} Institute of Rural Development Planning-Dodoma, P.O.Box 138 Dodoma-Tanzania.

ABSTRACT

Climate change is threatening many lives and is expected to have more significant impact on the livelihoods of the rural poor in developing countries including Tanzania. Its effects impact different groups of the societies differently. Adaptations strategies vary among different groups as well. This paper presents the results of a study conducted among the Maasai pastoralists in Ketumbeine ward in Longido district. Three specific issues addressed in this paper includes examining the temperature and rainfall trend in Longido District, examine the climate change adaptation measures undertaken by Maasai pastoralist and assessing the role of local institutions in adaptation to climate change. Trends from recorded historical climate data from meteorological stations and the stories from the villagers prove that climate change is real and has adversely affected livestock and general livelihoods of Ketumbeine pastoralist society. Climate change adaptations strategies have helped the pastoral society to ensure availability of water, pasture and treatment of animals although selling of animals to buy food before critical drought season is unavoidable. Local institutions involving government and non-government institutions like World Vision, Maasai Vision Organization (MVO), among others has greatly played role in helping Maasai society to adapt to the impacts of climate change. As intensity of adverse future climate impacts is likely to increase and reduce adaptive capacity, external interventions are required.

Key words: Climate change, impacts, adaptation measures, Maasai pastoralists, Longido district

1.0 Introduction

The pastoralists are amongst the vulnerable societies in sub-Saharan Africa countries to climate change due to being dependant to climate sensitive resources(Galvin et al., 2004). Pastoralists are faced by poverty due to the negative effects of climate change like droughts and unusual rainfall patterns all which increase conflicts over dwindling natural land resources (Mattee et al., 2006). Pastoralism is an extensive system in which production is based on seasonal availability of forage and water thus resulting into uncontrolled mobility. This system is mostly constrained by poor animal's husbandry practices, lack of modernization, accumulation of stock beyond the carrying capacity and lack of market orientation. Despite of the constraints this system has sustained the livelihood of the pastoral communities for many decades. The international community has claimed that the lifestyle of Maasai should be embraced as a response to climate change because of their ability to farm in desert lands(Oxfam, 2008).

Nearly 80% of the land in Tanzania is classified as semi-arid and the main source of livelihood in these areas is Pastoralism(Armitage, 1996). In Tanzania about 10% which is about 2.2 million people practice pastoralism under various forms of transhumance production(URT, 2003a). Over 90% of the livestock population in Tanzania is indigenous types, which are known for their low genetic potential. These animals are however, well adapted to harsh environmental conditions, and in addition have high resistance to diseases(URT, 1998).

Climate change effects impact different groups of the societies differently. Some societies in Tanzania for example Masaai, Barabaig and Nyaturu have their livelihood largely dependent on livestock husbandry (URT, 2003b). Livestock sector in the country is among the worst hit by the climate variability via repeated droughts. The Maasai pastoralist for example are facing challenges of lack of water and pastures something making them to move from one place to another seeking for water and pastures for their livestock and domestic use(Galvin, et al., 2004).

Alongside other East African countries, climate change has badly affected the country. Deteriorating water quality and quantity, loss of biodiversity and declining agricultural productivity due to climate change, are no longer potential threats but rather threats that have

already struck and caused Tanzanians repeated misery(Omambia et al., 2010; Yanda et al., 2005).

The effects of climate change in Tanzania are widespread and significantly interfere with agriculture, while at the same time, reducing the ability of the society to deliver services (Omambia, et al., 2010). As the effects of climate change in Tanzania continue to impoverish the population, became more severe and of repeated nature, different societies developed/relied on diverse local strategies to cope with the challenge. Some studies have shown that some societies in Tanzania are already coping with the effects of climate change (Paavola, 2004; Shayo, 2006). Intensified economic activities diversification and migration are among the adaptation measures by Tanzanian villagers to the impacts of climate change(Mbilinyi, 2013). However, such adaptation mechanisms are hampered by the severity and the speed of climate change effects, widespread corruption and resource constraints. This study attempted to examine the severity and speed of climate change through observing temperature and rainfall trend in Ketumbeine ward of Longido district, examine the climate change adaptation measures undertaken by Maasai pastoralist and assessing the role of local institutions in adaptation to climate change. Study of this nature has not been undertaken in Longido district. Results of this study will assist in designing appropriate climate change adaptation strategies to pastoralist.

2.0 Research Methodology

2.1 Description of the study area

The study was carried out in Ketumbeine ward in Longido District Council which is one of the seven districts in Arusha region. The district was established on 1st July, 2007 after the splitting of the former Monduli district into Monduli and Longido districts. Geographically, Longido lies between 2 20' to 3 10' latitudes and 36 00' longitude East of Greenwich. In this district, the main economic activity is pastoralism which is being practiced by Maasai tribe whereby about 90% of the population is engaged purely in livestock keeping. Other economic activities in the study area include mixed livestock and crop cultivation covering 5.6% of all respondents. The remaining 4.4% includes business persons, private sector employees and civil servants. Ketumbeine ward is located in the southern part of Longido district as shown in figure 1.

This study took Orkejuloongishu village in Ketumbeine ward as a case study. The village is a center of Ketumbeine ward. Ketumbeine ward covers an area of about 1,640.17 km² while Orjuloongishu village occupies a land size of about 372km². The village is about 50 kilometers South-west of Longido town. Since the land does not support farming, most of land area is covered by stones, hills and rocks with high temperatures during day.

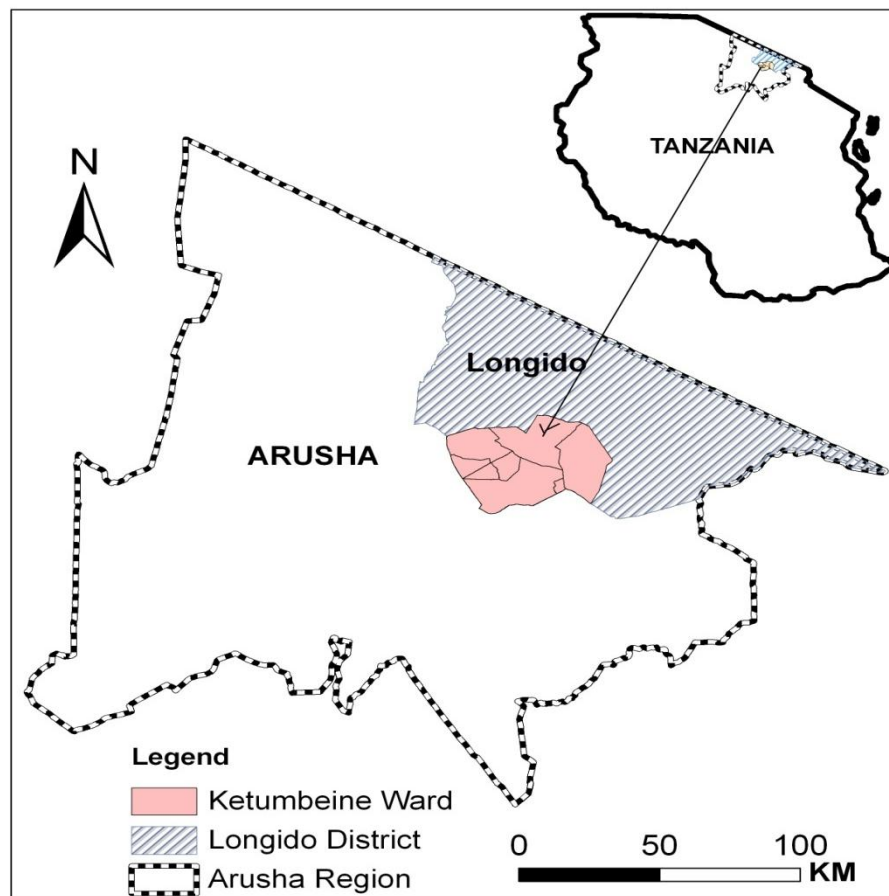


Figure 1: Map to show location of Ketumbeine ward in Loliondo district in Arusha region

Rainfall pattern is bimodal having highest peaks in December to January and in March (Figure 4). The hydrological year extends from August to July whereby it rains from September to June. Lowest rains are experienced in June (end of rain season) and September (Starting of rain season) whereby in June and July it is completely dry.

2.2 Data collection and analysis

Data collection for this study from Orkejuloongishu village was collected from 94 respondents which had a total population of 3,887 people. It involved 89 heads of households, 1 Livestock extension officer, 1 district environmental officer and 3 environmental responsible group leaders. Consultations were also made with the village leaders such as Village Executive Officer (VEO) and Livestock Extension Officer. Interview using semi-structured questionnaire was used to collect data from households whereby households were selected using simple random sampling. Purposive sampling was used to select key informants; these were District Environmental Officer, Environmental responsible group leaders and Livestock Extension Officer.

Non-participatory observation method was employed to study the situation of the environment that people live. Secondary data namely rainfall and temperature data was collected on request from Longido and Monduli districts and Arusha Airport. Focus Group Discussion involving the local institutions was also used to find more information about climate change adaptation measures in Orkejuloongishu village.

Data processing and analysis was done using SPSS and Ms-Excel Spreadsheet. The processed data was analyzed through descriptive statistic analysis whereby percentage, mean and standard deviation and frequencies were generated. Inferential analysis was employed to draw conclusions concerning the relationships and differences found in the research results.

3.0 Results and Discussion

3.1 Temperature and rainfall trends in Longido district over the past 30 years

This study used both recorded historical data and villagers stories and perception of climate change parameters. The results show that villagers/livestock keepers' perceptions with respect to changes in temperature and rainfall are closed related to empirical analysis of temperature trends from recorded historical data from meteorological stations.

Table 1 show that the villagers in study area perceive climate change in terms of increase in temperature and decrease in rainfall. Table 1 show that 52.08% of interviewed villagers said that

there is persistence increase in Temperature while 47.92% of respondents mentioned the shortage of rainfall.

Table 1: Indicators of climate change from villagers responses

Indicators	Frequency	Percentage
Temperature increase	75	52.08
Rainfall shortage	69	47.92
Total	144	100.00

Source: Field data (2012). Note: Table 1 has multiple responses

Evidence from rural communities show that they know the signs for climate changes and its effects. Villagers have very good narrative witness to show that climate is changing, this can be traced from the stories they tell (Mbilinyi, 2013).

Trend analysis of recorded historical temperature data and rainfall data from 1982 to 2011 are shown in Figure 2 & 3. The general observations in these two figures are that there was an increasing temperature trend (figure 2) and decreasing rainfall trend (Figure 3).

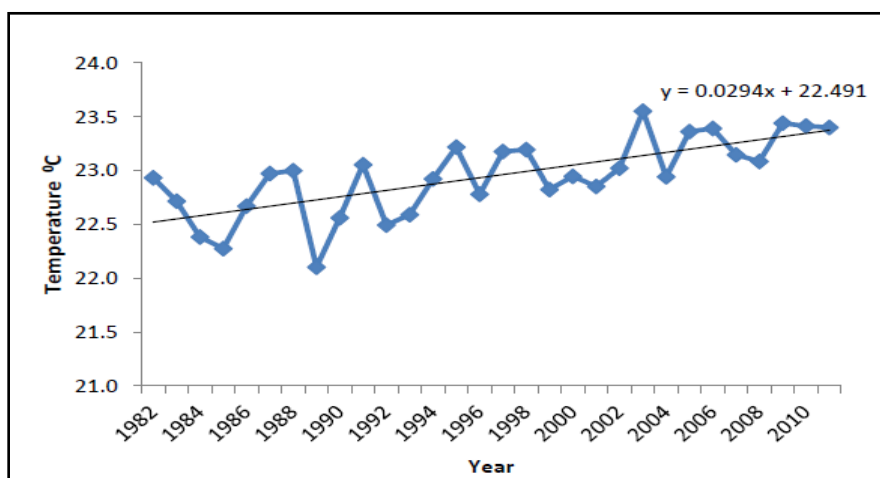


Figure 2: Temperature trend in the study area for the period 1982-2010(Source: Arusha Airport Authority, 2012).

The analysis of annual average temperature in the study area over a period of 30 years 1982-2011 in figure 2 showed an increase on average annual temperature by 0.5 units (2.5°C in 1982

to 23.0°C in 2010). Despite variations in temperature trends from 1982-2010, the regression line of temperature trends in figure 2 shows a positive slope (0.0294) indicating an increase trend.

The temperature observations under similar climatic conditions are in broad agreement with those reported by (Mary et al., 2009). The average annual temperature increased by 0.5°C. Such a change is not surprising but it validates that global warming can be revealed even at local scales.

Contrary to increasing trend in figure 2, figure 3 shows that rainfall has been in decreasing trend in Kitumbeine ward as from 1982- 2010. The rate of change in rainfall is higher than the rate of temperature with time, whereby the slope of rainfall trend regression line is -10.596 as compared with that of temperature slope (0.0294).

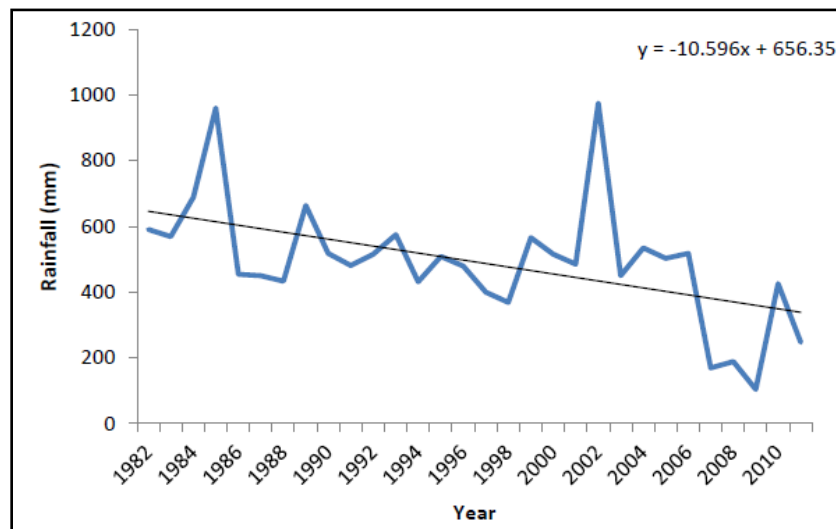


Figure 3: Rainfall trend in the study area from 1982-2010 (Source: Longido and Monduli District Council, 2012).

It can be seen that in 2010 the graph is at the lowest. This is accounted by serious drought in 2010 whereby the study area experienced 347 days of no rain.

(Fischer et al., 2002) reported that changes in rainfall amount and patterns, in addition to shifts in thermal regimes, influence local seasonal and annual water balances. These in turn affect the distribution of periods during which temperature and moisture conditions permit production. Changes in heat balance not only affect precipitation rhythm but in turn low rainfall affects both pastures and agriculture production and ultimately animals suffer from both lack of food and water.

3.2 Decadal monthly rainfall trends analysis and comparisons

Decadal average monthly rainfall trends was analyzed using a graph whereby the monthly average rain values from 1982-2011 was categorized in three groups time, that is 1982-1991, 1992-2001 and 2002-2011. The analysis in figure 4 shows that during 1982-1991 the decadal average monthly rains was higher compared to subsequent decades especially the month of November to January. During the last decade 2002-2011 the average monthly rainfall has decreased almost for the whole hydrological year (August –July).

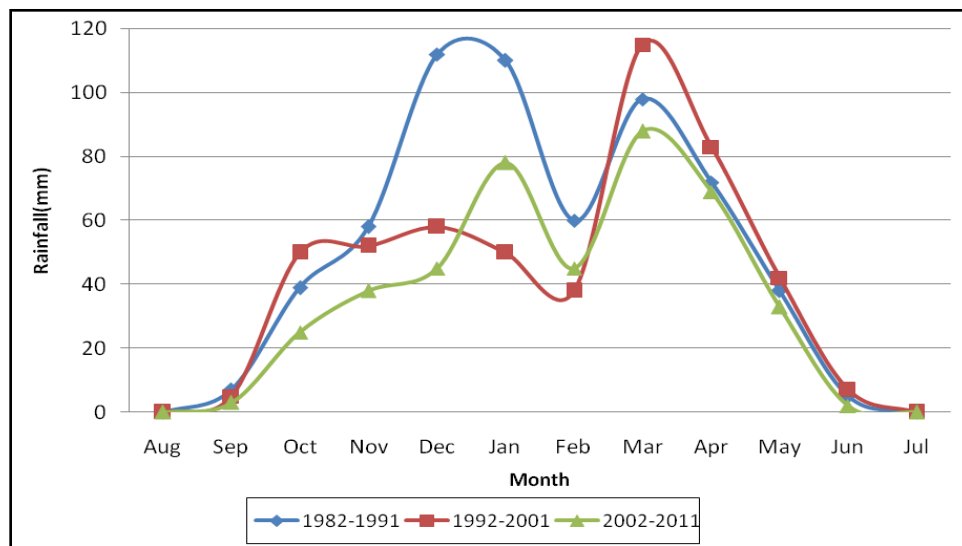


Figure 4: Decadal average monthly rainfall trends for 1982-1991, 1992-2001 and 2002-2011 (Data Source: Longido District Council, 2012).

The 2002-2011 line of decadal average rainfall trend shows a delayed onset of rain (September-October) and early end of rains (June) as compared to other decade line graphs. It can be

concluded from figure 4 analyses that the rains kept on reducing year after year. This confirms that climate change is real in the study area. Extreme weather events are also observed in Ketumbeine ward. In 2010, not a single drop of rain fell during exactly 347 days. According to (URT, 2003b), it was predicted that there will be an increase in extreme weather events in Tanzania. The extreme weather events in Tanzania are associated with flooding, droughts, cyclones, tropical storms all of which are projected to be more intense, frequent and unpredictable.

Already Climate change is threatening many lives and is expected to have more significant impact on the livelihoods of the rural poor in developing countries including Tanzania. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) predicts that climate change is likely to have a significant effect on agricultural production in many African countries (Mbilinyi, 2013).

3.3 Climate change adaptation measures undertaken by Maasai pastoralist

The climate change in the study village is evident, and has been described by persistence increase in temperature, shortage of rainfall and death of animals(Olais, 2012). The impact of climate change to pastoralist in Longido district was high and the pastoralists were the first people to be wiped out by climate change. In 1997, 2003 and 2009 for example hundreds of thousands of seasonal herders in Ketumbeine had been forced to forsake their traditional culture and migrated to other areas of the country following long droughts that killed their livestock. This drought caused hundreds of livestock to die for lacking water and pastures.

To curb the problem of climate change, this study carried out an assessment of adaptation measures to climate changes. Two aspects were assessed namely adaptation strategies on water and pasture.

Adaptation strategies on pasture

In terms of pasture, the findings revealed that most of the respondents 97.8% usually migrate from one place to another to seek pasture while remained percentage 1.1% store grass and 1.1% use grass from farms as shown in the figure 5.

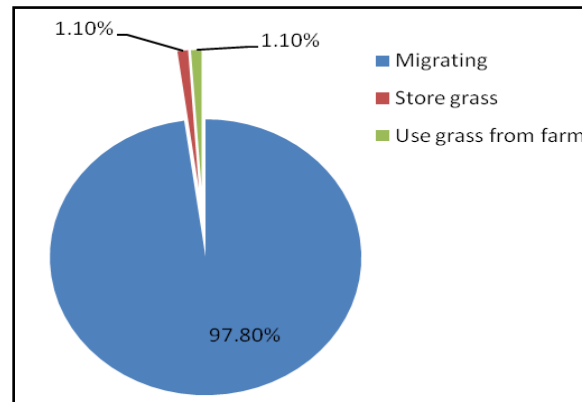


Figure 5: Adaptation strategies on pasture (Source: Field data, 2012).

Other adaptation strategies on pasture include the practice of keeping areas for feeding animals in dry season. This is usually done by the whole pastoral society in Ketumbeine ward. Some pastoralists would rather cut trees for the cattle to feed on branches. With an assumption that all trees are massively cut what will happen is that the area will be left bare hence vulnerable to degradation in terms of erosion.

Adaptation strategies on water

In dry semi arid areas the pastoralist use traditional ways of feeding animals with water for their livestock to survive to wait for the rain season. Figure 6 shows that most of the respondents (82.3%) migrate to other areas in search for water while the other make local drills (14.60%) and others (3.10%) use of water from earthen dams.

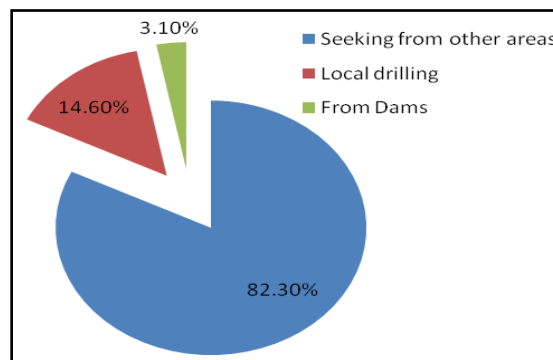


Figure 6: Adaptation strategies on water (Source: Field data, 2012)

Other adaptation measures

Other adaptation measures include rangeland improvement and landuse plan, sales of livestock before arrival of critical dry season, seeking for climate change information, among others. Money from sales of animals is retained and used to buy food from other places. This food bought helps them to survive the drought events.

Due to increased impacts of climate change in the Ketumbeine wards, the residents do seek information about climate change and adaptation measures from various sources. These sources include the leaders, radio, televisions and newspapers/magazine distributed by institutions working in the study area. Figure 13 has more details on these sources of information.

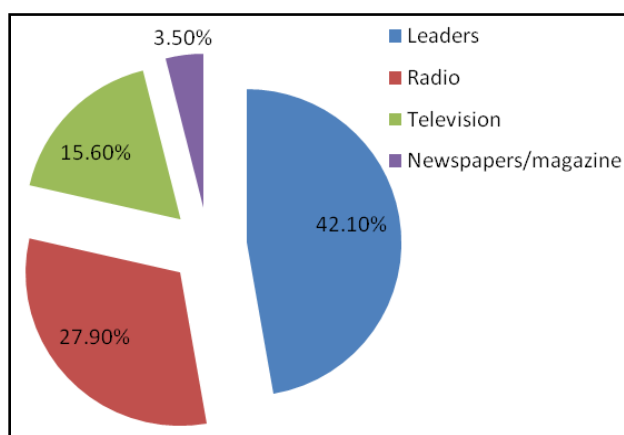


Figure 13: Climate change and adaptation measures information sources (Source: Field data, 2012)

Existence of diseases like East Cost Fever, Food and Mouth Disease, Black quarter and Heart Water has resulted into the loss of large number of livestock in the study area. In order to rescue livestock from the disease, most pastoralist societies take measures like to vaccinate their livestock (44.2%), use local medicine (42.6%) and seek of advice from extension officers (13.2%). Death of animals among pastoralists living in dry areas is also linked to climate change. Climate change in Tanzania is linked to increasing problem of plant toxicity to livestock and potentially to man. (Ngomuo, 2001) reported that significant losses of livestock during drought episodes were linked to plant toxicity. Studies in other parts of the world also indicate that the

problem of plant poisoning is worsened and/or triggered by climate change, specifically drought (Thurow et al., 1999).

3.4 The role of local institutions in adaptation to climate change

The study identified five (5) major local institutions which work in Orkejuloongishu village in Ketumbeine ward. Their roles include helping residents with climate change adaptations measures. These local institutions include African Wildlife Foundation (AWF), Maasai Vision Organization (MVO), World Vision, TRIAS (Belgian development organization) and the government of Tanzania.

The government of Tanzania has ongoing program which aim to support people in Longido district which is food insecure. Among the government activities include food provision to support peoples livelihood, construct grain store houses for storage of food to be used during hunger, and establishment of pastoralists saving and credits organizations like SACCOS (Savings and Credit Cooperative Organizations) and VICOBA (Village Community Bank). These village financial organizations helps the villagers to meet their financial needs in establishing small businesses to support their livelihoods. Education on harvesting of livestock before serious drought, compensation of livestock which die during extreme events and sending some villagers to climate change adaptations study tours are also among government roles in helping villagers to adapt to climate change. According to (Mbilinyi, 2013), as a result of climate change, both livestock keepers and farmers have design their own coping strategies including the intensified diversification of rural economic activities.

According to (Shayo, 2006) and (Omambia, et al., 2010) the direct outcome of climate change have led local people in some parts of Tanzania to adopt other activities apart from their traditional livelihood and agriculture. In places where climate change has resulted into repeated agricultural failures, it is now common to find members of typical farming villages doing extra farm activities to maximize survival. (Omambia, et al., 2010) further contends that climate change has also forced people to move from their villages to urban areas for paid employment. For example, it is common to find young people mostly after primary education moving to big

cities to look for jobs. Sadly, employment opportunities are limited and some end up being jobless and even harassed.

TRIAS main roles are the development of a sophisticated warning system, buy vaccination to livestock, construction of grain stores, construction of water reservoirs for man and animals as well as repairing of old water pipes. The warning system gathers climate-related information throughout the year, with the aid of modern scientific and indigenous indicators. With the system's readings both the herdsman and the government can take timely measures to prevent the worst consequences of drought. Vaccination of livestock is done as prevention measures towards epidemic diseases which are caused by climate changes. Maasai can sell cattle before critical dry season and keep it in TRIAS stores. Some of the grain is used as food in drought and when drought is over and grain market price is good, they can sell the grains and buy cattle again.

In developing countries like Tanzania, major pressing issues like food security, poverty, and water availability are all interconnected with climate change (Omambia, et al., 2010). Unfortunately climate change has badly affected food availability and many people find it hard to meet their basic needs (McCarthy, 2001; Mwandosya et al., 1998). Climate change affects many sectors that support human livelihood namely economy, ecosystems, water resources, weather events, health issues, desertification, sea level rise(McCarthy, 2001).

World Vision trains livestock keepers on how to curb the situation of climate changes for their livelihood survival by giving them financial support to do small business. Also buys vaccination as prevention measures towards epidemic diseases which are caused by climate changes. In addition, World Vision provides pastoralists with upgraded breeds of livestock and encourages drought resistance crops including root crops.

African Wildlife Foundation (AWF) and Maasai Vision Organization (MVO), do work together in supporting one another since MVO is still very young, they do Village Land Use Planning, whereby demarcating of areas for different uses is done. They are also concerned with Livestock

and wildlife conservation towards managing them and the resource managements. Community and institutions make participatory way of protecting them in following the bylaws made by the community themselves and secure habitat zones and connectivity. AWF and MVO enable communities to benefit from wildlife resources and sharing of wildlife benefits.

4. Conclusion and Recommendations

The climate change in the study village is evident, and has been described by persistence increase in temperature, shortage of rainfall and death of animals. Climate change in Ketumbeine ward is characterized by increased temperature and decreasing rainfall for the past thirty years as well as death of animals. Recent decadal (2002-2011) average monthly rainfall analysis shows that the rain amount was lower compared to the two previous decades (1992-1991 and 1992-2001). The delay of onset of rains and early end of rains is also observed in the recent decade (2001-2011). The increase in temperature affects rainfall rhythm and in turn affects pastures and water availability that affect livestock negatively.

Adaptation measures adopted by Ketumbeine ward Maasai pastoralists are related to water and pastures for animals, fighting animal diseases and support of livelihoods. Strategies associated with pasture availability involves migrating with animals to nearby districts in a search for pastures, use of reserved communal pastures, use of stored grass and cutting down tree branches to feed animals. Adaptation measures related to water availability involves local drilling of wells, use of water from earthen dams and seeking of water for animals from other places in the neighborhood. Other crosscutting adaptations include rangeland improvement, landuse plan, sales of livestock before the arrival of critical dry season; seek climate change and adaptation measures information as well as treating their affected animals. Climate change adaptation is a dynamic process. Climate change impacts will change over time, and individual elements of adaptation must change with them. Adaptation work requires a variety of technical measures that can be applied at different speeds at different times. This also means that any required inputs should be programmed and sustained for the whole of the adaptation period, government and NGOs as well the community should have to practically work on it.

Local institutions which constitute government and non-governmental institutions play a critical role in supporting adaptation. However, the intensity of adverse future climate impacts is likely to increase, thereby increasing vulnerability and reducing existing adaptive capacity. External interventions in the form of new information and technology aimed at improving coping capacities, institutional coordination for better articulation (connections among institutions) and improved access (connections of institutions with social groups), and inflows of finances support for local leadership will be critical to strengthen local institutional capacities.

Acknowledgement

The authors acknowledge with thanks the good cooperation and support from different people who supported the study in one or another. Special thanks to Kitumbeine ward residents, local institutions and officials for their valuable information about evidence of climate change and adaptation strategies. Much appreciations to Longido and Monduli district councils and Arusha Airport Authority for providing the historical climate data.

References

1. Armitage, D. R. (1996). Environmental management and policy in a dryland ecozone: The Eyasi-Yaeda basin, Tanzania. *Ambio*, 25.
2. Fischer, G., Shah, M., and Velthuisen, H. v. (2002). *Climate change and agricultural vulnerability*: IIASA, Internat. Inst. for Applied Systems Analysis.
3. Galvin, K. A., Thornton, P. K., Boone, R. B., and Sunderland, J. (2004). Climate variability and impacts on East African livestock herders: the Maasai of Ngorongoro Conservation Area, Tanzania. *African Journal of Range and Forage Science*, 21(3), 183-189.
4. Mary, A., and Majule, A. (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi arid areas of Tanzania: The case of Manyoni District in Singida Region, Tanzania. *African Journal of Environmental Science and Technology*, 3(8), 206-218.
5. Mattee, A. Z., and Shem, M. N. (2006). *Ambivalence and contradiction: A review of the policy environment in Tanzania in relation to pastoralism*: IIED.

6. Mbilinyi, A. (2013). Do We Really Know How Climate Change Affects Our Livelihood? Evidences from Village Communities in Rural Tanzania. *Economic and Social Research Foundation(ESRF), Policy Brief No.3/2013*,
7. McCarthy, J. J. (2001). *Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change*: Cambridge University Press.
8. Mwandosya, M. J., Nyenzi, B. S., and Lubanga, M. (1998). *The assessment of vulnerability and adaptation to climate change impacts in Tanzania*: Centre for Energy, Environment, Science and Technology.
9. Ngomuo, A. J. (2001). Common Poisonous Plants of Tanzania. In SUA (Ed.), *Compendium*.
10. Olais, J. L. (2012). *Assessment of Adaptation Measures by Maasai Pastoralists to the Impacts of Climate Change in Longido District: A Case of Ketumbeine Ward.*, Institute of Rural Development Planning (IRDP), Dodoma.
11. Omambia, C. S. A. N., and Gu, Y. (2010). The Cost of Climate Change in Tanzania: Impacts and Adaptations. *Journal of American Science*, 6(3).
12. Oxfam. (2008). Maasai can fight climate change.
13. Paavola, J. (2004). *Livelihoods, vulnerability and adaptation to climate change in the Morogoro Region, Tanzania*: CSERGE.
14. Shayo, C. (2006). *Adaptation Planning And Implementation: Agriculture And Food Security*. Paper presented at the UNFCCC African Regional Workshop on Adaptation.
15. Thurow, T. L., and Taylor, C. A. (1999). Viewpoint: the role of drought in range management. *Journal of Range Management*, 413-419.
16. URT. (1998). *Arusha Region Socio-Economic Profile*.
17. URT. (2003a). *2002 Population and Housing Census General Report*.
18. URT. (2003b). *Initial National Communication under the United Nations Framework Convention on Climate Change, (UNFCCC)*.
19. Yanda, P. Z., Kangalawe, R. Y., and Sigalla, R. J. (2005). *Climatic and socio-economic influences on malaria and cholera risks in the Lake Victoria region of Tanzania*: AIACC Working Paper.