HAROLD PUPKEWITZ
GRADUATE SCHOOL OF BUSINESS
POLYTECHNIC OF NAMIBIA
Leadership | Technology | Entrepreneurship | Innovation

IMPACT OF CLIMATE CHANGE IN NAMIBIA- A CASE STUDY OF OMUSATI REGION

By

Martha Wilhelm

Mini Thesis
Submitted in Partial Fulfilment of the Award of a Degree of Masters of International Business (MIB)

SUPERVISOR

Dr. Ravinder Rena
B.A., M.A., B.Ed., LL.B., M.Phil., Ph. D.

October, 2012

DECLARATION

I, Ms. Martha Wilhelm, declare that the present work *"Impact of Climate Change in Namibia- A Case Study of Omusati Region"* carried out under the guidance of Dr. Ravinder Rena is my original work and has not been submitted in any other Institution for any degree.

Date: Signature:

Place: Windhoek **Martha Wilhelm**

RETENTION AND USE OF THESIS

I, Martha Wilhelm, a candidate for the degree of Master of International Business accept the requirements of the Polytechnic of Namibia relating to the retention and use of Master's thesis deposited in the Library.

In terms of these conditions, I agree that the original of my thesis deposited in the Library will be accessible for purposes of study and research, in accordance with the normal conditions established by the Librarian for the care, loan or reproduction of theses.

Place: Windhoek Signature:

Date: **Martha Wilhelm**

DEDICATION

I dedicate this thesis work to my late Grandmother, Sylvia Palyovendji Heelu, for the kind of person she has moulded me into and my late partner, brother and best friend, Ananias Melongo Shigwedha, for his genuine love, care and faith in me. Losing them has been the biggest blow life has ever thrown at me they were my greatest pillar of strength and source of motivation.

I also dedicate this work to, my beautiful kids/cheerleaders, Anna Kwambi Ndapandula and Jerry Pandeni Tuuthigilua. Words cannot describe how much I love them. They are such little strong soldiers that endured so much at tender ages yet none of that broke their spirit.

I dedicate this thesis to my parents, my father, the late, Werner Wilhelm, for his endless love and support. My Mother, Eva Ndahekelekwa Alfeus, for her continued motherly care, support and endless motivation.

ACKNOWLEDGEMENT

My gratitude goes to my research supervisor Dr Ravinder Rena for his wonderful advices and patience whenever I needed support during my entire academic year.

I would like to thank the entire teaching staff and administration of the Graduate School Business of Polytechnic for their wonderful support.

I would also like to thank the respondents from Oshitutuma village Namibia that took part in this research for their cooperation and support.

I would like to thank my entire family and friends for their incredible support and motivation. A special gratitude goes to my brother, Abraham Wilhelm and Natalia Wilhelm for being my cheerleaders throughout this process.

Finally but not least, special feelings of gratitude goes to my best friends, Anna Kangombe for the many hours of editing and proofreading my work, my brothers from another mother, Jeremiah Haipinge and Amin Haipinge for their immense support an motivation throughout my studies.

And lastly but definitely not the least, I would like to thank my wonderful MIB course mates for some great years of learning and collaborating together. We did it!

Martha Wilhelm

October 2012

Table of Contents

TABLE OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

NCRs	Northern Central Regions
UNDP	United Nations Development Programme
MET	Ministry of Environment and Tourism
UNFCCC	United Nations Framework of Convention on Climate Change
NCAR	National Centre for Atmospheric Research (NCAR)
INC	Initial National Communication
IPCC	International Program on Climate Change
MDG	Millennium Development Goals
MOE	Ministry of Education
NDP	National Development Plan
NPC	National Planning Commission
GEO3	Global Environmental Outlook 3
OECD	Organization for Economic Cooperation and Development
OXFAM	Oxford Committee for Famine Relief

ABSTRACT

Climate change is said to be a threat to country's development. This thesis investigates the impact of climate change in Namibia with a specific focus on the socio-economic impact of flooding in the North Central Regions of Namibia. The thesis examines the socio-economic conditions of the local people as a result of the 2009 flooding in Oshitutuma village. The thesis's literature review had looked at climate change and flooding concept within Namibia, Southern Africa, Africa at large, and the Global contexts.

The thesis relied on two techniques of data collection: interviews and document review (use of secondary data). The findings presented in the thesis suggest that the 2009 has caused major damages to the Oshitutuma village and had caused the government a great deal of money in attempting to help the villagers cope with the floods. People's houses were destroyed, their agricultural crops were washed away, business buildings were destroyed and closed, schools were destroyed, disrupted and people were cut off from major services such as clinics.

The last part of this thesis presents the conclusion drawn from the research findings as well as some recommendations to policy makers on the possible ways of dealing with the issue of climate change related floods. The impacts of climate change will increase the challenge of ongoing poverty alleviation efforts in Namibia. This demonstrates the immediate need for an acknowledgement and improved understanding of vulnerabilities so that appropriate adaptation measures can be implemented swiftly. The thesis findings further demonstrate that residents of Oshitutuma village in Namibia are already experiencing the effects of climate change. Therefore it is imperative that support for adaptation is provided immediately and that efforts to develop a strong cross-cutting national adaptation strategy are prioritized

Key words: Climate change, Namibia, agricultural crops, Oshitutuma village, global warming

CHAPTER ONE

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

It is a definite fact that our past, present and future as human beings was, is and will be shaped by prevailing climatic conditions (Midgley, Hughes, Thuiller, Drew, and, Foden, 2004). Midgley et al further stated that Climate is considered as the one global variable which has a direct and profound impact on every aspect of human existence. Our natural environment, economies, political and power structures, cultural, special interactions and developments are all shaped by climate. The progression in development and human technological advancement has had an intense and lasting impact on our natural environment, and our climate as a whole

Climate change presents significant threats to the achievement of the MDGs especially those related to eliminating poverty and hunger and promoting environmental sustainability. An increasing body of evidence (e.g. the Stern and the IPCC Reports) are pointing to the disproportionate negative impact climate change will have on the poorest nations, those nations who have contributed least to the problem. Climate change threatens to significantly set back countries' efforts to improve the lives of their citizens and to meet the MDGs.

This thesis aims to investigate climate change impact Namibia and its threats on the achievement of Namibia's developmental agendas. The researcher endeavoured to achieve this by critically assessing the socio economic impacts of floods in North Central Regions of Namibia.

1.1.1 What Is Climate Change?

Climate is the long-term average weather conditions for a region. Over the past few centuries, the climate of the earth has varied significantly in terms of average weather conditions. Such significant variations in climatic conditions are referred to as 'climate change' (Ministry of Environment and Tourism (2003). Although the change in climate may be due to natural variability, there is scientific evidence that human activities have contributed significantly more Green House Gases (GHGs), such as carbon dioxide, methane, nitrous oxide that cause climate change. This has been mainly through use of fossil fuels and changes in land use patterns due to increases in global human population. One consequence of climate change is the observed increase in global temperature (called global warming) during the last 200 years (Topfer and Hunter 2002). The earth's atmosphere has become hotter and this has been attributed to an increase in heat-trapping gases, referred to as GHGs. GHGs include naturally occurring water vapour, carbon dioxide, ozone, nitrous oxide and methane.

Although these gases occur naturally in very low concentrations, substantial increases due to human activities have been detected. For instance, it is estimated that since the industrial revolution in the 1850s, carbon dioxide in the atmosphere has increased by more than 30%, methane by more than 150%, nitrous oxides by 17% and ozone by 35% (Topfer and Hunter, 2002). Carbon dioxide causes about 70% of the global increase in temperature. The average surface temperatures have increased by 0.3 to 0.6^0C since the late nineteenth century. Human activities such as burning of fossil fuels, deforestation and changes in land-use patterns are likely to contribute to increasing levels of GHGs.

Climate change is predicted to have adverse effects on both natural ecosystems and humankind. The average sea level is predicted to rise by about 9-88 cm by the year 2100 (Topfer and Hunter (2002) INC (2001) and to submerge low-lying areas and small islands. The

mean annual temperature in southern Africa is projected to rise by 2 to 5^0C by 2050 while rainfall is likely to decrease in the western and southern parts by up to 15% (IPCC, 2001, Scholes and Biggs, 2004). Changes in weather patterns are likely to reduce food production and loss of biodiversity where for instance, rainfall is predicted to decrease due to climate change. Floods, droughts, heat waves and storms are likely to adversely affect human and animal health. Where rainfall is predicted to increase, incidences of diseases such as malaria and gastro-intestinal infections could also increase. It must be recognised that climate change is a global concern. It is complex and caused by an intricate interplay amongst various factors most of which are not restricted to national boundaries. For example, deforestation of tropical rain forests reduces trees that are a carbon 'sink', thus reducing the capacity of trees to absorb carbon dioxide emissions from the atmosphere, which leads to global warming. This in turn contributes to melting of ice at the poles with resultant increases in sea levels further away from the poles.

Hence the effects of climate change may be experienced close to or further away from the contributing country. One obvious question to ask therefore is 'should Namibia be concerned about climate change?' Can Namibia achieve its developmental agendas amidst the challenges posed by climate change?

1.1.2 Background to this Study

Namibia is considered to be one of the most vulnerable countries to the effects of climate change in sub-Saharan Africa (SSA). Since Namibia is home to several different eco-regions (e.g. tropical, semiarid, desert), the particular challenges posed by climate change will vary by region, and the responses are best formulated at the regional and the local levels. A 1998 Climate Change Country Study identified that the climate change risk for Namibia includes a warming of up to 2 degree celsius (C) over the coming 50 years, and an overall more

variable and extreme climate with regional reductions of rainfall (Namibia National Climate Change Policy 2011).

Preliminary estimates of climate change impact on natural resources alone (agriculture and fisheries) suggest that Namibia could lose annually between 1 and 6 percent of Gross Domestic Product (GDPs) if no action is taken to adapt to climate change (Jones and Thornton 2009). This will affect the poor most (because they are more dependent on natural resources). Namibia's rural communities and the poor throughout the country are the most vulnerable to the negative impacts of climate change. This is because adaptive capacities amongst these vulnerable groups are considered to be very low. This vulnerability is exacerbated by existing marginal or lack of adequate service delivery to remote areas as such endeavours are generally considered prohibitively expensive. In addition, low population densities, long travel distances and the lack of infrastructure further increase Namibia's vulnerability to climate change.

The majority of the population living in these flood-affected regions is directly dependent on subsistence agriculture, livestock rearing, forestry, eco- tourism, indigenous biodiversity and fisheries (Reid, Sahlén, and Macgregor, 2007). Increasingly, due to the effects of worsening climatic conditions on long-term agricultural productivity, the adaptive capacities of farmers, pastoralists and natural resource managers are compromised. Land degradation – soil erosion, bush encroachment and deforestation – is becoming progressively worse in most parts of the country, but more acute in the six flood-affected regions. This leads to vegetation degradation and loss of soil fertility which affects agricultural productivity. Climate change is expected to only exacerbate this trend. The expected climate change impacts on the regions include: decline in water availability, increasing temperatures due to higher evapo-transpiration, and changing patterns of rainfall. This, in turn, will affect water resources within the Cuvelai-Etosha Basin, the Kavango and Zambezi Rivers, forests, and other natural ecological systems,

agriculture and food security, power generation at Ruacana water fall, infrastructure (housing, shelters and roads, telecommunication), tourism (lodges, camping sites, game) and human health (diseases, sanitation and water quality).

The frequency and intensity of extreme events such as droughts and floods have increased across SSA and Namibia is no exception. These events caused major disruptions to the economy of the country, thus increasing its vulnerability. For example the 2003/4 drought cost the Government of the Republic of Namibia (GRN) N$ 275 million in provision of emergency relief. Extreme events are predicted to increase with devastating impacts on the lives of many people. In terms of Namibia's economy, Reid et al (2007) suggests that over a 20-year period, annual losses due to climate change impacts on the natural resource base alone could be 1% to 6% of the Namibian GDP. In monetary terms this translates to annual losses ranging from N$490 million to N$1.4 billion if measures to mitigate the impact of climate change are not put in place. One of the predicted consequences of climate change is sea level rise, which is expected to increase by 18-59 cm over the 20th century (also see Topfer and Hunter, 2002 on page 2

1.1.3 Definition of Terminologies

1.1.3.1 *Oshanas:* refers to an Oshiwambo word used to refer to low-lying land areas that are prone to seasonal flooding.

1.1.3.2 *Flood:* This study has adapted the definition by the Oxford dictionary which defines flood as a great flowing or overflowing of water, especially over land not usually submerged.

1.1.3.3 *Cuca Shops*: The word cuca chops in this study refers to small informal local shops in the Northern Central Regions (NCR) that sells almost everything such as liquor, food etc.

1.1.4 Research Problem

The northern part of Namibia comprising the regions of Kunene North, Omusati, Oshana, Ohangwena, Oshikoto, Kavango and Caprivi has been experiencing excessive long-lasting rainfalls over the past three years (2008/2009 and 2010/2011) which caused severe flooding, particularly in low-lying areas as well as prolonged water logging on the uplands. The floods in the floodplains or '*oshanas*' caused severe damage to homes and infrastructure, displaced hundreds of families, destroyed food stocks in granaries, and led to major losses of livestock.

In 2009, Namibia and neighbouring Angola have received heavy rains which led into localised flooding. The north-eastern and north-western parts of Namibia were the most affected, where thousands of families were displaced. Omusati, Ohangwena Oshana and Oshikoto regions, in the north-western part of the country were the worst affected. The flooding in the main Cuvelai basin raised water levels in Oshakati by more than 0.5m in few days and large parts of the town were submerged. Heavy rains washed away roads and bridges. Most feeder roads connecting to major towns were washed away. It is estimated that around 130,000 people were affected. Some schools were closed down, as children cannot cross the flooded rivers and road networks.

Majority of health facilities in the affected areas were no longer accessible. The flooding also submerged fields, causing extensive damage to crops. Reports from the Ministry of Health indicated 143 suspected cholera cases, of which nine have been confirmed with seven related deaths reported on 9 February 2009.

This situation has motivated the researcher to undertake an in-depth analysis that assess the socio-economic impact of the flood situation in the North Central Regions of Namibia (NCR) with a view to understand the situation and make practical recommendations on possible

solutions to policy/decision makers especially in helping the affected communities cope with the disaster in the future and minimise the negative impacts.

1.1.5 Research Objective(s)

- The primary objectives of the study are to
- Critically assess the socio economic conditions of the vulnerable groups affected by floods in Oshitutuma village of the Omusati region in 2009.
- Investigate the impact of floods on progress achieved in developmental projects within this village.
- The research study endeavoured to find answers to the following major questions:
    - What has been the most severe damages caused by these floods? School building, churches, hospitals/clinics, businesses, houses, roads etc.
    - What developmental projects were being undertaken within the region prior to the floods and how were there affected?
    - What were the GRN interventions and how useful were they?

Getting answer to these questions was necessary to help the researcher obtain an overall picture on how these events are hampering the GRN developmental agenda and progress achieved in this regard. It was further necessary to enable the researcher to formulate the most practical recommendations on how best the vulnerable communities in this regard can be best assisted and the overall best approach on tacking the impact of climate change in Namibia, especially from the adaptation point of view.

1.1.6 Assumptions

It is assumed that the vulnerability of the Oshitutuma village to seasonal flooding is due to uncertainties of the future potential hazards at the time when people settled there, the lack of land as well the lack of adaptation capacity. In addition, the village is also set up within an area highly exposed to flood water from Angola during the rainy season. This is because some of the houses are erected quite very much at the edge of the *oshanas* (natural water ways). These

potential hazards including the impacts of environmental degradation and climate changes (which is associated with many flooding worldwide and this is causing more extreme events e.g. floods) were not known or understood at the time.

A National Capacity Self Assessment (NCSA) for Global Environmental Management done for Namibia between 2004 and 2005, revealed that the capacity at local and regional level were too low regarding environmental issues such as climate change (Zeidler, 2005). It is important to note that such settlement was established long time ago during a time when all those environmental hazards were too low to non-existent and also when natural features were in pristine conditions compared to the current situation of degradation, deterioration of natural vegetations that encourage infiltration. It is imperative again to emphasis that floods had often occurred in the area, but the frequency and intensity of those floods were low compared to what has been seen in recent times. It is further assumed that the main problem lies with the planning authority as they have failed to regulate and control the settlers. This is because since the flood started to be a problem to local residents, responsible planning authorities have failed to regulate the local residents regarding where to settle and not to settle. These assumptions explain the rationale of choosing Oshitutuma village as a sample based on its vulnerability to flood.

1.1.7 Scope of the Study

This study will focus on the socio-economic impact of climate change, particularly the 2009 flood in the NCRs, on development in Namibia. Climate change is defined as Climate is the long-term average weather conditions for a region whereas flood is defined as involving the flowing and rising of water. This study will consider the socio-economic impact of floods for the year 2009 only.

1.1.8 The Rationality and Significance Behind the Study

This research is timely because recent floods in Namibia have been aggressive, destructive and frequent. In the past it would have taken around a decade to experience such destructive flooding. During the 2009 flood, water level in oshanas, which is part of the Cuvelai system, has been increasing dramatically since February to March. This has resulted in the flooding of settlements and other areas.

1.2 NORTHERN CENTRAL REGIONS (NCRS)

1.2.1 General Introduction

Namibia's NCRs constitute four regions: Ohangwena, Omusati, Oshana and Oshikoto – often referred to as the 'four Os'. In many aspects, the NCRs differ greatly from the rest of Namibia. While the NCRs constitute 10% of the country's surface area, they are home to approximately 43% of the country's population (Central Bureau of Statistics, 2001). The population in the NCRs is expected to approach one million by 2015. In 1951, the population in the NCRs amounted to merely 200,000 people. Today, the NCRs are Namibia's most densely populated areas.

In Omusati region, population density amounts twelve people per km^2 – almost five times higher than the national average. Even though the NCRs are strongly characterized by the agro-silvo-pastoral subsistence practices up to this day, the percentage of the urban population is continuously growing. Trade is the main source of income for urban dwellers in the NCRs (Mendelssohn, Schlesinger and Williams, 2000). Biogeographically, the NCRs are mainly influenced by the Cuvelai Basin, an ephemeral river system bringing runoff rainwater from Angola during the rainy season. The Cuvelai Basin drains in the Etosha Pan in the South of the NCRs. There are six main landscape types in the NCRs: Western and Eastern Kalahari woodlands, Cuvelai, Karstfeld, mopane shrub lands, and salt pans and surrounding plains

Mendelssohn, Obeid and Roberts (2000). The quality of groundwater in large parts of the NCRs is extremely poor and of limited use for human purposes – especially due to high groundwater salinity. In many areas, total dissolved solids amounts to more than 5000 milligrams per litre, whereas 2600 milligrams per litre are considered the maximum concentration suitable for human consumption. Approximately half of the area of the NCRs has medium to high soil salinity.

The potential for crop cultivation is high in the north-western part of the NCRs, but low to very low in most other parts. Livestock densities are highest in the central and north-eastern part of the NCRs. About 25% of cattle, 43% of goats and 70% of donkeys in Namibia are found in the NCRs (Mendelssohn, et al., 2000).

1.2.2 Socio-Economic Background and Pre-Crisis Conditions

Northern Namibia is home to almost half of Namibia's population. The five flood-affected regions (Kavango excluded because of minimal impact) account for a combined population of 859,975; 79,826 people in Caprivi, 228,384 in Ohangwena, 228,842 in Omusati, 16,1916 in Oshana and 16,107 in Oshikoto. The population of the NCRs is organized into four political regions, Ohangwena, Oshana, Omusati, and Oshikoto, each with a regional governor, and subdivided into 41 constituencies. Kavango is subdivided into 9 constituencies while the Caprivi has 6. On a lower level local governments are responsible for the affairs of towns and larger villages. Traditional authorities hold a great deal of influence and are actively involved at all levels of regional and local government.

The climate in the NCRs can be described as semi-arid. The area is characterized by high temperatures and rain that varies greatly in amount and timing. Average rainfall per year is 350-500 mm, with the majority falling from November to April. The soil types are largely

dominated by mixtures of sands and clays. The potential for crop production is low in many areas due to poor water-holding capacity, low nutrient content, high salt content, and hard layers of clay below the surface.

The topography in the region is characterized by a flat plain, although the level of micro-elevation is of great importance for agriculture because of the groundwater levels and presence of hardpans. Large areas of land have been deforested. For the people living in rural communal areas of northern Namibia, subsistence agriculture remains the main means of livelihood. However, the irregular rainfall and the unsuitable terrain pose serious threats to food security and to livelihoods. In the Northern Central and Kavango rural areas most people are involved in subsistence farming, with mahangu (pearl millet) and sorghum as their main crops. Livestock ownership in northern Namibia mainly consists of cattle, goats, donkeys, and poultry, with cattle ownership being relatively unequally distributed. In the Caprivi the staple crop cultivated is predominantly maize, with some millet in the drier western regions. It should be noted that the level of risk in the Caprivi is somewhat higher than in the other regions under survey due to frequent attacks from wildlife on crops and livestock; seasonal and variable flooding; foot and mouth disease; and loss of household members (labour) to HIV and AIDS.

The success of farming in northern Namibia is dependent both on adequate rainfall and on the availability of labour at critical times in the agricultural cycle. Many young people, however, leave the rural areas to look for employment and another way of life in the urban areas. There are three main urban centres in the NCR, and one each in Caprivi and Kavango which all lie along main roads and are growing both in size and in economic importance. People living in the rural areas often retain close links with the people living in the urban areas; remittances from family employed or involved in diverse business activities in urban areas

contributes to rural household income. Similarly, production from rural areas contributes to the food economy of people living in urban settings.

Although subsistence farming is the main activity for most households living in northern Namibia, it represents a poor, and in some years insufficient means of survival (Mendelssohn et al 2000). Due to poor soil quality and uncertain climatic conditions, people pursue diversification in agriculture and pastoralism, and diverse economic options. Within this system, people are to a large extent dependent on tree products and other natural resources. Another consequence of the poor soil quality and the uncertain climatic conditions is that the farms are spatially spread. In general rural people are not living in concentrated villages, and because of the distances, households live quite independently from one another. The precarious situation of village life is exacerbated by the impact of the high levels of HIV infection. About 23% of Namibians aged between 15 and 49 are HIV-positive according to UNAIDS. The North Eastern Caprivi region has the highest HIV prevalence in Southern Africa, 43% according to the 2004 sentinel survey. HIV/AIDS is impacting the ability of subsistence farmers to grow enough food for themselves in North Central Namibia and Caprivi. Although Northern Central Namibia is situated along a flood plain, floods of this extent are relatively rare in the area, with the last flood of similar impact said to have occurred in the 1950s.

However, according (Mendelssohn et al 2000) the Caprivi has been frequented by floods almost every other year due to its geographical vulnerability with three major floods recorded since 2003. The Caprivi has a relatively well established and experienced Regional Emergency Management Unit REMU that seasonally prepares to relocate affected communities to higher grounds within the flood plain. It must be noted that the level of flooding experienced this year in the Caprivi is considered to be a normal, yearly event, and that water levels this year were lower than those recorded in 2007. It is for this reason (as explained below) that the flood

situation in Caprivi was not seen by the mission as an extraordinary event of a similar calibre to the flooding experienced in the NCRs.

1.3 RESEARCH AREA: OSHITUTUMA

1.3.1 General Introduction

Oshitutuma village is located 40 km North-West of Oshakati in Oshikuku Constituency, Omusati region. The village lies on the main road between Oshakati and Ruacana. The constituency's population was estimated to amount approximately 8 299 (4 747 Females and 3 552 Males) individuals in 2001. Child mortality per 1000 children born was estimated to be 15 for females and 37 for males. Life expectancy is 67 years for females and 49 years for males (Central Bureau of Statistics, 2005). Oshikuku constituency is very rural yet not so remote. Homesteads are sparsely scattered around the area, with settlements in the range of few hundred households. The Oshitutuma village consists of about 110 households made up of a total 311 women and 363 men (Kreike 2004). The village prominent features are: a clinic, combined school (up to grade ten), open market and church. Additionally, there are various so-called '*cuca shops*' selling alcoholic and non-alcoholic beverages plus very few selection of parked food. There are about two big retailer trading shops that supplies goods to the villagers and small enterprises. The school, church and clinic are all electrified and some few houses too. There is also a telephone land line and cell phone reception is quite good.

Homesteads are scattered all over the village area, agriculture is practiced on the fenced fields around the homesteads, and grazing land has no limitations outside these fences. It has to be kept in mind that the availability of certain infrastructure does not necessarily mean that all citizens have de facto access to it. This can be due to lack of funds to pay fee-based products or services or the far distance of many homesteads from the location of the given public

infrastructure. The village has been provided with tap water since 1998. The water provision is enabled by one pipeline from Ogongo village (Omusati region). The pipeline is an off-take from the Etaka Canal. At the time of research, there were five community water taps in Oshitutuma, and approximately 32 private water taps. As discussed above, not all household within reach of a water tap have a de facto access to fee-based tap water.

There are two ethnic groups in Oshitutuma village, the Aakwambi and some very few Ovakwanyama amounting about to 0.02 percentage of the total population. There are no signs of hostility or quarrels between members of the two tribes. The household is the fundamental unit in Ovambo culture. An Ovambo household is called homestead and consists of a fenced agglomeration of huts and open areas, each with a distinct function, e.g. cooking, storage, threshing, sleeping, or receiving guests. Traditionally, household heads in Ovambo culture were primarily male (Kreike, 2004).

However, based on the interview sample, the number of households with a female household head has increased, partly because of deaths of men. The sampled households consisted of 7.7 individuals on average, 4.5 thereof children under the age of 18. Even though polygamy was common in Ovambo culture, it strongly decreased with Christianity from the late 19th century onwards (Kreike, 2004). Polygamy has become uncommon in Oshitutuma; however, it still exists marginally. Like many other villages, in Oshitutuma, the community boundaries are defined by the affiliation to a specific headman. Headmen are responsible for the population of their village, thus if a household belongs to a specific village, it is under the patronage of a particular headman. All interviewed households in Oshitutuma were aware of which village they belonged to. What has to be considered in the notion of community in Oshitutuma is that, like many villages in the northern Namibia, substantial contributions to livelihoods come from outside the geographical boundaries of the village. The most important

factors in this context are cattle posts mainly elsewhere within the northern regions due to lack of grazing land, and financial contributions from family members working in the cities.

In Oshitutuma, the government is represented by the Counsellor of Oshikuku Constituency, who is a member of the ruling SWAPO party. The Counsellor's office and residential house are in Oshikuku. The headman is the traditional leader of an Ovambo Community (Kreike, 2004). The village is under the management of a headman and an Area Secretary who runs the day to day matters concerning the village. The role of the village headman in Ovambo culture is a mediator and supporter rather than a ruler with strong power over resources or decisions in the community. The main function of the headman in Oshitutuma can be specified as follows: settle disputes among community members, allocate land, advice people on resource use practices, and ensure that law and regulations are adhered to in the community.

The Oshitutuma village is vulnerable to flooding year in and year out. According to Dolcemascolo (2004) vulnerability is defined as a set of conditions and processes resulting from physical, social, economic and environmental factors, which increase the susceptibility of a community to the impact of hazards. Being located in floodplains, the Oshitutuma village, like other informal settlements, is particularly susceptible to seasonal floods like those that have occurred in the past few consecutive years. The village receives an annual rainfall of 380 mm and most of the vegetation is mainly mopane trees, few throne bushes, and most of the land is barely covered, making the land vulnerable to flood during the rainy season. Oshitutuma village prominent features are school, open market, church, and clinic. The economy depends on agriculture mainly substance farming a combination of mahangu and small livestock. It is also common for its invention of boats that was made to assist the villagers to cross *oshanas* during the rainy season in 2009.

1.3.2 Livelihoods Baseline

The livelihoods of Ovambo societies have been described as agro-silvo-pastoral (Kreike, 2004). Here, the livelihoods are described in depth for Oshitutuma. It will be shown that rural economies in the community are mainly based on subsistence agrosilvo- pastoralism. Small-scale market involvement is practiced by a majority of villagers, however, besides many structural obstacles; it is limited by relatively low agricultural and livestock outputs. These, in turn, greatly depend on rainfall. Cooperation with formal institutions is not strongly performed, but informal cooperation with neighbours and family members is practiced widely. There are vast differences in living conditions, wealth and access to resources within the community.

Farming is the main pillar of livelihoods in Oshitutuma and practiced by all interviewees. About 85% of the interviewees additionally keep livestock. Natural resources from the wild are utilized by all interviewees, whereas the intensity and types of resources used differ greatly. It is difficult to estimate average field sizes in the area, as more than 70% of the interviewees were not able to indicate the size of the area under cultivation. Based on the available data, field sizes per household are estimated to be about three hectares on average, ranging between approximately two and seven hectares. Thus, the area under cultivation is very small-scale.

Almost one fifth of households have herds larger than 30 animals, some 14% do not own livestock at all. Another 14% of households keep less than ten animals. Half of the households have herds between ten and 30 animals. These indications do not include herds at the cattle posts, which are treated separately in the following paragraph. Goats are the most common livestock species in Oshitutuma (owned by 73% of the interviewed households). Approximately two thirds of the households own cattle, and 46% donkeys. Sheep (9%) and pigs (5%) are more of an exception. Chicken are furthermore very common farm animals in Oshitutuma, they are

kept by at least three quarters of households. Besides grazing, browsing trees and shrubs are substantial nutritional components of livestock in the NCRs, especially in the dry season (Kreike, 2009).

1.3.3 Organization of the Thesis

The thesis is structured and divided into seven main chapters:

Chapter 1: focuses on the research introduction, objectives, research questions, research problem and also on the significant of the research. This section is the core heart of the whole research as it validates the importance of this research project. It further presents the basic general information about the Northern Central Regions and its socio-economic conditions as well as the key background information on the research.

Chapter 2: focuses on the literature review of the research project.

Chapter 3: Presents climate change and its impact on the Namibian economy.

Chapter 4: focuses on the methods used throughout the research process and that is the interview carried out plus the use of secondary data.

Chapter 5: presents the findings of the research based on the methods, thus aiming at providing answers to the research questions.

Chapter 6: discussed the main findings of the research regarding how the impacts of the 2009 flood in the NCRs.

Chapter 7: brings together all the sections, main points of each section are been used in drawing the conclusion of the research. It further offers some practical recommendations to policy and or decision makers be considered in finding ways of dealing with the flood and climate change in general

CHAPTER TWO

LITERATURE REVIEW

2.1 GENERAL INTRODUCTION

Literature review is always the first method in gathering data and information, and understanding the circumstances surrounding the research topic. The researcher gathered information through reading various books, journals and research papers relevant to the issue of climate change and its impact on development.

2.2 CLIMATE CHANGE WITHIN SOUTHERN AFRICA (SADC MEMBER STATES)

The Southern African countries are all members of the Southern African Development Community (SADC) political ensemble. Southern Africa has a combined population of nearly 119 million people and a GDP of US$ 142 billion (Scholes and Biggs (2004). However, there is a great disparity between countries in relation to areas, size of economies and populations. For instance, South Africa alone represents close to 40 percent of the population and 73 percent of the GDP of the region whereas Swaziland represents less than 1 percent of the regional population and less than 1 percent of the regional GDP. The climate of Southern follows a pronounced gradient, with arid conditions in the west and humid conditions in the east. The rainfall regime is characterised by a great variability at various time scales from intra seasonal, through inter annual to decadal and multi decadal. Inter-annual variability is particularly pronounced in the drier part, where the coefficient of variation can be as high as 40 percent.

2.2.1 Predictions of Future Climate Change in Southern Africa

There is widespread acceptance that the climate of southern Africa will be hotter and drier in the future than it is today. By 2050, average annual temperature is expected to increase by 1.5 2.5° C in the south and by 2.5-3.0° C in the north compared to the 1961-1990 average (Ragab and Prudhomme, 2002). Temperature rises will be greater in the summer than in winter,

exacerbating stress on crops. Recent model outputs obtained by scientists from the US-based National Centre for Atmospheric Research (NCAR) and the National Oceanic and Atmospheric Administration (NOAA) revealed 'very clear and dramatic warming of the Indian Ocean into the future, which means more and more drought for southern Africa' (NCAR, 2005). This study showed that monsoons across southern Africa could be 10 to 20 percent drier than the 1950 1999 average. Annual regional precipitation is expected to reduce by 10 percent, with greater reductions in the north than in the south (Ragab and Prudhomme, 2002).

2.2.2 The Impacts of Climate Change on Development in Southern Africa

More than anywhere else, understanding the link between climate change and development is crucial in Africa, where agriculture and other climate sensitive sectors are the mainstay of most national economies (United Nations Development Programme (UNDP), 2005). Since the millennium development goals (fig. 1) are the most widely agreed targets for the developing countries to measure their progress towards sustainable development, it seems interesting to see how climate change can affect the realisation of these goals.

Figure 1: Millennium Development Goals (MDGs)

Source: United Nation Development Programme (2003**)**

It was obvious, right from the outset, that meeting the goals (targets have been set for the year 2015, using the situation in 1990 as baseline) was never going to be easy, and that a considerable amount of efforts was needed from the developing countries with the support of the global community. In southern Africa, while some countries, especially those that were formerly under armed conflict (Angola and Mozambique) are making commendable progress in some areas, other countries are witnessing a drop in their Human Development Index (HDI). In many cases, this can be attributed to a decrease in life expectancy as a result of HIV/AIDS and/or a collapse in national income. For instance, between 1990 and 2001 Botswana, Lesotho, South Africa, Swaziland, Zambia and Zimbabwe regressed rather than progressed in developmental terms (UNDP, 2005).

According to Pachauri (2004) the food situation is said to be already worrying in southern Africa, with about half of the populations at risks. Between 1990 and 2001, the number of undernourished people rose in Botswana, Swaziland and Zambia. Together with South Africa and Zimbabwe, these countries also experienced an increase in child mortality. Income poverty also became more widespread in Angola, Zambia and Zimbabwe. The challenge posed by climate change, when super imposed on the multitude of structural problems the African countries are facing, means that meeting the MDGs can actually be a much greater task than previously thought. In many of these countries, climate is likely to be one among many other factors that determine whether the MDGs will be met or not. Where people are unprepared or adaptation strategies are inadequate, climate change can easily set back development gains by affecting key sectors such as agriculture, water resources, infrastructures and health. On the other hand, meeting the goals means that stronger economies and more resilient societal and environmental systems will emerge, thus reducing the vulnerability of the populations to the negative impacts of climate change.

In southern Africa, an additional warming of the globe can adversely influence the MDGs in many ways: a warmer and drier climate, characterised by increased frequency and intensity of El Niño events, will drastically reduce soil moisture and water runoff to rivers, thus hampering crop production, which has a major influence on food security and poverty reduction (Goal 1); increased aridity will exacerbate land degradation, desertification and loss of biological diversity, a set of processes that are not compatible with environmental sustainability (Goal 7); a long-term rise in temperatures, and occasional flooding due to La Niña events, may increase water and vector-borne diseases.

Poor nutrition due to crop failure can exacerbate disease impacts (Goal 6); increased frequency of climatic disasters can remove children from school (Goal 2) due to increased poverty, food shortage, isolation (for example when roads are damaged by floods), and child abandonment; women often get a disproportionate share of the burden when disasters strike because they have less opportunities than men; this can undermine their education and development, and affect their welfare and that of children (Goals 3, 4, 5); the importance of agriculture (Fig. 1) and the heavy dependence of many southern African economies on natural resources mean that more intense and frequent droughts will have a major bearing on development in general.

A collapse in national income, combined with the heavy costs of disaster response operations, has the potential to reduce the ability of governments to invest in key socio-economic sectors.

2.2.3 Southern Africa's Responses to Climate Change

Southern African countries have recognized the challenge posed by climate change and are working with the global community to address the problem. A strong indication that the southern African region is committed to tackling climate change is that all the ten countries

covered in this study have ratified the UNFCCC, and as of 29th April 2005 seven of them (Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa and Zambia) had ratified the Kyoto Protocol (website: www.unfccc.int).

2.3 CLIMATE CHANGE IN AFRICA AT LARGE

2.3.1 Historical and Current Climatic Conditions, Changes and Extreme Events in Africa

The Third Assessment Report (TAR) of the IPCC (IPCC 2001) highlights major issues related to potential impacts that could occur as a result of climate change in Africa. It also underlined the fact that Africa is characterized by a low adaptive capacity. Major areas of concern addressed in the TAR regarding the possible impacts of climate change relate to water resources and food security/agriculture, including changes in: precipitation and insulation, length of growing seasons, water availability, carbon uptake, incidences of extreme weather events, changes in flood risks, desertification, distribution and prevalence of human diseases and plant pests (IPCC 2001). The report also revealed that the impact of increased temperature and reduced precipitation in some regions resulting from climate change could lead to overall reduction in agricultural productivity and yields, including rangeland and livestock production, threatening food security and heightening the risk of famine. Based on crop modelling, estimated yield reductions in dry lands across Africa may lead to tens of millions of people more at risk of food insecurity by the 2080s (Parry, Rosenzweig, Iglesis, Fischer, and Livermore (2000)

2.3.2 Observed Changes

Based on historical records, a warming of approximately 0.7°C over most of the continent during the 20th century is reported in the IPCC TAR, 2001). Observational records show that this warming occurred at the rate of about 0.05°C per decade with a slightly larger

warming in the June-November seasons than in December-May (IPCC, 2001). Very high temperatures records have also been indexed e.g. the five warmest years in Africa have all occurred since 1988, with 1995 and 1998 being the two warmest years. With regard to changes in precipitation, an average of a 25 percent decrease in rainfall has occurred over the African Sahel during the past 30 years. This change has been characterized by a decrease in the number of rainfall events. A decrease in precipitation has occurred over the twentieth century, particularly after the 1960s, in the subtropics and the tropics from Africa to Indonesia (IPCC, 2001).

Floods are recurrent in some countries of Africa; even communities located in dry areas have been affected by floods. The years 2000 and 2001 witnessed a huge flooding event in Mozambique, particularly along the Limpopo, Save and Zambezi valleys. In 2000, floods resulted in half a million people made homeless and 700 losing their lives. The floods had a devastating effect on livelihoods, destroying agricultural crops, disrupting electricity supplies and demolishing basic infrastructure such as roads, homes and bridges (UNEP 2002).

2.3.3 Likely Future Climatic Changes in Africa

Africa is a continent characterized by a highly variable climate. Some key limitations to knowledge regarding future African climate have been identified by Hulme, Doherty, Ngara, New and Lister *(*2001) as the mostly poor representation of the climate variability of El Niño in the global climate models, and the absence in these models of any representation of regional changes in land cover and dust and biomass aerosol loadings. However, climate change models suggest that, in general terms, the climate in Africa will become more variable. Since 1900 mean surface temperature in Africa has increased by only 0.5º, yet by 2100 it could increase by 2–6ºC (Hulme et al 2001). As for changes in precipitation, different views and arguments, which could to a large extent be considered as conflicting, have been cited, e.g. models of future

climate change suggest a future warming that may ultimately lead to a more humid regime in the Sahel and parts of the Sahara (Brooks, 2005). This suggestion is based on observations since the late 1990s of an amelioration of the regional climate, and abundant rainfall throughout much of the Sahel and in parts of the Sahara in 2003.

Similar results are obtained by Claussen, Nrockin, Ganopolski, Kutzbaki, and Petoukhov, (2003), who reported a potential increase of vegetation cover of up to 10 percent of the Saharan land area per decade as a result of increased CO2 concentrations. Increased CO2 concentrations trigger increased rainfall which is then sustained through vegetation-atmosphere feedbacks (Maynard, Royer and Chauvin 2002).

Furthermore, Claussen *et al* (2003) examined the impact of a one percent increase in atmospheric CO2 of per year for 80 years, using models that produce realistic climatologically representations of the present-day Sahara, and found that the Sahara shifts northwards in a number of models. Some studies have illustrated the large regional differences that exist in rainfall variability, e.g. East Africa has displayed a stable rainfall regime, and while a considerable multi-decadal variability and recent drying has been experienced over the Sahel with up to a 20 percent expected decrease of rainfall (Hulme *et al* 2001).

Hulme further stated that other regional predictions for changes in temperature and rainfall suggest a decrease in rainfall of 10-25 percent over the northern parts of Africa in the months of June, July, August and 10-60 percent in March, April and May between 2010-2039 (Hulme, *et al* 2001). Similarly the model predicted a decrease of 15-62 percent in southern latitudes for the July, June and August and 8 to 36 percent for September, October and November. An increase in rainfall of 10 and 35 percent in the western part of the continent for the December, January and February period (which is normally dry). A similar trend is predicted for the September, October and November period (between 7 and 28 percent).

However some studies have indicated that, these general trends may include hidden variations within the regions and countries, e.g. southern Africa may be drier in general terms, but some countries of the region may become wetter than the average (Hulme *et al* 2001)

2.3.4 Extreme Events

The IPCC (2001) reports changes in some extreme climate phenomena indicating that extreme events, including floods and droughts, are becoming increasingly frequent and severe. Certain regions of Africa are more prone to extreme events than others. Flooding and droughts are now common across Africa. It is probable that the increased frequency of recorded disasters results from a combination of climatic change and socio-economic and demographic changes.

2.3.5 Africa's Specific Key Impacts and Vulnerabilities to Future Climate Change

Africa's vulnerability to climate change is also acknowledged in the IPCC Third Assessment Report (TAR). The report highlighted areas of particular concern to Africa as being: water resources, agriculture and food security, human health, ecosystems and biodiversity, forestry, coastal zones and attaining the Millennium Development Goals (MDGs). The following is a highlight of specific impacts of climate change in Africa:

2.3.5.1 Health Impacts

The health effects of a rapidly changing climate are likely to be overwhelmingly negative. Desanker (2002) stressed that the vulnerability of Africa to health impacts is a function of climatic as well many other non climatic factors such as: poverty, conflicts and population displacement, access and availability and management of health services, in addition to other factors related to drug sensitivity of the pathogens, awareness and attitude towards preventive measures. Urban growth unaccompanied by strong public health infrastructure makes African countries even more vulnerable (World Health Organisation (WHO), 2005). Africa is already

vulnerable to a number of climate-sensitive diseases (Guernier, Hochberg, and Guengan, 2004), some of the most important of which are highlighted below:

- Lift valley fever, which afflicts people and livestock, is closely related to heavy rainfall events, which are predicted to increase with climate change. An outbreak in 1997 associated with an El Niño event killed up to 80 percent of livestock in Somalia and northern Kenya. Cholera, associated with both floods and droughts, may increase with climate change. Increased temperatures could increase the levels of cholera bacteria in tropical seas and lakes. Changes in rainfall will affect the transmission potential, and the presence and absence of vector- and water-borne pathogens (IPCC 2001).
- Increased flooding could facilitate the breeding of malaria carriers in formerly arid areas. Small geographical changes in the distribution of malaria may expose large numbers of people to infection e.g. densely populated east African highlands (Lindsay and Martens, 2002).
- The population of disease-carrying mosquitoes is expected to increase as a result of changes in temperature and precipitation, leading to increased malaria epidemics (Lindsay and Martens, 2002).
- Heat stress and drought are likely to have a negative impact on animal health, production of dairy products, meat and reproduction (Lindsay and Martens, 2002). This in turn could impact food security leading to protein deficiency and malnutrition.

2.3.5.2 Impacts on Agriculture and food Security

Land resources contribute up to 50 percent of household food requirements and up to 40 percent of household incomes (AMCEN/UNEP, 2002), with 70 percent of the continent's population depending on agriculture for their livelihood. Moreover, agriculture is the most important sector in the economy of most African countries, representing approximately 30

percent of Africa's GDP and contributing about 50 percent of the total export value. Agriculture is mostly subsistence in nature with a high dependence on rainfall (over 95 percent) for irrigation. As a result, agriculture in Africa is highly vulnerable to changes in climate variability, seasonal shifts, and precipitation patterns (AMCEN/UNEP, 2002). Model results (Hadley Centre, *Commonwealth Scientific and Industrial Research Organisation*, Canadian Climate Centre) indicate that only 80,000 km2 of agricultural land in Sub-Saharan Africa with currently severe environmental constraints (out of more than 15.1 million km2) are expected to improve with climate change, whereas more than 600,000 km2 currently classified as moderately constrained would migrate to the class of severe environmental limitations (Fischer , Shah, Van Velthuizen , 2002).

African countries whose economies rely heavily on one or two agricultural cash crops are vulnerable to climate change. A study in Uganda concluded that an increase in temperature of an average of 2ºC would drastically reduce the area suitable for growing Robusta coffee in Uganda, where it is a major export crop and limit growth to the highlands only (Department for International Development, 2004). Arnell, 2002) pointed out that, even with a stabilization of CO2, cereal crop yields in Africa will still decrease by 2.5 to 5 percent by the 2080s. With regard to fisheries, carbon isotope records in sediment cores suggests a decrease of up to 20 percent in the primary productivity of Lake Tanganyika in East Africa, implying a roughly 30 percent decrease in fish yields (O'Reill, Allin, Plisnier, Cohen, McKee, 2003). Predicted future climate change may further reduce the Lake's productivity. Climate change may also adversely affect the rangelands which represent up to 83 percent of the agro-ecosystem area in sub-Saharan Africa. General impacts of climate change on agriculture include (Food and Agriculture Organisation (FAO) 2005):

- Reduction in soil fertility

- Decreased livestock productivity directly (through higher temperatures) and indirectly (through changes in the availability of feed and fodder)
- Increased incidence of pest attacks, resulting from increase in temperature
- The manifestation of vector and vector born diseases
- Negative impacts on human health affecting human resource availability

The impact of these changes on agriculture is exacerbated by the lack of adaptation strategies, which are increasingly limited due to the lack of institutional, economic and financial capacity to support such actions (FAO, 2005) Increasingly variable growing season conditions (shifts in start of rainy seasons, length and quality of rains, etc) are disrupting subsistence agricultural production leading to famine and severe loss of livelihoods in many semi-arid regions of Africa. Improved seasonal forecasts and application of these results at the community level is a high priority in ensuring communities transition smoothly to the changing climate.

2.3.5.3 Impacts on the Millennium Development Goals

Climate change has the potential to undermine economic development, increasing poverty and delaying or preventing the realization of the Millennium Development Goals (MDGs) (Pachauri 2005). Particularly, the lack of effective adaptation to the adverse effects of climate change can jeopardize the achievement of MDG goal 1 (eradicating extreme poverty and hunger), goal 6 (combating HIV/AIDS, malaria and other diseases) and goal 7 (ensuring environmental sustainability). This indicates that a direct link can be seen between climate change and development, where the impacts of climate change could largely impede development efforts in key sectors while at the same time development strategies and plans could have an impact on coping capacity to climate change. Considering that the adverse effects of climate change pose an additional burden to development goals, the mainstreaming of adaptation into sustainable development adaptation and taking into account additional climate

change risks have started to be considered for support through additional funding. For example, Organisation for Economic Co-operation and Development (OECD) Member Countries declared (the Declaration on Integrating Climate Change Adaptation into Development Cooperation) that they will work to better integrate climate change adaptation in development planning and assistance, both within their own governments and in activities undertaken with partner countries. In 2003, the European Commission produced a communication entitled "Climate Change in the context of development co-operation", in which it proposed a European Union (EU) action plan aimed at integrating climate change concerns into EU development co-operation activities.

Similarly, the World Bank's progress report on its investment framework for clean energy and development asserts that "it is essential that the Bank Group, along with other International Financial Institutions, play a leading role in ensuring that maximum impact is obtained from these funds (UNFCCC funds) by mainstreaming appropriate investment and appropriate risk in the global development portfolio". Also, competition for scarce resources, such as freshwater, land or fish resources brought about by changes in climate can lead to conflict which will impact on the successful achievement of the MDGs. TAR (2001) highlights conflicts over water resources, especially in international shared basins, as an important aspect of Africa's vulnerability to climate change.

Increased pressure on resources deepened tensions between nomads and agriculturalists in Niger during the 2005 crisis (Oxford Committee for Famine Relief (OXFAM), 2006), and it was argued that increased competition over land was one of the triggers of the conflict in Darfur. Nomadic societies, who have historically been supported by the Kalahari, and the Karoo in Southern Africa, can no longer follow their traditional migration paths due to variations in annual and seasonal rainfall. Areas where wetter weather and permanent water is found are

already densely populated leading to loss of human life and livestock (Global Environmental Outlook (GEO) 3, 2005). Competition over water resources and the displacement of populations as a result of dam building have led to conflict within nations (GEO 3 2005) usually where other political, religious or ethnic tensions already exist.

2.4 THE GENERAL WORLD OUTLOOK FOR CLIMATE CHANGE

2.4.1 General Introduction

Without changes in policy, GHG emissions are projected to accelerate. However, these projections are wide-ranging, given uncertainty about the rates at which productivity will grow, energy intensity will improve, and emerging and developing economies will converge toward the living standards of advanced economies. For example, even studies based on the widely used Special Report on Emissions Scenarios (SRES) developed by the United Nations Intergovernmental Panel on Climate Change (IPCC) show significant variations in projected emission growth. Emission projections in studies based on this source range from 22 percent to 88 percent between 2000 and 2030, and from –40 percent to 237 percent between 2000 and 2100. The estimates based on more recent, "post-SRES" scenarios exhibit a similar range, although the median is lower in 2030 and higher in 2100 Business-as-usual (BAU) projections imply a sizable risk that global climate would change dramatically by the end of the century.

The IPCC projects that, in the absence of emission control policies, global temperatures will increase by 2.8°C on average over the next century, with best-guess increases ranging from 1.8°C to 4°C across SRES scenarios (IPCC, 2007). The probability of higher temperature increases is not negligible. Stern (2008) points out that if BAU concentrations of GHGs stabilize at or above 750 parts per million (ppm) in carbon-dioxide-equivalent (CO2e) terms by the end of the century, as implied by the latest IPCC scenarios, there would be at least a 50

percent chance that global temperatures would increase by more than 5°C, with potentially disastrous consequences for the planet (also see Weitzman, 2008, on the analysis of catastrophic risks from climate change).

Global warming would have a multifaceted and potentially devastating impact on climate patterns (IPCC, 2007). Precipitation would increase at high latitudes and decrease in most subtropical land regions. Other likely manifestations of warming include increasing acidification of the ocean; melting of snow and sea ice; and an increase in the intensity of extreme events such as heat waves, droughts, floods, and tropical cyclones. At higher temperatures, the probability of catastrophic climate changes would rise (for example, melting of the west Antarctic ice sheet or permafrost; a change in monsoon patterns in south Asia; or a reversal of the Atlantic Thermohaline Circulation, which would cool the climate of Europe).

2.4.2 Economic Costs of Climate Change: How will Climate Change Affect Economies?

The global climate is projected to continue to warm in coming decades, as new GHG emissions augment the already large stock of past emissions (Baumert, Kevin, Timothy, and Jonathan 2005).

According to Dasgupt (2007) increases in energy-related emissions of carbon dioxide, the largest and fastest-growing source of GHG emissions, are driven by growth in GDP per capita and increases in population, and these increases are only partially offset by improvements in the intensity of energy use. Catching-up economies, especially large and fast-growing countries such as China and India, contribute most to the growth in. Advanced economies account for most past energy-related emissions and thus for most of the current stock of these emissions.

However, when changes in land use and deforestation are considered, a different conclusion emerges: advanced economies account for less than half of the current stock of total

emissions (Den *et al* 2005) Economic estimates of the impact of climate change are typically based on "damage functions" that relate GDP losses to increases in temperature. The estimates of GDP costs embodied in the damage functions cover a variety of climate impacts that are usually grouped as market impacts and nonmarket impacts. Market impacts include effects on climate-sensitive sectors such as agriculture, forestry, fisheries, and tourism; damage to coastal areas from sea-level rise; changes in energy expenditures (for heating or cooling); and changes in water resource (Baumert, Herzog and Pershing, 2005).

Nonmarket impacts cover effects on health (such as the spread of infectious diseases and increased water shortages and pollution), leisure activities (sports, recreation, and outdoor activities), ecosystems (loss of biodiversity), and human settlements (specifically because cities and cultural heritage cannot migrate). Existing studies tend to underestimate economic damages from climate change, particularly the risk of worse-than-expected outcomes. The three main benchmark studies (Mendelssohn *et al*, 2000) and the review of the literature in the *Stern Review* (2007) point to mean GDP losses between 0 percent and 3 percent of world GDP for a 3°C warming (from 1990–2000 levels) .

However, these estimates of damages are often incomplete—they rarely cover nonmarket damages, the risk of local extreme weather, socially contingent events, or the risk of large temperature increases and global catastrophes. Moreover, available estimates tend to be based on a smaller increase in global temperatures than projected in the IPCC's latest scenarios. Studies typically calculate damages for a doubling of CO2e concentration from pre-industrial levels. Yet the latest IPCC's Business As Usual (BAU) scenarios are expected to result in a tripling or quadrupling of concentrations by the end of the century, implying higher temperatures than those assumed in most studies.

More recent, risk-based approaches to the analysis of damages from climate change point to significantly higher estimates than those suggested in the earlier literature (Stern, 2008). Estimates of total global damages also mask large variations across countries and regions. Damages tend to be greater for countries with higher initial temperatures, greater climate change, and lower levels of development. A moderate rise in temperature increases agricultural productivity in countries with low initial temperatures, but decreases it in hotter countries. Similarly, warming reduces deaths from cold in countries with initially colder climates, but increases mortality and morbidity in countries with warmer climates.

According to Boyer (2000) although warming reduces expenditures on winter heating in countries with an initially cooler climate, such countries may incur additional expenditures on summer cooling. Countries with initially warmer climates also incur additional costs for cooling. Boyer (2000) further stated that beyond initial temperature, the level of development has a strong effect on the extent of damages from climate change. First, a lower level of development typically implies a larger dependence on climate-sensitive sectors, particularly agriculture. Second, populations in these countries are typically more vulnerable to climate change because of lower income per capita, limited availability of public services (such as health care), less-developed financial markets, and poor governance. Third, the same factors also restrain the adaptive capacity of the economy. Some estimates of damages from climate change explicitly specify costs as a function of income level (Nordhaus and Boyer, 2000). Often, higher initial temperatures and lower levels of development go hand in hand, compounding the damaging impact of climate change on developing economies.

All three of the main benchmark studies suggest a similar distribution of the climate change impact across regions, by adjusting regional impacts for the study-specific global impact. The regions likely to experience the most negative effects include Africa, south and

south east Asia (especially India), Latin America, and Organization for Economic Cooperation and Development (OECD) Europe (if catastrophic risk is included). In contrast, China, North America, OECD Asia, and transition economies (especially Russia) should suffer smaller impacts and may even benefit, depending on the actual extent of warming. In India, the large negative impact is due to catastrophic risk (such as a change in the monsoon pattern), agricultural damages, and deteriorating health. In Africa, the main effect estimated by Nordhaus and Boyer is deteriorating health from the spread of tropical disease; however, recent estimates of the likely effects on agricultural potential also project substantial agricultural damages (Cline, 2007). OECD Europe is largely affected by the risk of catastrophic impact and damages to coastal areas. Physical estimates of the impact of climate change confirm that Africa and Asia are particularly vulnerable. In these regions, almost 1 billion people would experience shortages of water by 2080, more than 9 million could fall victim to coastal floods, and many could face increased hunger. Pacific island countries are perhaps the most immediately vulnerable among the poor countries, as even a small further rise in sea level would dramatically affect their environment.

Two main areas of uncertainty plague estimates of damages from climate change at all levels, as is reflected in the large variation in the present value of damages. The first is the limitation of current scientific knowledge about the physical and ecological processes underlying climate change. For example, there is only incomplete information about how rapidly GHG concentrations will grow in the future, how sensitive climate and biological systems will be to increased concentrations of GHGs, and where the "tipping points" are, beyond which catastrophic climate events can occur. The second source of uncertainty relates to how best to quantify the economic impact of climate change. The magnitude of losses from climate change depends, for example, on how well people and firms adapt and at what cost, as

well as on the extent to which technological innovation can reduce the impact. For example, health effects from the spread of tropical disease may be lower if the spread of malaria can be reduced. Similarly, losses in agricultural yields may be limited if heat- and drought resistant crops can be developed. Conventional approaches to evaluating damage from climate change also tend to neglect dynamic macroeconomic linkages.

Climate change is largely a supply-side shock, but it may have significant effects on trade, capital flows, and migration, as well as on investment and savings. The *Stern Review*'s estimate that climate change would produce a large welfare cost—equivalent to a permanent reduction in consumption of about 14 percent of world output over the next two centuries is much higher than the average annual estimated output loss. This reflects a low elasticity of marginal utility to consumption and an assumed pure rate of time preference of approximately zero, both of which give a large weight to consumption losses from distant generations.12 Many consider these assumptions unpersuasive because they imply a much higher-than-observed savings rate and a lower-than-observed rate of return on capital (Nordhaus, 2007). Stern (2008) points out that discount rates are conditional on the path of future growth in consumption, implying that a lower discount rate should apply in a world with climate change than in a world without it, all other things equal. He also underscores that basing discount rates on market rates is fundamentally inappropriate in cases involving welfare trade-offs across far-apart generations and across countries with different levels of income.

Technological change and uncertainty over future discount rates may also justify using lower discount rates (Pindyck, 2007). What is the relative importance of the different sources of variation in damage estimates? The *Stern Review*'s estimate of the percent loss in GDP per capita by 2200 under its baseline climate scenario (which assumes relatively high emissions and includes market impacts, nonmarket impacts, and catastrophic risk) ranges from about 3 percent

to 35 percent (90 percent confidence interval), with a central estimate of 15 percent . Hope (2006) finds that the two most important sources of variation in estimates of welfare losses are the climate sensitivity parameter and the pure rate of time preference.

Uncertainty surrounding the nonmarket impacts and the elasticity of marginal utility with respect to income also ranks high, whereas uncertainty about market impacts ranks lower. Weitzman (2007) concludes that the choice of the discount rate overshadows any uncertainty about the costs and benefits of climate change a century from now. He also argues that the most important source of variation is uncertainty over probability and scale of catastrophes. Webster *et al* (2003) find that nearly half of the variation is attributable to uncertainty about emission forecasting. Non-negligible tail risks of large damages from climate change would justify an early and significant policy action. Uncertainty generally increases the benefits of policy delay, but because both the damages from climate change and its costs are irreversible, policy implications of uncertainty are more ambiguous (Pindyck, 2007).

The significant probability of climate catastrophes strengthens the case for earlier abatement—that is, reduction of GHG emissions— with abatement initiatives increasing in intensity as learning progresses (Stern, 2008; and Weitzman, 2008). Even with aggressive abatement, however, it will be necessary to pursue adaptation—adjustments in ecological, social, or economic systems in response to climatic impacts. If serious efforts to cut emissions were undertaken immediately, some climate warming would still occur, making adaptation unavoidable. However, adaptation is an inadequate response on its own, because there are natural limitations to humans' ability to adapt at higher degrees of warming (DeLong 2006).

2.4.3 How can Countries best Adapt to Climate Change?

Societies have historically adapted to changing environmental conditions, and individuals and firms can be expected to continue altering their behaviour in response to changing climate conditions (for example, by planting more drought-resistant crops). However, government involvement is also likely to be needed to spur adaptation, in order to overcome market failures (individual firms and households unable to incorporate the full social benefits of adaptation into their decision making), to meet the need for public goods and services to support Adaptation (for example, coastal protection or investment in public health infrastructure), and to augment the private sector's capacity to adapt, for example, in poor countries (DeLong 2006) .

Quantitative analyses of adaptation costs are scant, but studies focusing on public sector costs suggest that adaptation may put a strain on government budgets, especially in developing economies that have weak adaptation capacities and are likely to be more severely affected by climate change. Based on simple extrapolations of current expenditure patterns, the UNFCCC (2007) estimates additional annual adaptation investment in agriculture, health, water, and coastal protection of about $40 billion a year in 2030, perhaps half of which might be expected to fall on the public sector. The study also projects additional infrastructure needs of $8 billion–$130 billion, some of which would fall directly on governments. Further refinements of adaptation cost estimates are needed in order to try to narrow the wide range of uncertainty surrounding these estimates and to broaden their coverage where possible—factoring in, for example, the need to adapt to increased climate variability. Economic and institutional development is perhaps the best means of improving climate related adaptive capacity. Development promotes diversification away from heavily exposed sectors; improves access to health, education, and water; and reduces poverty. To be effective in fostering adaptation, development strategies need to take climate change vulnerabilities into account, while seeking

to avoid mal-adaptation (IPCC 2007). Higher-quality institutions also strengthen countries' ability to adapt to climate change (Kahn 2005).

Fiscal self-insurance against climate change is also needed. Government budgets must include room for adaptation expenditures, and social safety nets must be strengthened, especially in countries that will be severely affected (Cline 2007). External financing may be needed to complement domestic resources in cases where the demands of adaptation overwhelm poor countries' capacity. The recent launch of a UN fund to provide dedicated financing to such countries is a welcome step in this regard. A flexible exchange rate regime and policies that make capital and labour more flexible may help reduce the macroeconomic cost of the types of abrupt shocks (such as extreme weather events) that are likely to accompany climate change . Such shocks typically destroy capital and disrupt production, and adjusting to them requires reallocating people and capital across and within sectors.

According to Stern (2008) many of these policies can be implemented fairly quickly and at a small cost to the budget, making them part of an effective adaptation strategy that can dampen the macroeconomic impact of climate shocks. Factoring in climate-adjusted costs and risks).The financial markets' capacity to reallocate costs and risks to those most willing and able to bear them also will help reduce the social costs of adaptation. However, this capacity is dependent on the quality of macroeconomic and financial policies

CHAPTER THREE

THE IMPACT OF CLIMATE CHANGE IN NAMIBIAN CONTEXT

3.1 GENERAL INTRODUCTION

The Namibian economy is diversified, and the wealth of the nation is concentrated in the non-flooded area, hence the flood had only a minor impact on the overall macroeconomic aggregates (Central Bureau of Statistic (CBS) 2008). However the affected area accounts for more than 60 percent of the total Namibian population. Thus, the flood disaster has affected household living conditions and it has affected more the people than the assets (Post Disaster National Assessment (PDNA) 2009).

3.2 KEY CLIMATE CHANGE ISSUES IN NAMIBIA

Namibia, with a total land area of 824,268km^2, is one of the most arid countries in sub-Saharan Africa. It receives low and highly variable rainfall that ranges from an average of 25 mm in the southwest to 700 mm in the northeast (Mendelssohn et al 2000). The Namibian economy depends heavily on its natural resources that include mineral deposits particularly diamonds, wildlife, fisheries and woodlands, a large area of arid rangeland and a small area of arable land.

The majority of Namibians (about 60%) live in rural areas and depend mainly on agriculture for subsistence. In 2000, agriculture contributed 5.6% of the GDP of which almost 90% was from production of cattle and small stock (Initial National Communication (INC) 2002). Mining accounted for 13% of the GDP. Fisheries are the third-largest economic sector. Protected areas make up about 14% of Namibia's land surface. The scenic beauty and wildlife attract many tourists annually and so tourism contributes up to a third of Namibia's foreign exchange

earnings. The economy of Namibia relies heavily on its natural resources is clear and hence its vulnerability to climate change is certain.

3.3 CLIMATE CHANGE PREDICTION IN NAMIBIA

Climate change is predicted to cause significant spatial changes in vegetation structure (Midgley, Hughes, Thuiller, Drew and Foden,2004). Due to hotter drier conditions, the more arid-adapted desert and arid shrub land vegetation types are projected to attain spatial dominance over the grassy savannah. The resulting reduction in vegetation cover and Net Primary Productivity will affect livestock production and wild fauna. On the other hand, increase in atmospheric CO2 will favour growth of C3 woody trees and shrubs especially in north-eastern parts of Namibia by 2080 ((Midgley et al 2004).

Increasing woody biomass in Namibia mainly due to bush encroachment is predicted to make Namibia a net 'sink' for CO2 (de Klerk 2004). Bush encroachment is defined as 'the invasion and/or thickening of aggressive undesired woody species resulting in an imbalance of the grass: bush ratio, and a decrease in carrying capacity' (de Klerk 2004). Bush encroachment is one symptom of desertification in savannahs of Namibia. It reduces botanical diversity and adversely affects water-use efficiency and underground water tables. Bush encroachment increases evapo-transpiration, water run-off and less infiltration to subsoil, thereby contributing to desertification.

While it is economically undesirable, increase in bush encroachment will increase the uptake of CO2 from the atmosphere through the process of photosynthesis. De Klerk (2004) further revealed that occurrence of most encroacher species showed a positive correlation with rainfall. The positive contribution of bush encroachment to climate change as a carbon sink is however negated by its economic costs to Namibia, such as loss of productive rangeland that

supports extensive commercial and subsistence livestock production and ranching. Strategies such as conversion of encroaching species into charcoal are being implemented already (i.e. factories in Otjiwarongo and Okahandja).

The Southern African Millennium Ecosystem Report (Scholes and Biggs, 2004) and the INC (2004) to the UNFCCC both established that climate change will severely affect water availability, rainfall patterns and agricultural production in future. Furthermore, existing evidence of desertification, i.e. in the form of land degradation and bush encroachment, and recurrent drought, make Namibia very vulnerable to the effects of climate change. The INC states that while Namibia is a minor producer of greenhouse gases, it is likely to suffer effects of climate change severely. Major climate change issues in Namibia therefore relate to how it will respond to adverse impacts.

3.4 GENERAL CLIMATE CHANGE EFFECTS AND CHALLENGES ON NAMIBIA

It is predicted with a high degree of certainty that Namibia will become hotter throughout the years (with a predicted increase in temperatures of between 1°C and 3,5°C in summer and 1°C to 4°C in winter in the period 2046 - 2065), with increased variability in rainfall trends (Ministry of Environment and Tourism(MET), 2008). Considerable spatial heterogeneity in the trends has been observed, but it appears as if the northern and central regions of Namibia are experiencing a later onset and earlier cessation of rains, resulting in shorter seasons in most vicinities.

As far as predictions for the future are concerned, it is not obvious whether Namibian rainfall will be reduced, although intensity is likely to be increased (Dirkx, Hager, Tadross, Bethune, and Curtis (2008). These ambiguities in changes in rainfall and runoff in Southern Africa in general and Namibia in particular, suggests that groundwater recharge may suffer a reduction of 30-70% across Namibia; a potential exception could be found in the recharge of

alluvial aquifers that have their origins in central areas of Namibia (MET (2008). It is predicted, even without the additional stresses of climate change on the water resources, that demand will have surpassed the installed abstraction capacity by 2015 (MET, 2008).

It is important to underscore that variability is likely to remain the key aspect of Namibia's climate in the future. Vulnerability to environmental change not only depends on change in frequency or duration of climatic conditions, but also on the capacity to respond adequately to those changes. Poverty, lack of income and employment opportunities greatly exacerbates the vulnerability of households as these factors substantially constrain access to productive resources, such as agricultural production and food security. Ultimately they contribute to limited adaptive capacity and vulnerability. Adaptation is the process to improve society's ability to cope with changes in climatic conditions across time- and policy scales. Following a brief vulnerability assessment by group of consultants, of "agricultural policy in the context of climate change adaptive responses for the agricultural sector are structured along technical, policy and institutional topics, and include *inter alia* diversification options, management practices, improving the exercise of best technical options as well as the improving the characteristics of such available options, and communication and translation of information.

The importance of addressing climate change from a developmental perspective, cutting across policies and warranting action *today* is highlighted" (Dirkx et al, 2008). In terms of managing the impacts of drought and floods the capacity for disaster risk preparedness, rather than disaster response, should be strengthened. Spatial planning that takes ecosystem requirements into consideration has the potential to markedly reduce flood related costs. In order to address the disaster-related risks suffered by the majority of the rural population it is of utmost importance to look into the matter of developing pro-poor disaster insurance schemes.

According to Mfune and Ndombo (2005), the direct effects of climate change on the various economic sectors could potentially be felt in thematic areas such as water; agriculture; fisheries; ecosystems, biodiversity and tourism; coastal zone; health; and energy. In relation to this brief study, all interviewees were well aware of general climate change impacts, but only some could highlight specific Namibian impacts and even fewer could recommend how do deal with these issues. In this regard, information and communication was deemed as very important, especially translating the impacts to grass root levels for communities to be better prepared and to make informed decisions regarding their livelihood options. Furthermore, appropriate and "practical" policy frameworks were highlighted as important to support the climate adaptation and mitigation process. An interviewee, specifically proposed that the next National Development Plan 4 (2012-2016) should be adapted and centred around climate change issues so that each role player, sector can enhance the adaptation and mitigation aimed at reducing the impact poverty. The need to have environmental, socio economic and political will, mainly driven by the parliamentarians was highlighted. This exercise should include enforcement and indicator mechanisms to hold stakeholders accountable on taking serious and relevant climate change action.

3.5 IMPACT OF FLOOD ON FOOD SECURITY

According to the PDNA report (2009) the households that are experienced acute transitorily food insecurity were mostly headed by subsistence farmers that have lost their mahangu stocks, and have experienced average estimated losses of 80 percent. The report further stated that, these are mostly single female-headed households, with low crop production, low expenditure per capita, and low livestock ownership in their communities. The vulnerable populations experienced transitory acute food insecurity as a direct effect of the floods (World Food Programme (WFP, 2008). Flooding has also affected wider populations, both rural and urban.

The 2009 floods washed away stocks of sorghum and mahangu stored from the previous and 2009 harvests (PDNA report, 2009). These losses have directly affected the rural populations that rely on mahangu harvests for subsistence, and indirectly affected urban populations, who rely on mahangu transfers from relatives in rural areas. Disruptions to road networks affected the provision of school lunch programs, which may have a long term negative effect on school children (Ministry of Education (MoE), 2009). Many of the most vulnerable households were still reeling from the shocks of the 2008 floods, and from the aftermath of several consecutive years of droughts. These households have had to adjust their coping strategies to include limiting food intake, reducing dietary diversity, migrating, borrowing cash, and purchasing food staples from the open market (PDNA, 2009).

3.6 POLICY/LEGAL FRAMEWORK FOR CLIMATE CHANGE IN NAMIBIA

Namibia has a policy on climate change that was developed as part of the National Development goals and more specifically the Namibian obligation under the second national communication to the UNFCCC. In conjunction, a national climate change strategy and action plan is also being prepared as a necessary tool to facilitate climate change adaptation and mitigation to reduce its impacts on socio-economic development of the country. The strategy will constitute a framework that will ensure effective implementation of obligations of UNFCCC, hence contributing to addressing this global problem.

Principles guiding the National Policy on Climate change range from sustainable development; stakeholder participation, education, training and capacity building to transparent planning and decision making (Mfune and Ndombo, 2009). The Namibia Climate Change Strategy is therefore based on three (theme-based) aspects.

- **Adaptation**: including themes such as food security and sustainable resource base; sustainable water resources; human health and well being and infrastructure.
- **Mitigation:** Sustainable energy and low carbon development; transport.
- **Cross-cutting issues on adaptation and mitigation:** such as capacity building, training and institutional strengthening; research and information needs; public awareness, participation and access to information; disaster reduction and risk management; financial, resource mobilisation and management; international cooperation and networking; technology development and transfer; and legislative development.

In addition, Namibia provides for a broad variety of other sectoral legislations, which directly or indirectly are important in addressing climate change issues.

These include:

- The Vision 2030 (as part of the strategic goal addressing protection of natural resources); the National Poverty Reduction Action Plan (NPRAP) (2000) (includes a people-centred poverty reduction approach linking it to poverty reduction efforts to regional needs, as established in regional poverty profiles)
- The National Development Plan 3 (as part of the strategic goal ensuring the protection of environmental concerns are the optimal and sustainable utilisation of renewable and non-renewable resources, especially focusing on sustainable energy)
- The Environmental Management Act (2007) (provides the environmental framework legislation, which includes principles for environmental assessments, environmental protection and sustainable use of natural resources)
- The National Disaster Bill;

- The Pollution Control and Waste Management Bill (make provision for the establishment of an appropriate framework for integrated pollution prevention, control and regulate the discharge of pollutants to the air, water and land
- National Drought policy (deals with national emergency and long term drought management policy and strategy to combat land degradation)
- The Water Resources Management Act, Act 24 of 2004 (WRMA), is based on IWRM principles, and provides overall guidance for the water sector, but is not yet fully implemented. Integrated Water Resources Management (IWRM) has been identified as an essential strategy for the development, sustainable utilisation, conservation and protection of the water resources in Namibia (IWRM JV, 2010).
- National Agricultural Policy (stipulates potential strategies to improve food security, expand income through export of products and to create employment. Commercial and subsistence agriculture is therefore seen as key in supporting the sustainable and equitable growth of Namibia's economy, whilst maintaining and improving livelihoods at household levels.
- Namibia Forest Act and Policy, (provides for enforcement mechanisms (licensing, certification, establishment of Forest management authorities) to protect forestry resources).
- The White Paper on Energy Policy of 1998 set the goals for security of energy supply through a diversity of reliable sources. Hereby, the Policy puts an emphasis on the development and sustainable use of Namibian resources (Ministry of Mines and Energy (MME) 2000). In 2000, the Rural Electrification Master Plan was completed and then revised in 2005. It identifies the need for the development of on-grid and off-grid infrastructure

The Constitution of Namibia highlights the need to develop and implement policies to maintain the ecosystems, ecological processes and biological diversity for the benefit of the present and future populations. The predicted negative effects of climate change may compromise the ability of the State to fulfil its constitutional obligations. The State, through its various government agencies and departments and in full partnership with the non-governmental and private sectors, has and will continue to develop and adopt preventative and adaptive activities to address environmental and climate change issues and problems (INC 2002)

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 INTRODUCTION

Research methodology refers to the method by which data is gathered for a research project. It is the blueprint for the collection, measurement, and analysis of data in order to achieve the objectives of a research project (Cooper and Schindler 2003) Research methodology is important in a research work because it specifies the sampling design. Here the researcher explicitly defines the target population and the sampling method used. The researcher also provides the motivation for choosing a specific targeting population. Additionally, the researcher identifies the data collection method used.

This chapter discusses the methods and techniques by which data was collected, where and when and from whom it was collected as well as the sample size used. It furthermore comprises a research design and plan, population and sample, data collection instruments, sources and procedures for data analysis. The reliability and validity of the data collected was also discussed to establish the validity of the results as well as the limitations faced in the collection of data. Section 4.2 highlights the research design.

4.2 RESEARCH DESIGN

This study aims to investigate the socioeconomic impact of climate change with specific reference to floods in central northern regions and use this information to establish how such impact hinder the Namibia's developmental agendas and progress achieved thereof. The research was conducted on a small-scale, primarily qualitative by design (descriptive studies), collected information from various key informant interviewees following a non-probability sampling technique, purposive snowball sampling. According to Ghauri and Gronhaug (2005) qualitative research "is a form of systematic empirical inquiry into meaning" By systematic he

means “planned, ordered and public”, following rules agreed upon by members of the qualitative research community. By empirical, he means that this type of inquiry is grounded in the world of experience. Inquiry into meaning says researchers try to understand how others make sense of their experience.

The target group was identified in advance, being, agricultural farmers, school teachers and principals, owners of small local enterprises, the headman as well as the Secretary to the Headman. The benefit of using the snowballing technique was mainly to get references to those informants that are familiar with the issues making it easier to discuss the topic and to get as much information as possible. The same technique was used with regard to obtaining the relevant documentation (or referred to those people that would have the documents). This technique also provided the researcher room to have “quality” interviews (due to credibility of references or prior contact) with the interviewees. In total, the research collected information from 50 respondents plus 4 key informants.

4.3 SAMPLING

The sample was drawn from a village called Oshitutuma in the Omusati region. This is one of the geographically defined areas of particularly high climate change risk and vulnerability. In addition, the researcher opted to focus on this village because of ease of access and limited time. For this reason, the sample was drawn based on purposive sampling to include the areas that were affected by these floods. According to Denscombe (2010) purposive sampling operates on the principle that we can get the information through focusing on a relatively small number of instances deliberately selected on the basis of their known attributes. He further adds that purposive sampling works where the researcher already know something about the specific people because they are seen to give the most valuable data. A total of 50 respondents

(households) plus 4 key informants (a school principal, clinic matron, the headman and a representative of the business community) were interviewed

4.4 COLLECTION OF DATA

4.4.1 Semi-Structured Interviews

To collect data for this research study, the researcher carried out personal/individual interviews with villagers (agricultural farmers, school principals, local small enterprise representative and the village Headmen). The semi-structured interviews were necessary to allow the participants to speak more openly and widely on issues raised by the researcher (Denscombe, 2010). Not all questions were designed and phrased ahead of time. Some questions were created during the interviews, to allow both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues.

4.4.2 Secondary Data Sources

The researcher made use of various existing reports on climate change and floods from various sources. According to Cohen, Manion and Morrison, (2005) Secondary data is data collected by someone other than the user. Common sources of secondary data for social science include censuses, surveys, organizational records and data collected through qualitative methodologies or qualitative research. Secondary data analysis saves time that would otherwise be spent collecting data and, particularly in the case of quantitative data, provides larger and higher-quality databases that would be unfeasible for any individual researcher to collect on their own. Secondary data is considered to be essential especially in capturing past changes and or developments.

4.5 LIMITATIONS AND CONSTRAINTS DURING THE INFORMATION GATHERING PROCESS

Some participants did not fully understand what climate change is and how it applies to them or how to relate floods to climate change. This could be due to the fact that climate change is really still a new concept in Namibia. A lot of effort is needed to bring understanding and awareness of climate change and its impacts especially to people living in rural areas. A public awareness and education campaign that was commissioned by MET on climate change was carried out in major centres and towns in nine regions in Namibia by the Multidisciplinary Research and Consultancy Centre (MRCC) of the University of Namibia (Mosimane, 2004). It revealed that climate change does not elicit immediate importance for most people in the regions that they visited. During the present assessment, responses from stakeholders further confirmed that climate change is a new concept and is poorly understood.

A limitation of the assessment was that it was carried out from 17-28 December 2011. This is a holiday/festive season. Learners and teachers were on school holiday. Some people/villagers were not willing to be interviewed.

4.6 DATA ANALYSIS

4.6.1 Interviews

Discussions during the interviews were written down. The researcher then used the notes as basis while at the same time used her mobile phone to record some of the crucial conversation to ensure that no crucial information was omitted from the notes.

Information collected via the above mentioned methods were analysed through logical analysis and the use of Microsoft excel. Logical analysis according to Punch. (2009) is an outline of generalized causation, logical reasoning process, etc. It makes uses of flow charts, diagrams, etc. to pictorially represent these, as well as written descriptions

4.7 VALIDITY

According to Denscombe (2010), the issue of validity is more a credibility issues to demonstrate that data collected is accurate and appropriate. In order to address the accuracy and the appropriateness of data, the researcher tried to triangulate data by using data from the interviews of all responded and the literature related to the impact of climate change, especially on developing countries, with specific reference to floods. To further increase the validity for the data collection methods, the researcher made sure that feedback given during interviews answers are well considered to give less room for ambiguity. This was achieved through proper and thorough planning of the interviews, which the researcher rehearsed and cross-check before the conduction. Punch (2009) also points out that the issue on validity of interview response and questionnaires can be 'countered by careful design, planning and training'.

4.8 ETHICAL ISSUES

Cohen, Manion & Morrison (2005) states that *"although researchers know who has provided the information or are able to identify participants from the information given, they will in no way make the connection known publicly; the boundaries surrounding the shared secret will be protected."* Before the interviews were conducted, the researcher visited the Headmen for the purpose of seeking the permission to go around the village and carry out the interviews. The Headman also offered to that his Area Secretary to accompany the researcher to the local business area where the business representative was met and interviewed.

Below are the decisions taken with regard to some of the ethical issues relevant to the context of this research;

Table 1: Ethical Issues

Issues	**Decision**
Information given to participants	The participants were given background information and the main aim of conducting the interview.
Participants right of withdrawal	Participants were informed on their right to withdraw from the interview at any point they might have wished or withdraw from answering questions that they did not want to answer.
Informed consent	Since some of the participants involved were learners, the researchers first asked for permission from their parents in order for them (learners/children) to take part in the research.
Anonymity	The participants were informed that their real names will not be used in the final report and will only be made known to the researcher. Data was therefore made anonymous and names of participants were withheld.
Data collection	Before conducting the interview, participants were asked for their permission to allow the interview to be noted down by the researcher.
Data storage	The interview transcripts throughout the research process will be kept safely and permission obtained from Participants for further research or publication.
Data Protection Act	Should there be a need to disclose information about the participants involved in the study, permission will first have to be requested from those that have taken part.
Feedback to Participants on Completed Study	Participants (especially, the Headman) were given a preliminary copy of the final report should they wish to have one.

Source: Primary data analysis of the researcher

CHAPTER FIVE

RESULTS PRESENTATION, INTERPRETATION AND DISCUSSIONS

5.1 INTRODUCTION

This chapter focuses on the analysis and interpretation of the interview questions (refer to annex one). Data analysis and interpretation of data are closely related. In data analysis, the collected data is broken up into groups or elements which the researcher examines separately, and translates into immediate results. In interpretation, the immediate results will be translated into integrated and meaningful general references and findings. The findings must be relevant to the objectives of the research. If both data analysis and interpretation are not carried out properly, the success of the study cannot be assured (Punch 2001).

Descriptive statistics such as tables, pie charts and bar charts were used to aid the analysis of data because they are effective illustrations of depicting relations and trends.

5.2 INTERVIEWS

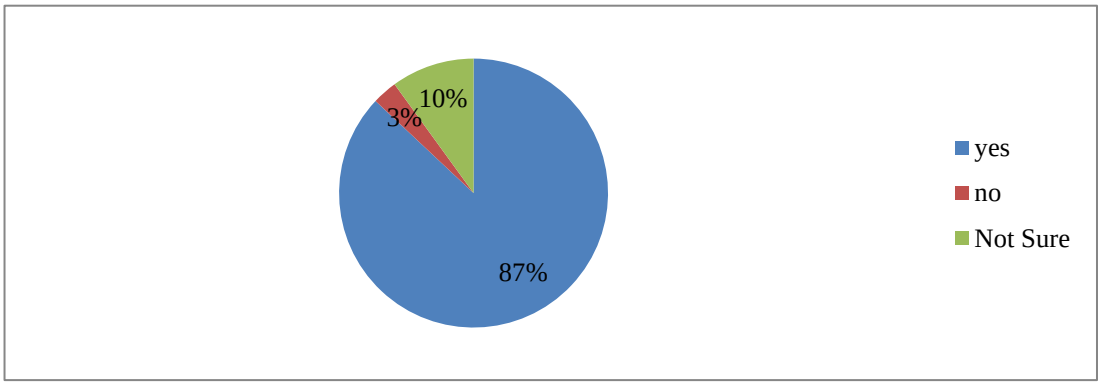
The researcher chose to interview the heads of the households face to face using a questionnaire, regardless of their gender and other members of their families between the ages of 16-70.Other members of the households were also interviewed but were regarded as a unity (regardless of how many people were interviewed within one households, they all constitute a unit) this was important to make sure that the heads of the households being interviewed provide primary information on how they were affected by the flood. In addition to the 50 respondents within households, the researcher also interviewed some key informants in the village i.e. the Headman, the School Principal, Business Community Representative as well as the Clinic Matron/Registered Nurse. The study was carried out three years after the 2009 flood, which is said to be the first ever devastating climatic event that was ever experienced not only within the Oshitutuma village but in all NCRs. The surveys were conducted over a period of two weeks, from 17-28 December, 2011.

Of the 50 + other 4 key respondents persons surveyed, 47 of the respondents provided valid responses to the questions, giving a response rate of about 94. The remaining 6 percent of the respondents refused to take part in the survey because they did not feel comfortable discussing their problems with a stranger.

5.3 KNOWLEDGE OF CLIMATE CHANGE

A question was asked about whether the respondents know the meaning of "climate change". It was important that the researcher determines the respondent's level of understanding of the subject matter to ensure the validity of their answers. For this purpose, the researcher offered some basic explanations on the meaning of climate change to those respondents who stated that they do not understand nor sure of what climate change is all about.

Figure 2: Knowledge on Climate Change



Source: Primary Data

About 87 percent of the respondents indicated they know what climate change is, whereas 10 percent indicated they are not sure about what climate change is about. Only 3 percent stated that they do not know what climate change is. This is corroborated by the fact that in community meetings, radio and television programs, and conversations among friends, the subject is discussed. Indeed, most respondents indicated these three media as sources of information about the environment (refer to table 2 below). Perhaps, the 2009 flood has raised awareness on natural disasters.

5.4 SOURCES OF INFORMATION ABOUT THE ENVIRONMENT

The researcher asked the respondents to rank the most three sources of information about the environment within their community.

Table 2: Sources of Information about Climate Change

Sources	Ranking
Community information meetings	15
Conversations with friends	20
Environmental groups	0
Print media: newspaper or magazines	0
Mass media: radio or television	10
The Internet/World Wide Web	0
Conversations with family members	0
Technical or scientific publications	0
School	5
Other	0

Source: Primary Data

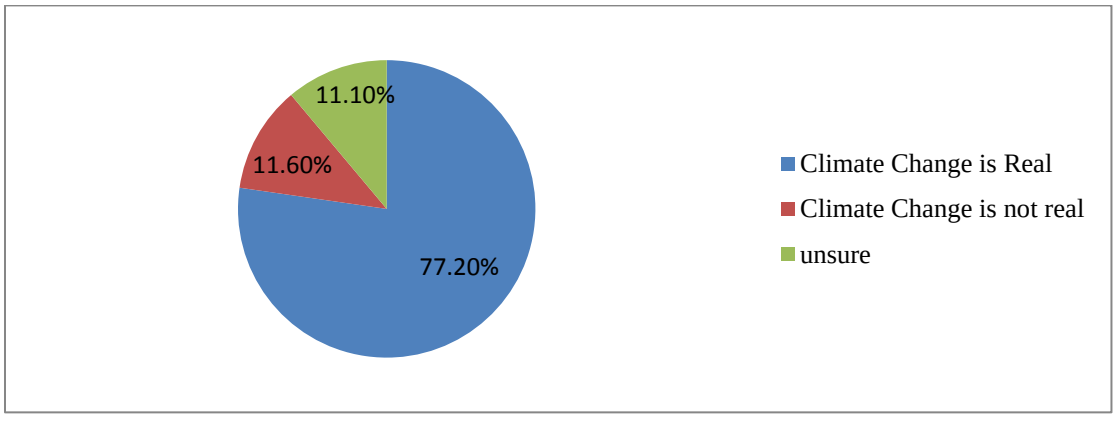
As it appears in table 1 above, about 20 respondents ranked conversations with friends, as the highest source of information about the environment. This according to the respondents happens when they visit each other. The majority of the respondents who ranked this source are elderly who stated that they are no longer physically fit to attend community meetings where such information is likely to be shared. About 15 stated that they get such information through

community meetings whereas 14 said they hear about such information from media such as radio and television. The remaining 5 respondents stated that they get such information from schools. These are mostly learners that were interviewed while on school holiday with their parents.

5.5 BELIEF IN CLIMATE CHANGE

As indicated in Figure 7 below, despite the fact that the flooding that affected the region was unprecedented, about ¼ of the respondents said they do not believe in climate change or they are unsure. According to those that are unsure, they have doubts on whether the climate is really changing or it is just part of the nature, which they term “God’s doing”. The respondents that stated climate change is not real (11.1 percent) are certain it is all "God’s doing". The majority of the respondents in this latter category are elders, ranging from 59-70 ages. They believe, this is just a sign of the “World coming to an end”.

Figure 3: Belief in Climate Change



Source: Primary Data

Having determined the level of knowledge and belief of the respondents in climate change, the researcher proceeded to discuss the extent of the geographical areas affected by the flood, the help offered by the Government of the Republic of Namibia (GRN), and whether this constitutes long-term solution.

5.6 NUMBER OF YEARS SETTLED IN THE VILLAGE

The researcher wanted to find out about the respondents' length of stay in Oshitutuma village. This was important to establish if flood is a new phenomenon to the respondents within the area, which could only be done drawing from the experiences of the residents of the area.

Table 3: Number of Years in the Village

Number of years	**percentages**
1-5	0
5-10	0
10-15	6
15-20	10
20-25	12
25-30	12
30-35	10
35-40	10
40-45+	40

Source: Primary Data

As it appears in table 2 above, about 40 percent of the respondents have been in Oshitutuma for quite a long time (between 40-45+ years). None had been in the village for less than 10 years and only 6 percent of the respondents had lived in the village for some few years which is 10-15 years.

5.7 THE VULNERABILITY OF OSHITUTUMA VILLAGE TO FLOOD

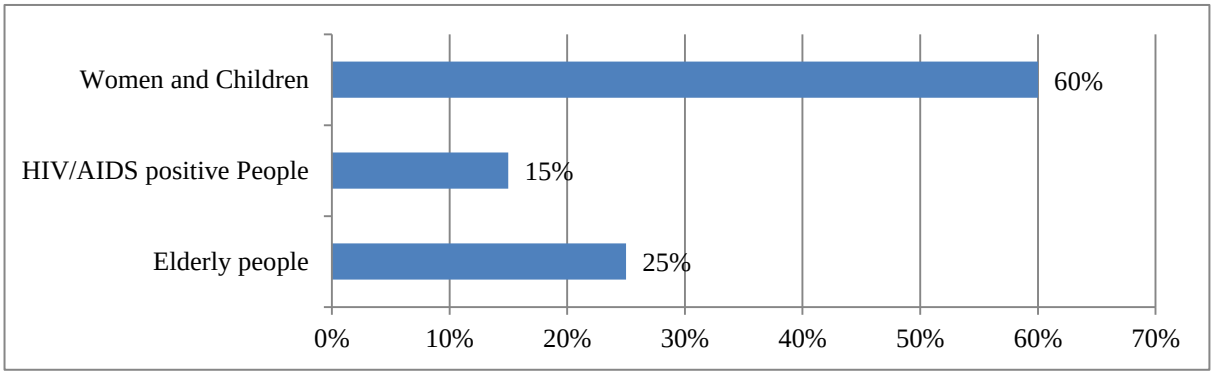
A question was asked about what the respondents think makes Oshitutuma village vulnerable to the impact of flood. The following were some of the factors identified by the respondents:

- the village is situated in a low-lying area;
- the village is located in the Cuvelai basin (*oshanas*), which are floodplains, and
- prolonged local rainfall coupled with floods from Angola.

5.8 THE MOST VULNERABLE GROUPS

The researcher further wanted to find out about the most vulnerable groups within the community/village to determine whether they have specific vulnerability because of their social characteristics. This vulnerability is within the context of coping with the impacts.

Figure 4: Vulnerable Groups



Source: Primary Data

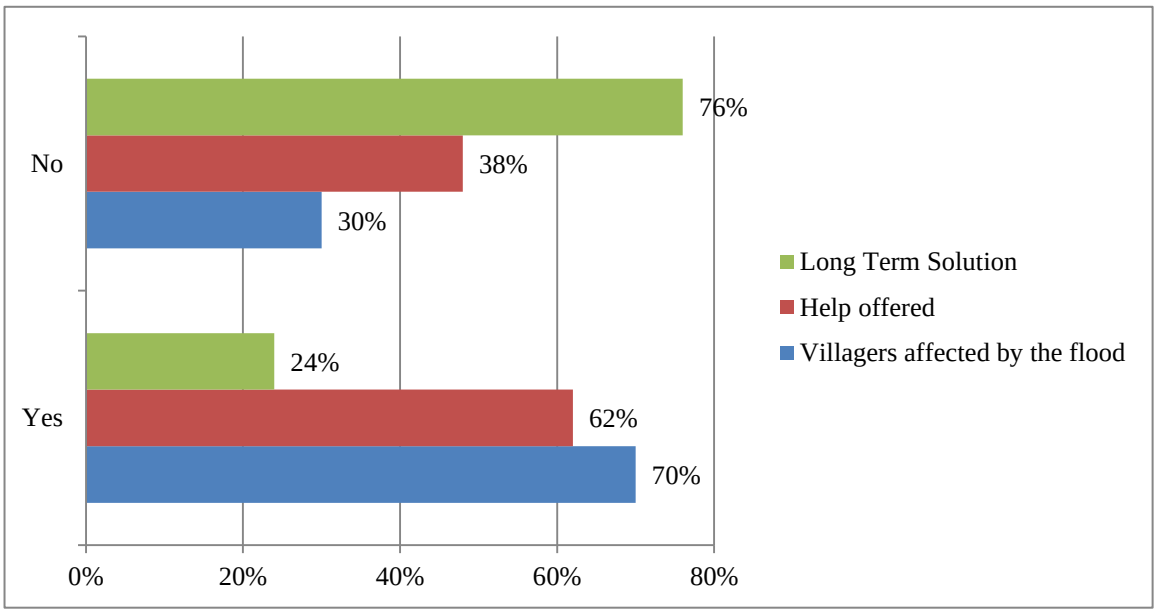
According to the respondents, 60 percents, women and children were the most vulnerable when it comes to flood. This is because women are believed to find it difficult to cross the water in *oshanas* because they cannot swim compared to men in general. The same goes with children, who according to most respondents suffered from cold and flu and diarrhoea. The elderly people are said to be the second (25%) most vulnerable to the impacts of flood because , they find it extremely hard to walk around especially with water in *oshanas* plus the fact that

already most of them are physically weak because of the their ages. Another reason given was that most old people survive on old age pensions, which they believe is not even enough to support them with their daily needs. However, most of their pension money was apparently now being used to renovate their destroyed houses especially for those who do not have working family members. As far as the people living with HIV/AIDS are concerned (believed to be most vulnerable by about 15% of the respondents), this was to difficulties of accessing the clinic for their ARV treatments because of water in the *oshanas*. Most of the HIV/AIDS patients on ARVs treatments had to miss their routine follow-ups at the clinic due to flood. In additions to the three groups, people with physical disabilities were also stated to being very vulnerable especially when it comes to crossing *oshanas* that filled with water.

5.9 THE EFFECTED POPULATION, ASSISTANCE OFFERED BY GRN AND THE LONG TERM SOLUTIONS OF FLOOD

Three questions were asked to determine how many of the respondents were affected by the flood and whether there was any sort of help offered to the victims, as well as their thoughts long-term solutions to flood.

Figure 5: Population Affected by Flood , Help Offered and Long Term Solutions



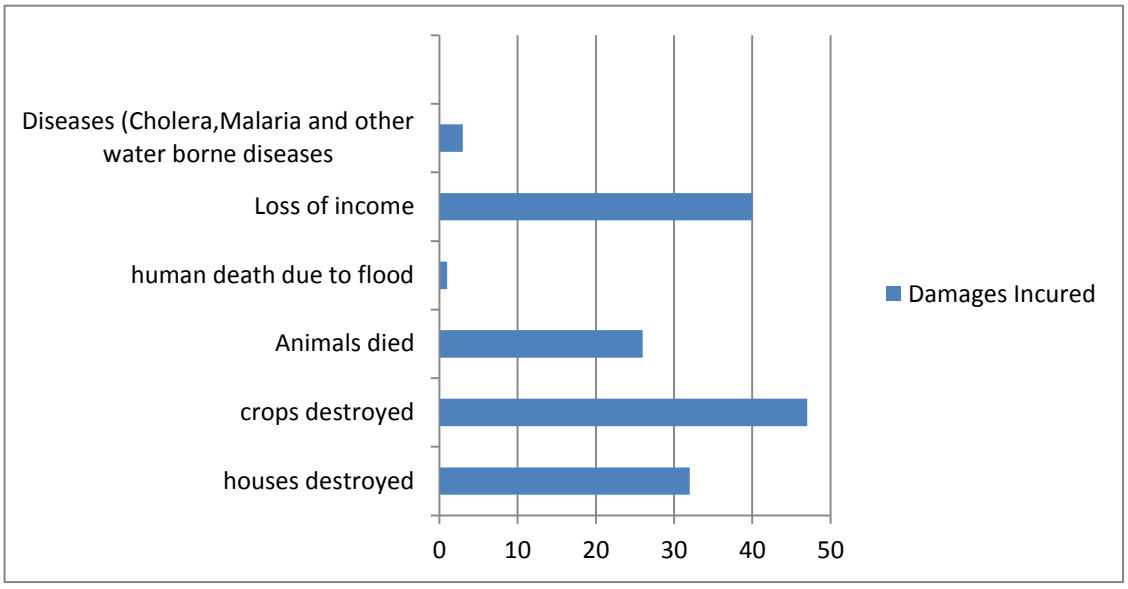
Source: Primary Data

As seen in figure 8 above, about 70 percent of the respondents indicated that they were affected by the 2009 flood, whereas 38 percent were not affected. Regarding the assistance given to the flood victims of 2009, 62 percent indicated that they were offered help by the government through the headman and their Constituency councillor. The assistance was, according to the respondents, in the form of relocation to temporary tents, food (and some other basic necessities). There was nothing given to the victims for the purpose of reconstructing their damaged houses and other important infrastructures. The rest of the respondents (38 percent) indicated that they were not offered any assistance. They further stated that assistance was mostly offered to those that had their houses completely destroyed. The researcher further wanted to find out from the respondents whether there are any long-term solutions to flood and what those could be. There is a strong feeling among the respondents that there is no long-term solution to flood. About 76 percent of the respondents feel floods are not a man-made thing, hence; it cannot be controlled by human beings except God. For this reason, they feel there is little that can be done. Only 24 percent think there is a solution to solving flood problem.

However, the solution they are suggesting is not really on controlling floods from occurring but rather on avoiding its impacts on residents. This, according to the respondents, can only be achieved by permanently relocating those households that are located in low-lying/ flood prone areas to somewhere else. This, according to them, will be challenging because of lack of land and also because only few residents would want to be relocated somewhere else permanently as most of them were born in that village and their ancestors was also buried there. Another solution they suggested is that of making sure that no more houses should be allowed to be built in low-lying, flood prone areas, a responsibility they reckon to be taken up by the village Headman.

5.10 THE DAMAGES INCURRED

Figure 6: Damages Incurred from 2009 Flood



Source: Primary Data

The findings are that, all 47 respondents stated that their agricultural crops were destroyed whereas 40 respondents stated that they lost income due to flood. The researcher sought to understand better how the respondents lost income due to flood. The majority indicated, since their crops were destroyed, they lost opportunities to sell some of their

agricultural surpluses and also because of losses of their animals on which they depend to get some income through sales. About 32 respondents stated that their houses were destroyed by flood water. Only 26 respondents indicated their animals died due to water. Majority of the respondents feel the reason why some of their animals were not killed by flood water is because most of their animals are kept at cattle posts which are far away from the village and are not affected by flood. The animals said to have died due to flood water are goats and sheep and some chickens. About 13 business buildings were said to have been destroyed and closed due to floods. One respondent stated that they lost a loved one due to drowning.

5.11 COPING MECHANISMS/ADAPTATIONS MEASURES

Taking into account the danger of flood and especially its impacts on the respondents, the researcher asked the respondents about the possible coping mechanisms, especially as far as agricultural activities are concerned. About 90 percent state that it was extremely difficult to cope with flood. According to the respondents, unlike drought, where farmers can opt to grow "drought resistant crops" it is unfortunately not the same thing with flood. The common crops grown in the village are mainly Mahangu, Millets and sorghums. None of these crops can grow in water, neither are others such as beans, water melons etc. ,for these reasons, the respondents stated that most of them barely survive out of pockets to buy most of their basic food. This situation is said to be extremely hard especially for old people that depends on a mere N$ 450 pension per month and worse for those who have no source of income at all because of unemployment. However, the respondents also indicated that the GRN did offer some assistances through "drought relief food" supplied through the office of the Constituency Councillor in conjunction with the Headman. These assistances are, however, according to respondents, mostly offered only to those that have suffered major losses (mostly those that had to be relocated) due to flood.

5.12 IMPACT ON THE SCHOOL

The researcher wanted to find out how the school was impacted by the 2009 flood. This question was specifically addressed to the school principal who indicated that the school was heavily affected and had to close for about three months (during the first term) because classrooms were filled with water and also because most learners as well as teachers were cut off or could not access the school. To make up for the lost time, the school had to forgo the August two weeks holiday. Moreover, the school principal stated that the school lost one of its pupils who drowned in the *oshanas* while going to school. The researcher also wanted to find out if the situation had an impact on the quality of education and the school overall performance during 2009. According to the School Principal, the pass rate, especially for the Grade 10 learners was very poor. The pass rate was reportedly gone down with 4% percent as compared to the previous year (2008). This, the school Principal accredited to the fact that the school had to close down for the three months. In addition the school principal stated that many learners could not concentrate at school because of the conditions of the classrooms and the fact that most of them had to pass through deep water as they come to school. The Principal also added that many learners lost their books in water.

5.13 IMPACT ON THE CLINIC

According to the clinic Matron, the Clinic did not really experience much of an impact because it is located on high ground. However, because most people could not access the clinic because of water in the *oshanas,* the Nurses had to be transported to individual people's houses especially where elderly people, disabled as well as children needed treatment. In addition to this, the Clinic Matron stated that the situation was mostly tough for the HIV/AIDS patients because it was extremely difficult for those on Antiretroviral (ARV) treatments because of difficulties accessing the clinic due to heavy flood. The challenge to the clinic was mainly because of lack of transport to transport the nurses and their treatment utilities. The matron

however mentioned that things were made easy because the GRN provided some helicopters that were availed at some later stages to help in this regard.

5.14 IMPACT ON THE BUSINESS COMMUNITY

According to the business representative, the business community suffered a huge blow during the 2009 flood. This was apparently more because, the cuca shops are located right within *oshanas* which get fully flooded. Only few shops were able to operate despite being under water. About 70% of the businesses were reported to be closed. There was no assistance given to the business community by the GRN and owners had to struggle to get money to re-open their business after the water had dried up. The researcher also asked whether some business owners sought for credit from commercial banks to re-open their businesses. This is apparently a challenge for most of the business owners at the area because of their size (very small) and many are regarded as non credit worth by the lenders.

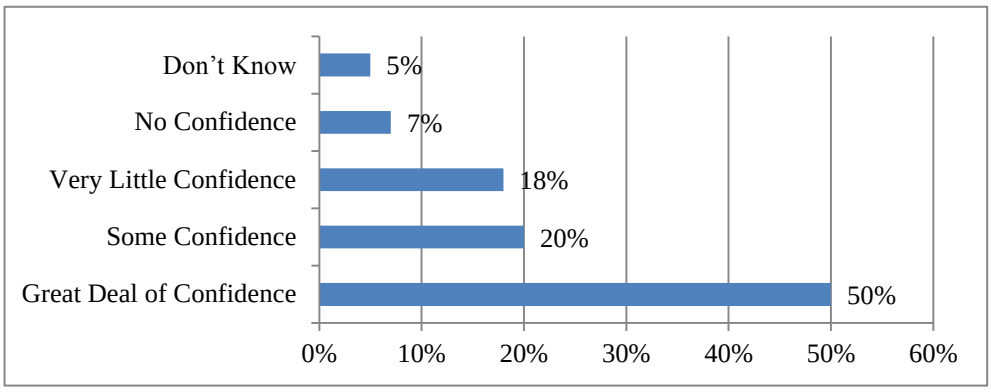
5.15 DISEASES/ OUTBREAK CAUSED BY FLOODS

According to the Matron, some cases of Malaria, diarrhoea, cold as well as flu were reported. This was largely experienced by those residents that were temporarily settled in tents. The living situation at the settlement was reported to be not conducive and had a lot of mosquitoes, hence exposing the people to diseases such as Malaria. . Some of the patients that were treated for Malaria were said to have been exposed to the disease because they days in water (and some reported overnight camping) catching fishes

5.16 LEVEL OF CONFIDENCE IN GRN

The researcher sought to determine the respondents' level of confidence in GRN in responding to floods.

Figure 7: Level of Confidence in Government



Source: Primary Data

About 50 percent of respondents stated that they have a great deal of confidence in the GRN's ability to deploy responsive measures to minimise the impacts of floods on residents, whereas 20 percent have some confidence but feels that the sort of responsive measures which the GRN deploys are not sustainable because they do not address the problem in the long run. Some 7 percent of respondents do not have any level of confidence in the GRN at all, stating that the GRN has failed to offer them with any sort of assistance despite the fact that they were also affected by the flood. This sentiment is shared more by the business community and other respondents who were not relocated to temporally tents but still were affected by floods. The remaining 5 percent stated that they do not know or are not sure.

5.17 GENERAL EFFECTS ON DEVELOPMENT

Climate change is said to be threatening development in general. to understand how development was affected especially by the 2009 flood, the researcher asked the Headman specifically whether there were any developmental projects within the village/constituency that was affected/delayed or disrupted by the flood. According to him, the flood did disrupt the building of the tarred road that was to link their village to Okalongo Constituency. The work was scheduled to begin in 2009 April but had to be put on hold due to flooded *oshanas*. The Headman also indicated that, apart from the road construction project, there are other individual

activities by some villagers- meant for betterment of their standard of livings- that were either destroyed by flood water or disrupted. These includes, building of their houses, some were busy digging pipeline for personal water taps in their houses but had to stop because of floods.

5.18 OPPORTUNITIES PRESENTED BY FLOOD

Floods are generally not just seen as a threat but sometimes may also present some opportunities. The researcher wanted to determine if there were any opportunities or positive aspects presented by the 2009 flood in Oshitutuma village. According to the respondents, the 2009 flood did present to the local residents an opportunity for fishing. The water from Angola brought along lots of fish. Most of the residents in the village benefited a lot through catching and selling of fish and of course eating at their houses. Hence, the incomes of most respondents were supplemented through the sales of fishes. In addition, most respondents stated that during the flood season, most people did not spent money on meat because there were plenty of fishes in the *oshanas*.

5.19 CHALLENGES AND FEARS FOR FUTURE FLOODS

Looking ahead, the researcher asked the respondents what are their fears for the future as far as flooding is concerned. About 90 percent of the respondents indicated they fear the future and especially are uncertain as to how the flood patterns are going to be for coming years. Those that had been severely affected and had to live at temporary settlement fear if this is going to be a continuing occurrence for the next several years.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The first section of this chapter deals with the conclusion based on the whole report , whereas the second section looks at the possible recommendations that could be implemented and taken into account in order to reduce the Oshitutuma residents' vulnerability from seasonal floods and overall reduce the impact of climate change on the achievement of Namibia's development goals.

6.2 CONCLUSIONS

The results of the data gathered through interviews have assisted the researcher to reach certain conclusions. Through these results, the researcher discovered how flood had impacted the residents of Oshitutuma village. This is just one village among hundreds of villages in the six Northern affected Regions; there are others that may have been hugely affected . For this reason, that it is safe to conclude that climate change does have the potential to undermine Namibia's development goals and threaten the achievement of national development goals, including Vision 2030. This is backed up by not only looking at the highlighted impacts but also the amount of money spent by the government especially towards relocation and resettlements of floods victims. This money could have been spent on other developmental activities/initiatives necessary for the achievement of the country's developmental goals; however, the focus has been shifted towards the costly emergency response exercise (the challenges posed by climate change).

The damages to infrastructure and loss of livelihoods caused by the extreme flooding of the year 2009 in Northern Regions have exposed the regions' vulnerability and unpreparedness for climate change impacts. The findings further highlighted the linkages between vulnerability

to climate change and pressing socio-economic issues in Namibia such as poverty, lack of income and employment opportunities. The villagers' vulnerability to climate change exacerbates issues of poverty and lack of income due to the impacts of flooding.

As a country, Namibia needs to prepare itself to effectively use the threats and opportunities of climate change to lay solid foundation for a sustainable and prosperous Namibia. The impacts of climate change will increase the challenge of on-going poverty alleviation efforts in Namibia. It will hit hardest, those whose livelihoods are more intimately tied to local resource bases and therefore more climate-sensitive. Survey findings point to high vulnerability within agriculture-based livelihood system. This demonstrates the immediate need for an acknowledgement and improved understanding of vulnerabilities so that appropriate adaptation measures can be implemented swiftly. In addition, within these subsistence systems, those groups already marginalized will be at a higher risk; special attention should be given to reducing vulnerability amongst women, young children, elderly, and the ill/disabled.

The findings from the local-level surveys conducted demonstrate that residents of Oshitutuma village are already experiencing the effects of climate change. Therefore it is imperative that support for adaptation is provided immediately and that efforts to develop a strong cross-cutting national adaptation strategy are prioritized. Sectors that address water, food security, health, and disaster management must be involved and have a coordinated action plan. Many of the solutions proposed by communities to adapt to climate change are existing intervention activities; therefore, in some cases, building up project support for adaptation may simply be a matter of scaling up or reprioritizing certain activities.

6.3 RECOMMENDATIONS

As indicated in the conclusion, the residents of Oshitutuma, and in many other flood affected regions in Namibia are already experiencing the impacts of climate change. Therefore it is imperative that support for adaptation is provided immediately and that efforts to develop a strong cross-cutting national adaptation strategy are prioritized.

The following are general recommendations for all other stakeholders who could play a meaningful role in reducing the vulnerability of the local residents or communities from seasonal floods:

- **Improve adaptation capacity of the local resident**

According to Ellis and Imasiku, (2009) the worst flood experienced in Namibia was in 1972). However, according to the available records, the 1972 flood did not affect the Oshitutuma residents hence many residents could not recall the event of 1972. Recent seasonal floods (not only that of 2009 but the following years, 2010 and 2011) experienced by Namibians have created significant damage to the country's economy. The number of people affected by flooding has been increasing every year. For this reason, it is very important to find ways and measures that could decrease the vulnerability of residents such as those in Oshitutuma village to future floods as intense flooding has been the case for the past several years. One of the ways of reducing problems resulting from flooding is through improved adaptive capacity. There should be adaptive measures in place to help local residents cope with the impacts of climate change, especially those related to floods. In addition, people need to be educated about the danger of unplanned settlement. This will help to lessen the impact of increased flooding, hence reducing the vulnerability of the residents.

- **Relocation to Safer Areas**

The findings of the research points out that, residents stated that Oshitutuma is vulnerable to flooding because it is located on low-lying ground. In this case, housing relocation to safer (higher) grounds is a possible solution. The most preferred solution would be for the homeowner to move voluntarily to a higher location close by. It should be however taken into account that this recommendation may not be feasible to residents of Oshitutuma village because of lack of available land. Moreover, despite the damages experienced by these residents, many still feels being relocated permanently from their houses is not an option because they do not want that. The following are some of the common factors that cause failure of relocation programs:

- resettled sites which are inappropriate, or distant from the communities' original livelihoods or social networks;
- new settlements which no longer allow for kinships or social cohesion;
- failure to provide for farming needs (e.g. space for livestock, tool sheds);
- inadequate housing materials;
- groups resettled together that belong to different ethnic or cultural groups, or social backgrounds; and conflict or competition with adjacent communities with valid claims over resettlement sites.

Successful resettlement programs post-disaster have tended to include the following features:

- the affected communities have participated actively in the site selection, housing design and features of resettlement planning;
- past livelihoods (e.g. fishing, crop cultivation) have not been disrupted;
- basic needs and aspirations—health, education, jobs, water, transport—continue to be accessible and affordable at the new sites;
- the resettled community belongs to similar ethnic, cultural background or has similar occupations (e.g. farming/fishing);

- they lack excessive emotional ties to the old sites, and are able to bring with them items of high emotional, spiritual or cultural value; and the housing designs, layouts and natural habitats conform to the community's way of life.

- **Strengthen Capacity**

It is recommended that communities' capacity be strengthened through recruitment and training of community health extension workers in life saving skills, such as provision of first aid to reduce the effects of injuries and drowning in the community during the crisis.

- **Preparedness for future hazard events**

Given the past trend of these flooding events as well as the likelihood of future flooding, there is a strong need for some special funds in light of the imminence of the next flooding seasons during the coming years. Moreover, emergency response interventions must involve working with communities to prepare for future inundation, working immediately to reduce the risk and preparing together for possible future relocation and other flood mitigating actions.

- **Lay the foundations for long-term recovery**

Being an arid country, Namibia is predominantly prone to weather-induced hazards, mainly droughts, wildfires, and windstorms. Floods, although relatively more infrequent than these other hazards, often result in population displacement, economic disruption such as transport communication, livestock, crops and other physical and environmental assets are destroyed, resulting in significant economic costs. In these circumstances, developing a resilient Namibia becomes a progressive development undertaking which requires reconstructing the livelihoods and socio-economic systems of affected communities to standards higher than those pre-disaster levels so as to reduce exposure to and impact of prospective hazards. Transitions from disaster to development create windows of opportunity for such transformations in which the role of emergency response is fundamental. Early Response (ER) is transformational because it involves early warning – early action; hence, early protection, stabilization and

rehabilitation measures to generate quick stabilization of household and community welfare in the aftermath of disasters while building capacity to scale up pilot ER interventions and to strengthen longer-term development programmes and reforms. To be effective, ER should aim to support national, regional and local capacities, strategies and policies required to promote sustainable solutions in long-term recovery and reconstruction by providing guidance for utilizing long-term development plans and priorities in the affected regions as the take-off point for building back differently.

- **Food, Agriculture and Income: Protection and Diversification**

The flooding has caused substantial disruption to livelihoods, especially for subsistence farmers. Therefore, it is imperative for the government to provide immediate employment opportunities, restore basic conditions for farmers and to promote diversification. With this in mind, interventions are recommended in cash-for-work programmes, provision of agricultural inputs/technology, increased use of micro-finance and vocational training. To top the list of priority for support should be the most vulnerable groups within the communities.

- **Strengthen the Early Warning System and should be made readily available**

Early Warning System (EWS) are some of the types of precautionary measures that enable the responsible institutions, stakeholders and local residents to make timely decisions, rather than having to be caught unaware, avoiding damages. These EWS should integrate the warnings of possible floods and water level and intensity. Community members (general public) need this kind of information so that they are able to make informed decisions such moving to high ground during flooding season.

- **Strengthened Community Environmental Awareness and outreach activities**

There is a strong need to strengthened community awareness campaign about climate change. This is important because environmental education will make general communities aware about the environmental problems and will equip local communities with knowledge on how to overcome these

problems. The affected communities have, to a large extend, lost their traditional coping mechanisms to floods following the many years of relative climate stability. It is now critical to revive and update adaptation practices through major awareness campaigns. A good example is the *Learning to Live with Floods* campaign carried out in Mozambique following the 2000 floods. Community leaders and school children were taught to learn to live with floods , never forget past disasters and their markers, understand their impacts, lower future risks, and know what to do in case of an emergency.

Namibia needs to adopt adaptation measures that makes the effects of climate change less disruptive and spare the poor and the vulnerable from shouldering an unduly high burden. There is a strong need to diversify the economy to ensure less reliant on sectors such as agriculture that are more vulnerable to climate change effects. Policies Makers need to develop development policies which make more resources available for minimizing risks. Namibia cannot afford to follow the "***development as usual"*** approach hence the need for adaptation which requires a different kind of development such as breeding crops that are drought and flood tolerant, climate-proofing infrastructure to make it resilient to climate risks and accounting for the inherent uncertainty in future climate projections in development planning.

Climate change undoubtedly threatens development and worsens communities' standards of living. The researcher hopes these recommendations will be useful to decision makers as well as policy makers in addressing the issues of climate change particularly flooding; by finding possible adaptation measures.

7. REFERENCES

Arnell N.W., (2004), Climate change and global water resources: SRES emissions and socioeconomic scenarios. Global Environmental Change

Bank of Namibia 2006 Annual Report

Baumert K. A., Herzog T., and Pershing J., (2005). *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy* (Washington: World Resources Institute).

Baumert L., Kevin A., Herzog T., and Pershing J., (2005). Navigating the Numbers: Greenhouse Gas Data and International Climate Policy (Washington: World Resources Institute).

Böhringer C. and Andreas L., (2005). "On the Design of Optimal Grandfathering Schemes for Emission Allowances," European Economic Review, Vol. 49

Boyer J., (2000). Warming the World: Economic Models of Global Warming (Cambridge, Massachusetts: MIT Press).

Brooks N., (2005). Drought in the African Sahel: variability, change and agency/ -Saharan Studies Programme, Tyndall Centre for Climate Change Research and School of Environmental Sciences, University of East Anglia, Norwich.

Carter TR, Jones RN, Lu X, Bhadwal S, Conde C, Mearns LO, O'Neill BC, Rounsevell MDA, Zurek MB (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, (eds)

CBS, (2006). Namibia Household Income and Expenditure Survey 2003/2004. Central Bureau of Statistics, National Planning Commission, Windhoek, Namibia.

Central Bureau of Statistics (2001) National Accounts 1993 – 2000. Windhoek, Namibia.

Central Bureau of Statistics (2005). 2001 Population and Housing Census – Omusati Region. Windhoek, Republic of Namibia.

Claussen M., Brovkin V and Ganopolski A, (2003). Climate change in northern Africa: The past is not the future. Climatic Change

Cline W., (2007). Global Warming and Agriculture: Impact Estimates by Country (Washington: Center for Global Development).

Cohen L., Manion, L., and Morrison K., (2005). Research Methods in Education (5th ed), Routledge/Falmer, London & New York

Cooper D. and Schindler P., (2003). Marketing Research, USA: McGraw-Hill Companies, Inc.,

Dasgupta G. and Partha M. 2007, "Commentary: The Stern Review's Economics of Climate Change," National Institute Economic Review, Vol. 199

de Klerk J. (2004). Bush Encroachment in Namibia: Report on Phase 1 of the Bush Encroachment Research, Monitoring and Management Project. Windhoek, MET

Denscombe M., (2010). The Good Research Guide for Small-Scale Research Projects, Open University Press, Glasgow.

Desanker P.V., (2002). Impact of climate change on Africa /Center for African Development Solutions, Johannesburg, South Africa-University of Virginia, Charlottesville, VA, USA, August 2002

Dilley M., (2003). Regional Responses to Climate Variability in Southern Africa: Coping with Climate Variability: The Use of Seasonal Forecasts in Southern Africa. Ashgate Publishing Limited, Hampshire, England.

Dirkx E., Hager C., Tadross M., Bethune S., and Curtis B. (2008). Climate change vulnerability and adaptation Assessment. Desert Research Foundation of Namibia and Climate Systems Analysis Group. Prepared for the Ministry of Environment and Tourism.

Dolcemascolo G., (2004). Environmental Degradation and Disaster Risk. Bangkok: SENSA and SIDA.

Ellis H., and Imasiku N., (Eds). (2009). Floods in north becoming more intense and destructive. *Earthbound*. 4 (1)

FAO, (2005). The state of food insecurity in the world 1999. Rome, Food and Agriculture Organization.

FAO, (2008). Climate and Food Security: A framework document. FAO, Rome.

FAO, (2008). Climate Change adaptation and mitigation in the Food and agriculture sector, FAO, Rome.

Fischer G., Shah M., Van Velthuizen H., (2002). Climate change and agricultural vulnerability-. IIASA, Luxemburg

Ghauri P, Gronhaug K (2005). Research methods in business studies. Dorset: Prentice Hall

Government of Namibia (2002). Namibia Initial National Communication to the United Nations Framework Convention on Climate Change.

Hope C., (2006). "The Marginal Impact of CO2 from: An Integrated Assessment Model Incorporating the IPCC's Five Reasons for Concern," Integrated Assessment, Vol. 6

Houghton J. T., Meira Filha L. G., Callander B. A., Harris N., Kattenberg A., and Maskell K., (1996). "The Science of Climate Change." Second Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

Hulme M. R. M., Doherty T., Ngara M. G, and Lister D., (2001). 'African climate change: Climate Research

Huq S., Reid H., and Murray L.A., (2006). Climate Change and Development Links. London, IIED)

INC (2002). Initial National Communication to the United Nations Framework Convention on Climate Change. MET: Windhoek

Intergovernmental Panel on Climate Change (IPCC) (2007). Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, and L.A. Meyer (Cambridge, United Kingdom: Cambridge University Press).

Intergovernmental Panel on Climate Change Working Group I (2000) Special Report on Emissions Scenarios (Cambridge University Press, Cambridge, UK).

Intergovernmental Panel on Climate Change Working Group I (2007) Summary for Policy Makers (Cambridge Univ Press, Cambridge, UK).

International Monetary Fund (IMF) (2008). "The Fiscal Implications of Climate Change" (Washington, forthcoming). International Road Federation, various issues, World Road Statistics (Geneva).

IPCC (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK. New York, US, Cambridge University Press.

IPCC (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK, New York, US, and Cambridge University Press.

IPCC (2007). Summary for Policymakers Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

IPS (2004). Development-Africa: Millet, Sorghum Could Hold the Key to Food Security. Inter Press Service News Agency. www.ipsnews.net/africa/interna.asp

Jones P. G., and Thornton P K (2009). Croppers to livestock keepers: Livelihood transitions to 2050 in Africa due to climate change. Environmental Science and Policy

Kahn F., and Matthew E., (2005). "The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions," Review of Economics and Statistics, Vol. 87 (May), pp. 271–84.

Kopp S., Raymond J., and William A. Pizer., (2007). Assessing U.S. Climate Policy Options (Washington: Resources for the Future).

Kreike E., (2004). Re-creating Eden: Land Use, Environment, and Society in Southern Angola and Northern Namibia. Portsmouth, NH, Heinemann

Lindsay S.W. and Martens W.J., (2002). Malaria in the African highlands: past, present and future. Bulletin of the World Health Organization

Maynard K., Royer J. F., and Chauvin F., (2002). Impact of greenhouse warming on the West African summer monsoon, Climate Dynamics

Mendelssohn J., Obeid S. E.L., and Roberts C., (2000). A profile of North-Central Namibia. Windhoek, Gamsberg Macmillan Publishers.

Mendelssohn R., Michael S., and Larry W., (2000). "Comparing Impacts across Climate Models," Integrated Assessment, Vol. 1

Mfune J.K., and Ndombo B., (2005). An Assessment of the capacity and needs required to implement Article 6 of the United Nations Framework on Climate Change (UNFCCC) in Namibia. Prepared for the Ministry of Environment and Tourism, Government of Namibia

Midgley G., Hughes G., Thuiller W., Drew G., and Foden W., (2005). Assessment of potential climate change impacts on Namibia's floristic diversity, ecosystem structure and function. Cape Town, South African National Biodiversity Institute, Kirstenbosch, Cape Town.

Midgley G., Hughes G., Thuiller W., Drew, G., and Foden, W. (2004). Assessment of potential climate change impacts on Namibia's plant species biodiversity, and ecosystem structure and function. Namibian National Biodiversity Programme. Directorate of Environmental Affairs.

Ministry of Environment and Tourism (2002). Namibia Initial National Communication to the United Nations Framework Convention on Climate Change, Windhoek, Namibia.

Nangula S. and Zeidler, J. (2004). National Biodiversity Professional Training Framework for Namibia, National Biodiversity Programme, Ministry of Environment and Tourism, Directorate of Environmental Affairs.

National Planning Commission (2007). Omusati Regional Poverty Profile. National Planning Newsham A. (2007). Knowing and deciding: participation in conservation and development initiatives in Namibia and Argentina. Centre of African Studies. Edinburgh, University of Edinburgh.

Newsham A., and Thomas D., (2009). "Agricultural adaptation, local knowledge and livelihoods diversification in North-Central Namibia." Tyndall Working Paper

Nordhaus William D., (2007). "A Review of the Stern Review of the Economics of Climate Change," Journal of Economic Literature, Vol. 45 Office, Harare, Zimbabwe

O'Reilly C.M., Allin S.R., Plisnier P-D., Cohen A.S., and McKee B.A., (2003), Climate change decreases aquatic ecosystem productivity of Lake Tanganyika, Africa, Letters to Nature, Nature

OXFAM (2006). Causing Hunger: An Overview of the Food Crisis in Africa, Briefing Paper

Gubler D. J., and Reiter P., (2000). "The Potential Health Impacts of Climate Variability and Change for the United States: Executive Summary of the Report of the Health Sector of the United States National Assessment." Environmental Health Perspectives

Pindyck R. S., (2007). "Uncertainty in Environmental Economics," Review of Environmental Economics and Policy, Vol. 1, No. 1, pp. 45–65. Pizer, William A., 2002, "Combining Price and Quantity Controls to Mitigate Global Climate Change," Journal of Public Economics, Vol. 85 Press

Post-Disaster National Assessment (2009). Namibia, Windhoek

Punch F.K., (2001). Introduction to Social Research – Quantitative & Qualitative Approaches, Sage, London.

Punch, K., (2009), Introduction to Research Methods in Education, Sage Publications Ltd. London.

Ragab R., Prudhomme C., (2002). Climate change and water resources management in arid and semi-arid regions: prospective and challenges for the 21st century. Biosystems Engineering

Reid H., L. Sahlén J. Stage MacGregor J., (2007). The economic impact of climate change in Namibia: How climate change will affect the contribution of Namibia's natural resources to its economy. Environmental Economics Programme Discussion Paper 07-02. International Institute for Environment and Development, London.

Reid H., Sahlén L., Stage J., and MacGregor J., (2008). "Climate change impacts on Namibia's natural resources and economy." Climate Policy.

Republic of Namibia (2002). Namibia Initial Communication to the United Nations Framework Convention on Climate Change

Republic of Namibia (2003). Namibia and Climate Change booklet. Ministry of Environment and Tourism. Government of Republic of Namibia.

Republic of Namibia (2004). Vision 2030: Policy Framework for Long-term National Development, Main document Scholes, R.J. and Biggs, R. (2004). Ecosystem Services in Southern Africa: A regional assessment. The regional scale component of the SAfMA

Scholes R. J., and Biggs R., (eds) (2004) Ecosystems Services in Southern Africa: A Regional Assessment. CSIRO, Pretoria

Stern N., (2006) Stern Review of the Economics of Climate Change. Cambridge University Press, Cambridge

Stern N., (2008). "The Economics of Climate Change," Richard T. Ely Lecture, American Economic Association Meetings, New Orleans, Louisiana (January 4). Stern, Nicholas, and others, 2007, The Economics of Climate Change: The Stern Review (London: HM Treasury).

Stromberg D., (2007). "Natural Disasters, Economic Development, and Humanitarian Aid," Journal of Economic Perspectives, Vol. 21 Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva

Topfer K. and Hunter, J. W. (Eds) (2002) Climate Change Information Kit. UNEP & UNFCCC. U.S. Climate Change Science Program (US CCSP), 2007, Scenarios of Greenhouse Gas Emissions and Atmospheric Concentrations and Review of Integrated Scenario

Development and Application, Synthesis and Assessment Product 2.1 (Washington: Department of Energy).

UNCTAD and UNEP. 2008. Organic Agriculture and Food Security in Africa

UNDP (2003). Human Development Report 2003: Millennium Development Goals: A Compact among Nations to End Poverty. New York, Oxford, Oxford University Press.

UNDP (2006). Beyond Scarcity: Power, Poverty and the Global Water Crisis. Human Development Report 2006. New York: Palgrave Macmillan. Vulnerability. Intergovernmental Panel on Climate Change. Cambridge University Press.

UNEP (2002) Africa environment outlook. Past, present and future perspectives. Earthprint, Hertfordshire

UNFCCC (1992).United Nation Framework Convention on Climate Change (UNFCCC)

United Nations Development Program (2000) Namibia: Human Development report 2000 – 2001. UNDP, Windhoek, Namibia.

United Nations Development Program (UNDP), 2007, Human Development Report 2007/2008, Fighting Climate Change: Human Solidarity in a Divided World (New York).

United Nations Framework Convention on Climate Change (UNFCCC), 2007, Investment and Financial Flows to Address Climate Change (Bonn).

van Oosterhout, S., 1996. What Does "In Situ Conservation" means in the Life of Small-scale Farmers? Examples from Zimbabwe's Communal Areas. In: L. Sperling and M. Loevinsohn (eds). Using Diversity: Enhancing and Maintaining Genetic Resources On-farm. IDRC, New Delhi,

Van Rooyen, J., Sigwele, H., 2006. Towards regional food security in southern Africa: a (new) policy framework for the agricultural sector. Food Policy, Vol. 23, No. 6

Webster, Mort, Chris Forest, John Reilly, Mustafa Babiker, David Kicklighter, Monika Mayer, Ronald Prinn, Marcus Sarofim, Andrei Sokolov, Peter Stone, and Chien Wang, 2003, "Uncertainty Analysis of Climate Change and Policy Response," *Climatic Change*, Vol. 61, No. 3

Weitzman Martin, 2007, "The Role of Uncertainty in the Economics of Catastrophic Climate Change," Working Paper 07-11 (Washington: AEI-Brookings Joint Center).

Weyant, John P., 2004, "Introduction and Overview," *Energy Economics*, Vol. 26, "EMF 19 Alternative Technology Strategies for Climate Change Policy" (July)

World Bank (2006) *World Development Indicators 2006* (World Bank, Washington, DC).

World Bank (2007) *World Development Indicators Database* (World Bank, Washington, DC).

World Bank, 2006, *Clean Energy and Development: Towards an Investment Framework* (Washington). Wright, Brian D., 1983, "The Economics of Invention Incentives: Patents, Prizes and Research Contracts," *American Economic Review*, Vol. 73 (September)

Zeidler, J. (2005). Namibia's National Capacity Self Assessment (NCSA) for Global Environmental Management. Final NCSA Report Intergovernmental Panel on Climate Change Working Group I (2007) *Climate Change 2007: The Physical Science Basis*, eds Solomon .

8. ANNEXES

8.1 Interview guide /questions

What Climate Change?

From which of the following do you receive most of your information about the environment?

Please tick three of the most appropriate

Sources	Ranking
Community information meetings	
Conversations with friends	
Environmental groups	
Print media: newspaper or magazines	
Mass media: radio or television	
The Internet/World Wide Web	
Conversations with family	

members Technical or scientific publications School Other	

Do you believe climate change is real?

- Climate change is real
- Climate Change is not real
- not sure

Was there any help offered to the victims of flood?

Yes:----------

No:----------

Do you think there is any long-term solution to the issue of flood? Elaborate on your answer?

Yes: ----------

No: ----------

How long have you been in Oshitutuma?

Number of years	**Percentages**
1-5	
5-10	
10-15	
15-20	
20-25	
25-30	
30-35	
35-40	
40-45+	

What do you think makes your village vulnerable to floods?

What were your personal damages caused by floods?

Have you suffered from any disease outbreak such as Cholera, Malaria and other water borne disease due to flood?

Did you experience any economic loss (direct or indirectly) due to flood?

Who within your community do you consider to be the most vulnerable to floods?

- Women and Children

- Elderly People
- HIV & AIDS Affected people

What your coping mechanism/adaptation measures?

Do you have confidence in the GRN in responding to events such as floods? Why?

Do you believe climate change has an impact on development in general?

Was there any developmental project affected by floods?

How was the school affected by flood?

How was the Business community affected?

How was the clinic affected by flood?

Was there any outbreak of any disease caused by floods?

How was the influx of patients on a daily basis during the flood season?

What are the opportunities presented to you by floods?
