AN ASSESSMENT OF CLIMATE VARIABILITY ON KEY FOREST ECOSYSTEM SERVICES AND ITS IMPACTS ON LIVELIHOODS OF COMMUNITIES IN ONESI CONSTITUENCY, OMUSATI REGION.

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE HONOURS DEGREE IN INTEGRATED ENVIRONMENTAL SCIENCE

OF

UNIVERSITY OF NAMIBIA

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26 October , 2017

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ABSTRACT

Ecosystem Services (ES) provide a lot of benefits to rural communities in Northen Namibia, however the changes in availability and access to ES affects dependent livelihoods.Whereas the change in availability and access of ES affects the ability of communities to adapt to climate variability as well as compromise their resilience. Changes in ES induce responses from communities in order for them to cope and adapt to prevailing conditions. Understanding of ES changes and responses employed would allow for appropriate messages and actions that would enable enhancement of resilience and better adaptation to the changing ES due to climate variability. The study was undertaken in Onesi Constituency using triangulation; by survey, focus group discussions and key informant's interviews that were used to collect both qualitative and quantitative Key informant interviews, mixed focus group discussion and questionnaire survey were employed to collect data. The key informants included headmen, and other traditional leaders as well as government officials who work with communities. Information was collected on knowledge, perceptions, coping strategies, uses, availability, access and observations on ES changes and trends. The results indicate that ES available are support, provisioning and cultural. The key forest ES were timber, non-woodyforest products (fruits, medicinal plants, weaving material, thatching grass, mopane worms, dyes and fibres). The general trend indicates that availability of these key ES has been declining. This has made some households to be more vulnerable as the source of livelihood has decreased. Furthermore, the frequency of drought and floods has been increasing affecting both crop yields and livestock numbers, leaving many people reliant on food aid. The impacts of climate variability were found to be more severe in drought compared to flood period. Human factors may also contribute to the decline availability of ES through overexploitation as the surveyed communities were found to be heavily dependent on ES for livelihoods.There is potential for creating awareness and sensitizing communities based on the research findings as some of the effects of climate variability are exacerbated by human ignorance. Training and capacity building in managing ES resources will go a long way in improving longevity of these ES as well as building resilience among ES dependent livelihoods.

ACKNOWLEGEMENT

The information and results put forward within this paper are based on work carried out in Onesi Constituency thus I am thankful to all the respondents that took part in this study . Appreciated and great thanks to my determined group of researchers and Mr Lazarus for the effort and time in assiting me throughout the study .

I am also thankful to the Omusati Regional Council , Onesi Constituency office and the traditional learders for being cooperative and granting the assistance required in carrying out research in the respective villages within Onesi constituency .

Greatest and deepest thanks to the Almighty for the unstoppable love and guidance throughout my years of being in school and for the opportunity of enabling me to carry out this research when all hope was lost.

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LIST OF ACRONYMS

ASSAR- Adaptation of Scale in Semi-Arid Regions

ES- Ecosystem Services

GIS -Geographic Information Science

GPS - Global Positioning System

IECN -Integrated Environmental Consultants Namibia

IPCC- Intergovernmental Panel on Climate Change

MEA - Millennium Ecosystem Assessment

NCMR- No Coping Mechanisms Recorded

NWFP-Non- Woody Forest Products

SAfMA - Southern African Millennium Ecosystem Assessment

SARs- Semi- arid Regions

UNEP- United Nations Environment Program

UNFCCC- United Nations Framework Convention on Climate Change

CHAPTER ONE:INTRODUCTION

1.1 Background

Namibia amongst other Southern Africa countries is endowed with a vast number of forest resources even though these resources are greatly affected by climatic variability and change. Namibia's climatic conditions support little or dense woodlands with most of these forests being found in the north-eastern parts of the country towards Kavango and Zambezi regions (Erkkilä&Siisskonen, 1992).

Ecosystem services are crucial and significant to people's livelihoods and the benefits derived from them are classified into four categories types:provisioning, regulating, cultural and supporting services Millennium Ecosystem Assessment framework (MEA, 2005).Increasing population growth and climate fluctuations linked to prolonged periods of droughts and floods globally sway the availability of such services to an extent that such ES are disappearing and thus negatively impacting the lives and livelihoods of people reliant on the services. When such services are wedged people's way of living is compromised to a level that revenue obtained from the sale of such products is little and insufficient to cater for household needs, food security is hampered in rural households, land degradation may result Adaptation of Scale in Semi-Arid Regions (ASSAR, 2015). It is noted that climate variability has different ways of impacting people's lives and livelihoods whereby ecosystems are subjected to fluctuation of accessibility and availability of resources to be accrued by different social groups hence making it difficult for social group's adaptability to climate variability (Tasokwa,Nyariki, Mkwambisi&Kogi- Makau, 2011).

Integrated Environmental Consultants Namibia-IECN (2011) defined climate variability as "normal variations in climate on temporal or spatial scales beyond that of individual weather events". Gradual fluctuations in temperature and precipitation are likely to lead to longer dry seasons that may perhaps elicit biophysical stressors and distress fire outbreaks ensuing ecosystem structure and function alteration(James, David &Toral, 2012).However , the decreased levels of precipitation were found to likely impact forest mortalities whereas droughts are likely to increase the severities of forest decline or death and forest fires erupting from excessive heating of surface grounds from extreme temperatures during dry spells(James, David &Toral, 2012).

Climate variability would impact rural livelihoods in most regions that are dependent on forest resources and biodiversity for their livelihood and contribution to socio-economic empowerments within households (IECN, 2011). Examples of such resources impacted include timber and non- timber forest products, ecosystem functions and interactions, wild fruits, herbs and medicinal plants. Fluctuations in temperature also impact the lives of farmers and their livelihood's abilities to adapt to dry seasons without grazing for their livestock as well as hindering the ability of successful agricultural production subsequently leading to food insecurity and crop failure(IECN, 2011). In addition, high temperatures also impact the outbreak of pests and diseases that hinder crop and livestock husbandry, also reducing accessibility and availability of non-forest products & wildlife (ASSAR, 2016). With respect to vulnerability and sensitivity to climate change; Onesi Constituency is likely to experience an inconsistent supply of forest ecosystem services in a way that their supply is threatened and thus compromising the availability and accessibility of Ecosystem Services (ES) to future generations and livelihoods dependent on such services (ASSAR, 2016).

1.2 Problem statement

The study sought to determine how climate variability affects the availability and accessibility of key Ecosystem Services in Onesi Constituency. Reviewed literature has shown that climate variability has resulted in both negative and positive impacts that exert pressure on key forest ES in ways that limits the benefits derived from those services associated with different social groups. Residents of Onesi Constituency are dependent on subsistence farming as well as deriving benefits from ecosystem services and products making them vulnerable to the risks and impacts associated with floods and droughts that characterize recent climate variability (ASSAR, 2016). Conversely,Omusati region is faced with many challenges associated with reduced availability and access of ecosystem services and made worse by increasing human and livestock populations. When such services are impacted livelihoods are compromised to an extent that incomes derived from the sale of such products is insufficient to cater for household needs, food security is hampered in rural households and also results in degradation and deterioration of natural resources. The study sought to gather information that will aid in understanding this dynamic in order to be better prepared to design adaptation strategies.

1.3 Research Objectives and research questions

1.3.1 Objectives

Main objective

To assess the effects of climate variability on accessibility and availability of forest Ecosystem Services and the resultant impacts on livelihood strategies of the communities in Onesi Constituency.

The study was guided by the following objectives:

1. To identity key the forest Ecosystem Services (ES) within the study sites of Onesi Constituencythat communities are dependent on for their livelihoods
2. To assess the benefits associated with ES to different social groups
3. To evaluate the communities' opinions on climate variability and its effects on accessibility and availability of forest ecosystem services within the last 5 years.

1.3.2 Research questions

1. What are the key forest Ecosystem Services in Onesi Constituency that are vital to the livelihood and well-being of the people?
2. What are the spatial and seasonal patterns of these key ES?
3. How do different social groups access and benefit from these ES?

1.4 Significance of study

The study was an attempt to elaborate and clarify the link between climate variability and forestry key Ecosystem Services accrued to different social groups; as a means of equipping rural communities with knowledge on how to adapt to changes in climate variability. In addition, the information gathered will enable researchers to assist with development of mechanisms for alternative livelihood strategies conforming to local communities that would aid in preserving the availability and accessibility of ecosystem services.

1.5 Limitations

The study was limited by potential weaknesses which incorporated research biases and perceptual misinterpretation of which the researcher had no control over. Methodological limitations were experienced during focus group discussions and questionnaire interviews; taking into consideration self-reported because respondents haddifficulties in remembering

experiences or events or trends that occurred at some point in the past. Access to people may also limit the study because the targeted audience by chance could be busy in the fields or working at markets and also because residents within the study may require some sort of incentive or payment in order for them to respond.

CHAPTER TWO: LITERATURE REVIEW

2.1 Ecosystem services and climate

Ecosystem Services refers to the direct and indirect contributions of ecosystems to human well-being and upliftment of their rural livelihoods(Ecosystem Millennium Assessment in Milind, Mark, Dian &Jagdish 2015). These Ecosystem Services are catergorized into three types: 1) provisioning services that emphasizes on the tangible physical products attained from ecosystems comprising of hereditary assets, nourishment, fiber and fresh water; 2)regulating services are characterized as the returns procured from the direction of biological system forms, including the control of atmosphere, hydrology, buffering of great climate occasions and some human ailments thus sustaining and maintaining the natural environmental functionality; 3) Cultural services focus on the non-material benefits people attain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, aesthetic experience and sense of place and supporting services that centers on ecosystem services that are necessary for the production of all other ecosystem services. Some examples include biomass production, soil formation and retention, nutrient and water cycling, and provisioning of habitat (ASSAR, 2015).
Exclusively Ecosystem Services are highly threatened by a vast number of environmental conditions and anthropogenic stressors. Ecosystem services are often co-produced through nature-human interactions in social-ecological systems whereby enabling the recognition of inter-human relations that are bearing upon human-nature relations and on Ecosystem Services MEA (2005) in (Milind *et al* ,2015).Ecosystem services, especially in semi-arid regions, can vary over space and time based on all the services derived from ecosystem services. Communities living in the semi-bone-dry districts of Africa and Asia are typically poor with constrained access to administrations and employment open doors (ASSAR, 2015). Although Semi-Arid Region (SARs) of Southern Africa are culturally and ecologically diverse (SAfMA, 2005), a lot of other challenges are likely to continue with warming and highly variable rain, adding to the stress. Reduced water availability, increased risk of disease, reduced crop and livestock productivity and damage to infrastructure and buildings, poverty, unemployment and inequality, low levels of education, population growth and HIV and AIDS and other health problems already experienced in these semi-arid regions of Southern Africa make them particularly vulnerable to the impacts of climate change (Shackleton *et al*, 2008).With a decline

in farming efficiency, individuals living in SARs of Southern Africa are progressively depending more on biological systems and environment administrations for their survival in spite of their affectability to atmosphere(SAfMA, 2004).

2.2 Benefits derived from ecosystem services

Acording to Sylvanus *et al* (2017), results showed that the most important ES were provisioning and support compared to the importance attributed for regulating and cultural ES. Respondents from the study further elaborated that benefits were mostly derived from edible plant species,honey , fuelwood and timber compared to edible insects and worms (Sylvanus *et al*, 2017).Most plants occurring in the environmnetal have subtantial benefits to people and their livelihoods whereas some plants i.e have phamaceutical benefits in treating diseases and ailments.

Woodlands and associated wild land covers provide a very wide range of provisioning services that are used by local people as upliftment mechanisms for rural livelihoods (Ryan *et al*, 2016). Women are disproportionately involved in the harvesting, processing and sometimes consumption of many of these goods, although this changes in favor of men for labor intensive commercial products such as charcoal, honey and timber. Marginalized groups unable to compete in local labor markets depend heavily on these goods, and wild food nutritionist important for children. Only a few products have international commodity chains (e.g. honey,marula and baobab fruit pulp and seed oil), despite considerable potential. Many case studies in the study region attest to the importance of these food sources during droughts or other household income shocks (Ryan *et al*, 2016) . For instance, during a year with poor harvests, wild foods can account for 30% of calorie consumption. However, a recent global analysis has questioned the prevalence of this coping strategy, indicating that households prioritize reducing consumption and selling assets in times of crisis and that wildland products play a minor complimentary role in the coping strategy portfolio (Ryan *et al*,2016). Similarly results on woodlands illustrated 76% of total energy used in the region being in the form of potentially renewable biomass derived from forest Ecosystem Services. Total employment in the traded woodfuels sector is between 1.4 and 2.5 M people with a traded value of $780 M per year (Martin Tamsin, Mwala & John, 2013).

2.3 Impacts arising from climate variability

Climate variability impacts the growth of short season growing plants resulting in reduced plant populations.While drought frequencies are more likely to result in lower woody plant growth rates, and an increase in drought-driven mortality events that are currently rare (Ryan *et al,* 2016). Changes in climate, such as greater rainfall variability or rising temperatures, affect the availability of natural resources and increase vulnerabilities, such as food and water security. Other effects include negative health impacts due to malnutrition and favorable conditions for disease transmission (UNEP, 2011).Flooding has benefits and negative impacts on the environment even though flooding outweighs drought benefits. However, when resources on land are insufficient; people's daily livelihood strategies and activities are hindered because of poor grazing areas degraded by overstocking thus plummeting the accessibility key forest Ecosystem Services. About 20-30% of plant species in the next 100 years will be threatened by the danger of extinction as a result of climate variations (Toulmin, 2009).

Statistics in Malawi revealed that drought cases have affected millions of people severely exacerbating hunger however an estimated number of 28 million people in southern Africa including Zimbabwe are affected by hunger (the Namibian, 3 June 2016).With climate variability in mind, vegetation structures, distribution of species have gradually changed in response to gradual shifts in temperature and rainfall whereas resultant in altering the functionality of ecosystem and destabilizing agricultural production in some African countries (Fujikura & Masato, 2011, pp. 110-111).Namibia is challenged with climate variability that is likely to impair ES consequently leading to extinction of about 20 to 30% of plant and animal species Coetzee (2010). The expected change in temperature, precipitation, run off and infiltration will consequently alter ecosystem structure and functions there after triggering the loss of grassy savanna to spatial dominance of desert and shrub land vegetation subsequent to bush encroachment (Coetzee, 2010).

2.4 Ecosystem Services , Climate variability and Gender

Similar study by Sylvanus *et al* (2017), revealed that social differentiation in relation to age , gender , income and experience was influenced by the manner in which repondents perceived the importance of ES . However the positive attitude of women towards the use and management of ES is a result of how women perceived the benefits they derived from the

environment thus enabling them to be pro-active in the management and use of ES (Sylvanus *et al* ,2017).Also the study revealed that the forged relationships between women and the environment in the changing dynamics of climate variability was influenced by the type of benefits and forest products collected from provisioning ES (fuelwood , timber , medicinal plants and fruits) as part of women domestic chores.Moerover neither the age, gender and occupational statuses influenced the use of cultural ES but rather were influenced but the past experiences and importance of what people could obtain from cultural ES with fluctuations recorded for both floods and droughts (Sylvanus *et al* (2017).

Poor social groups bear the brunt of Climate Change as indicated by Bäthge (2010),not just on the grounds that they are more reliant on common assets, additionally in light of the fact that they do not have the essential ability to adjust to environmental change. Around 66% of the total population living in neediness are ladies, which underlines their more prominent helplessness to the evolving atmosphere. The differential effect of environmental change on ladies and men is because of social standards, customary parts and diverse force structures. Ladies are typically in charge of giving the family its essential sustenance, yet they infrequently have entry to and control over the assets required to satisfy this assignment when development conditions break down. Thus atmosphere incited crop disappointment likewise puts the nourishment security of the whole population at danger (Denton 2002: 14). Moreover, ladies need land rights, possession rights for the method for creation, innovation, funds to ensure that they are the spear headers of household chores in harvesting and management of ecosystem services (Rodenberg 2009: 11).However, see on overall overview of climate change in Asia hence literature concurs similarly hence it is generally accepted that poor people are proportionately more exposed to environmental hazards and environment-related conflicts than other economic sectors of the population United Nations Development Programme (UNDP, 2011).

2.5 Climate Change Coping and Adaptation Measures

Adaptation is crucial in areas or ecosystems vulnerable to the impacts of climate change were communities are required to adapt and enhance their resilience .The extent to which communities adapt to the impacts or the change in climate is determined and shaped by the ability of communities to access resources and the investment decisions they make in the face of climate change (Vaatainen & Hachikela, 2011) . In one study in Cameroon households vulnerable to climate change were mostly involved in carrying out fishing and selling of forest products as a

strategy in coping with floods however some households (18%) had no coping strategy when they were faced with difficulties of climate change/ variability (Molua, 2009).

Adaptation should be undertaken and done at different levels were communities fund for most adaptation even though the government assists(Vaatainen & Hachikela,2011).Local communities in Zambia strengthened their indigenous coping strategies with drought where communities were involved in harvesting forest products, farming with diversified crops and animals to supplement failing harvests, sending families away to areas with high rainfall patterns (Vaatainen & Hachikela, 2011). Fuelwood collected from the forests is the main energy source for most rural communities for lighting purposes; however, these actions lead to increased efforts to find fuelwood that result in environmental degradation that intensifies fuelwood scarcity (Toulmin, 2009). Coping mechanisms put in place for over exploitation of fuelwood included the use of efficient cook stoves, solar cooking and biogas which reduced the pressure exerted on forests in Cameroon (Toulmin , 2009). These coping strategies require communities to engage and adopt mechanisms vital in coping and adapting to climate change.

In addition, the main coping strategies for communities in Kanyangala included the collection of wild fruits and tubers selling reeds and mat, use of traditional medicine for livestock, selling of grass and food for work during drought. The coping strategies have helped but they were not ecologically, financially and socially sustainable on a not long term as climate exacerbated (Vaatainen & Hachikela, 2011).

CHAPTER THREE : METHODOLOGY

3.1 Introduction

The methodology section gives an overview of the basic research plan , design , study area and data collection techhiques and analaysis .

3.2 study area

The study was conducted in Onesi Constituency, Omusati Region, Namibia (Figure 1)

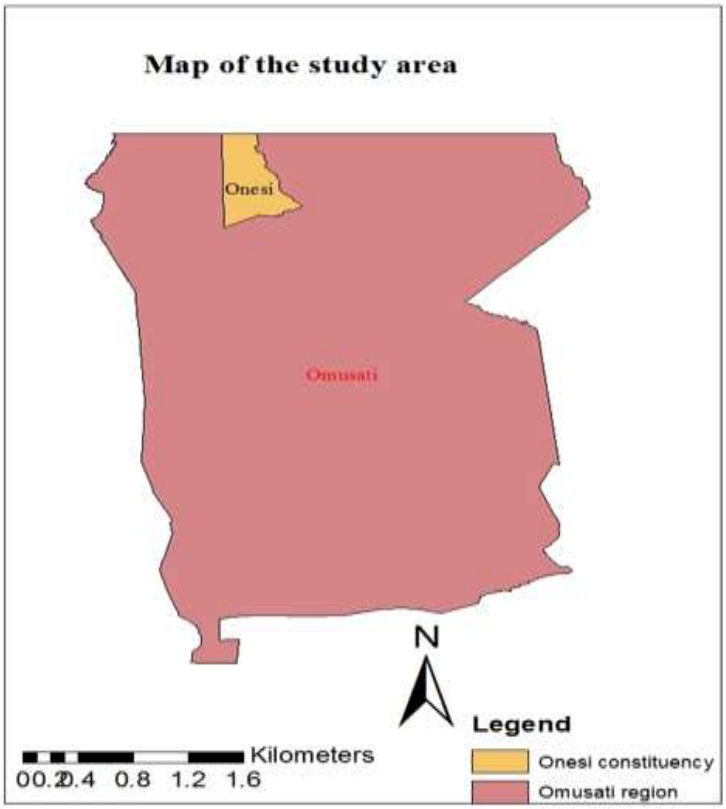


Figure 1 Location of Onesi Constituency in Omusati Region

Onesi Constituency is situated in the North western part of the country in Omusati Region. According to Namibian Statistics Agency (NSA, 2011), the Omusati Region is the third highest and densely populated region comprising of 12 constituencies. The region has an estimated population of about 243 166 inhabitants with a population density of 9.1 people per km^2 of which 13149 are residents in Onesi Constituency 7170 being females and 5979 males, (NSA,

2011).The majority of the inhabitants in Omusati Region reside in rural areas (94%) whilst 6% of them reside in urban areas.

The climatic conditions in the north-central regions of Namibia including Onesi Cconstituency are described as semi-arid region with annual total rainfall ranging from of 250-600mm and maximum temperature between 24° C and 36℃ whilst minimum temperatures range from 7° C to 21℃ (Mendelsohn, Jarvis & Robertson, 2013). The study by ASSAR (2016) in Onesi Constituency revealed that communities were highly vulnerable and sensitive to climate variabilities in relation to droughts and floods, whereby with an increasing population ecosystem services are highly vulnerable to degradation because of population pressure exerted on the forestry ecosystem services.Weak governance and structural inequalities also exacerbate the vulnerabilities of communities.The region is dominated by *Colophospermum mopane* (mopane), *Berchemia discolor* (bird plum), *Sclerocarya birrea* (marula) and few *Hyphaene petersiana* (makalani palm) trees with people predominantly practicing agricultural farming with the staple crop pearl millet and rearing of livestock (Mendelsohnet *et al* 2013). The people within the region relay on the canal passing through the region's capital (Outapi) from Ruacana River to Oshakati. Also the people within the region depend on the water for irrigation purpose, drinking water for livestock and other household uses (NSA, 2011).

3.3Research design

The study incorporated a mixed method design by cross sectional study using triangulation; by survey, focus group discussions and key informant interviews that were used to collect both qualitative and quantitative data (Janice & Niehaus, 2009).The qualitative and quantitative approaches were both principally and primarily focused on the identification of key forest ES whilst assessing the benefits accruing from those ES to different social groups and how those services contribute to the wellbeing and vulnerabilities of communities during periods of flood and drought. The data obtained from the structured questionnaire, focus group discussions and key informant interviews yielded different types of information that will enable researchers to make appropriate relation of the results.

3.3 Sampling method

The study used a multistage sampling method. The study area was purposively selected to cater for areas near the community forest and villages were clustered according to location ;West

(Onandjandja and Okathitukeengombe), North (Uukwananga and Ontsinka) and East. (Enongo and Oshihau). And in each cluster formed and established ; two villages were selected at random using a random number generator with ten households selected randomly in each village.A total of 60 households were interviewed.The method generated results of the type of key forest ecosystem available in the constituency during periods of droughts and floods with regard to their distribution and availability.

3.4 Research instruments and data collection

The study used a detailed survey instrument i.e. questionnaire encompassing of open and closed ended questions to capture all necessary information pertaining to demographic characteristics and information on forestry key ecosystem services. However, a pilot study was done to test for validity. The survey was administered using face to face communication and audio recording instruments were used for record during the focus group discussions and key informant interviews with the participants.

3.5 Data Analysis

Data captured from questionnaires were analyzed using descriptive statistics in Statistical Package for Social Sciences version 21 (SPSS, 2013). The results were presented in graphs and tables for comparison purposes .Remote sensing methods were used to determine the spatial and seasonal distribution of forestry key ecosystem services resulting in the generation of maps .

CHAPTER FOUR: RESULTS

3.1 Introduction

The chapter gives an overview of the results generated from the study in Onesi Constituency , thus gives descriptive data findings on Ecosystem Services in relation to benefits , impacts , coping mechanisms and adaption measures of livelohoods to climate variability.

3.2 Demographic results of the research

Socio-economic demographics of the respondents including gender, occupation, marital status and level of education are presented in Table 1.

Table 1.1 Demographics of respondents

Demographics	**Uukwananga (N=14)**	**Ontsinka (N=11)**	**Onandjandja (N=10)**	**Oshihau (N=10)**	**Okathitukengombe (N=5)**	**Enongo(N =10)**	**Total (N=60)**
Gender : Female	42.9	27.3	70	40	60	80	51.7
Male	57.1	72.7	30	60	40	20	48.3
Age Group 20-28	0	0	30	20	0	0	8.3
29-39	0	18.2	10	30	20	20	15.0
40-49	35.7	36.4	10	30	40	30	30
50-59	28.6	18.2	20	10	0	10	16.7
>60	35.7	27.3	30	10	40	40	30
Occupation							
Traditional leader	7.1	9.1	10	10	0	1	8.3
Self employed	21.4	0	20	20	20	20	16.7
Unemployed	42.9	54.4	40	40	40	70	48.3
Employed	28.6	36.4	30	30	40	0	26.7
Marital status							
Single	35.7	36.4	20	20	40	70	36.7
Married	50	54.4	40	70	40	20	46.7
Widowed	0	9.1	10	10	20	10	8.3
Divorced	14.3	0	20	0	0	0	6.7
Separated	0	0	10	0	0	0	1.7
Level of Education							
No formal	37.5	18.2	10	10	20	20	20
Primary	21.4	45.5	40	40	60	40	38.3
Secondary	21.4	18.2	40	50	20	40	31.7
Tertiary	21.4	18.2	10	0	0	0	10

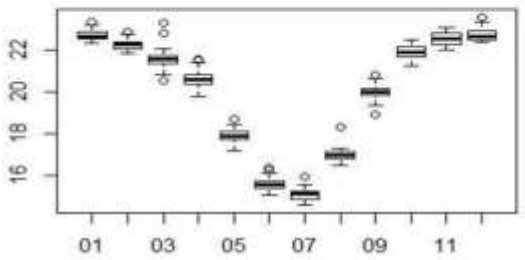
Note: the figures in the table are represented in percentages (%) whilst N represents the total number of respondents in each village

From the demographics given in the table above; the majority of the respondents were females (51.7 %) whereas (48.3%) were males. With the highest age group ranging within the of >60 years and least represented by age group 20-28 (8.3%). Whereas most people are unemployed

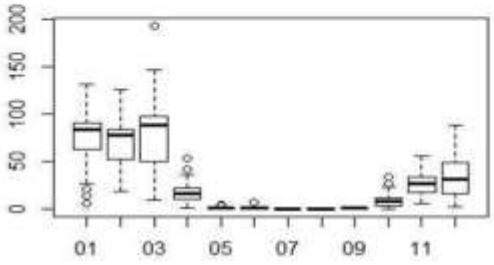
(48.3%) of the respondents thereof while only (26.7%) are formally employed.With most people being single (36.7%) or married (46.7%) whereas the level education attained from primary (38.3%) and secondary (31.7%) school is high with Oshihau , Okathitukeengombe and Enongo not having any levels of tertiary education attained .

3.3 Climate variability

Figure 2 below shows the mean temperatures and precipitation of Omusati Rregion since 1982. Temperature has extreme variabilities in January , February with March having more extremities compared to all the months with high variability occurred in November . However March with the same variability in temperature is still the same with high variability in precipitation . Thus the table shows the rainfall received months in Omusati Region varies the most in months were precipaitaion is received (November , December , January , February and March) these are also the months when due to their availability ES are likely to benefit communities.



Monthly mean temperature 1982-2015, Omusati region



Monthly mean Precipitation 1982-2015, Omusati region

Figure 2 Trends in monthly mean temperature and precipitation in Omusati region, 1982-2015

3.4 Key Ecosystem Services wiithin the study sites of Onesi constituency

The ES that were considered important for livelihoods in the six villages of the constutency include provisioning , cultural and support services *(Table 2).* However communities are dependent on both Timber and Non-forest Ecosytem Services for the upliftment of their livelihoods (*Table 3*) .

Table 2 Forest Ecosystem Services in Onesi Constituency and % of respondents considering them available

Ecosystem Services	**Uukwananga (N=14)**	**Ontsinka (N=11)**	**Onandjandja (N=10)**	**Oshihau (N=10)**	**Okathitukengombe(N=5)**	**Enongo (N=10)**	**Total (N=60)**
Provisioning	100	100	100	100	100	100	100
Cultural	35.7	9.1	20	30	0	40	25
Support	100	100	100	100	100	100	100

Note : N represents the total number of respondents in each village

Respondentsfrom the six villages primarily considered and indicated that provisioning and support ES were the most available compared to cultural (25%) that is also unavailable to Okathitukeengombe (0%) with Enongo (40%) utilizing more of cultural ES among the six villages

Both woody (Fuelwood and timber) and non-wood (fruits, medicinal plants and edible worms) forest products were reported as being available and communities benefiting from them (*Table 3*)

Table 3 Availability of woody and non wood Forest Ecosystem Services in Onsei Constituency and % of respondents indicating availability

Key ES	**Uukwananga (N=14)**	**Ontsinka (N=11)**	**Onandjandja (N=10)**	**Oshihau (N=10)**	**Okathitukengombe (N=5)**	**Enongo (N=10)**	**Total (N=60)**
Forest & Non-Timber forest products	100	100	100	100	100	100	100

Note : Figures in the table above are represented in percentages (%) whilst N represents the total number of respondents in each village

3.5 Benefits from ES to different social groups

Major types of benefits received from ES during floods and drought as recorded from the six villages are indicated above in (Table 4). Few ES benefits were recorded for Onandjandja because of the location of the village (west side of Onesi Constituency). However, the major benefits recorded during flood periods were medicinal plants from different plant species(73.3%) with a slight decrease recorded during the drought period (71.7%) . Whereas (66.7%) of the respondents indicated they received more benefits during flood periods compared to drought (58.3%). Of the 60 respondents interviewed , (51. 7 %) indicated they received less benefits for *Berchemia discolor* during flood periods compared to droughts periods (53.3%).Also (63.3%) of the respondents from the six villages indicated they receive substantial benefits during floods compared to drought (36.7%). as indicated in (table 4).

Table 4 Benefits derived from ES during droughts and floods

Benefits from ES	**Uukwananga (N=14)**		**Ontsinka (N=11)**		**Onandjandja (N=10)**		**Oshihau (N=10)**		**Okathitukengombe (N=5)**		**Enongo(N=10)**		**Total (N=60)**	
	D	F	D	F	D	F	D	F	D	F	D	F	**D**	**F**
Diospyrosmespiliformis	0	7.1	36.4	100	0	0	90	60	20	60	0	40	23.3	41.7
Andasonia digitata	100	64.3	0	54.5	0	0	80	70	40	80	60	60	50	53.3
Sclerocarya birrea	71.4	57.1	100	100	0	60	50	30	80	80	50	60	58.3	66.7
Hyphanene petersiana	64.3	92.9	36.4	36.4	0	0	60	0	40	80	40	80	41.7	51.7
Birchemia discolor	71.4	35.7	100	100	0	0	60	20	60	100	20	80	53.3	51.7
*Grewia flavescens& retinervis (*Photo 1)	0	7.1	0	0	30	100	70	0	0	60	0	0	16.7	23.3
Medicinal plants	64.3	71.4	100	54.5	70	100	50	30	100	100	60	100	71.7	73.3
Edible worms (Photo 2)	21.4	0	90.9	100	0	70	40	50	60	100	20	100	36.7	63.3
Grasses *: Eragrostis rotifierrendle* and *Heteropogon contortus*	42.9	21.4	100	100	10	70	0	0	60	20	20	40	38.3	43.3
Colophospermum mopane (weaving)	21.4	14.3	100	100	0	60	50	30	100	100	100	100	56.7	61.7
Hyphaene petersiana weaving (photo1)	92.9	71.4	36.4	18.3	0	0	30	60	40	60	80	60	50	45

Note : The figures in the table are represented in percentages(%) with (N) representing the number of respondents in each village Drought represented by (D) and Flood represented (F).

Figure 3 ES benefits in relation to income recieved

Figure 4 Sale of Mopane worms at open market

4.5.1. Income accrued to social groups

Table 5 below summarizes the associated benefits accrued to different social groups from the sall of ES.Male respondents received more income (22.7%) of the respondents compared to the females of those who were interviewed. (8%) of the respondents were within the age class group of >60 with more respondents within the age group of 29-60. Only Ondjndja out of the six villages received no income from the sell of ES because of its location and the unavaibility of forest products for sale.Moreover most of the respondents who are unemployed in Uukwananga (12.5%) , Enongo (12.5%) and Okathitukeengombe (12.5%) receive a substantial income in contrast to Ontsinka and Oshihau who receive (0%) with the total number of respondents summing upto (10%) . Results further shows that there are considerable benefits received from ES from respondents who had not completed or attained any education (1.7) as shown in(Table 5).

Table 5 Income benefits derived from ES in relation to social groups

% of respondents that Receive income from ES									
	Village name	**Uukwananga %**	**Ontsinka %**	**Onandjandja %**	**Oshihau %**	**Okathitukeengombe %**	**Enongo %**	**Total (Yes)**	**Total (ALL)%**
Gender	Female	12.5	0	-	0	12.5	12.5	37.5	13.6
	Male	18.8	12.5	-	12.5	6.3	12.5	62.5	22.7
Age groups based on age classes	29- 60	18.8	6.3	-	12.5	12.5	18.8	68.75	18.3
	>60	12.5	6.3	-	0	6.3	6.3	31.25	8
Occupation	Traditional leader	0	6.3	-	0	0	6.3	12.5	3.3
	Self employed	6.3	0	-	6.3	0	6.3	18.8	5
	Unemployed	12.5	0	-	0	12.5	12.5	37.5	10
	Employed	12.5	6.3	-	6.3	6.3	0	31.3	8.3
Marital status	Single	6.3	0	-	6.3	12.5	12.5	37.5	10
	Married	18.8	12.5	-	6.3	6.3	12.5	56.3	15
	Divorced	6.3	0	-	0	0	0.0	6.3	1.7
Level of education attained	No schooling completed	6.3	0	-	0	0	0	6.3	1.7
	Primary education	6.3	6.3	-	0	12.5	12.5	37.5	10
	Secondary education	12.5	0	-	12.5	6.3	12.5	43.8	11.7
	Tertiary education	6.3	6.3	-	0	0.	0	12.5	3.3

As shown in Table 6 , there were considerable differences concerning how respondents use ES in relation to farming. Respondents within the six villages indicated that they utilized Ecosystem Support Services for land cultivation (49%) with most respondents within the age group of 29-60 and >60 . Whilst few respondents within the age group of >60 utilized land for rearing livestock (2%) and of 65 households interviewed , (49%) indicated they used both land for cultivation and livestock rearing. Oshihau village, had more female respondents (64%) who use land for cultivation purposes compared to males (36%). Moreover only Uukwananga village (100%) indicated they utilized land as habitat for rearing livestock whilst all the other five villages indicated they do not.More females utilized land for both cultivation (55.9%) and livestock rearing compared to males (44.1%).

Table 6 Benefits obtained from ES in relation to farming by age group

Demographics	**Uukwananga (N=14)**	**Ontsinka (N=11)**	**Onandjandja (N=10)**	**Oshihau (N=10)**	**Okathitukengombe(N=5)**	**Enongo(N=10)**	**Total (N=60)**
Land for cultivation					-		49
Age group < 29	0	0	8	4	0	0	
Age group 29-60	16	8	8	8	16	4	
Age group >60	4	12	4	4	0	4	
Habitat for rearing livestock							2
Age group < 29	-	-	-	-	-	-	
Age group 29-60	-	-	-	-	-	-	
Age group >60	100	-	-	-	-	-	
Both							49
Age group< 29	0	0	3	0	0	0	
Age group 29-60	15	18	6	3	3	15	
Age group >60	9	0	6	6	6	9	
Land for cultivation							
Female	12	12	12	16	0	4	64
Male	8	8	8	8	0	4	36
Habitat for rearing livestock							100
Male	100						
Both							
Female	14.7	17.6	2.9	11.8	5.9	2.9	55.9
Male	23.5	17.6	14.7	11.8	8.8	23.5	44.1

Note : The figures in the table are represented in percentages(%) with (N) representing the number of respondents in each village.

4.6 Communitie's opinions on climate variability and its effects on accessibility and availability of forest ES within the last five years

Table 7 below shows benefits derived from fruits are greater during floods (96.7%) with differences observed during drought (91.7%), whereas other respondents indicated that benefits from fruits were constant for the past five years during flood (3.3%) and (8.3%) recorded for drought. Also respondents indicated there was a substantial decrease on the availaibilty of medicinal plants during floods (16.7 %) compared to droughts (60%).

Respondents interviewed elaborated that the trend of *Gonimbrasia belina* and Okatulu have been changing drastically during droughts (90%) compared to floods (85%). With the observed trend of weaving material decreasing during drought (40%) than during floods (45%). Also there wa adecrease in the trend of fuelwood (80%) and timber (65%) during floods compared to drought.

Table 7 Trend of availability of ES during periods of drought and floods

Ecosystem Services	**Uukwananga (N=14)**		**Ontsinka (N=11)**		**Onandjandja (N=10)**		**Oshihau (N=10)**		**Okathitukengombe (N=5)**		**Enongo(N=10)**		**Total (N=60)**	
	D	F	D	F	D	F	D	F	D	F	D	F	D	F
Fruits : Decrease	64.3	85	100	100	100	100	100	100	100	100	100	100	91.7	96.7
Constant	35.7	14.3	0	0	0	0	0	0	0	0	0	0	8.3	3.3
Medicinal plants														
Decrease	0	7.1	81.8	0	100	40	100	50	40	0	50	0	60	16.7
Constant	100	92.9	18.2	100	0	60	0	50	60	100	50	100	4	3.3
Edidble worms														
Decrease	85.7	92.9	100	45.5	100	100	60	90	100	100	100	90	90	85
Constant	14.3	7.1	0	54.5	0	0	40	10	0	0	0	10	10	15
Weaving materials														
Decrease	57.1	35.7	0	27.3	60	100	50	50	60	0	50	10	45	40
Constant	42.9	64.3	100	72.7	40	0	50	50	40	100	50	90	55	60
Fuelwood														
Decrease	78.6	50	100	100	100	100	70	50	100	0	100	100	90	80
Constant	21.4	50	0	0	0	0	30	50	0	100	0	0	10	20
Timber														
Decrease	85.7	28.6	100	63.6	100	100	100	60	60	80	50	80	85	65
Constant	14.3	71.4	0	36.4	0	0	0	40	40	20	50	20	15	35

Note : The figures in the table are represented in percentages(%) with (N) representing the number of respondents in each village Drought represented by (D) and Flood represented (F).

Table 8 Coping mechanisms of communities to ES

Coping Mechanisms	Uukwananga (N=14)		Ontsinka (N=11)		Onandjandja (N=10)		Oshihau (N=10)		Okathitukengombe(N=5)		Enongo(N=10)		Total (N=60)	
Fruits	D	F	D	F	D	F	D	F	D	F	D	F	D	F
NCMR	92.9	85.7	54.5	81.8	50	60	90	80	100	100	70	70	75	78.3
Obtain from other villages/ markets	7.1	14.3	45.5	18.2	50	40	10	20	0	0	30	30	25	21.7
Medicine														
NCMR	85.7	71.4	90.9	90.9	50	80	100	100	100	100	90	80	85	85
Use readily available material	14.3	28.6	9.1	9.1	50	20	0	0	0	0	10	20	15	15
Mopane worms														
NCMR	85.7	78.6	90.9	81.8	30	60	100	100	100	100	80	70	80	80
Obtain from markets ,Zambia , Katima , Other villages	14.3	21.4	9.1	18.2	70	40	0	0	0	0	20	30	20	20
Weaving materials														
NCMR	78.6	71.4	90.9	90.9	40	100	90	100	100	100	60	60	75	85
Use readily available material	21.4	28.6	91	9.1	60	0	10	0	0	0	40	40	25	15
Fuelwood														
NCMR	85.7	57.1	72.7	72.7	100	100	60	80	100	100	80	80	81.7	78.3
use *Hyphaene petersiana* tree materials	0	7.1	27.3	27.3	0	0	40	20	0	0	20	20	15	13.3
Housing sticks , *Hyphaene petersiana* tree material / *Pechel-Loesche luebnitziae*	14.3	35.7	0	0	0	0	0	0	0	0	0	0	3.3	8.3
Timber														
NCMR	92.9	64.3	72.7	63.6	80	50	80	80	100	60	70	60	81.7	63.3
Use modern resources	0	21.4	27.3	36.4	10	50	0	10	0	40	30	40	11.7	31.7
use palm tree materials	7.1	14.3	0	0	10	0	20	10	0	0	0	0	6.7	5

Of the 60 respondnets interviewed ,as shown in (Table 8) above, (78.3%) indicated that they had no coping mechanisms for lack of fruits during floods. Whereas (21.7%) of the respondents had coping mechanisms; they obtained them from other nearby villages or markets compared to (25%) of those who didn't have any coping mechanisms during drought (Table 8) .Still (80%) of the respondents indicated No Coping Mechanisms Recorded (NCMR) for *Gonimbrasia belina* during drought (80%) and floods (80%) whereas a little proposition of the respondents had coping mechanism during floods (20%).

Coping mechanisms for fuelwood in (Table 8) above include respondents who had NCMR for flood periods of (78.3%), where (13.3%) use palm tree materials and alternative fuelwood sources represented by (8.3%) of the respondents who use a combination of alternative fuelwood sources i.e. (*Hyphaene petersiana , Pechel-Loesche luebnitziae* or use of old fences removed from homesteads as a source of fuel).

3.6 Adaptation mechanisms

Of the ranked adaptation mechanisms ,most respondents were dependent of drought relief and planting of trees taking second place ,collection of fuelwood ranked thirdly and Use *Hyphaene petersiana* tree materials as fuelwood ranked fourth.

Table 9 Ranking of Adaptation mechanisms of all 60 respondents

Adaptation Mechanism	**Rank**
Drought Relief	1
Planting trees	2
Collect fuelwood and store for future use	3
Use *Hyphaene petersiana* tree materials as fuelwood	4

CHAPTER FIVE : DISCUSSION

5.1 Introduction

This section provides a summary of major results and findings discussed in detail and depth .

5.2 Ecosystem Services in Onesi Constituency

The results generated from the study revealed that all the six villages had access to provisioning and support ES whilst (25%) of the respondenst had access to cultural ES. The provisioning ES available in the area primarily were used in households to support day to day lives and livelihoods . People use both non-wood and woody forest products for the enhancement of their lives whenever normal farming conditions are affected by the unpredictable and changing climatic patterns . Non-wood forest products highly used by the villages include fruits i.e *Berchemia discolor, Diospyros mespiliformis,Sclerocarya birrea* (to mention only a few) , edible worms , medicinal plants , fuelwood and timber. However the above mentioned NTFP's are primarily important for regions in North Central Namibia which is slightly different with existing literature by (Sylvanus et al ,2017).

5.2.1 Medicinal plants

Benefits derived from medicinal plants are abundant during floods this suggests that most medicinal plants occurring within the villages are not severely affected by floods due to their ability of withstanding floods and occurring naturally in the environment . The most frequently used medicinal plants across of the villages include *Pechel-Loesche luebnitziae* that is mostly used to cure cough , *Sclerocarya birrea* used for treating diarrhea , *Terminalia Prunioides* used for teating coughs and colds. Also its interesting to note that *Aloe littoralis* is only used in Onstinka and Oshihau where it appears abundant compared to the other four villages. *Aloe Littoralis* is mostly used to treat stomach ache and skin irritations . The benefits during floods fluatuate only slightly because people still have access to medicinal plants thus enabling communities to enhance their resilience to the changing climate .

5.2.2 Edible worms

In North Central Namibia communities highly value *(Gonimbrasia belina*) mopane worms as a delicacy meal and for its protein source. However the change in climate variability affects the availaibility of the worm for consumption purposes in households. This finding is in agreement with studies by (Ryan et al, 2016) even though the study (Sylvanus et al ,2017)'s findings

disagrees on the importance of edible worms to livelihoods considered important. During floods the worm is abundant even though it may be affected as it falls in flowing or stagnant water. However, its similarly different during drought because the *Gonimbrasia belina* worms are severely affected during drought due to extreme temperatures that inbihit the eggs from hatching and develop into edible worms. This condition may affect the availability of eggs hatching and developing into edidle worms for the next season thus making the benefits less compared to flooding seasons . The above findings concur with the risk vulnerability and risk assessment by ASSAR (2016) where households dependent on the harvesting of mopane worms were reported more vulnerable to the change in the availability of these ES.

5.2.3 Other Ecosytem Services

The benefits obtained from thatching using *Eragrostis rotifierrendle* and *Heteropogon contortus* were considearably constant during both floods and drought thus showing that most of these ES were not significantly affected by floods or drought. Grass maybe abundant and available for grazing and thatching purposes but during floods it may rot or be covered up in water (thus inaccessible for grazing).Also its interesting to note that *Grewia flavescens & G. retinervis* fruits and associated benefits were more available to Onandjandja compared to the other villages because of the location; Onandjandja is located in the westrern part of Onesi that is higly sandy and encroached by *Terminalia prunoides* species that dominate the entire area. Despite been affected during drought and floods in relation to availability and accessibility of the ES , these plant species are extensively exploited by humans and elephants thus limiting the amount of resources available within this unpredictable weather patterns for the enablement of livelihoods dependent on it as it is the only fruit available in their area.

5.3 Associated income from Ecosystem Srvices

Income received is obtained from the sale of ES ,*Berchemia discolor, Diospyros mespiliformis, Sclerocarya birrea, Hyphaene petersiana and Adansonia digitata* fruits. Fruits are collected and used at household levels whereas a portion of those fruits may be sold or further processed into products that are sold at markets or around communities during times when the rains are sufficient and drought not severe enough. Also , the collected fruits of *Sclerocarya birrea* are further processed into a wine (Omagongo) and drink (Oshinwa) and oil that is considered a valued delicacy ingredient that is used in complementing meals and sold to markets and local people.

Of all the respondents interviewed and those who indicated (Yes) they obtain income from the sale of ES , females were considered as the least of people who received income from ES. Income received through the sell of ES mostly derived from mopane worms, weaving baskets from the most frequent occurring plant species of *Hyphaene petersiana* (see example page 17)that are sold at open markets and villages to at least enable them to obtain income that would aid in the uplifment of livelihood strategies. These findings are consistent with existing studies by (Sylvanus et al, 2017) were women were perceived for the responsibility of collecting fruits, medicinal plants for the household consumption and sell. The males that indicated they received income , were mainly those who were involved in the weaving of granary baskets and through the sell of *Colophospermum mopane* fuelwood stumps to local farmers and markets. Note that Onandjandja receives no income from the sell ES because of the unavailability of fruit plant species in the area . Enongo is the only village that is involved in trade with foreign investors , were people collect *Adansonia digitata* and sell it to the German traders who then pay the traders according to the taste , quality and quantity of the fruits sold.

The way people utilize ES is determined by the benefits people derive from the ES. For instance , age group within 29-60 obtain income from the sale of ES compared to respondents within the age group of > 60 because of their better knowledge of benefits derived from ES which enables them to be involved in selling ES. Despite receiving an income, the elderly are more vulnerable to impacts and possibility of not making any income when these ES are unavailable and accessible as a result of drought and flood impacts that sway the availability of ES.The respondents likely to obtain income are those who have attained primary, secondary and secondary education compared to those who have not completed school thus making them vulnerable to the arising impacts of floods and drought.

5.4. Support ES in relation to farming

The findings revealed that there were considerable differences concerning how respondents used ES in relation to farming. Most of the resondents within the age group 29-60 used most of the land for cultivating crops where respondents from onadjandja used ant hills to fertilize the soil in enhancing soil fertility concurring with Ryan et al (2016). Uukwananga is the only village where land is used for the purpose of livestock rearing. In comparison , ES are important to males in relation to livestock farming compared to females who use most of the land for cultivating crops thus making households dependent on supporting ES in enhancing their livelihood strategies.

5.6 Trend of Ecosystem Services

5.6.1 Trend of Fruits

In general , the findings from the study revealed that there has been a substantial decrease in the benefits derived from NWFP's in the six villages excluding Onandjandja that does not have fruits. Of the respondents that took part in the study , (96.7%) responded that they has been a decrease in fruits mostly *Berchemia discolor and Sclerocarya birrea* that are greatly affected when excessive rains are received. The fruits normally fall prematurely as a result of heavy rainfall that causes the fruits to fall off before they mature. The matured and ripe fruits that fall onto the ground are carried away by flood water and while those not collected may rot with nothing left for consumption or sale. Despite the decerease observed by respondents during floods , during drought the benefits are quite better even though the fruits benfits keep declining as the climate varies from year to year . A small percentage from the respondents indicated the trend of fruits has been constant for the past five years ; the findings simirlarly concurs with James, David & Toral (2012).

5.6.2 Trend of Edible worms

The trend observed by respondents is that worms are less available during droughts as a result of extreme high temperature , the variability in temperatures interrupts the cycle of mopane worms being available for the next season since most eggs burst and fail to hatch to enable the development of the caterpillar into a larva that will pupate and emerge as an adult . This observed trend of temperature also affects livelihoods and worm harvesters who are dependent on the worms as a sources of protein and for those who dependent on it as a socio- economic uplifter in relation to income generation.With temperature getting higher in future the worms maybe driven towards extinction.

However there's no significant difference between drought and flood in the observed trend on availability of mopane worms. During floods the respondnets indicated that the trend of edible worms has been decreasing compared to those who indicated a constant trend during floods.

5.6.3 Trend of Fuelwood and Timber

Fuelwood has been noted as the highly used energy source at local levels in most households. Many respondents indicated an observed decrease in fuelwood during droughts and women and children (Photo 3) walk long distances to serach for good fuelwood because the only available fuelwood is insufficient.. However the unavailability of fuelwood is a result of both environmental and human contributing factors of deforestration that have contributed to the unavailability of fuelwood in most areas.

Figure 5 Children Often used to gather fuelwood in Ontsinka village

There's accessibility of ES during flood and drought , although availability of these ES decreases both during drought and flood years, decreasesing more drastically in drought. However, during flood years, (80%) of the respondents indicated an observed decrease in fuelwood during flood despite the fuelwood being accessible it is not available for use due to it being wet.

5.6.4. Trend of other ES

There's accessibility of other ES despite drought and flood impacting the availability of the ES. Availability of weaving materials is perceived not to have not changed over the past five years. *Hyphaene petersiana* has been noted as the only constant ES that has not been impacted by the changing climate availability has rather been constant . Grazing area required for livestock grazing during drought becomes overgrazed leaving farmers vulnerable to the impacts of drought with the possibilities of losing their livestock because of insufficient grass for grazing (figure 6).

Figure 6 Overgrazed grazing area during dry season

5.7 Coping Mechanisms

Some villages in Onesi Constituency have undertaken measures in dealing with climate variability however not all villages have coping mechanisms of which most of the respondents indicated they cant have coping mechanisms in place because "floods and droughts are there to stay" in relation to (Molua, 2009).With this in mind theres no potential or hope for people to change to more effective and adaptative measures that can enhance their resilience to climate variability. Onesi Constituency is known to be a flood and drought striken area that requires communities to be involved in ameriolating the impacts however this is the opposite of what communities are doing on ground.

The main coping strategies revealed during the study included people obtaining fruits from other villages or markets tocomplement the unavailability of fruits within their villages .Some respondents indicated they obtained mopane worms from markets, nearby villages and also Katima Mulilo a town almost 1000 km away despite the distance . These stragies are working for those with coping mechnisms during times when accessibility and availability of these ES affected by climate variability . Though its not guaranteed that most communities will be able to keep up ecologically , socially or be financially sustainable to climate variability along the years.

The unavailability and inaccessibility of ES especially fuelwood and timber has prompted respondents to use readily available materials to supplement the unavailability of fuelwood during times of need . Although a large number of respondents indicated they did not have coping mechanisms whereas a small proportion opted to use alternative energy sources which included *Pechel-Loesche luebnitziae and Hyphaene petersiana* (Toulmin, 2009) . Yet , its sad to mention that (8.3%) of the respondents indicated they have turned to removing homestead fence sticks to supplement for indaquate fuelwood during drought and floods because of fuelwood scarcity. Whilst coping mechanisms for timber include the use of modern materials for the construction and building of houses.

5.8 Adaptation mechanisms

Despite communities experiencing difficulties on how to deal with the flood and drought impacts in Onesi Constituency ; several adaptation mechanisms were provided by the respondnets of which only the most and frequently appearing mechanisms were ranked. Adaptation measures used by communities are supposed to assist communities in adapting to climate variability while ensuring that the adaptation measures have the potential to assist and equip communities with the capacities to sustain themselves while enhancing resilience of livelihoods and social groups .

The most appearing adapatation measure by communities was the reliance of communites on drought relief food (Photo5) provided by the government, which leads to dependency syndrome by community members because they are unable to equip themselves and adapt to the changing variations in climate in contrast with (Vaatainen & Hachikela, 2011) were most communities are responsible for funding for their own adaptions with little assistance from the government .

Figure 7Drought relief food as an adaptation mechanism for communities

Some respondents indicated they took up proactive measures in planting indigenous and exotic plant species within their homestead and fields to compliment unavailability of forest trees that can aid in the provisioning of raw-materials and fruits.Whilst some respondents indicated that

they collected and stored fuelwood and grass for use during times when they are unavailable (Photo 6).

Figure 8 Stored ES (fuelwood and grass) for future use during time of scarcity

CHAPTER SIX : CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The impacts of climate variability were found to be more severe during drought with a general decrease compared to flood period. Human factors also contributed to the declining availability of ES through overexploitation of the resources.The older aged population with no formal education and unemployed are the most vulnerable to the impacts of climate variability. The older age people are highly dependent on ES thus when these ES are unavailable their livelihoods are severely affected because ES are a compliment to their daily lives and the little social pension grant they receive is insufficient to cater for all household needs. Whereas for those with no formal education are vulnerable because they don't receive any information with regard to climate variability. However the current coping mechanism used by the villages may be ideal and conducive for the mean time but may not be sustainable in the long run as climate changes exacerbate.There is potential for creating awareness and sensitizing communities based on the research findings as some of the effects of climate variability are exacerbated by human ignorance. Training and capacity building in managing ES resources will go a long way in improving longevity of these ES as well as building resilience among ES dependent livelihoods.

6.2 RECOMMENDATIONS

There's need come up with alternatives to livelihoods rather than dependency on ES. This can be done in various ways:

- Promoting education and making it available, as people become educated they are able to exploit other means of survivor and depend less on ES Create other sources of employment for the unemployed to at least enable them to be more resilient to impacts of climate variability by promoting the processing and marketing of forest and non-timber forest products enhances and helps people to reduce the associated risks to climate variability.
- Increase support by increasing the pension grant to support the old age with coping with impacts of impact of climate variability when ES are insufficient at household level.

- Find reasons for and tackle dependency syndrome prevalent in Oshihau , Enongo and Uukwananga “Oshanakulya oshanakulonga(food for work)villages.”
- Improve enforcement on regulations that control harvesting of ES e.g Forest permits for harvesting forest products.
- Enhancing resilience by training and awareness programmes that can enable communities to be be equipped with information and knowledge required in adapting to climate variability.
- Communities to adopt the use of efficient cookstoves that have the potential to reduce pressure on the forests.

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