

AN ASSESSMENT OF DETERMINANTS OF ADAPTIVE CAPACITY OF LIVESTOCK
FARMERS TO CLIMATE CHANGE IN OMUSATI REGION, A CASE OF ONESI
CONSTITUENCY

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CERTIFICATION

I certify that this research work titled “**Assessment of determinants of adaptive capacity of livestock farmers to climate change in Omusati region, a case of Onesi constituency.**” was undertaken and completed by Ms. *Haukongo Cornelia* and that the research work was supervised by me and thus herein submitted for consideration to the Department of Integrated Environmental Science, Faculty of Agriculture and Natural Resources, Ogongo Campus of the University of Namibia, in partial fulfilment of the requirements for the award of a Bachelor of Science in Integrated Environmental Science .

Student

Signature.....Date.....
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Supervisor Name:

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ABSTRACT

Livestock farming contributes over 60% to agricultural GDP. In rural communities, livestock is used as a source of income but also seen as a symbol of wealth and status. Livestock is a source of livelihood and wealth of many households which needs to be safe guarded and saved from effects of climate change. Productivity of livestock farming in rural areas depends on status of grazing and ability of the farmers to supplement feed in times of limited grazing. This research sought to identify the determinants of adaptive capacity of livestock farmers to climate change in Omusati region. The study further analysed the determinants of adaptive capacity to identify barriers and enablers of adaptive capacity of livestock farmers to climate change. Key informant interviews, mixed gender group discussions and a survey questionnaire were used to triangulate the information gathering. Adaptive capacity of livestock farmers were found to be influenced by level of technology, level of education, asset base, and social network/capital. These determinants were either barriers or enablers to adaptive capacity of livestock farmers. Many families that have livestock obtained some of them through inheritance from family members which coupled with little marketing, may affect decision making to adapt to changing environment such as reducing livestock numbers by selling when grazing is limited. Unattractive market prices for livestock discourage selling as a strategy to adapt to limit grazing which causes many livestock deaths as many farmers are unable to purchase supplementary feed. Thus price setting and marketing, rangeland management, land use planning, fodder production under irrigation are some of the strategies that could be employed to enhance resilience of livestock farmers to climate change.

Key words: Climate variability, Adaptive capacity, determinants, grazing and livestock farmers.

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- ❖ Mrs. Victoria (Onesi Chief control officer Regional Council)
- ❖ Mr. Paul Tjirondelo (Headman, Omaenene)

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DEDICATION

I am dedicating this to the Namibian livestock farmers in general, but most especially the ones that reside in the Northern regions. These are the farmers that are mainly pinched hard by climate variations and experience floods and drought hence their lively hoods are changed during this seasons. I also dedicate this paper to the extension officers that work hard to help the farmers through all their trials. May they use this paper to add onto their knowledge so that they see how better they are able to help farmers to adapt to climate variability.

DECLARATIONS

I, Cornelia Haukongo hereby declare that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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GLOSSARY TERMS

Adaption	Adaptation means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage they can cause, or taking advantage of opportunities that may arise
Adaptive capacity	The ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behavior and in resources and technologies
Vulnerability	Vulnerability is seen as multi-dimensional and understood to be strongly influenced by structural factors, governance systems and inequalities. However, vulnerability is also something that even (most) marginalized and poor individuals can act to reduce. However framing of vulnerability, makes it a function of exposure, sensitivity and adaptive capacity, we analyse each of these three factors holistically e.g. beyond a strictly biophysical context. Vulnerability refers to the degree to which people, resources, systems, and cultural, economic, environmental, and social activity is susceptible to harm, degradation, or destruction on being exposed to a hostile agent or factor or hazard
Social group	A more or less homogeneous group of people within the landscape, such as fisher folk, women agricultural labourers or ‘migrant workers.

ABBREVIATIONS

UNAM	University of Namibia
GDP	Gross Domestic Product
SPSS	Statistical Package for Social Sciences
ASSAR	Adaption at Scale in Semi- Arid Regions
ORC	Omusati Regional Council
TA	Traditional Authority
ORDP	Omusati Regional Development Plan

CHAPTER 1: INTRODUCTION

1.1 Background

Livestock play a major role in the agricultural sector in developing nations, and the livestock sector contributes 40% to the agricultural GDP (FAO, 2008). Global demand for foods of animal origin is growing and it is apparent that the livestock sector will need to expand (FAO, 2008). Livestock are adversely affected by the detrimental effects of extreme weather. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to declines in production and reproduction efficiency.

Climate variation is a major risk to the sustainability of livestock systems globally. Consequently, adaptation to, and mitigation of the detrimental effects of extreme climates has played a major role in combating the climatic impact on livestock (Belay, Recha, Woldeamanuel, & Morton, 2017). There is little doubt that climate change will have an impact on livestock performance in many regions and as per most predictive models the impact will be detrimental. (Kelly, Anwar, Macadam, & Liu, 2012) Climate change may manifest itself as rapid changes in climate in the short term or more subtle changes over decades (Ogalleh, Volg, Eitzinger, & Hauser, 2012). Generally climate change is allied with an increasing global temperature, mean global temperature may be 1.1–6.4 °C (DVS, 2015) warmer than in 2010. The difficulty facing livestock is weather extremes such as intense heat waves, floods and droughts. All in all these aspects and changes lead to production losses, extreme events also result in livestock death. Animals can adapt to hot climates, however the response mechanisms that are helpful for survival may be detrimental to performance (Kelly, Anwar, Macadam, & Liu, 2012).

70% of Namibia's population depends on agriculture for livelihood, in rural communities in northern Namibia, mixed farming is practised. Livestock contributes more than 60% of agricultural GDP which adversely shows that farmers greatly depend on livestock for survival. On numbers farmers in Omusati region have 265 446 goats and 294 258 cattle (2015 livestock census) and other livestock

Livestock numbers in Omusati decreased by 4% for goats and 12% for cattle in 2015 due to drought (2015 Omusati livestock census) Livestock plays a key role in most households' livelihoods and status. Northern Namibia in general has faced increased extreme climatic

conditions such as drought and floods which affect production of livestock as rangelands are affected. Many farmers have been experiencing livestock deaths especially during prolonged droughts and sometimes during floods (ORC, 2010).

1.2 Problem Statement

Livestock is a source of livelihood and wealth of many households in Northern Namibia however losses have increased due to drought/flood related climatic conditions threatening livelihoods of many. In order to safeguard the source of livelihood, resilience to climatic shocks needs to be improved among farmers as well as enable them to market so as to earn income that can be used to cope and adapt to these changing environments. Thus understanding of how livestock production and marketing are affected by climate variability is key to finding solutions that would increase resilience of the farmers.

1.3 Objectives

- ❖ To identify farmers perceptions on climate change
- ❖ To identify factors (barriers and enablers) that influence or affect adaptive capacity of livestock farmers in terms of livestock production and marketing.
- ❖ To identify the responses and adaptation measures that livestock farmers take in light of climate change
- ❖ To suggest policy implications of these barriers and enablers on livestock production and marketing.

1.4 Justifications

This research seeks to identify the determinants of adaptive capacity of livestock farmers to climate change. This work is important in that it will help identify information or barriers and enablers of adaptive capacity of livestock farmers which would in turn assist with strategies that would enhance adaptive capacity of these farmers in light of climate change. Livestock is a source of livelihood and wealth of many households which needs to be safe guarded and saved from effects of climate change. To maintain livelihoods of livestock households, livestock health and productivity needs to be improved thus resilience of the livestock farmers need to be improved in order for them to be able to earn a living from livestock and minimize losses

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Agriculture continues to be the backbone of most African economies (Felix, Alfred, Boakye, & Irene, 2016). The agricultural sector is the major domestic producer across the continent and employs between 70% and 90% of the total labour force (FAO, 2008). In addition, agriculture supplies up to 50% of household food requirements and up to 50% of household incomes. Most of the income is generated by beef cattle, dairy cattle, goats, sheep and chickens. Together these five species generate 92% of the total revenue from livestock in Africa. In many rural communities, livestock is the only asset of the poor, but it is highly vulnerable to climate variability and extremes (FAO, 2008). The impact of climatic changes is expected to heighten the vulnerability of livestock systems and reinforce existing factors that are affecting livestock production systems (Anim, 2013)

2.1.1 Climate variation and causes

Climate variability is defined as changes in the mean state and “other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events” (Ankidawa, 2015; Felix , 2016). Climate variability is also said to be a measure of climate change (Kelly, Anwar, Macadam, & Liu, 2012). As a result of climate variation, changes in agricultural farming system’s productivity are projected because crop growth, development, and yield are products of ecophysiological processes regulated by interacting environmental variables that, together with atmospheric CO₂ concentrations, nutrient availability, and species-related and management related variables, include climate-related variables such as temperature, water availability, and wind speed (Anim, 2013)

2.1.2 Direct effects of climate change on livestock

The most significant direct impact of climate variability on livestock production is said to come from the heat stress. According to (Olarinde, Adepoju, & Jabaru, 2001), (Bushesha & Mvena, 2015) Heat stress results in a major financial burden to livestock farmers, this affects through increase in mortality, reduction in reproductive efficiency and animal health. Thus, an increase in air temperature, such as that predicted by various climate change models, could directly affect animal performance (Olarinde, Adepoju, & Jabaru, 2001).

2.1.3 Indirect effects of climate change on livestock

Climate variability is said to have the potential to impact the quantity and reliability of forage production, quality of forage, water demand for cultivation of forage crops, as well as large-scale rangeland vegetation patterns. According to (Kabobah, Nukpezah, & Ntiamoa- Baidu, 2009) coming decades, crops and forage plants will continue to be subjected to warmer temperatures, prominent carbon dioxide, as well as wildly fluctuating water availability due to changing precipitation patterns (Coetzee, 2014).

With the likely emerging scenarios that are before now evident from impact of the climate change effects, the livestock production systems are expected to face more of negative than the positive impact (Da Cunha, De Oliveira, Nascimento, & Ribeiro, 2005). Also climate Variation influences the water order, availability and quality (Shankara, Shivamurthy, & Kumar, 2014). Changes in temperature and weather may affect the quality, quantity and distribution of rainfall, snowmelt, river flow and groundwater. Climate variability can result in a higher intensity precipitation that leads to greater peak run-offs and less groundwater recharge.

Based on the findings of (Bushesha & Mvena, 2015) longer dry periods may reduce groundwater recharge, reduce river flow and ultimately affect water availability, agriculture and drinking water supply. The deprivation of water affects animal low reproductive rates and a decreased resistance to diseases. More research is needed into water resources' vulnerability to climate variability in order to support the development of adaptive strategies for agriculture (Skinner & Mark, 2013).

2.1.4. Climate variability and heat

Temperature increases could accelerate the development of pathogens and parasites that live part of their life cycle outside of their host, which negatively affects livestock (Skinner & Mark, 2013). Climate change may induce shifts in disease diffusion, outbreaks of severe disease, or even commence new diseases, which may affect livestock that are not usually exposed to these types of diseases. Evaluating disease dynamics and livestock adaptation will be important to maintain their resilience. Global warming and changes in precipitation affect the quantity and spread of vector-borne pests such as flies, ticks, and mosquitoes. Adding up, disease transmission between hosts will be more likely to happen in warmer conditions (Belay, Recha, Woldeamanuel, & Morton, 2017).

Livestock in higher latitudes are said to be more prone to the increase of temperatures than livestock located in lower latitudes, due to reasons that livestock in lower latitudes are usually better adapted to high temperatures and droughts. Confined livestock production systems that have more control over climate exposure will be less affected by climate variability's. "Confined livestock production systems that have more control over climate exposure will be less affected by climate change" (Kelly, Anwar, Macadam, & Liu, 2012).

2.1.5 Impact of climate change on livestock diseases

Variations in temperature and rainfall are the most significant climatic variables affecting livestock disease outbreaks (Shankara, Shivamurthy, & Kumar, 2014). Warmer and wetter weather (particularly warmer winters) will increase the risk and occurrence of animal diseases, because certain species that serve as disease vectors, such as biting flies and ticks, are more likely to survive year-round.

Certain existing parasitic diseases may also become more prevalent, or their geographical range may spread, if rainfall increases. The effects of climate change on livestock diseases depend on the geographical region, land use type, disease characteristics, and animal susceptibility (Ochenje, Ritho, & Mbatia, 2016). Animal health can be affected directly or indirectly by climate change, especially rising temperatures. The direct effects are related to the increase of temperature, which increases the potential for morbidity and death. (Coetzee, 2014) Evaluating disease dynamics and livestock adaptation will be important to maintain their resilience. Global warming and changes in precipitation affect the quantity and spread of vector-borne pests such as flies, ticks, and mosquitoes.

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Evaluating disease dynamics and livestock adaptation will be important to maintain their resilience. Global warming and changes in precipitation affect the quantity and spread of vector-borne pests such as flies, ticks, and mosquitoes. In addition, disease transmission between hosts will be more likely to happen in warmer conditions (Falaki, Akangbe, & Ayinde, 2013).

2.1.6 Quantity and quality of feeds

The availability and quality of feed will be affected mainly due to an increase in atmospheric CO₂ levels and temperature (Felix, Alfred, Boakye, & Irene, 2016). The effects of climate change on quantity and quality of feeds are dependent on location, livestock system, and species. Some of the impacts on feed crops and forage are:

Quality of feed crops and forage could be affected by increased temperatures and dry conditions due to variations in concentrations of water-soluble carbohydrates and nitrogen. (Belay, Recha, Woldeamanuel, & Morton, 2017) Temperature increases may increase lignin and cell wall components in plants, which reduce digestibility and degradation rates, leading to a decrease in nutrient accessibility for livestock.

(Anim, 2013) Extreme climate events such as flood, may affect form and structure of roots, change leaf growth rate, and decrease total yield. Impacts on forage quantity and quality depend on the region and length of growing season. “An increase of 2 °C will produce negative impacts on pasture and livestock production in arid and semiarid regions and positive impacts in humid temperate regions” (Kelly, Anwar, Macadam, & Liu, 2012). The length of growing season is also an important factor for forage quality and quantity because it determines the duration and periods of available forage. A decrease in forage quality can increase methane emissions per unit of gross energy consumed.

2.1.7 Water

Global agriculture uses 70% of fresh water resources (FAO, 2008), making it the world’s largest consumer. However, global water demand is moving towards increased competition due to water scarcity and depletion, where 64% of the world’s population may live under water-stressful conditions by 2025 (FAO, 2008).

Water availability issues will influence the livestock sector, which uses water for animal drinking, feed crops, and product processes. The livestock sector accounts for about 8% of global

human water use and an increase in temperature may increase animal water consumption by a factor of two to three. To address this issue, there is a need to produce crops and raise animals in livestock systems that demand less water or in locations with water abundance (Abid, Scheffran, & Scheider, 2015).

2.1.8 Impact of livestock on climate change

Livestock contribute 14.5% of the total annual anthropogenic GHG emissions globally. Livestock is said to influence climate; through land use change, feed production, livestock production, manure, and processing and transport. Feed production and manure emit CO₂, nitrous oxide (N₂O), and methane (CH₄), which consequently affects climate change. Livestock production increases CH₄ emissions. Processing and transport of animal products and land use change contributes to the increase of CO₂ emissions (Anim, 2013).

2.1.9 Adaption to climate variation

High adaptive capacity determines a reduction in the system's vulnerability to disturbances that might occur in the future (Kelly, Anwar, Macadam, & Liu, 2012), in an anticipatory manner or to disturbances that occur slowly, either reactively or separately (Abid, Scheffran, & Scheider, 2015). Adaptive capacity represents the potential of system to adapt, relatively than just adaptation. Thus, adaptive capacity can be considered as the adaptation space within which adaptation decisions are feasible. Adaptive capacity highlights the resources available for adaptation rather than the most potential or most desirable adaptation actions (Belay, Recha, Woldeamanuel, & Morton, 2017).

3.1 Study area

Map of the study area

Legend

- Onesi constituency
- Omusati region

0 0.4 0.8 1.2 1.6 Kilometers

8

3.2 Research design

The research covered both qualitative and quantitative; Qualitative methods involved key informant interviews and mixed gender group discussions were used to gather information

Basically focus on assessing on how individuals were affected by climatic variations in the village and quantitative it was entirely to look at how many households were affected through the destructions. This researcher opted for both qualitative and quantitative approach to answer the research question, which will be a meaningful contribution for policy-makers.

3.3 Population

The target population was all livestock farmers affected by floods in Onesi constituency from which a sample was selected.

3.4 Sampling method

Probability sampling was used specifically purposive sampling. There are a number of villages in Onesi constituency but the main focus was Okathitukeegombe, Omaenene, Oshihau, Elondo A, B and C and Omakuva villages reason being they were most affected by floods, were random sampling was used to select households within the village and a minimum number of 24 farmers were selected per village.

3.5 Data collection

During the process of conducting this research primary data as well as secondary data was obtained from relevant documents. Data was obtained through face-to-face interviews, which was conducted by the researcher, so formal methods of collecting data were used whereby formal interviews were conducted on individual households. A survey questionnaire was also administered among 36 farmers in the Onesi constituency to solicit information on livestock production and marketing and factors that influence adaptive capacity of livestock farmers to climate. The information was then recorded also through group discussions and key informants. The methods were triangulated in order to increase validity and reliability of the data

3.6 Data analysis

Notes were taken during the key informant interviews which was then compiled using an excel data entry form and was analysed using descriptive statistics (SPSS software). Data findings from the questionnaires and interviews were captured using MS Excel spread sheet and of which results were presented in tables and graphs.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

A Questionnaire was used and also focus group discussion of which the results are presented below. Descriptive are important to show characteristics of the farmers that were interviewed as that have effect on how they adapt and cope with climate variability.

Table 1 Summary of the household demographics

		Village					
		okathitukengombe	elondo	enongo	oshihau	Omaenene	Total
Gender	Male	10%	10%	10%	13.3%	6.7%	50%
	Female	6.7%	13.3%	10%	6.7%	13.3%	50%
Education	basic school	0%	13.3%	10%	16.7%	10%	50%
	secondary/vocational school	10%	6.7%	10%	0%	3.3%	30%
	non-formal	0%	0%	0%	0%	3.3%	3.3%
	Non	6.7%	3.3%	0%	3.3%	3.3%	16.7%
Marital status	Married	10%	16.7%	6.7%	16.7%	16.7%	66.7%
	Single	3.3%	6.7%	0%	0%	0%	10.0%
	widow/widower	3.3%	0%	13.3%	3.3%	3.3%	23.3%
Reason for keeping livestock	home consumption	3.3%	0%	0%	0%	0%	3.3%
	traditional purpose	3.3%	0%	10%	0%	6.7%	20%
	home consumption and traditional	3.3%	6.7%	0%	0%	0%	10%
	traditional purpose and selling	3.3%	0%	0%	0%	3.3%	6.7%
	all options	3.3%	16.7%	10%	20%	10%	60%
Bought livestock	Yes	10%	16.7%	13.3%	13.3%	13.3%	66.7%
	No	6.7%	6.7%	6.7%	6.7%	6.7%	33.3%
Inherited livestock	Yes	6.7%	6.7%	3.3%	3.3%	3.3%	23.3%
	No	10%	16.7%	16.7%	16.7%	16.7%	76.7%
Keep livestock for family	Yes	3.3%	0%	3.3%	3.3%	3.3%	13.3%
	No	13.3%	23.3%	16.7%	16.7%	16.7%	86.7%

The gender of the households head were 50% female and 50% male (table one), of which 66.7% were married and 10% single, majority of households head education fall under basic education

category with 50%, those whom have reached secondary grades are said to be 30%, non-formal education 3.3%, and the ones that have no education background are 16.7%. Furthermore it shows that most household have acquired their livestock rough family however about 23.3% inherited their livestock.

4.1.1. Perception of livestock farmers on climate variability effects

Onesi livestock farmers feel that pasture hardly last their animals for long, simply because it only last for 3-5 months every year. The farmers perceive that rainfall seasons are getting shorter and there is not enough of anything, not even water for their animals. Farmers expressed that the major challenge brought about by climate variability is drought and floods (though they labelled drought to be the worst)

Respondents perceive climatic changes to be GOD's work and that the only out of this changes is that people should repent and pray for God to show mercy. It is difficult for most farmers to sell or cull livestock as some of them are inherited or are for other family members who stay far (this affect adaptive capacity and timely decision making) however they only sell animals when there is need to do so in case of emergency needs for cash

Farmers feel that the load of animals each farmer has nothing to do with the changes in the environment hence that livestock numbers should not be restricted –they would rather let them die than sell. Surprisingly most farmers responded that even if they are warned of impending drought they would rather wait and see what happens to their livestock rather than reduce numbers, farmers fell that Selling livestock is not their reason for keeping livestock

4.1.2 The pasture/grazing area in Onesi constituency and How animals surviving currently

The conditions are bad, there is no grass. During rainy season the grass hardly gains momentum, because it is usually grazed up faster due to the fact that the survived livestock is usually to week to wait for further growth and gain quality.

In Onesi constituency animals' carrying capacity is not considered , some farmers have so much animals such as cattle 's that go up to 100 in one kraal, with others simply have less, in terms of land; the soil is bare, not under grass cover. Calves are suffering seems no milk being produced. Only donkeys surviving a bit the grass is too short and cattle cannot take it in seems they use

their teeth to get the grass from the ground. The farmers simply expect the government to assist them with animals' feeds, at the same time they look up to the government to set or better yet to reduce the market prices. Farmers are unable to afford to buy animal feed, most of farmers do not have formal work and there is no natural pasture nowadays, however some farmers sustain their livestock through fodder that they averagely buy at Etunda Irrigation scheme, etc.

4.1.3 Assistance that farmers require from the government

The farmers are crying out to the Namibian government to If possible to subsidize the market prices. Farmers are requesting the government to construct dams for their animals to drink and they should per place in the village vicinity, farmers are suffering a lot and travelling long distances to look for fodder (time, transport costs, etc.). Onesi farmers require that the help the government is offering to commercial farmers should also apply to communal farmers.

4.1.4 Marketing and sells of livestock in Onesi

We do have interest to sell animals they say, but such business is really challenging. The buyers are offering lower price. For example MeatCo weigh the animals before buying. You can set the price of N\$7000.00 but it will be decreased to N\$3000.00. Farmers say the medicine to vaccinate animals is expensive. Although selling animals is not really within their cultural roots, they normally sell or buy when there is a serious need such as someone passed away or there is a wedding event. In addition, they feel that getting to the marketing places is a challenge for them. Furthermore there is no a legal or well-known place where they can take their livestock in the villages and sell. There is a kraal at Epalela but the awareness and clear information on when to sell and how is never communicated.

4.1.5 Response of livestock farmers in Onesi constituency should the Namibian government decided to limit the number of animals

‘That we do not think it can be possible, we think instead of limiting the number of animals maybe we have to come up with some strategies which will ensure good grazing land’. We are not supporting minimizing of animals because that’s what improves our livelihoods’’ they say. Furthermore the numbers of animals we have are related to our needs, family requirements and ability to manage some said.

4.1.6 Response on the type of livestock that is greatly affected by climatic changes and animal types they are willing to sell when such changes occur

All animals are just affected equally (goats, cattle and donkeys) they said. Because of cultural attachments most farmers believe that they cannot sell their animals, if drought or floods come that affects them then its okay they should just die. Selling to formal market is like making an offering to church they say.

4.1.7 Animals that survive better in drought and floods

Flood affects goats more due to parasites and disease brought by water compared to cattle. During flood time goats and sheep die more than cattle do. We recall the year 2008, 2013 we have lost most of our animals to drought said the farmers.

4.1.8 Cattle species affected/survive better.

Brahamn can survive better because they can travel as far as possible to look for better pasture. But although indigenous species are resistant to drought, thus they can survive better than Brahamn and other exotic species. Exotic species are sensitive to drought, plastic intake, etc.

Farmers prefer mixing breeds because the exotic species have good body building and more meat compared to indigenous species. The government also encourages farmers to buy exotic species for better livelihood.

4.1.9 Response on what the farmers feel is leading to animal death nowadays

Because of educational background some farmers understand that it is climatic changes that are leading to poor natural pasture during extreme dry seasons and also pathogens during extreme wet seasons (floods) that bring diseases hence causing their livestock to die.

4.1.10 Farmers response on the government decide to establishing a marketing, how many animals livestock they will be willing to sell per year

We have animals and willing to sell animals but Outapi is far from us they say. The distance they travel to Outapi is just the same as the one they take to Epalela. In addition, not only establishment of market place required, but also defined procedure on how farmers should sell their animals, currently farmers are just selling to traders (business man who are buying cattle from farmers at lower price and they go sell them at the known kraal at a higher price (farmers are being cheated).

Table 2 Descriptive statistics of livestock numbers

Descriptive Statistics					
Number of animals	N	Minimum	Maximum	Mean	Std. Deviation
Goats	27	4	100	25.5	20.4
Cattle	18	1	35	16	11.7
Donkey	23	1	10	3.8	2.5
Sheep	3	2	7	4	2.6
Goats died in the past year	23	1	100	16.8	20.3
Cattle died in the past year	22	2	37	14	9.4
Donkey died in the past year	7	1	10	3.1	3.2
Sheep died over the past year	1	4	4	4	.

The descriptive statistics of the household livestock shows that Onesi farmers currently have a large number of goats as compared to the rest of the livestock in the constituency (Table 2). On mean average 25.5 is obtained by goats, 16 is cattle, sheep and donkeys obtained 4. The statistics also shows that the large mortality of livestock type over the past year was goats followed by cattle's.

Village	<div> <div>RAINFALL ONSET</div> <div>←</div> <div>→</div> <div>RAINFALL ENDING</div> </div>											
	Time Period	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Okathitu keengombe	10 years Before 2007											
	Last 10 Years											
Enongo	10 years Before 2007											
	Last 10 Years											
Elondo A+B+C	10 years Before 2007											
	Last 10 Years											
Oshihau	10 years Before 2007											
	Last 10 Years											
Omakuva	10 years Before 2007											
	Last 10 Years											
Omaenene	10 years Before 2007											
	Last 10 Years											

Figure 2 Perception on changing decadal Rainfall pattern in Onesi Constituency

The figure 2 shows the onset and off set of rainfall in all the six villages, the figure also clearly describes and represents the farmer's perception on the onset and off set rainfall in Onesi constituency. Table also shows that rainfall use to start off very early around October and end around the month of April. However in the current 10 years rainfall the start of rain is delayed and the offset period is sudden, hence indicating that, the rainfall seasons are growing shorter.

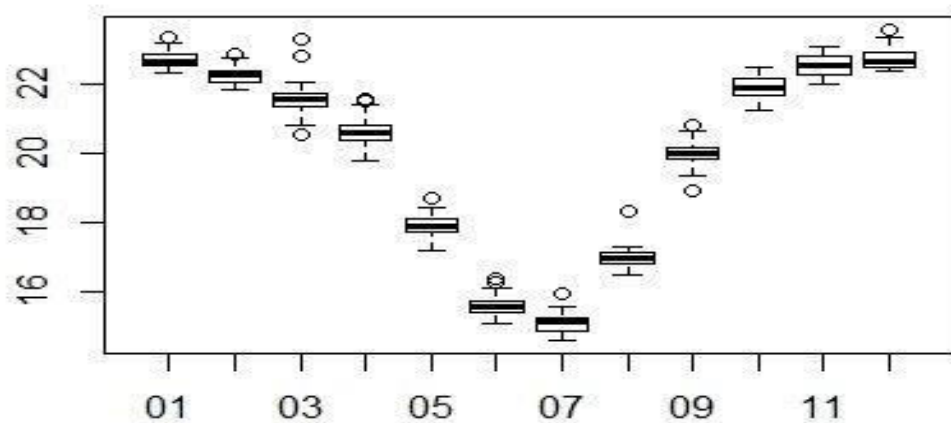


Figure 3: Mean monthly temperature from 1982 to 2015 of Omusati Region

Source: own generated graph from Cru data set

The figure 3 shows the mean monthly average temperature as from 1982 to 2015. The bars shows that November month had the greatest variations in temperature, September and June had the lowest temperature variations. Temperature variations pose great impacts on the climatic conditions (Falaki, Akangbe, & Ayinde, 2013)

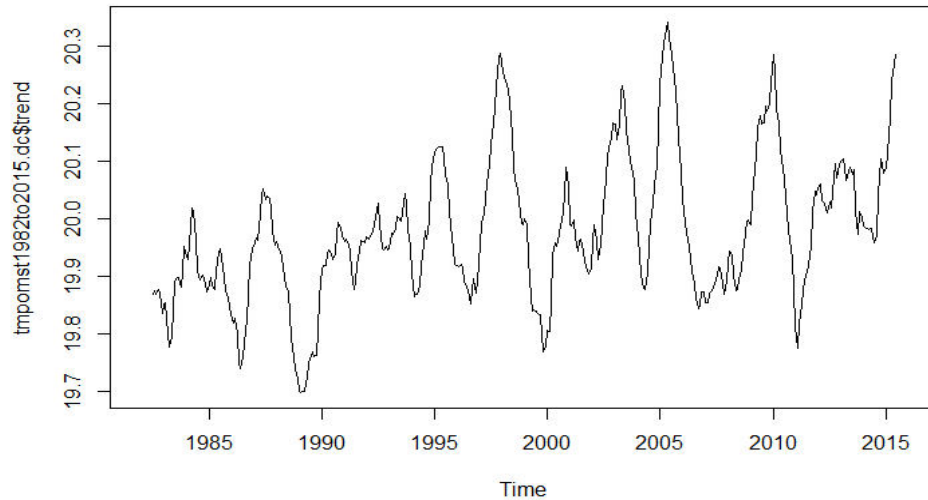


Figure 4 Temperature trend from 1982 to 2015 for Omusati region

Source: own generated graph from Cru data set

The figure 4 shows the trends in temperature as from the year 1985 to the year 2015. As seen, from 1985 to 1995 the temperature picks were a bit fractal and also not very sharp. This simply means that in the past decade temperature patterns were more predictable as compared to the sharp picks that are with the current decade which shows there are greater fluctuations.

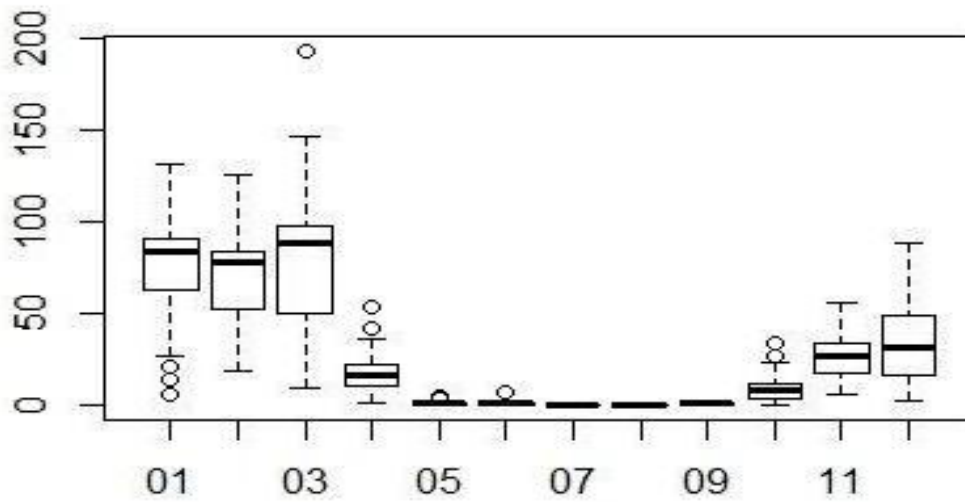


Figure 5 Mean monthly rainfall for 1982 to 2015 of Omusati region

Source: own generated graph from Cru data set

Figure 5 shows the mean monthly rainfall of all the 12 months since 1982 to 2015. The months of May, June, July, August and September shows quiet narrow bares, this simply means that , this were the months when there were very little changes in rainfall. However in the month of March, January, February and November shows that there have been little changes in the monthly rainfall over the past years.

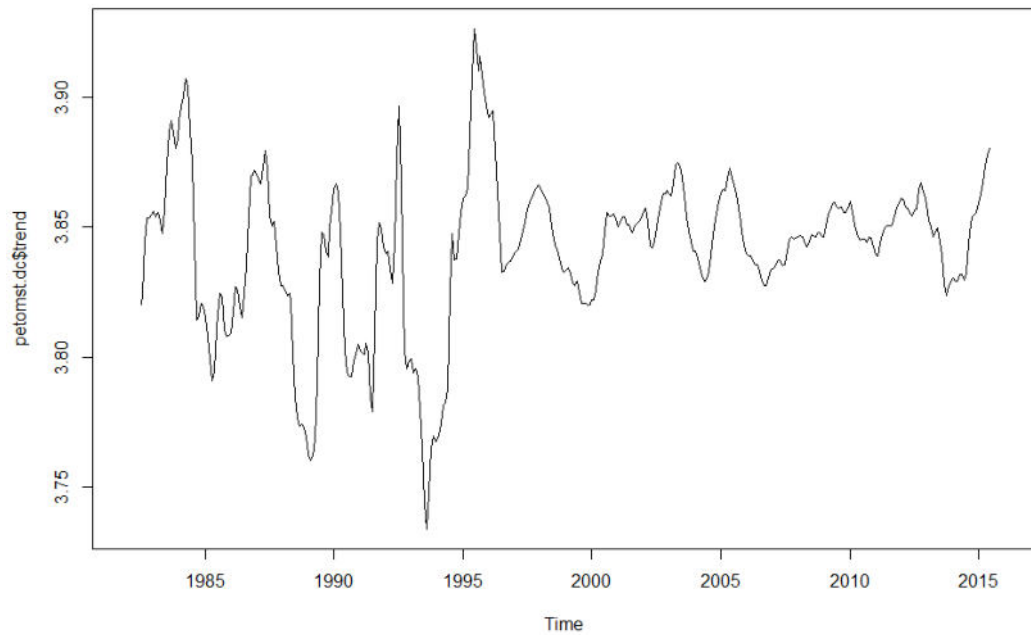


Figure 6 : Precipitation patterns from 1985 to 2015 of Omusati region

Source: own generated graph from Cru data set

There were picks that were very high especially from 1985 to 1999 showing that it was hard to predict what will be of the following year in terms of precipitation (Figure 6). However today it is not so difficult to predict what will be of the following year because some patterns have gradually became shallow.

4.2 Rainfall Anomalies

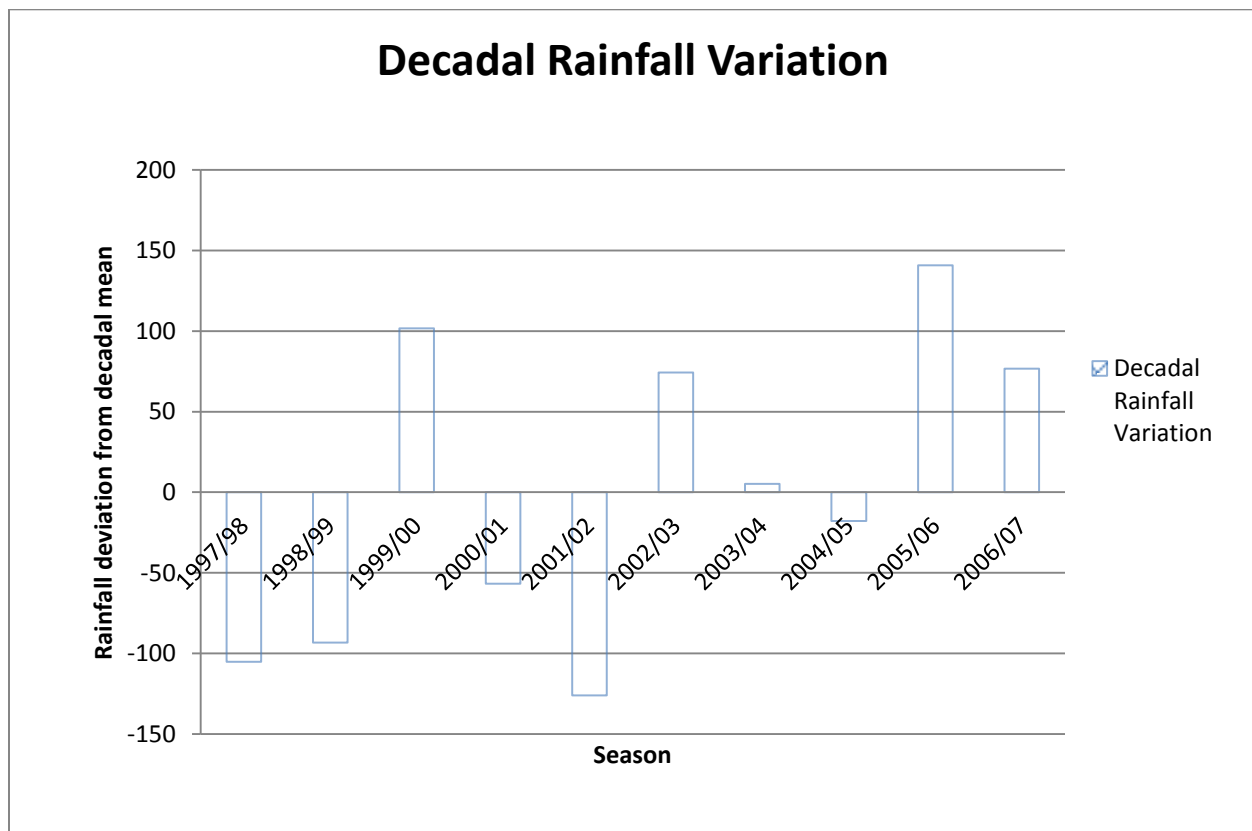


Figure 7: Decadal mean variation for 1997/98 -2006/07 seasons

Source: own generated from data from Omahenene

Figure 7 describe the rainfall pattern and how it has been changing as from 1997 to 2007. Indicated is the measures obtain as below and above 10 year mean average, there has been above and below changes that have been occurring which leads to no consistency, 1997 to 1999 rainfall was lower than average mean, in the year 2000 it farmers received 100mm which was above the 10 year mean and there after it wend low again covering the year 20001 and 2002 and towards 2003 it raised above mean again.

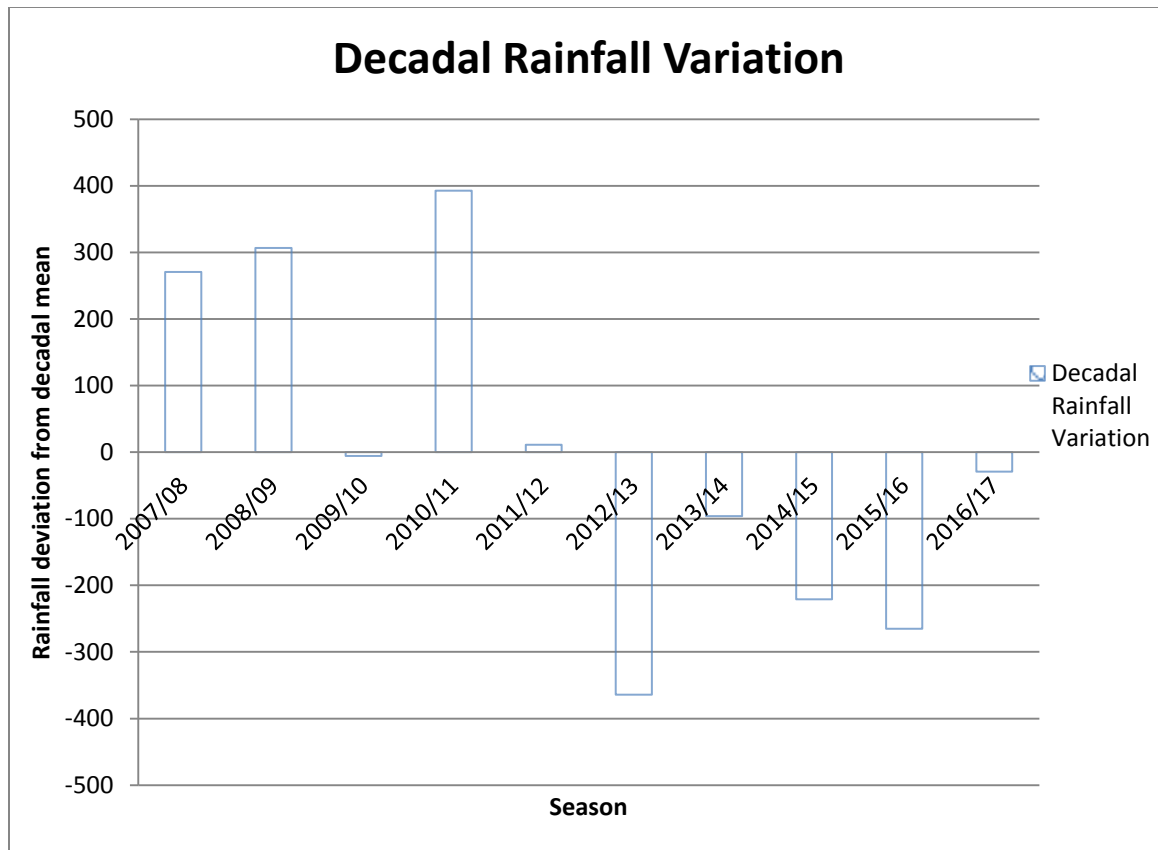


Figure 8: Decadal mean variation for 2007/08 -2016/17 seasons

Source: own generated from data from Omahenene

Rainfall varies within each year, there is no consistency in the flows , Figure 8 leads to a point where rainfall was slightly higher and has exceeded 10 year mean in 2007 to 2009 however the following year of 2009 to 2010 the flow when below average. After 2012 rainfall has proceeded on a continuous pattern below mean of which the highest obtained below the 10 year average was -360mm.

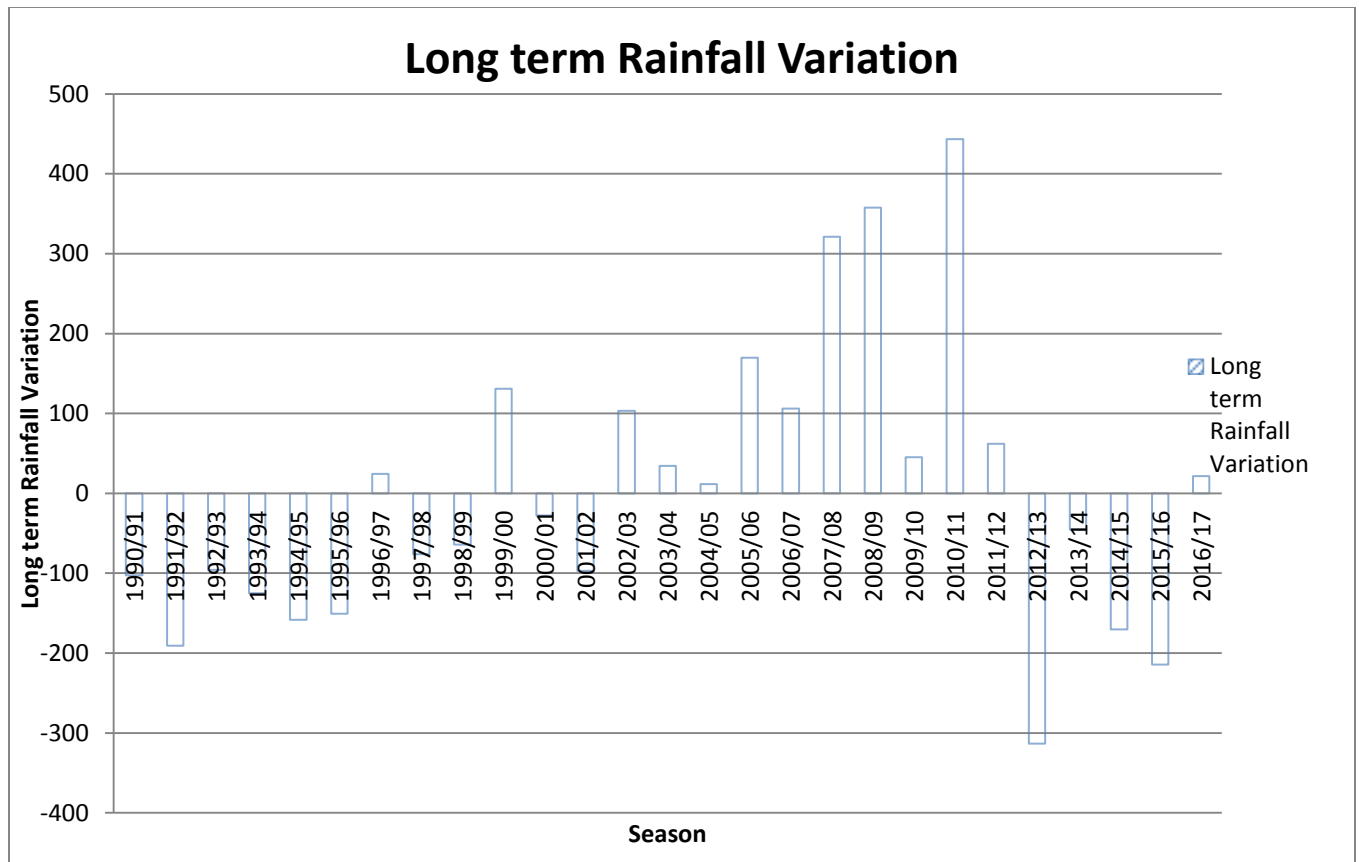


Figure 9: Long term rainfall variation from 1990/91-2016/17 seasons

Source: own generated from data from Omahenene

Rainfall variation of 1990/91-2016/2017 (figure 9) concur with what has been said by the farmers, because in as much as the rainfall seasons are growing shorter and the years are becoming unpredictable in terms of rainfall flows, there are some seasons/ years that were better than others, hence extremities such as floods and droughts are becoming more and more prominent .

4.3 Adaptive Capacity

Table 3: Determinants of adaptive capacity

Village	Determinants of Adaptive capacity	N	Mean	Std. Deviation	Skewness	Adaptive capacity
Okathiuk engombe	Education	19	1.11	0.459	4.359	Low
	Technology	19	1.42	0.507	0.348	Low
	Assets	19	1.37	0.597	1.443	Low
	Social network	19	1.16	0.501	3.339	Low
Elondo	Education	19	1.11	0.459	4.359	Low
	Technology	19	1.11	0.459	4.359	Low
	Assets	19	1.37	0.684	1.696	Low
	Social network	19	1.53	1.307	2.357	Low
Enongo	Education	10	2.5	1.841	0.668	Moderate
	Technology	10	2.3	1.252	0.144	Low
	Assets	10	1.3	0.483	1.035	Low
	Social network	10	1.9	1.449	1.035	Low
Oshihau	Education	13	2	0.913	0.777	Low
	Technology	13	2.31	1.548	0.824	Low
	Assets	13	2.31	1.437	0.955	Low
	Social network	13	4	1.08	-0.469	High
Oma kuva	Education	29	2.52	1.526	0.515	Moderate
	Technology	29	2.17	1.416	0.889	Low
	Assets	29	1.59	1.119	1.906	Low
	Social network	29	2.21	1.449	0.521	Low
Omaenen e	Education	23	3	1.834	0	Moderate
	Technology	23	2.83	1.586	0.162	Moderate
	Assets	23	2.48	1.563	0.435	Low
	Social network	23	4	1.382	-1.019	High
<i>Lickert Scale ranking 1-2= low, 3= Moderate, 4-5 = High</i>						

Factors of adaptive capacity describes that farmers in all the six villages who obtained less than 2 (two) mean average fall under low adaption ability, those of whom obtained 3 (three) on mean scale fall under the moderate category, those who obtained 4 and above have high adaption abilities (Table 3).

When it comes to education Omakuva, Oshihau and Okathitu village farmers have very low adaptive capacity, Omaenene, Enongo and Elondo village on mean scale fall under moderate category.

4.4 Discussion of results

4.4.1 Education factors

The results clearly shows that some farmers if not most, have very little knowledge on education simply because of what they had to say about causes of climatic changes, some farmers are genuinely think that all that is happening currently in terms of rainfall and extreme temperature is because of God and that repenting is a solution to climatic problems. Farmers do not believe that they could be the cause of the changes.

Marketing in formal rooms is almost impossible for Onesi livestock farmers, because they have very little knowledge on the marketing requirements and hence they feel robbed if they were to take their animals to places such as MeatCo.

To complement the findings is (Kelly, Anwar, Macadam, & Liu, 2012)who mentioned that the ability for farmers to understanding what climate is and the nature of its changes is very important in the role of better adaption.

4.4.2 Culture Factors

It has been noted that in Onesi constituency culture greatly influence how farmers perceive things. Farmers still consider livestock as a form of wealth, they keep their livestock for a whole lot of cultural related of which factors such as keeping livestock for traditional rituals such as weddings and funerals seem to be the main reasons for keeping livestock hence Farmers are so hesitant when it comes to selling their animals in order to overcome harsh climatic changes. A state of acquisition also plays a very important role on how farmers adapt to climatic changes, on demographics (figure 1) shows that about 76.7 farmers acquired their livestock through inheritance and 86.7% of the livestock farmers in Onesi constituency keep animals mainly for their extended family , this clearly indicate why it is hard for them to adapt to climatic changes through selling , because all this requires informed group decisions hence most farmers leave this livestock to die, even if they have background knowledge on the benefits of selling to support other remaining animals through buying feeds, they cannot do anything about it.

4.4.3 Economic factors

Although livestock sales do take place many are not willing to sell as a strategy to adapt as prices are low, the prices offered by the formal market to the farmers are very low, that is the reason why they are hesitant on selling their livestock and believe that livestock dying due to floods or drought is better than giving it away as an offering to the formal markets, even when there is a need. Due to this results this leads to a concept of ; the higher livestock mortality is allowed by the farmers the greater the economic and social losses, this agrees with (FAO, 2008) and also (Felix, Alfred, Boakye, & Irene, 2016)

4.4.4 Temperature and rainfall in Onesi

With reference to (figure 4 and 5) it shows that over the past decade rainfall and temperatures were more predictable, because there were very little changes in the patterns. However in the current decade fluctuations are much notable and the picks in changes are very high. This simply means that temperature and rainfall is changing year after year. Which makes it hard to predict hence agrees with the research concern which is climate variability's.

(Figure 5, 6 and 7) the decadal rainfall anomalies concur with (Table 2) of farmers perception on climate variability, that really the rainfall seasons are becoming shorter, of which this could mean that if livestock farmers in the region do not adhere and adapt to the changes thrown in by climate, they will find survival even harder than it is they now.

With all this discovered, the results highly agree with author (Felix, Alfred, Boakye, & Irene, 2016) who spoke of temperature increase having great impact on the livestock as it affects the water availability as well as the forage development along with the (FAO, 2008) that has covered the issues impacts of climate variability in terms of changes in rainfall that are changing year after year.

4.4.5 Rangeland management practices (overgrazing/overstocking)

Livestock numbers have been decreasing due to deteriorating rangelands and frequent droughts. Rangelands seem not to recover even after good rainfall due to overgrazing and overstocking as a result of limited grazing land. Clearly livestock farmers in Onesi depend more on communal land for pasture.

4.4.5 Adaptive capacity

As described under (Table 3) farmers are far from education hence they do not use much of educational views in their adaption mechanisms, also wealth, most farmers do not have asserts or money to help them adapt better to climate variability's example to buy feeds for their animals in times of drought or relocate their livestock in seasons of floods.

The results under adaptive capacity compliments (Kelly, Anwar, Macadam, & Liu, 2012)'s study in a sense that the results help motivate why (Kelly, Anwar, Macadam, & Liu, 2012) mentioned that less ability to adapt to climate variability leads to greater destructions.

4.4.5 How farmers adapt to climate variability

With reference to the group discussion, farmers in Onesi constituency basically depend on Communal land for pasture and there after all grass is cleared from the communal lands, farmers than start feeding their livestock with residues from their crop fields however during heavy droughts some farmers relocate their livestock to the cattle post, that are far from the residing lands, especially the cattle.

4.4.6 Does livestock farmer's perception on climate Variability and change supported by climate records?

Base on livestock numbers in Omusati has decreased by 4% for goats and 12% for cattle in 2015 due to drought however in contrast with the data provided by the farms the Omusati regional data does not agree with what farmers are saying simply because they have indicated that all livestock is equally affected, though goats are more affected (DVS, 2015). Hence the farmer's perception of all livestock being affected equally does not concur with the statistics of Omusati livestock census.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Livestock production is affected by climate variability Rainfall has been decreasing in the current decade with consequences, rangelands are gradually being degraded, drought drawing livestock mortality as a major challenge. Other factors such as Cultural (reasons for keeping livestock and how livestock was obtained), economic factors and rangeland management practices (overgrazing/overstocking) affect decision making on measures taken to adapt.

Cultural factors such as keeping livestock for traditional rituals such as weddings and funerals seem to be the main reasons for keeping livestock but inheritance of livestock from family members also affect any decision to adapt to changing environment, Although livestock sales do take place many are not willing to sell as a strategy to adapt as prices are not productive. Many farmers do not heed the opportunity to reduce the herd size as the formal markets are not attractive .Education, assets, technology and social network inadequacy act as barriers to adaptive capacity of farmers.

5.2 Recommendation

It is recommended that there should be more of climate information sharing, especially through extension officers to the livestock farmers, it is however of importance for the government to improve the price settings when it comes to livestock sales and also markets should be improved and brought closer to the villages for farmers to be able to accept more the idea of reducing the numbers of livestock to a manageable rates in order to survive the changes brought about by climate.

Training on rangeland management is of utmost importance for the farmers to have wide in sight of how to improve pasture lands example through growing fodder crops, Awareness on land use planning is encouraged, the government should work on advancing incentivise for formal livestock markets to attract livestock sales.

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APPENDICES

Appendix 1 Section (A) Demographic questionnaire

Determinants of livestock farmer's choice on adaption methods to climate change in Northern Namibia: A case study of Onesi

University of Namibia: Ogongo campus

Farmer's household survey questionnaire

This research survey questionnaire is purely for academic purpose, with the objective of understanding, assessing and comparing farmer's perception on climate change effects on livestock production and marketing with statistical analyses of observed climate data, farmers adaption practices and barriers to adaption, as part of a broader research project that assess the impact of climate change in semi-arid regions in Africa. Hence dear respondent you are assured of confidentiality of any view expressed in relation to this research.

I therefore entreat you to provide information as accurate as possible for true results. Thank you for your best and kind cooperation!!!

Name of interviewer :				
Date of interview:	D	M	Y	
Name of respondent :				
District				
Community/village				

Section A: Demographic

1a. Sex

1: Male 2: Female

2a. Age of respondent

1: 25-35

2: 36-45

3: 46-55

4: 56-65

5: 66-75

6: 76 +

3a.Originality /Nativity

1: Born and raised in the community/village

2: Migrant

4a. Number of years stayed in the community/ Village

Do you have any social responsibility (social position) in the community / Village?

1: Yes

2: No

If yes! Please specify

6a. Respondents level of education

1: Basic /Middle school

2: Secondary school/ Vocational

3: Tertiary

4: Non-formal

5: Non

7a. marital status

1: Married

2: Single

3: Widow/Widower

4: Divorced/ Separated

8a. Respondent's household size

1: 1-5

2: 6-10

3: 11-15

4:16-20

5: above

9a. occupation (please specify)

.....

10a. what type of livestock do you have and how many are they?

Code	Type of livestock		Number
1:	Goat		
2:	Cattle		
3:	Donkey		
4:	Sheep		

b. How did you acquire them?

.....

c. where do you graze your livestock

.....

d. how many have died over the past 5 years?

.....

11a. what purpose do you keep livestock for?

1: Home consumption 2: traditional purpose 3: Selling
 4: Home consumption and Selling 5: Home consumption and Traditional purpose
 6: Traditional purpose and selling 7: all options

12a. Religion of the respondent

1: Christian 2: Traditional 3: Others

12b. what are the ecosystem services do your livestock provide??

Provisioning services: products obtained from ecosystems	
Food	
Fiber, skins and related products	

Medicinal resources	
Fertilizer Manure	
Power Draught	
Regulating services: benefits obtained from the regulation of ecosystem processes	
Waste recycling and conversion of nonhuman edible	
Land degradation and erosion prevention	
Water quality regulation/purification	
Regulation of water flows	
Climate regulation	
Pollination	
Supporting services: ecosystem services that are necessary for the production of all other ecosystem services	
Maintenance of soil structure and fertility soil	
Habitat services	
connectivity Seed dispersal in guts and coats	
Primary production Improving vegetation growth/cover	
Cultural services: nonmaterial benefits people obtain from ecosystems	
Knowledge systems and educational values	

Traditional and formal knowledge about the; cultural identity	
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Thank you for your great assistance!!!!!!

Appendix 2 Section (B) group discussion Questionnaire

Determinants of livestock farmer's choice on adaption methods to climate change in northern Namibia: A case study of Onesi

University of Namibia: Ogongo campus

A very good afternoon to you all, am Cornelia Haukongo, student at University of Namibia Ogongo campus, I am here to conduct my research that is sponsored and made possible my ASSAR project (Adaptation to scale semi-arid region). The focus of ASSAR as a project is looking at Onesi Constituency. With regards to the issues of climate change, how people can adapt to climate change and how our ecosystem are being affected by Variation change. In short variation change is referred to increasing temperature, drought or flood; those are the climate variability we will focus on. I am working together with Jacobina Abed as an assistant. We have some questions on livestock farming as a system and how livestock are being affected. For the past three/four years we experienced drought and nowadays grazing areas are becoming scares. So we would like to find out how peoples livelihoods are affected, how are they coping with climate changes and what measures are they putting to adapt, and try to figure out what else can we do.

- 1. How is the pasture/grazing area. How are animals surviving currently?**
- 2. What do you think is causing grazing to be limited? Because in most cases, even with good rainfall grazing is still limited...why??**
- 3. How long does grazing last in terms of months and what do farmers do there after?**
- 4. How do you describe the rainfall patterns in Onesi?**

- 5. How is the carrying capacity of animals?**

- 6. Are there challenges brought about flood/ drought .What do you think make you not able to adapt or cope when there is drought/flood. Is it because you do not have money for supplementary feeding? Or is it that you do not have access to cattle post where you take livestock in drought Or is it that some of the animals are not yours, they could be inherited and you are not able to cull or sale them to minimize loss ?**

- 7. In Onesi which variable is a major concern between flood and drought/high temperature and how does either of the variable affect your livestock??**

- 8. Which group of people (men, women/children) are affected most in terms of floods and drought?**

- 9. How is the livelihood affected by climate change?**

10. In your own opinion, what do you think could be the cause of the change in climate that we are experiencing?

11. What would you suggest be done in order to minimize effects of these climatic changes?

12. In terms of traditional related issues... how does this affect decision making with regards to adaptation/mitigation to climate change?

- a) Why aren't you able to cull or sell this livestock when there is drought or when there is limited grazing??

13. Do you sell your livestock? Which type of livestock do you sell? Where do you sell?

14. Do you sell livestock to MeatCo's new system of mobile slaughter houses? Were you selling to them previously? If not why were you not selling to them?

15. How many times does MeatCo visit your area per year?

- a) Does it mean if there was a market place you would frequently visit?
- b) Would you consider limiting or reducing the number of livestock that you keep?? And should the government decide one day to limit the number of livestock that you have in order to save the grazing?
- c) What would be your reasons if the government decided to limit the number of animals, how will you respond to that?
- d) Which livestock is more affected by climate change?

16. Which animals survive flood better?

17. Which animals survive drought better (cattle's, goats, sheep, donkeys)?

18. If you heard that in 3 - 4 years to come there will be drought, will you be willing to sell away your animals or cull them?

19. Between goats and cattle, which one will you sell away first and which one will you keep?

20. Which cattle species do you keep and which ones are affected/survive better than?

- a) Which species do you prefer to keep between indigenous and exotic?
- b) Why do you prefer that breed?

21. What do you think is leading to animal death nowadays/ climatic changes? what are the diseases affecting your livestock and at each variable.(flood and drought)

22. Is the government giving any support to your livestock?

23. How do you want the government to help you?

24. Which specific help would you require from the government?

25. What suggestion do you have to improve the natural pasture?

26. Over the past 5 years, has there been an increase or decrease in the number of animals decrease or increased?

27. If the marketing place is established at Outapi, how many animals will you be willing to sell per year?

28. Are there any question, suggestions or comment?

END OF THE FOCUS GROUP INTERVIEW!!!

Thank you all for your great time and contribution, we hope to come back with feedback

Appendix 3 Researcher helping a farmer to understand adaptive capacity



Appendix 4 captured is lack of pasture for livestock to feed on



Appendix 5 Researcher interviewing livestock farmers in Elondo village



Appendix 6 captured are cattle's of one livestock farmer in Oshihau Village



Appendix 7 questionnaire survey

