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DECLARATION OF ORIGINALITY

I, Amos Apraku, hereby declare that this thesis is my original effort, and that where I have used the ideas and words of others, all sources are fully and correctly acknowledged. No part of this work has been submitted to any other university for any form of award.

Signed……. Date ……

DEDICATION

I dedicate this thesis to my two lovely daughters:

Maame Yaa Afiriyie Acheampomaa Apraku

AND

Nana Akua Asantewaa Apraku

Your presence in my life keeps me motivated in everything I do. I love you so much.

ABSTRACT

This study examined climate change risk perceptions, vulnerability and the significance of 'assets' in climate change mitigation and adaptation in rural and peri-urban Eastern Cape, South Africa. It assessed the levels of local climate change awareness and how such awareness was articulated in local discourses, analysed actual risks (and awareness thereof) against those predicted by relevant statutory agencies, and examined the extent to which local residents drew on local knowledge, 'culture' and traditional practices (amongst other 'assets') to mitigate their vulnerability and adapt to adverse climatic changes. The study was conceptualised against the background that most climate change risk and vulnerability studies adopt a 'global' and 'continental' focus and ignore localised variations and specificities – which makes it impossible to craft local climate change impact mitigation strategies that make sense.

From survey, interview, focus group and observational data, the study found low levels of local awareness about climate change and its associated risks. It revealed that local residents blamed climate change-related phenomena on gods, spirits and other mystical forces. Agriculture, water resources, human settlements, health, ecosystems and biodiversity were found to be the most affected by climate change. A crucial finding was that, besides economic and other class-based assets, indigenous/local knowledge ('ideational assets') played an important role in the ways local residents adapted themselves to – and in some ways curbed - the adverse impacts of climate change.

The study concluded from these findings that households and communities have different degrees of vulnerability to climate change, depending on awareness levels and degrees of access to specific 'assets'. However, in the main, climate change impacts in the communities were potentially curbed by culture, with indigenous/local knowledge and related ideational assets being the main index of adaptation and weapon against disastrous impacts. The study extends current knowledge on the significance and contribution of indigenous knowledge systems to climate change impact mitigation and adaptation, particularly in Africa, and demonstrates how local knowledge can contribute to 'global' understanding of one of today's critical environmental challenges.

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To the Almighty I say, "YOU ARE INDEED GOD OF THE POOR!"

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LIST OF ABBREVIATIONS AND ACRONYMS

ACPC	African Climate Policy Centre
AIDS	Acquired Immune Deficiency Syndrome
AU	African Union
BCMM	Buffalo City Metropolitan Municipality
CBO	Community-Based Organisations
CSIR	Centre for Scientific Industrial and Research
DEAT	Department of Environmental Affairs and Tourism
DEDEA	Department of Economic Development and Environmental Affairs
DST	Department of Science and Technology
EU	European Union
FGDs	Focus Group Discussions
GCM	Global Circulation Model
GDP	Gross Domestic Product
GWP	Global Water Partnership
GOM	Government of Mauritius
HIV	Human Immune Virus
IKS	Indigenous Knowledge Systems
IOM	International Organisation for Migration

IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-tropical Convergence Zone
NCAR	National Centre for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NRF	National Research Foundation
NMBMM	Nelson Mandela Bay Metropolitan Municipality
RDP	Reconstruction and Development Programme
RDF	Rural Development Framework
RVSC	Risk and Vulnerability Science Centre
RWH	Rainwater Harvest
SADC	Southern Africa Development Commission
SOC	Soil Organic Carbon
SABC	South African Broadcasting Corporation
SAWRC	South African Water Research Commission
SST	Sea Surface Temperature
UFHREC	University of Fort Hare Research and Ethics Committee
UK	United Kingdom
UNDRO	United Nations Disaster Relief Organisation
UNEP	United Nations Environmental Programme
WMO	World Meteorological Organisation
4WD	Four-Wheel Drive

CHAPTER ONE

OVERVIEW OF THE STUDY

1.1 Introduction

Climate change is an added socio-economic developmental challenge to the existing problems facing the world today. Most studies on climate change impacts focus on the direct physical, chemical or biological impacts, while neglecting communities' risk perceptions and vulnerability (Kelly and Adger, 2000: 325). The impacts of climate change which are the subject of most research include rising sea levels, changing precipitation patterns, increase of extreme weather events, rising temperatures, decline in agricultural productivity, water security, and destruction of ecosystems and biodiversity (IPCC , 2007; Johnston and Schultze, 2010; DST, 2011).

The South African Department of Science and Technology (DST, 2011) notes that Africa is one of the most vulnerable continents to climate change due to the interaction of 'multiple stresses' such as poverty, inequality, HIV/AIDS, debt crises, and unemployment, which further cripple African governments' capacity to mitigate and adapt to climate change impacts. In the case of South Africa, the negative effects of climate change has further widened the boundaries of poverty and inequality, created a new set of refugees who migrate into new settlements to seek new livelihoods, and placed an additional demand on infrastructure (Parry et al., 2007 cited in Frayne et al., 2012:78). If left unchecked, the impact of climate change in South Africa in the near future is likely to be severe due to high agriculture dependency on weather, limited capacity to adapt and inadequate political commitment to climate change related issues (Collier et al., 2008).

In the eastern parts of South Africa (eastern coastal provinces; that is KwaZulu-Natal and Eastern Cape), studies have highlighted erratic rainfall patterns over the years

coupled with rising global sea levels and local temperature variations due to climate variability (DST, 2011).The DST further notes that extreme rainfall events such as thunderstorms may increase in frequency and intensity in the Eastern Cape in the coming years due to climate change (DST, 2011:21). This is corroborated by Johnston and Schultze (2010:19), who assert that, “the Eastern Cape is one of the provinces with the biggest exposure to climate change impacts but also the province with the least adaptive capacity due to lack of knowledge and expertise”. This is evident in Port Elizabeth and East London which are located in Agulhas Bank of the south coast (Carr et al., 2006: 253) and the subtropical high-pressure belt of the southern coastal region (DST, 2011). Agulhas Bank refers to the extensive south coast continental shelf (<120m depth) in the Indian Ocean in the South African coastal plain that extends from Cape Point (~18 degrees E) to East London (~28 degrees E) (Carr et al., 2006: 253). This area produces warm ocean currents, which are part of the oceanic global conveyor circulation. The subtropical high-pressure belt is a region of high pressure that encircles the globe around the latitudes of 30 degrees in the Southern Hemisphere and 30 degrees in the Northern Hemisphere (DST, 2011). The Agulhas Bank and the subtropical high-pressure belt are characterised by a continuous fluctuation in rainfall patterns, a transition in wind speed and direction, variations in the sea-surface temperatures, and extreme weather conditions due partly to cold and warm currents from the Agulhas and southern Benguela regions respectively (Schumann et al., 1995: 232, Shannon et al., 2003). The Benguela region covers the shelf region to approximately 500m depth, extending from 29 degrees S (in the vicinity of the Orange River mouth, the boundary between Namibia and South Africa) southwards along the west coast and East to 28 degrees E (East London). The area covers 220000 square kilometers and incorporates the west coast, the Agulhas Bank and the south coast (Schumann et al., 1995).

Previous studies reveal that climate induced effects on societies are not evenly distributed and vulnerability to these effects vary between communities, social groups, households, and individuals (Davies, 1993; Guyer, 1997; Adams, 1998; and Morrow, 1999). Given these differences in vulnerability to climate change, there is a need to

examine and compare the vulnerability of one society to another and any other socio-economic problems which come with climate change in vulnerable communities such as peri-urban and rural Port Elizabeth and East London. Within this context, this study examines the levels of climate change awareness among peri-urban and rural dwellers and how climate change impacts are framed and articulated in community level discourses in Kwelera, Phumlani (Needs Camp), Ncera, Kwanobuhle, Tirreville Lapland and Vasttrap communities in East London and Port Elizabeth. It also examines the actual risks posed by climate change in peri-urban and rural Port Elizabeth and East London, and the extent to which communities are aware of these risks and their levels of vulnerability. The study finally investigates whether (and to what extent) specific "assets" mediate residents' levels of risk and vulnerability to climate change.

1.2 Statement of the problem

Climate change is an "increase in mean annual surface temperature of the earth's atmosphere, due to increase in atmosperic concentrations of greenhouse gases, such as carbon dioxide, methane, chloroflourocarbons, and nitros oxide" (Bulkeley and Betsill, 2003; 1). This increase in the concentration of these gases is primarily due to human activities such as the combustion of fossil fuels (Johnston , 2008). These human activities have resulted in an increase in average temperatures as evidenced by the fact that the highest temperatures in the past 100 years were recorded between 1995 and the first six months of 2010 (Johnston and Schultze, 2010:5). The Intergovernment Panel on Climate Change (IPCC, 2007) notes that global atmospheric tempraratures are likely to rise by between 1.4 and 5.8 degrees celsius by the year 2100. These temperature rises are projected to increase extreme weather events such as heatwaves and increase the likelihood of severe droughts, etc (Johnston and Schultze, 2010). As global temperatures rise, there will also be widespread melting of snow and ice, and consequently, sea levels are likely to rise by between 0.1 and 0.9meters within the same period (IPCC, 2007).

On the global context, recent studies show that, human activities over the last 200 years have increased the concentration of greenhouse gases in the atmosphere, which consequently has led to the warming up of the earth surface (Johnston, 2008). Experts further hold that estimates of future climatic conditions are primarily built on future emissions and concentrations of most of these greenhouse gases (Hansen, 2005). However, critics argue that future climatic projections cannot be based solely on future emissions and concentrations of greenhouse gases; rather, the sensitivity of the global weather to the increased concentration levels of some of these gases, the warming and cooling capacity of the natural environment and processes, and the changing trend in atmospheric dust from volcanoes, should also be taken into serious account (Ruddiman, 2003; James, 2005). This notwithstanding, anthropogenic emissions of greenhouse gases have increased the atmosphere's ability to absorb the earth's outgoing infrared radiation which has caused a worldwide trend of rising temperatures and other forms of climate conditions (DST, 2011). Other studies also project that the world is at risk of experiencing changes in annual average precipitation patterns; increased hail storms, more intense rains leading to flooding, and longer dry spells (IPCC, 2007; Johnston and Schultze, 2010).

On temperature levels for example, the DST (2011) projects warm weather conditions on the African continent in the 21st century, with the warming likely to be greater than global annual mean in all seasons. Such trends are predicted to be more severe over the tropical zones (Kruger and Shongwe, 2004). While representing 11 percent of the world's total population, Africa is approximately responsible for only 3.5 percent of fossil emissions globally, yet it is the most vulnerable region to adverse impacts of climate change (Chevallier, 2010:191-192). Studies have shown that, some of the specific risks associated with climate change in the Sub-Saharan African region include decreased water and food security and quality, loss of biodiversity, extinction of plant and animal species, and increased incidences of air and water borne diseases (DST, 2011:33).

With its latitudinal location between 35 and 22 degrees Celsius South, South Africa has predominantly subtropical climate and as it is typical with subtropics globally, rainfall

patterns and other climatic conditions in South Africa display intra and inter annual variability (Engelbrecht and Landman, 2011: 2). Again, scientific studies show that, South Africa has been experiencing warm weather conditions since the1960s to date with annual average temperatures above 17 degrees Celsius (DST, 2011: 3). Johnston and Schultze (2010) have simulated climate change projections in the Eastern Cape province. They note that the province is experiencing increased frequency of extremely hot and cold days; higher evaporation rates due to increase in temperatures; up to ten percent reduction in suitable cattle farming area; up to ten percent in run off water (irrigation is affected); and ten to twenty percent reduction in suitable maize farming area. All these make the Eastern Cape one of the most vulnerable provinces to climate change, thereby threatening sustainable livelihoods in the province especially in rural areas where poverty levels are high (Johnston and Schultze, 2010).

In order to fully understand how vulnerable the Eastern Cape is to climate change, there is a need to unpack the concept of vulnerability within a climate change discussion. This study sees vulnerability as "the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to any external stress placed on their livelihoods and well-being" (Kelly and Adger, 2000: 328). Vulnerability is the capacity of a social system to anticipate, cope with, resist and finally recover from the impact of natural hazards (Chambers, Blaikie, et al.,1994). An individual, a community or a nation is considered vulnerable to climate change if such a person or community or nation can not respond and adapt to threats of climate change (Eriksen and Kelly, 2007).Therefore, the extent to which climate change damages or harms a system depends not only on a system's sensitivity but also on its ability to adapt to new climate conditions (IPCC, cited in Kelly and Adger, 2000: 326-327).

In view of how vulnerability in a specific community can be fertile ground for climate change to cause more livelihood shocks and stresses, this study examines the level of awareness among rural and peri-urban East London and Port Elizabeth communities to climate change and how is it articulated in community level discourses. What are the actual risks associated with climate change in peri-urban and rural Port Elizabeth and

East London, and to what extent are communities aware of these risks? Finally, the study examines the extent to which specific “assets” mediate their risk and vulnerability within the context of climate change.

There are studies which have been done in other developing contries in an attempt to understand the impacts of climate change in vulnerable communities. India has experienced increased vulnerability to climate change which has resulted in destruction of crops, property, as well as a negative impact on human health and well-being (Brenkert and Malone, 2005:57). Using its rich religious and cultural diversity to address socio-economic and climate related issues, the Indian government has adopted national and local development policies progarmmes (Brenkert and Malone, 2005) to deal with these climate change impacts. In the area of climate related disaster mitigation, India has assessed and zoned disaster proned areas for improved infrasturctural development (Brenkert and Malone, 2005: 58). On the other hand, there is the contrasting case of Mexico which is also vulnerable to drought and other climate related impacts (Maria, et al, 2010: 367-368). According to these authors, political system weaknesses, inappropriate technolgy, under-utilisation of indigeneous knowledge, and inaccessbility to financial and material resources has increased Mexican people’s vulnerability to climate change (Maria, et al., 2010:368). Given the Mexico’s relative inability to mitigate climate change impacts and the contrasting pro-active climate change interventions in India, what can be said about South Africa’s response to climate change in general? What can be said about climate change in Port Elizabeth and East London in particular? How are Port Elizabeth and East London peri-urban and rural communities perceiving climate change? How vulnerable are they and what assets do they have to mitigate or alleviate climate change impacts? These are among the key issues examined in this study.

National and continental studies on climate change mostly aim at measuring the extent of climate change in order to justify a particular mitigation approach without considering social issues (Parry et al., 2004 and Voigt et al., 2004). The Few studies which incorporate social issues lack local specificity (see Jallow et al., 1996; Wilkie et

al.,1999; Sousounis and Bisanz (eds), 2000; Cutter et al., 2003; and O'Brien et al., 2004). In the light of this, there seems to be negligible research attention paid to risk and vulnerability to climate change in peri-urban and rural communities in South Africa. Given this research gap, this study delves into peri-urban and rural communities' risk perceptions and vulnerability to climate change, with a specific focus on Port Elizabeth and East London rural and peri-urban communities.

1.2 Research questions

The following questions guide the research:

i. What is the level of climate change awareness among residents of Port Elizabeth and East London peri-urban and rural communities, and how is it articulated in community level discourses?
ii. What are the actual risks associated with climate change in peri-urban and rural Port Elizabeth and East London according to available South African meteorological data and to what extent are communities aware of these risks?
iii. To what extent do residents' assets mediate actual risks, their perceptions of risk and vulnerability to climate change?

1.3 Research aim and objectives

The main aim of the study is to examine vulnerability as well as perceived and actual risks posed by climate change in peri-urban and rural settlements in Port Elizabeth and East London, and to further assess how specific "assets" mediate people's risks perceptions and feelings of vulnerability. The specific objectives are:

i. To assess the level of climate change awareness among residents of peri- urban and rural communities in Port Elizabeth and East London, and how climatic change is articulated in community level discourses.
ii. To analyse the actual risks associated with climate change in rural and peri-urban Port Elizabeth and East London according to available South African meteorological data and the extent to which communities are aware of these risks.

iii. To examine the extent to which residents' assets mediate actual and perceived risks to climate change within their vulnerability context.

where assets refer to:

i. **Physical capital**. The stock of plants, equipment, infrastructure, and other productive resources owned within the study communities.

ii. **Financial capital**. The financial resources available to community members, such as savings and supplies of credit.

iii. **Human capital**. Investments in education, health and nutrition of individuals.

iv. **Social capital**. Rules, norms, obligations, reciprocity, and trust embedded in social relations, social structures and societies' institutional arrangements.

v. **Natural capital**. The stock of environmental assets such as soil, atmosphere, forests, minerals, water and wetlands (Moser, 1998 and Frayne, et al., 2012: 13).

vi. **Ideational capital.** Local knowledge about how to cope with adverse environmental conditions (see Akpan, 2011).

1.5 Significance of the study

The study has both theoretical and policy relevance. At a theoretical level, it has raised questions about Moser's 'asset accumulation framework' and extended its applicability by showing how assets mediate people's actual and perceived risks as well as specific contexts of vulnerability. Specifically, it also demonstrates how assets of local residents help them in coping and adapting to climate change. Additionally, it highlights the relevance of indigenous knowledge in climate change impact mitigation in local African settings and the need to combine formal approaches with local knowledge and institutions to better handle climate related issues. Finally, it identifies 'asset pots' in peri-urban and rural Port Elizabeth and East London communities in accordance with Moser's five-fold asset portfolios.

At the policy level, the in-depth analysis of peri-urban and rural communities' risk perceptions and vulnerability (within the context of climate change) would help policy makers to design and operationalise appropriate strategies to help communities to better adapt to climate change. In addition, it highlights various resources that enable households and communities to protect themselves or recover from the negative effects of severe weather conditions associated with climate change.

1.6 Organisation of the study

The rest of this thesis is organised as follows. Chapter two presents a literature review on climate change debates. It first looks at climate change from a global panoramic perspective before narrowing it to the local African context. The literature shows a widespread consensus that the world climatic systems are changing as results of natural and anthropogenic factors. In sub-saharan African, the records show that the average change in some of the climate variables are projected to be higher than the global figures with some degree of sub-continental differences due to variations in climatic zones. Chapter three, which is also a literature review, chapter focusses on Africa's vulnerability to climate change and some of the available coping and adaptation strategies. With widespread changes in global climatic conditions, the literature further shows the world is at risk and vulnerable to global climatic changes. However, Africa seems more vulnerable to climate change, especially because its agricultural systems rely overly on natural conditions. The chapter goes on to identify water resources, food security, and ecosystems and biodiversity as some of the most vulnerable sectors to climate change, apart from agriculture. Finally, the chapter explores public awareness campaigns, efficiency in water usage and improvement in water technology, conservation agriculture, changes in crop varieties and planting patterns, carbon sequestration and some indigenous practices as some of the potent climate change adaptations strategies available to Africans.

Chapter four presents the theoretical framework of the study which assisted in the analyses and presentation of the findings. The main conceptual framework adopted in

this study is Caroline Moser's asset accumulation framework. This framework is supported by the concept of indigenous knowledge systems. The two concepts draw together six different capitals namely: natural capital, physical capital, social capital, human capital, financial capital and ideational capital (local knowledge). These assets guide the subsequent discussions of the research findings in chapter six seven and eight. Chapter five presents the various methods that were used to collect data for the study. The methods used were semi-structured in-depth interviews, focus group discussions, key informant interviews, a cross-sectional mini-survey and visual sociology. The justification of the methods used, their shortcomings and how such shortcomings were overcome are also presented in the chapter. Three different chapters are devoted for presentation of the empirical data of the study, with each chapter representing one research question of the study as mentioned in section 1.3 of this thesis. Chapter six is the first empirical chapter of the thesis. It presents findings on climate change awareness in the study communities and local conceptions and misconceptions on climate change. Chapter seven presents findings on local climate change risks, meteorological data and community awareness on such risks. Chapter eight presents findings on household and community assets, risk perceptions, and local vulnerabilities. Chapter nine, which is the summary, discussion and conclusion chapter helps readers to make meaning out of the research findings in line with the research objectives and the conceptual framework elucidated in chapter one and four respectively. Some policy-oriented recommendations, the thesis' contribution to knowledge and some areas for postdoctoral research inquiry are also given in this chapter.

1.7 Writing style

In line with South African writing convention, this thesis has adopted the UK English style. However, quotes that were written in other styles, such as American English or South African English, have been left as originally quoted. Double quotation marks (“ ”) have been used for direct quotation from texts or from respondents where necessary, while single quotation marks (‘’) apply to words or phrases that are used not necessarily

in their conventional meaning. Unfamiliar concepts, terminologies, names of locations, plant species and rivers are put in italics where necessary. References from all sources (books, journals and internet sources) have been combined and arranged alphabetically (starting with the surname) for ease of reference. Readers therefore only have to search for the surname at the appropriate alphabetic listing. The referencing style of the thesis conformed to the APA style as adopted by the Faculty of Social Sciences and Humanity at the University of Fort Hare.

CHAPTER TWO

CLIMATE CHANGE DEBATES: GLOBAL AND LOCAL PERSPECTIVES

2.1 Introduction

The numerous unprecedented changes in weather patterns, observed since the 1950s, have led to widespread consensus about a changing world climatic system (IPCC, 2013). The amounts of snow and ice have diminished drastically, sea levels have risen and the concentrations of greenhouse gases in the atmosphere have increased leading to changes in precipitation and rainfall patterns (IPCC, 2007; 2013). The emissions of greenhouse gases into atmosphere together with other anthropogenic activities have caused a change in global climatic conditions with corresponding negative effects on agricultural productivity, biodiversity, ecosystems, human health and other socio-economic indexes all over the world (IPCC, 2007). Despite the various scientific revelations on climate change and its associated impacts on livelihoods (see for example IPCC, 2000; 2007 & 2013), some 'dissidents' still hold contrary views relating to climate change as a concept, particularly its causes, the extent and trend of changes, as well as the knowledge claim by climate scientists. Hall et al., (2015a & 2015b) refer to such dissidents as climate change 'skeptics' or 'contrarians' or 'deniers' or 'dismissers' or 'antagonists'. Climate change skeptics argue that scientific revelations and projections on climate change, especially those of the IPCC are blown out of proportion thereby twisting and exaggerating global climate discourse (Jankó, Móricz, and Vancsó, 2014).

In an attempt to further discredit climate change revelations and projections given by the IPCC and institutions alike, Shani and Arad (2015) refer to climate scientists as climate change 'alarmist' whose only interest is to consistently raised false alarms about the degree and trend of changes in global climatic conditions. Climate change contrarians further argue that the field of climate science is not homogenous, and that it

is characterised by changing structure and continuous re-demarcation of boundaries and study areas (Jankó, Móricz, and Vancsó, 2014). By virtue of its incessant re-structuring and boundary re-demarcation, climate change skeptics believe that climate revelations and projections based on climate science should be opened for thorough scrutiny as climate 'facts' presented by climate scientists are uncertain and are in dispute with the realities of life (Shani and Arad 2014; 2015). They believe that mainstream climate science methodologically dwells only on knowledge-making process with special attention on climate modeling (Jankó, Móricz, and Vancsó, 2014), and keep producing what Hulme (2008) refer to as *hyped rhetoric* which does not produce new knowledge, but rather exaggerates and re-brands what is already known.

The various arguments projected by both climate change 'alarmists' and 'contrarians' indicate that the cream of the climate change 'academic tussle' is not whether indeed there has been observed changes in global climatic conditions over the years; but rather it is about the extent of changes in global climatic conditions as given by climate scientist, the knowledge claim to such changes and the projections regarding the trend of future changes in global climatic conditions. The major gap identified in the arguments presented by both climate change 'alarmists' and 'contrarians' is that; in their submissions, both parties have failed to look at climate change and its related effects from a local perspective. Thus the global, continental and sub-regional analysis does not clearly tell the climate change story in specific local communities, which is the core interest of this study. The focus of this thesis is therefore not to enter the climate change 'war' by way of supporting or opposing any of the 'camps'. However, it builds on the literature provided by both parties (climate change 'alarmists' and 'skeptics') to assess the risk and vulnerability levels of selected rural and peri-urban communities in the Eastern Cape Province of South Africa, and how available asset categories are used to mediate the impacts of climate change on livelihoods.

Taking insights from climatic warnings from different international bodies on current and projected climatic conditions, this chapter focuses on looking at some of the various

climate change discourses from a global perspective to local levels with emphasis on some sub-region climate debates in Africa.

2.2 What causes climate change?

Apart from natural variations and natural events, climate scientists believe that the fast changes in global climatic conditions are anthropogenically induced through modern manufacturing activities, human settlement, deforestation, and crude farming practices (IPCC, 2013). Through such human activities, some harmful gases called greenhouse gases are emitted into the atmosphere, which react with other natural processes to cause changes in global climatic conditions (Ragab & Prudhomme, 2002).

Some of these gases, which, when emitted into the atmosphere act as a 'wide blanket' covering the earth's surface and obstructing infrared radiation, are carbon dioxide (CO_2), methane (CH_4), hydrogen sulphide (H_2S), nitrous oxide (N_2O), nitrogen oxides (NO and NO_2), sulphur dioxide (SO_2), chlorofluorocarbons (mainly CFC_{11} and CFC_{12}), hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs, general formula C_xF_y), and sulphur hexafluoride (SF_6) (IPCC, 2007; 2013; Pittock, 2009). The World Meteorological Organisation (WMO, 2012) indicates that the collective contribution of greenhouse gases such as carbon dioxide, methane, nitrous oxide and chlorofluorocarbons accounts for approximately 96 percent of the world's radiative forcing. Radiative forcing refers to the net change in the energy balance of the earth system due to some imposed perturbations as results of greenhouse gas emissions (IPCC, 2013: 680).These gases are closely linked to anthropogenic activities in the biosphere, soil, oceans and in various industrial processes.

CO_2, which is considered the commonest of the greenhouse gases, is emitted mainly from the burning of fossil fuels – coal, diesel and natural gas – at thermal power stations and production plants, and in vehicles (IPCC, 2007). Other sources of CO_2 emissions

are through the manufacturing of cement from limestone, the destruction of carbon-rich soils for construction purposes, and deforestation (IPCC, 2007; 2013). H_2S, SO_2 and NO_x – which cause 'acid rain' – are also emitted through the burning of fossil fuels, and the manufacturing and use of fertilizers. CH_4 is emitted through the digestive processes of animals such as cattle and sheep, decaying vegetable matter, and burning of bio-residues from fossil fuel production (Pittock, 2009). HFCs and CFCs are atmospherically dangerous gases used in some aerosols and refrigerants, while SFC_6, HCFCs and PFCs are industrial gases used mostly as solvents in the electrical and electronic industry (Watson et al., 1997; Pittock, 2009; IPCC, 2007; & 2013).

The above paragraph shows how human activities contribute either directly or indirectly to the emission of greenhouse gases into the atmosphere. All these gases when emitted into the atmophere react with other chemicals to distrupt various weather events leading to changes in world climatic conditions. Apart from these gases, experts believe that clouds can also contribute to global warming by absorbing heat radiation and leading to warming of the atmosphere and the earth's surface, or control global warming by reflecting incoming sunlight and thereby cooling the atmosphere (Hansen, 2005).

One of the major questions researchers continue to ask is: how much do human activities contribute in increasing the concentration of greenhouse gases and how much of this is natural? The IPCC through its various climate assessment reports (see IPCC, 2001; 2007; 2013), conclude that since the 1750s, the global atmospheric concentration of carbon dioxide, methane, nitrous oxides, and sulphur oxides have increased astronomically as a result of anthropogenic activities more than all natural activities combined.

The leading argument by IPCC and WMO on the primacy of human factors in world climate variability is supported by studies conducted in the Mediterranean regions and some parts of Africa.These studies suggest that, the warming trend in the Indian Ocean as a result of high concentrations of greenhouse gases from industrial processes is one of the important factors behind the drying in these areas (the Mediterranean and African regions).Through changes in atmospheric circulations and increased surface

evaporations due to high temperatures (Hoerling, 2003) the globe as whole is experiencing a fast warming trend.

Human activities (e.g deforestation, burning of fossil fuels, construction etc) continously increase the atmospheric concentration of greenhouse gases which warm the atmosphere and affect other climatic variables (Watson et al., 1988:3; Pittock, 2009). Increases in the concentration of greenhouse gases in the atmosphere cause continuous changes in regional and global temperature and precipitation patterns, as well as fluctuations in other climate variables (IPCC, 2013). Alterations in precipitation and other weather variables result in changes in global soil moisture, an increase in global mean sea levels, and prospects of more severe and extreme high temperature events such as floods in tropical and low-land areas and droughts in arid and savanna areas (Watson, 1998; Leary et al., 2009). It also needs to be emphasized that land degradation and deforestation are negatively affecting the environment which is gradually losing its resilience and capacity to absorb and sequester the environmentally hazardous gases (such as CO_2). This is also affecting carbon sinks such as oceans which generally absorbs CO_2, and the intake of the same gas by plants through photosynthesis (SADC & UNDP, 2010:16). Kandji et al., (2006) are of the view that deforestation and all other forms of environmental degradation reduce the quantity of stored carbon, weakening the health and resilience of ecosystems. With a highly degraded and weakened environment, critical and essential aspects of sustainable development such as hydrological systems, food production, human settlement and coastal systems are all affected.

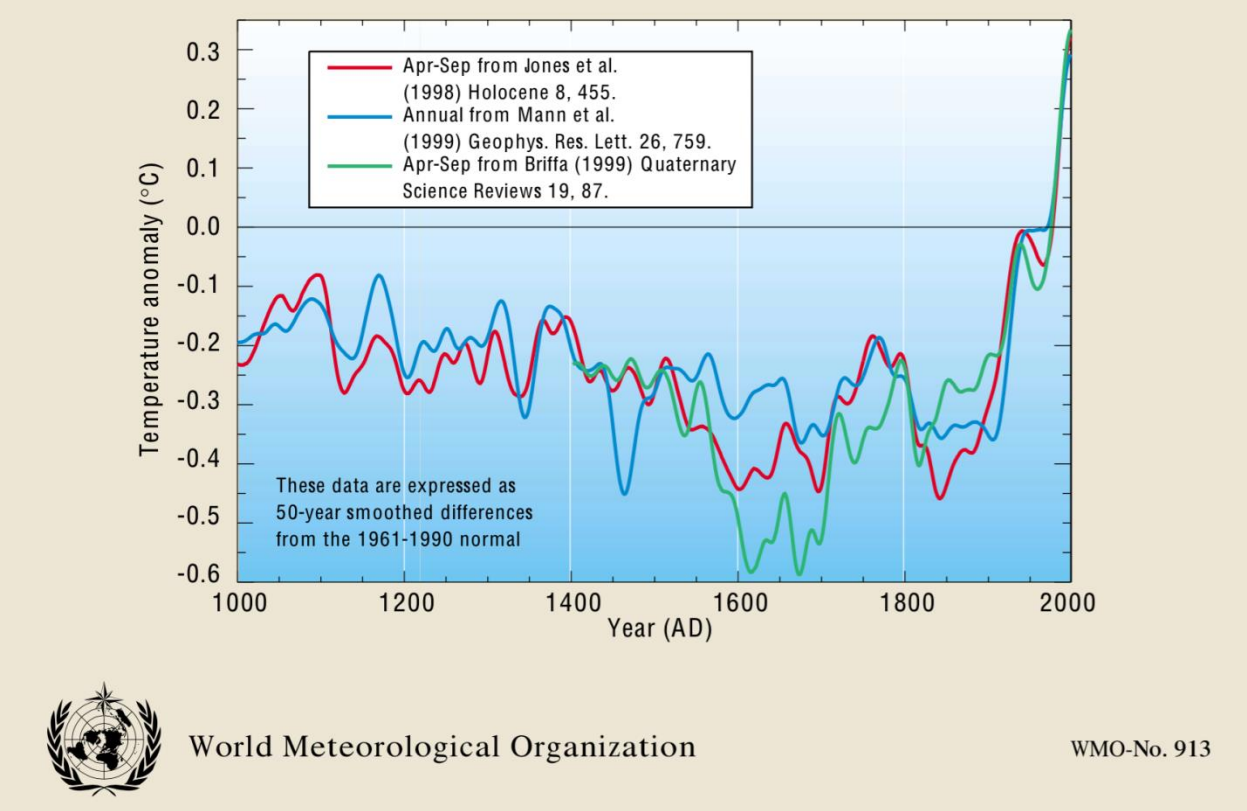
2.3 Climate change evidence: A global panoramic view

The Intergovernmental Panel on Climate Change's (IPCC) fourth and fifth assessment reports (AR4 – 2007; AR5 – 2013) reveal that global temperatures and sea levels have been on the rise over the past ten decades, while precipitation and rainfall patterns have been fluctuating and causing many forms of socio-economic problems globally. These

views are shared by the African Climate Policy Center (ACPC, 2014), which posits that climate change is widely acknowledged as the most defining challenge of the 21st century.

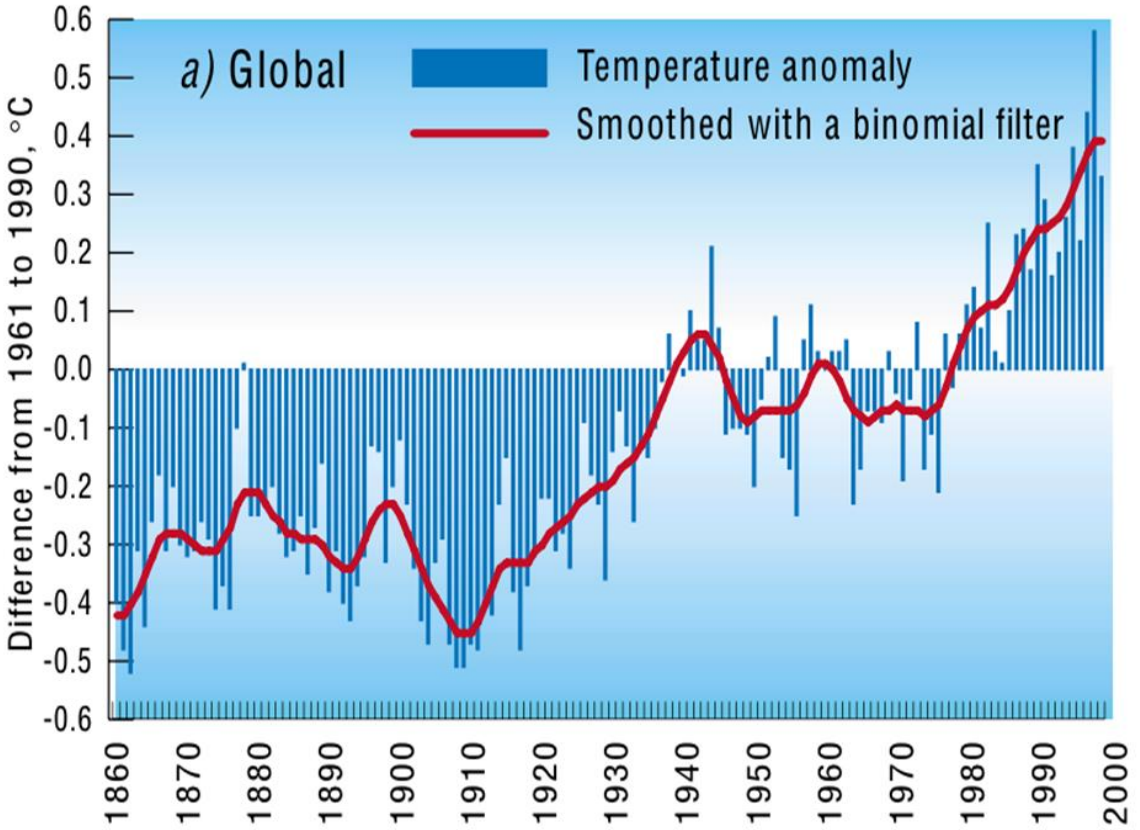
Evidence from climate sensitive indicators such as tree rings, ice cores and boreholes indicates that during pre-historic and medieval times, global warming stood at only 0.05° Celsius per century (Pittock, 2009). At the end of the last glaciation (the 'period of ice' spanning over some 10,000 years ago), the average rate of warming was 5.0° Celsius, representing approximately 0.05° Celsius per century. However, from the beginning of the 19th century, global temperatures started rising, and have since kept a rising trend to date. Evidence gathered from available natural archives and various forms of temperature estimates by the World Meteorological Organisation (WMO) indicate that indeed the pre-historic and medieval periods experienced lower temperature values than the 20th century. The diagram below shows global temperature trends from the beginning of the eleventh century up to the end of the twentieth century as provided by the WMO.

Figure 2. 1 Global temperature trends from the 11th to the 20th century



According the data presented in figure 2.1 above by the WMO, from the eleventh to the fifteenth century, the world experienced relatively mild and consistent temperature values. The lowest temperature values, according to the data were recorded from the late sixteenth century up to the beginning of the seventeenth century. However, global temperature values started rising drastically from their cooler levels in the beginning of the twentieth century (1910) as shown in figure 2.2 below; a situation attributed to changes in global climatic conditions.

Figure 2. 2 Global temperatures from the second half of the 19th century to the end of the 20th century



IPCC, 2013

The IPCC notes that temperatures have risen globally at an average of 0.74° Celsius for the past century, with the second half of the century being twice as warm as the entire century (IPCC, 2007; 2013). According to the data presented in figure 2.2 above, global temperature trends of the last two decades of the twentieth century and the first decade of the twenty first century are deemed 'outrageous ' as they show an exponential increase. The year 1998 is recorded as the warmest of the twentieth century (+0.58 degrees Celsius). Globally, annual average temperature at the end of the twentieth century was approximately 0.6 degrees Celsius, a figure far above those recorded in preceding centuries (see figures 2.1 and 2.2 above).The IPCC (2007; 2013) further asserts that the past 50 years alone have seen an average rise of 1.3° Celsius in temperature levels, while Pittock (2009: 3) estimates the rate of warming over the next century to be more than 5.0° Celsius, which is 100 times more than the warming

experienced during the glaciation period. Despite the climate portrait threatening global livelihood painted so far, the IPCC (2007; 2013) projections postulate that in future the world would continue to experience an increasing rise in temperature levels, with a projected global mean temperature rising from 1.8° Celsius to 4.0° Celsius by the end of the 21st century.

With regards to evaporation, estimates show that evaporation rates in the tropical Atlantic regions have increased by 5-10 percent over the past two generations alone, (Curry, 2003; cited in Pittock, 2009:7). With an estimated increase in global mean temperature and a decrease in average rainfall volumes in the 21st century, it is projected that evaporation would further increase globally, even though it is difficult to specify the rate of such increase, particularly, on national, sub-regional and continental bases (see Pittock, 2009; IPCC, 2007; 2013). Despite the difficulty in predicting evaporation rates in specific local areas, it is estimated that globally, climate change would adversely affect water cycle in the 21st century leading to a negative change in world hydrological regime (Kay & Davies, 2008). With a negative change in global hydrological regime, coupled with increased wind speed and temperature values, there would consequently be an increase in evaporation levels globally. Some of the immediate impacts of increased evaporation on livelihoods – particularly agriculture – are the reduction in soil moisture and fertility leading to a reduction in crop and animal production, especially in less developed countries with less developed agricultural infrastructure (Chu et al., 2010).

In addition to temperature fluctuations and increased evaporation rates, changing precipitation patterns are also a characteristic of a global changing climate. Rainfall – which is the backbone of agriculture and other forms of livelihood in Africa – continues to fluctuate across the globe (Zinyengere et al., 2013:120). It is additionally observed by scholars that rainfall variability, for example, is high globally; however, the extent of excessive increase and abnormal decrease in the amount and volumes of rainfall in

various parts of the world all because of changes in precipitation call for the attention of pundits (Porter & Semenov, 2005).

Different data sets from different independent climate models suggest that generally, global precipitation has been declining since the beginning of the 20th century even though there are some isolated exceptional regional and sub-regional cases of increased levels – for example, the Antarctic region – (see IPCC, 2013). Various climate projection models predict that global precipitation levels are expected to follow a declining trend in the 21st century (IPCC, 2007, 2013). The table below shows the trends of estimated annual global precipitation per decade from 1901 to 2008.

Table 2. 1 Trends of estimated annual global precipitation per decade from 1901-2008

Data set	**Area**	**Trends in mm yr–1 per decade (1901-2008).**
CRU TS 3.10.01 (updated from Mitchell and Jones, 2005)	Global	2.77 ± 1.46
GHCN V2 (updated through 2011; Vose et al., 1992)	Global	2.08 ± 1.66
GPCC V6 (Becker et al., 2013)	Global	1.48 ± 1.65
Smith et al. (2012)	Global	1.01 ± 0.64

IPCC, 2013; WG1: 202

According to the data presented in table 2.1 above, three out of the four data sets indicate a declining inter-decadal precipitation since the beginning of the 20th century, although the level of decline is not uniform across regions. Becker et al., (2013), for instance, present an outlier which indicates that some parts of the globe experienced increase in precipitation within the period under review, despite the general global trend

of decrease. Dore (2005) indicates that since the beginning of the 20th century, the high latitude region (the Northern Hemisphere) has experienced increase in precipitation with general decreasing pattern southward to the Mediterranean; and eastwards to parts of china, Australia, and the small Island States in the pacific (Dore, 2005: 1168). However, the equatorial regions have become more variable with fluctuations in precipitation pattern within the same period (Dore, 2005).

In sub-Saharan Africa, Shinoda et al., (1999) posit that the droughts in the 1970s and 1980s on the continent, particularly in the savanna areas in the western parts (for example Mali, Niger, Burkina Faso, Ghana and Benin) were primarily characterised by a reduced frequency of rainfall events and general precipitation activities. In a related analysis, Nicholson and Kim (1997) note that the pattern of declining precipitation on the continent since the beginning of the 20th century is apparent throughout the Sudan-Sahel zone including the Ethiopian Plateau; while the Southern Africa region has remained relatively wet, amidst isolated drought events. Finally, Garcia and Vargas, (1998) indicate that, since the late 1960s, there has been a pattern of continued aridity in the North Africa region partly due to reduced precipitation activities and changes in global climatic conditions.

Sismilarly, literature shows that since the 1960s, snow cover has experienced a decrease of approximately 10 percent, whilst the Antarctic Penisula area – “the region of ice deposits” – has experienced fluctuations in sea-ice levels due to rapid regional warming, leading to a disintegration of several large semi-permanent ice shelves attached to the mainland (IPCC, 2001; 2007; Pittock, 2009). Additionally, some parts of the North and South American regions have also seen a great reduction in ‘ice caps’ (ice deposits in highland mountainous areas) as well as a rapid melting of the Patagonian sheet in South America causing many forms of destruction to pipelines, roads and other property (Pittock, 2009; IPCC, 2013).This melting ice is partly contributing to rising sea levels. For example, between 1993 and 2008, global sea levels have risen by about 3mm as a result of factors such as volcanic dust, surface

warming and melting of the Greenland and Antarctic ice sheets, with the net effect of coastal erosions in some of the affected regions (Leary, et al., 2009).

Other equally important aspects of climate change are the issues of prolonged droughts and surges in storms. With projected increase in fluctuations in precipitation and rainfall patterns and volumes, particularly in tropical and high latitude areas, it is estimated that longer periods between rainfall events would intensify in the 21st century (IPCC, 2007). The WMO (2015) indicates that such fluctuations in precipitation and rainfall patterns would lead to a greater risk of droughts in arid and semi-arid regions globally. In sub-Saharan Africa, the IPCC (2007: 850) laments that the continent is very likely to bear the brunt of global annual mean warming in the 21st century than any part of the globe, with drier subtropical regions warming more than the moisture tropical regions. In the Mediterranean Africa, the Northern Sahara, and the Southern Africa regions; it is projected that annual rainfall is likely to decrease, leading to a widespread of prolonged dry weather conditions in the continent in the 21st century IPCC (2013). This suggests that the projected continuous decrease in global precipitation volumes in the 21st century, as shown in table 2.1 above, would lead to a corresponding extended dry weather conditions.

Relating to storm surges, tide measurements indicates that, in the twentieth century alone, global average sea-levels rose by between 1 and 3mm due to changes in global climatic conditions, leading to a widespread of coastal flooding and storm surges (Lowe & Gregory, 2005 :1313). To corroborate this observation, the IPCC (2007) projects that between 1990 and 2100, global average sea level rise is likely to be between 9 and 88cm, with associated increase in wind speed and storm surges as some of the direct consequences of such rising sea levels due to climate change. Dasgupta et al., (2009 : 3) argue that climate change would intensify storm surges in two way; firstly, through rising sea-levels as a result of thermal expansion and ice cap melting; and secondly, through warmer oceans, which is likely to increase cyclone activities and subsequently heighten storm surges. The Department of Environmental Afairs (2011) reveals that a comparative analysis of 20th and 21st centuries sea-level extreme events indicate that

coastal flooding and storm events of a given height are now happening more frequently than before. This revelation suggests that changes in global mean sea levels and erratic precipitation patterns in most parts of the world have resulted in the frequency and intensity of global storm events. It is estimated that the continuous increase in storm surges and their related flooding events in the 21st century would threaten lives and property in low-lying and 'unprotected' coastal areas (Pittock, 2009; IPCC, 2007).

The main question arising from all these climatic changes is; what are the consequences of such climatic variations on crop production, livestock and poultry production, human health, transport and infrastructure, biodiversity and ecosystems, food and water security, and livelihoods in general? The rest of this chapter looks at the various debates on climate change around Africa, first assessing some of the risk and vulnerability levels and impacts in different regions in Africa, and finally looking at some of the adaptation and mitigation strategies in Africa.

2.4 Climate change in Africa: Emerging continental evidence

The African continent is made up of a variety of geo-climatic zones: the Sahara and arid Sahelian North African climate region, the tropical and savanna West African bloc, the semi-arid and mountainous East Africa region, and the subtropical and relatively temperate Southern Africa climate zone (IPCC WG1, 2013). Although it is on record that the average change in some of the climate variables in Africa are projected to be higher than the global figures (IPCC, 2013), the degree of such changes are estimated to vary from one subregion to another (Zinyengere et al., 2013). For example, in the Sahel region (from Ethiopia through Chad to Mauritania), temperatures are projected to maintain a rising trend from one season to another, characterised by intra-seasonal variation with an estimated 6 percent decline in the mean annual rainfall figures by 2025. The tropical regions (from Sierra Leone through Ghana to Kenya – the West and East African regions) on the other hand, are projected to experience an estimated

increase of 4.5 percent in rainfall within the same period interspersed by floods and their associated waterborne diseases (Zinyengere et al., 2013). The Southern African region (from Angola to Malawi down to South Africa), whose geophysical features are the combination of those of the sahel and tropical regions, (i.e. sub-humid, arid, and semi-arid zones) is expected to go through an approximately 4 percent decrease in rainfall and a rising level of evaporation due to rising temperatures by the end of the 21st century (IPCC, 2007; IPCC, 2013; Zinyengere et al., 2013). Thus, Africa is projected to get warmer in the 21st century more than the global annual warming average, with corresponding effects on rainfall patterns and rising sea levels (IPCC, 2013). The drier sub-tropical regions of the continent are projected to warm up more than the moister tropics in the 21st century with the prevalence of extreme weather events such as floods, droughts, hailstorms and high temperatures set to increase (Kruger & Shongwe, 2004; IPCC, 2013). In a contintent with different geophysical and ecological characteristics, some of the salient questions to be asked are: what are the specific sub-regional climate realities and scenarios? Is vulnerability to climate change on the African continent universal, or there are some variations based on regional environmental and socio-economic characteristics?

2.4.1 North Africa climate debates: A synopsis

The northern Africa region is made of five countries: Egypt, Libya, Morocco, Algeria and Tunisia. It is characterized by arid vegetation and is susceptible to climate change challenges relating to environmental and anthropogenic systems. The sub-Saharan and Sahelian climate of the region is greatly controlled by the monsoonal system that brings rainfall to the region in only one season (May/June) per year (Polcher et al., 2011). The volume of rainfall, the consistency and duration, as well as the rainfall calendar of the northern Africa region, is mostly influenced by other climatic events in the west Africa region due to the degree of climate connectivity between the two regions (IPCC WG1, 2013:1282). With such a short duration of rainfall and low volume of rainfall per year due to climatic factors, the north African region is classified as one of the regions in the

world with lowest rates of renewable water resources per capita (i.e. less than 150mm^3 yr^{-1}) (Thomas, 2008: 38). According to this classification, the region from Egypt in the east to Morocco in the west is one of the most highly water-stressed regions of the world.

One of the key issues which is of great research interest to scholars in the context of climate change discussions in the Northern Africa region is the relationship between climate change and environmental degradation, agricultural productivity, food and water security, population growth, and economic and social stability in the region (Janpeter, 2012). With an established relationship between water and agriculture – which is the cornerstone of livelihoods in Africa and human existence as a whole – there are significant concerns about the long-term impact of climate variability on water and food security and the compounding socio-economic ramifications on the region (Abufayed, Elghueb, & Rashedb, 2002).

With the current global trend of changes in climatic conditions, average availability of water in the world will decline and the frequency of events such as drought will increase with corresponding consequences of low agricultural yield and devastation of vegetation in areas such as the North African zone would be one of the most affected zones (Sanders, Goesch, & Hughes, 2010). Records show that the northern Africa region has dry summers (June/July) and relatively wet winters. In the eastern and western parts of the region (Morocco and Algeria respectively), studies point to below average rainfull patterns since the 1970s to date (Fink et al., 2010; Meddi et al., 2010). It is further highlighted that such a deficit in rainfall and precipitation patterns tends to affect livelihoods in the region. According to regional and global climate models developed by Patricola and Cook (2010), the north African region is expected to warm up by 6° Celsius in the 21st century compared to the 20th century. This temperature pattern is predicted to be followed by extreme weather related events such as drought and fire outbreaks in the region. Patricola and Cook's (2010) models suggest future climate change uncertainties in Africa as a whole.

2.4.2 East Africa Climate debates: An overview

Geophysically, the east African bloc, which covers Somalia, Eritrea, Rwanda, Burundi, Tanzania, Djibouti, Ethiopia, Comoros, Kenya and Uganda, is characterised by semi-arid lands, mountain chains, large lakes and a varying sea surface temperature (SST) influenced by the Indian Ocean (Parry et al., 2007). Atmospheric movements in the region are mostly heralded by gradients in temperature and their associated pressure which influence general air circulations (Omondi et al., 2013). An analysis of weather events in the region show that rainfall, temperature levels, and other important climate variables in the region are driven by events in the Indian ocean (Marchant et al., 2007). Scholars have observed that global rising sea levels, tropical cyclones, the low level of easterly flow of moist air into the region, and the weakening of the low-level westerly flow over the Indian Ocean, are the main drivers of uncertainties in climatic conditions of the eastern African region (Black, Slingo, and Sperber, 2003; Shongwe et al., 2011).

Williams and Funk (2011) argue that the scarcity of traditionally long rains over some parts of Ethiopia and Kenya could be a result of the warming levels of the Indian Ocean in recent years. Decadal observations of the climate conditions of the region estimate that the coming years stand a higher chance of experiencing declines in rainfall, increasing temperatures, and rising sea levels accompanied by droughts and a decline in agricultural productivity because of fluctuations in SST (Meehl et al., 2009). Muthama et al., (2008) and Omondi et al., (2009) add that decadal oscillation evidence of the east Africa region suggests that the next three decades will mark a period of extreme variability in inter-annual patterns in temperature, precipitation and rainfall. Omondi et al., (2009) further note that “the impacts of persistent decadal climate anomalies have far reaching socio-economic implications that they would impose on the regional socio-economic systems” (Omondi et al., 2012: 140). Extreme climate related events influenced by sea-surface temperature changes and oscillation patterns will impact negatively on agricultural production and other weather-linked economic activities of the sub-region, thereby extending the frontiers of poverty in the east African sub-region. The unpredictability of the climate conditions in the eastern African belt – an area whose

economies and livelihoods are closely aligned to rain-dependent systems and activities – will bring serious hardships such as poverty, food and water insecurity, diseases, famines, and migration (Solomon et al., 2007).

2.4.3 West Africa climate change debates: A summation

The West Africa sub-region, which extends from Sierra Leone, through Mali, Ghana and Nigeria to Cameroon, is characterised by a large diversity of ecosystems ranging from tropical and sub-tropical evergreen forests and savanna grasslands to desert vegetation (Dalibard, et al., 2014). It covers a broad bioclimatic gradient from an arid climate with approximately 300 mm of rainfall per year, to tropical forest zones with over 1200 mm of rainfall per year (Heubes et al., 2013: 49). The wide range of climatic conditions of the region supports a broad diversity of plants and general ecosystems. The plant diversity is high on the southern belt, and decreases proportionally moving towards the north (ibid). The diversity of West African ecosystems and their various climate regimes subject the region to what experts refer to as “diverse inter-annual, inter-decadal, and multi-decadal variations” in precipitation and rainfall (Delire, Ngomanda, & Jolly, 2008: 3). West Africa is also characterised by annual insolation resulting in complex dynamics in the atmospheric-ocean-circulation interactions (Dalibard et al., 2014). Such complex interactions between ocean and wind systems in the region keep the margins of the tropical zone mostly dry because of the disparities between evaporation and precipitation (i.e. evaporation is always higher than precipitation in the region) (Solomon, et al., 2007; Dalibard et al., 2014).

The savanna belt of the region (areas around Senegal, Mali and Benin) are represented by dry vegetation with grasslands and dry forests characterised by relatively low rainfall (from approximately 500 to 1000mm of rainfall per year) and a long, dry, sunny, dusty and windy season – the harmattan season – which starts in November and ends in March each year (Solomon et al., 2007). Due to its dryness and lack of rain, the harmattan season is further marked by wild bush fires and airborne diseases resulting in

pervasive destruction of farms and livestock, and a detrimental effect on human health (Maley, 2012).

Various studies by the United Nations Food and Agriculture Organisation to monitor production of food and cash crops have established that the West Africa region, which is credited as the world's largest producer of cocoa from its tropical rainforest belt (Liberia, Ivory Coast and Ghana), has been experiencing declining levels in production of both cash and food crops since the 1980s due to unrealistic and unpredictable weather conditions (FAO, 2008). The 'nature dependent' type of agriculture, which is the main socio-economic activity in the region, makes precipitation and rainfall patterns a key variable in the regional economy. Negative changes in global climatic conditions which affect local climate mean a decline in agricultural output and a corresponding drop in income levels and livelihood deterioration (FAO, 2008). This implies that if the current trend of climatic conditions persists, the general livelihoods of the population in the region would be adversely affected.

2.4.4 Southern Africa climate change debates: Emerging evidence

The Southern African sub-region varies from arid in the west, semi-arid in the east, and semi-arid, humid and sub-humid in parts of the north and central zones (SADC & UNEP, 2010; IPCC, 2013). In addition to these geophysical traits, the climate of the sub-region, according to Ragab and Prudhomme (2002), is greatly influenced by the wind systems prevailing in the arid and semi-arid regions. The sub-region is also characterised by the southeastly wind systems – which bring about rainfall from the Indian Ocean; the Inter-Tropical Convergence Zone (ITCZ) – which brings about extremely warm and cold conditions; and the sub-tropical eastern continental moist maritime winds – which are conducive for cyclones (SADC & UNEP, 2010: 11).

The IPCC (2007) reports that the sub-region has experienced an average increase in temperature of over 0.5° Celsius in the last century alone. It has also witnessed a

relative decline in the volume of rainfall (NCAR, 2005) and recurrent isolated droughts. For example, from 1910 to 2005, the region experienced nine different prolonged and life-threatening droughts with the worst ones occurring between 1921-1930 and 1967-1973, and the most recent in 2004-2005 (SADC & UNEP, 2010: 14). Evidence and climate change prediction models suggest that the Southern Africa sub-region's climate will be hotter in the years ahead than it is currently. Ragab and Prudhomme (2002) project that by the year 2050, the annual average temperatures in the northern part of Southern Africa will rise by between 2.5° and 3.0° Celsius, whilst the southern part of the region will experience a rise between 1.5° and 2.5° Celsius. In addition to such expected increases in temperature Kandji et al., (2006) state that the annual precipitation in the region is expected to decline by approximately 10 percent with a greater reduction in the northern part compared to the southern part.

From the foregoing, it is clear clear that the region is characterised by sub-humid, arid and semi-arid zones which have been experiencing rising temperatures and significant decreases in rainfall levels over the past decades; a situation which could likely translate into a large scale crop failure (Nhemachena, 2009). For instance, the early summer months of September, October and November are the main planting months in the sub-region where maize and other cereals are planted. Unfortunately, different climate change models show that this is the same period when rainfall is expected to decline by an average of 10 percent and a corresponding increase in temperature levels of about 3.7 percent (Zinyengere et al., 2013: 121; IPCC, 2007; Tadross et al., 2009). With such climate projections, Thornton et al., (2009) forecast that cereal yields in most countries in the Southern Africa region, (especially maize) are likely to decline by an average of 10 percent by the middle of the 21st century due to high dependency on rainfed production systems. Parry et al., (2004:65) further observe that general crop yield in Africa may decrease by up to 30 percent in the last quarter of the 21st century; with the decline in cereal production in Southern parts of Africa projected to exceed the general African averages. This view is also supported by Fischer et al., (2005) who note that there will be a 50 percent decline in maize, wheat, sorghum and soybean production in the Southern Africa sub-region by the end of the third quarter of the 21st

century due to changing climate conditions. Scholarly data further indicate that generally, the region's yearly average temperatures have increased by approximately 0.13° Celsius per decade since the beginning of the 1960s (Fischer et al., 2005) with an observed average rainfall of 450 mm per year which is below the world's average of 860 mm per year (WMO, 2014).

Benhin (2008: 666) further asserts that "climate change resulting in higher temperatures and worsening rainfall patterns, together with the already scarce water resources in the region are expected to have a significant effect on all sectors." Thus, key aspects of national economies (such as agriculture, and tourism) are expected to pay a hefty toll for a sustained and unfavourable climate variability. In South Africa, for example, literature suggests that sustained climatic variability trends could by 2050 lead to a fall of about 1.5 percent in the nation's GDP (Benhin, 2008). Additionally, the continuous loss of biodiversity due mainly to climatic conditions could cause irreparable damage to the region's ecotourism with South Africa's share (the economic giant of the region) of such forecast damage estimated at R100 billion (i.e. about US$10billion, according to the exchange rate in July 2014) (Kruger & Shongwe, 2004; Benhin, 2008; SABC).

2.5 How vulnerable is Southern Africa to climate change?

Arguably, one of the most highly sensitive or vulnerable regions to climate change in the world is the Southern Africa region. This is partly due to its fragmented climatic conditions, relatively low coping and adaptation mechanisms, and high dependency (over 60 percent) on agriculture for livelihoods (IPCC, 2007; Cooper et al., 2008; Zinyengere, 2013:119). The high level of the Southern Africa region's vulnerability to climate change is also partly informed by the high dependency on crop and animal production on rain-fed conditions and precipitation patterns (Twomlow et al., 2008; Ziervogel et al., 2008). Furthermore, the combined effects of a decreasing labour force in the agricultural sector, low income generation, food and water insecurities due to ill-health and the allocation of much of the already scarce resources in the region to

fighting the HIV pandemic renders the whole sub-region more vulnerable to climate change impacts in various ways (SADC, 2014). The negative impacts of climate change on agriculture in the SADC region therefore pose a great threat to the socio-economic development and the general livelihood improvement of people because of the close relationship between weather events and the major socio-economic activities in the region (agriculture, tourism, mining and transport).

Recurrent weather related events such as droughts, floods, and hailstorms further render households in the HIV-ravaged sub-region more vulnerable to poverty and diseases due to massive destruction of property, crops, animals, and many other forms of livelihood (SADC, 2010:13). Additionally, weather uncertainties caused by El Niño events decrease agricultural productivity to a great extent, heightening the already hazardous food security situation of the region and the continent as a whole (SADC, 2010). El Niño refers to an unusual warming of the tropical Pacific Ocean that occurs irregularly at about 3-6 year intervals in response to large scale weakening of trade winds. The weaker trade winds allow warmer water around the equator in the far eastern Pacific Ocean to emerge. The warmer water then changes wind patterns and alters storm cycles around the globe with a corresponding effect (See WMO, 2014 2014).

For instance, Glantz et al., (1997) note that the 1991 and 1992 droughts experienced in the region, caused by El Niño related events and leading to the warming of the Pacific Ocean, remain some of the most worst weather events the region has ever experienced. These weather changes led to the loss of thousands of farm animals and tonnes of food crops, and eventually led to pervasive food shortages across the region (SADC, 2002).

In addition to crops and livestock production, another aspect of agriculture which is highly vulnerable to climate change in the Southern Africa region is marine species conservation and aquaculture as a whole. The projected trend in rising sea levels will eventually lead to salinization and contamination of freshwater streams, rivers, springs, and all other coastal aquifers along the coasts (Pittock, 2009). The high levels of

salinization as a result of rising sea levels will lead to infertility in agricultural lands next to coastal areas, culminating in poor agricultural yield (Pittock, 2009). Infertility in agricultural lands and the extinction of some plant and animal species means an imminent economic decline due to climate change.In 2009, the government of Mauritius (GoM) (one of the major tourism destinations in sub-region) reported that the continually rising sea levels will eventually submerge some of the low lying coastal areas such as the coastal wetlands and mangrove areas which are crucial for nursing fish and other forms of marine species, leading to loss of revenues and decline in GDP (GoM, 2009 cited in SADC & UNEP, 2010).

The intricate relationship beteween macroeconomic growth and weather-dependent economc activities leaves the general growth of the region at the mercy of climate variability (Ziervogel et al., 2008). Adverse effects of weather events on the economy of the region could destabilize the region socially and economically. South Africa, for example, which produces approximately 50 percent of the total maize consumed in the region, has for the past decades experienced fluctuations in maize production partly because of changes in seasons, unpredictable rainfall patterns, high cost of farm inputs, etc (Benhin, 2008). The growing body of literature on climate change points to the fact that decline in agricultural productivity in most underdeveloped and developing countries persistently alters the structure and performance of the economies of such countries and general international trade (Deke et al., 2001; Gbetibouo & Hassan, 2005). The continuous changes in climatic variables will therefore negatively affect general livelihoods in the Southern African region because of the intimacy between rainfall, agriculture and economic activities and livelihoods.

2.6 Conclusion

Climate scientists have revealed that, the planet earth is warming and changing at an alarming, unprecedented and destructive rate. Among the key climate variables affected by climate change are temperature, rainfall, wind speed and precipitation patterns leading to widespread melting of ice shelves, increased evaporation, droughts, storm

surges, hailstorms, volcanic eruptions and rising sea levels. Agriculture, biodiversity, ecosystem, human health, infrastructure and other sensitive aspects of socio-economic lives of societies are negatively affected globally by changes in climatic conditions. Human activities are identified by climate scientists as the primary causes of the changes in global climatic conditions through the emissions of greenhouse gasses, especially carbon dioxide. Scholars note that the process of global climate change is to some extent reversible through a fundamental change of human values and lifestyle. Climate change skeptics on the other hand believe that, scientific revelations and projections on climate change, especially those of the IPCC are blown out of proportion thereby 'twisting' global climate discourse. They further bemoan that those climate revelations and projections based on climate science should be opened for thorough scrutiny to avoid biases and misrepresentations.

In Sub-Saharan Africa, the average change in some of the climate variables are projected to be higher than the global figures in the 21st century. However, the degree of such changes are estimated to vary from one sub-region to another. In the Sahel region (from Ethiopia through Chad to Mauritania), temperatures for instance are projected to maintain a rising trend from one season to another, characterised by intra-seasonal variation with an estimated decline in annual rainfall volumes. The tropical regions (from Sierra Leone through Ghana to Kenya – the West and East African regions) are projected to experience a decrease in annual rainfall volumes; interspersed by floods and their associated waterborne diseases. The Southern Africa region (from Angola to Malawi down to South Africa), whose geophysical features are the combination of those of the sahel and tropical regions, (i.e. sub-humid, arid, and semi-arid zones) is expected to experience a decrease in rainfall and a rising level of evaporation due to rising temperatures by the end of the 21st century leading to widespread crop failures in the region.

Drawing on the literature presented in this chapter, it is clear that the arguments proffered by both climate change 'alarmists' and 'contrarians' have failed to analyse climate change and its associated impacts from a local and context specific perspective.

Thus, the global, continental and sub-regional analysis does not clearly portray the climate change story in specific local communities in developing countries. This critical research gap has further created a knowledge and policy gap between climate adaptation policy-makers on one hand; and climate realities in local communities, particularly in Africa, on the other hand. Bridging these knowledge and research gaps in the Eastern Cape of South Africa is the main aim of this study. To effectively achieve this aim, the next chapter looks at the vulnerability levels of various parts of Africa and how various asset categories are used to design ‘local’ mitigation and adaptation strategies.

CHAPTER THREE

VULNERABLE AFRICA? COPING WITH AND ADAPTING TO CLIMATE CHANGE IN VULNERABLE CONTEXTS

3.1 Introduction

What exactly is vulnerability to climate change? Individuals, households and communities across Africa are exposed to the adverse impacts of changing climatic conditions. These individuals, households and communities adopt various immediate response mechanims and long-term strategies to moderate the dangers associated with climate change on their lives and livelihoods. However, the main issue here is: are all African countries equally vulnerable to climate change? This chapter examines some of the socio-economic vulnerabilities to climate change in Africa with a more detailed focus on Southern Africa sub-region (which is the site of the present study). It also discusses the various mitigation, coping and adaptation strategies adopted by different communities in Africa to alleviate climate change impacts. The chapter concludes by demonstrating that from a sector-by-sector comparative analysis, levels of vulnerability differ among communities. What this implies is that climate change coping and adaptation strategies on the continent cannot be universal; hence, the need for locale-specific analysis of climate change risks and vulnerabilities in Africa.

3.2 Vulnerability to climate change in Africa

The discussion on vulnerability to climate change in Africa is built on the principle that in order to understand the vulnerability levels of a given society and prescribe practical adaptation measures, one has to first establish and anlyse the socio-economic and environmental conditions of that society. Conway and Schipper (2011) believe that this can be done by critically examining livelihoods and the prospects of human

development vis-à-vis global climate variabilities. The literature shows that Africa is one of the world's smallest contributors of greenhouse gas emissions and to global warming as a whole; however, it is one of the most affected continents in terms of climate change impacts (DST, 2011). Again, despite its relatively small contribution to global climate variability through carbon emissions, the vast forest reserves across East, West and Central Africa act as one of the major world carbon sinks for carbon dioxide emitted by the industrial world since air space is infinite (DST, 2011).

The negative impacts of climate change on Africa cut across almost all the major aspects of the socio-economic life of Africans. Some of the sensitive and vulnerable aspects of African societies are agriculture (crop, livestock, and fish farming), water resources, coastal and marine life, health, infrastructure and transport, energy, urban planning and management, tourism, biodiversity and ecosystems, environmental degradation and land desertification. These vulnerable aspects are discussed below, while others are discussed in Chapter 7 where the vulnerabilities of the study communities are analysed.

3.3 Water Resources

The demand for water resources globally has increased astronomically, due partly to industrialisation and global population growth rates. However, most parts of Africa, especially the northern African region (Algeria, Egypt, Morocco, Tunisa and Lybia) continue to experience a decline in water supply (see Abufayed et al., 2002; Ramanathan and Feng, 2009; Fink et al., 2010). Because of its naturally arid climatic conditions, water in the northern part of Africa is scarce in many parts of the region which rely mostly on conventional (ground and surface) water sources (Abufayed et al., 2002). It is clear from the analyses of different scholars that the dependency on water and its importance in the economies of north African countries make the whole region very sensitive to climate change (IPCC, 2007).

It is again on record that surface water, which constitutes approximately 80 percent of the total water resources in the Nothern region, is declining due to poor rainfall patterns, high temperatures and other climate related events (IPCC, 2007). What therefore makes the northern African climate change story more frightening and life-threatening is the relationship between surface water or water in general, rainfall patterns, agriculture and the entire socio-economic development of Africa. According to IPCC (2013), 50-85 percent of water demand in the North African region goes into household consumption and irrigation depending on individual countries. It is however worring to note, that between the years 2020 and 2025, the region is likely to exhaust its conventional water resources barring any exceptional increase in rainfall patterns (Abufayed et al., 2002). The impact of such a calamity on agriculture, which is the backbone of economies in the region, will be catastrophic.

The water shortage situation in the Northern region will be further aggravated by the decline in water quality due to anthropogenic activities (Janpeter, 2012). The projected water shortage scenarios mentioned above will become a major limitation to development in North African countries. Without a careful and strategic re-evaluation of current water resources management practices or exploring non-conventional sources of water in the region, it is highly likely that the region will become severely water insecure. Adaptive capacity to climate change impacts in the region is driven by public and private institutions as well as technology. It is however noted that institutional prioritisation of adaptation measures are lacking, which further renders the region more vulnerable to climate change impacts (Sowers et al., 2011).

3.4 Agriculture

Africa is approximately 60 percent arid or semi-arid. It is also characterised by fluctuating temperatures, humidity, rainfall and wind speed (Galvin et al., 2001). Based on its climatological characteristics, specialists argue that various climate projections pose a relatively greater challenge to acgricultural productivity in Africa because a large

proportion of the population depends on rain-fed crops and animal production for survival. Houghton et al., (2001) and Kabubo-Mariara (2009) note that climate variables indirectly affect different aspects of agriculture, especially livestock and crop production. They further argue that climate variability directly influences the quality and quantity of available pasture, grains and forage for feeding animals as well as the distribution and severity of diseases and parasites. Knox et al., (2010:67) estimate that sugar cane production in Swaziland, for example, will take an estimated 13 percent nose-dive by the end of the 21st century due to climate variability. The negative effects of climate change on agriculture are not only felt in food crop production, but also in cash crops. This shows the ravaging nature of climate change impacts on African economies and livelihoods (Zinyengere et al., 2013:124). The Food and Agriculture Organisation (FAO) projects that, should the current trend of climatic conditions in Africa persist, the continent is likely to experience a surge in loss of sources of livelihood and an expected widening of poverty margins because of climatic conditions (FAO, 2005).

In the same vein, the FAO further observes that livestock production in Africa has been on a declining trend over the years, partly due to climatic conditions coupled with other factors. The FAO (2005) estimates that animal production has stalled in the the Eastern Africa region due to unfavourable and unpredictable weather conditions. This is heavily impacting livelihoods since livestock production contributes more than 60 percent of agriculture's share of GDP contribution to the sub-regional economy (Kabubo-Mariara & Karanja, 2007). Unpredictable weather conditions not only affect the reproductive systems of livestock, but also aid the outbreak and spread of livestock diseases such as bluetongue, lumpy skin diseases, and foot as well as mouth diseases. Based on several observations and predictions, Kurukulasuriya and Mendelsohn, (2006) argue that the agriculture sector in the Eastern Africa region is predicted to suffer most from climate variability because of high temperatures and low precipitation. Drawing from these predictions, they further argue that two main climate events that will affect crop and livestock production in both arid and semi-arid areas of the region are flooding and drought (ibid).

Similarlay, in North Africa, apart from Egypt, whose agriculture sector depends mostly on the Nile river, all other North African countries depend almost entirely on precipitation for agricultural purposes. The IPCC (2007) estimates that the dependency on precipitation for agriculture, which influences productivity, will cause losses in agriculture in the North Africa region of between 0.4–1.3 percent of Gross Domestic Product (GDP) by 2100. Analysts are of the view that such a decline will be a major economic setback to the region considering the contribution of agriculture to the GDP of North African countries, especially Morocco which stands at approximately 17–20 percent (Janpeter, 2012).

3.5 Food security

Food security is defined as “a situation that exists when all people at all times, have physical, social and economic access to sufficient, safe and nutritious foods that meets their dietary needs and food preferences for an active and healthy life” (FAO, 1996:1 cited in Moyo, 2010). Building on the United Nations Food and Agricultural Organisation’s conceptualization and definition of food security, Moyo (2010) identifies four main conditions towards ensuring food security: adequacy of food supply or food availability, stability of supply without fluctuations or shortages from season to season or from year to year, accessibility to food supply or affordability, and quality and safety of food. He further stresses that, at both nation-state and micro-household levels, food insecurity affects people who cannot access adequate food irrespective of food availability. Food insecurity is predicted to be a major problem in Africa due to climate change. Adequate food supply as a condition for ensuring food security in Africa is under serious threat in the face of current climate trends. This will be compounded by exponential population growth rates and the accompanying high demand for food on the continent. Observations by different authorities and institutions about the decline in agricultural productivity in different parts of the continent due to changing climatic

conditions confirm that climate change is an affront to African food security (see FAO, 2005; Kabubo-Mariara, 2009; SADC, 2010).

The issue of stability in food supplies without seasonal or yearly fluctuations is another condition for ensuring food security and, as argued by Moyo (2010); however, this is severely under threat in Africa. Issues relating to food distribution channels – especially means of transporting food – which ensure good food supplies all year long are at the mercy of climate and weather conditions in Africa, especially in the western and eastern parts of the continent. The compound effects of inadequate food supply due to low production levels, and inaccessibility of food due to poor distribution channels, because of changing climatic conditions and their associated varied weather conditions and events result in unaffordability of food and compromised food quality. In a nutshell, one of the negative effects of climate variability in Africa will be worsening food insecurity due to a sharp decline in the production levels of food as well as distribution challenges on the continent. Such a decline in food production because of climatic conditions is a major setback in achieving the millenium development goal of reducing hunger and poverty on the continent by 2015 (Thomas, 2008). There is thus an urgent need to increase the resilience system of the continent through the adoption of technology, crop varieties and modern agricultural practices that are resistant to harsh climatic conditions.

3.6 Biodiversity and ecosystems

Globally, biodiversity is threatened by climate variability. Recent studies indicate that some plant and animal species on the continent are near extinct due to climate change (Parmasan & Yohe, 2003). In other words, continuous changes in the mean climate figures annually in Africa are adversely and significantly impacting the biodiversity and ecosystems of the continent (Walker & Schulze, 2008; Heubes, et al, 2013).

The sustainability of biodiversity and ecosystems as a whole is severely under threat from climate change caused by human-induced activities (deforestation, land use and industralisation) and natural events such as El Niño phenomena, landslides and volcanoes (Walker & Schulze, 2008: 114). Chambers (1997) adds that one of the key issues or elements at the centre of biodiversity and ecosystem conservation is humans; and that the well-being of humans is a key issue for the conservation or otherwise of biodiversity and ecosystems. Current climate trends assessments and future projections indicate that large proportions of Africa's biodiversity and ecosystems will be lost in the 21st century because of climate change (Sommer et al., 2010; Heubes et al., 2013).Climate uncertainties emanating from human activities such as industrialisation and construction are depleting the biodiversity reserves of the world. In Africa, anthropogenic activities supported by El Niño influenced events and seasonal rainfall variability has led to the extinction of some traditional and economically viable plants (see Norris et al., 2010; Engelbrecht & Landman, 2011; Pettorelli et al., 2012).

The IPCC (2007; 2013), notes that increased carbon dioxide concentration in the atmosphere, could change agro-ecology in the long run in Africa. Previously arable agricultural lands in Africa are gradually and progressively becoming more arid and desertified due to changing climatic conditions. Reported changes and current projections in the climatic conditions of the African continent show that seasonal precipitation and temperature patterns are expected to fluctuate in most parts of the continent, resulting in great loss of indigenous plant and animal species (Christensen, 2007; Pettorelli et al., 2012: 270).The economic effects of damaging ecosystems and biodiversity include a continuous decline in agricultural productivity and ecotourism in Africa.

3.7 Adaptation to climate change impacts in Africa

Adaptation to climate change is complicated, multi-dimensional and involves a number of steps and procedures (Bryan et al., 2009). Some of these processes and procedures

involve (1) identifying and analysing the nature of climate stress a given society is facing (i.e. the nature of the climate stimulus a particular society is responding to), (2) the socio-economic, geophysical and institutional characteristics of the affected society (i.e. the economic conditions, population growth rate, socio-cultural practices, ecology and government policies of the affected society, and (3) crafting appropriate adaptation measures based on the various societal characteristics mentioned above (Bryan et al., 2009: 415). Poor analysis of the complexity of the impacts of climate variability on society has resulted in some short-term panic responses which turn out to be long-term liabilities and increase society's long-term vulnerability to climate change (Ziervogel et al., 2008).

Dietz and Verhagen (2004) suggest that adaptation strategies to help the world's poor and most vulnerable to cope with the harsh results of climate change should generally be built around three key elements: preparing for adverse climate conditions by designing various types of buffers (anticipatory adaptation), coping with weather-related stresses as they occur (autonomous adaptation), and adapting and recovering from such stresses (planned adaptation). Anticipatory or proactive adaptive steps are taken before some perceived climate changes impacts are observed, for example building of water storage dams to fight drought and dry farming seasons (Dietz and Verhagen, 2004; Bryan et al., 2009). Autonomous adaptation strategies are not a conscious response to climate change, but are rather informed by changes in natural and ecological systems as well as market systems; for example, planting of new crop breeds to increase yields and meet market demands as well as increasing profit margins (Bryan et al., 2009). Finally, planned adaptation refers to policy-informed decisions and policies directed at maintaining the status quo or reversing whatever has changed environmentally, for example, regulating lumbering to maintain forest reserves and control deforestation (Dietz & Verhagen, 2004; Ziervogel et al., 2008).

The nature of responses to climate change stimuli in Africa is greatly influenced by the nature and extent of the exposure or stress, the characteristics of the society exposed to the stress, and the magnitude of the event (Bryan et al., 2009). Various studies

conducted in different parts of Africa suggest that different climatic conditions have different impacts on different aspects of livelihoods, and hence require different adaptive mechanisms (see Hounghton et al., 2001; Kabubo-Mariara & Karanja, 2007; Hassan & Nhemachena, 2008; and Kabubo-Mariara, 2009). It has been established that agriculture (one of the major sources of livelihood in Africa) is one of the main victims of climate variability, and requires urgent and prudent adaptive mechanisms. Discussed below are some of the various adaptive mechanisms adopted in Africa to ameliorate some of the negative consequences of climate change, supported by sub-regional or country level examples where necessary.

3.7.1 Public awareness campaigns

Public awareness campaigns as a climate change impact mitigation strategy have a double objective and significance: promoting modern agricultural technologies and conserving ecosystems and biodiversity. Researchers have found that almost half of African small-scale farmers (approximately 50 percentage) are not aware of climate change and its long-term repercussions on agricultural productivity (Kabubo-Mariara & Karanja, 2007; Hassan & Nhemachena, 2008). This implies that only a proportion of small-scale farmers in Africa will be willing to embrace new farming techniques to circumvent some of the negative impacts of climate change. As a corrective measure, one of the adaptive strategies adopted by the African Union (AU) supported by international organisations, sub-regional bodies, individual national governments, non-governmental organisations (NGOs) and Community-Based Organisations (CBOs) is to educate local farmers and the general public about changing climatic conditions and their ramifications on local agriculture (AU, 2014).

Public awareness campaign; if carried out and monitored properly, would allow local farmers to open up to new farming methods and techniques such as accepting new animal breeds and species including drought-resistant breeds to counter the negative effects of rising temperatures and reduced precipitation on agriculture as a whole.

However, such a campaign might not yield the desired results if not supported by robust research and constant monitoring of the persistent changing global and continental climatic conditions as well as sharing of national and sub-regional climate data.

The second objective or significance of public awareness campaigns is to preserve biodiversity and ecosystems. Through its Green Earth campaign programmes, the AU is sensitising the general public about the need to save the environment and save the world through conservation initiatives directed at African forests (AU, 2014). Conserving African forest reserves will indirectly mean reducing global warming and desertification as well as keeping indigenous plant and animal species alive.

Like any other development initiative, public awareness campaigns as a climate adaptation strategy in Africa is faced with a number of challenges. Key among such challenges is the issue of lack of sustainable local government support systems and structures. Even though climate change campaign 'champions' have emerged from continental to national levels of government on the continent; equivalent of such 'champions' are yet to emerge at the local levels of government (thus provincial and municipal levels) (Roberts, 2008). The lack of political interest and commitment among local government officials and their development partners in climate issues weakens the mainstreaming of climate issues within various provincial and municipal planning processes. Resources are therefore not adequately allocated to climate change awareness campaigns, thereby making the approach ineffective in Africa. In other words, lack of interest, commitment and poor resource (financial and material) allocation to climate awareness campaigns in Africa has put development agenda of local governments and continental climate change adaptation agenda at two opposing ends (Roberts, 2008; Quiroga, Suarez, & Solıs, 2015).

3.7.2 Efficiency in water usage and improvement in water technology

It is evident that in Africa water is a major factor in agricultural production. The intricate linkage between climate change, water and agriculture and the need to understand this

tripartite relationship and formulate appropriate policies to respond to climate change impacts and design programmes that will build a formidable resilience to climate variability in both the long and short term in Africa is imperative. Water resource management and efficient use of water is therefore a major ingredient in boosting agricultural productivity and general livelihood in the face of current climatic conditions in arid regions such as North Africa. The major question then is, how can this be achieved? Scholars have put forward some proposals to help beef up climate change mitigation strategies in the North Africa region. These include the adoption of supplementary irrigation systems, the revival and dissemination of indigenous water harvesting practices and technologically advanced water treament methods (Oweis et al., 2001). Oweis and Hachum (2003) argue that traditional practices such as using stone dikes as microcatchments on sloping lands can assist plant growth and control flooding. In Morocco and Tunisia, for example, trees and shrubs are grown with just 100-200 mm of annual rainfall when combined with contour ridges (Oweis et al., 2001). Morocco and other Northern Afircan countries have adopted some water-efficient technologies (for example desalination of sea water) for both domestic and commercial use (Maraseni et al., 2009). However, there are some trade-offs associated with such initatives. To begin with, what are the consequences in terms of greenhouse gas emissions associated with such energy intensive water utilization technologies and do African countries have the economic muscle to handle the concomitant effects of such emissions?

The on-farm-water use efficiency model is another adaptation mechanism for climate change impacts in Africa. On-farm-water use efficiency refers to the ratio of the required amount of water for a target production level to the actual amount of water used (Shideed et al., 2005; Thomas, 2008). Scholars argue that this model helps to determine the amount of water available and how the available water should be allocated to different farms and crops based on economic and agronomic factors of crop production in a particular country, farm setting or region (Shideed, et al., 2005). The model takes into consideration factors such as crop choices, irrigation technology, land allocation and choice, and prices of yield which are very important to commercial farmers and farmers growing multiple crops in different seasons (Maraseni et al., 2009).

According to Shideed et al., (2005), water efficiency models in agriculture have worked well in arid countries such as Egypt, Jordan, and Syria by helping farmers to take good decisions on the type of crops to be grown, on what land, at what time, the amount of water required, and the subsequent cost of production which influences the final consumer price. Water efficiency models of different kinds thus have the potential to help regulate water use in Africa, especially for irrigational purposes ,to keep crop production at good levels in order to meet demand. Under the same water efficiency models discussion, Mati et al., (2006) argue that, rainwater harvesting (RWH) can help augment the limited available water resources in Africa. Over-reliance on conventional river and groundwater sources for water supplies in most parts of the continent is no longer sufficient to meet the level of water demand on the continent. However, RWH can serve as one of the buffers against drought events in rural and dispersed settlements in climatically unfavourable, arid and semi-arid geographical regions (Mati et al., 2006). This assertion is validated by Kahinda et al., (2010:744) who believe that RWH can boost small-scale productive economic activities such as local beer brewing, brick making, watering of gardens, and so on.

Some of the key problems associated with most of the water efficiency and technology models as climate change coping and adaptation strategies in Africa are; lack of appropriate farming technology (including advanced irrigation equipment), land ownership and litigation issues, lack of technical knowledge on the part of local farmers to adopt modern farming practices and low annual rainfall volumes. Most of the models and their related technologies take into consideration factors like irrigation technology and equipment, crop choices, land allocation or choices, and the amount of water available (see Maraseni et al., 2009). Local farmer's financial ability to access some of these advanced irrigation equipment and their technical knowledge to effectively and efficiently operate them become a problem to the approach. Again, land ownership and its impacts on suitable land choices for farming purposes hamper some of these modern farming practices in Africa. Finally, the efficiency of RWH greatly depends on

how much rainfall is recorded per annum. This determines how much water can be harvested and how long will the harvested water last (Shideed et al., 2005; Mati et al., 2006 and Maraseni et al., 2009).

3.7.3 Conservation agriculture

Conservation agriculture refers to a form of agriculture that maintains and improves crop yield and resilience against drought while protecting and stimulating the biological functioning of the soil (FAO, 2002). Conservation agriculture, among many other things, employs minimum to zero tillage of farming lands to avoid soil exposure to climatic hazards (Rockstro¨m et al., 2009). Even though not widely accepted, conservation agriculture has proved to be one of the best practices to boost agricultural productivity and maintain soil fertility in some parts of the world as the practice helps in carbon sequestration in soils (Lal, 2002). Conservation agriculture can help increase the production of enough biomass to maintain permanent soil cover as well as for significant crop residues (Thomas, 2008). Thomas's viewpoint complements what Stewart and Koohafkhan (2004) earlier argued, that wind erosion can be considerably controlled and soil water storage increased by a small amount of residues. In arid regions such as Morocco, Egypt, Tunisia and Syria, to mention but a few, the retention of scarce soil nutrients is critical and crucial for farming purposes. The adoption of conservation agriculture in Sub-Saharan Africa is limited and scattered due to low understanding of the practice, short supply of farming inputs (fertilizers, herbicides and seedlings), and dynamics in sub-rgional hydrological and agro-ecological systems (Rockstro¨m et al., 2009).

However, due to the current climate conditions, conservation agriculture has been championed in some parts of Africa, especially in the northern and eastern parts (thus areas with arid, semi-arid, and dry sub-humid geo-ecological characteristics), as one of the best ways of mitigating some of the negative impacts of climate change on agronomy. In Morocco, for example, studies show that over the past two to three decades, conservation agriculture has increased agricultural yields in areas with

relatively low rainfall (Mrabet et al., 2003). Again, farm records indicate that the introduction of conservation agriculture in selected areas in Ethiopia, Kenya, Tanzania and Zambia has resulted in significant increase in year-on-year grain yield (particularly wheat, maize and teff) since 1999 as compared to conventional farming practices (Rockstro¨m et al., 2009).

Aside from the virtues of conservation agriculture extolled above, scholars have identified some problems associated with the practice. The first challenge associated with consevation agriculture in Africa is the availability of suitable machinery and technology. The lack of technical knwoledge on modern farming practices, weed control systems and modern farming machinery make most local farmers in Africa impervious to some 'climate resistant' agricultural practices like conservation agriculture (see Kabubo-Mariara & Karanja, 2007; Hassan & Nhemachena, 2008). Thus local farmers lack the needed farming inputs and technical knowledge to effectively implement conservational agriculture in large scales in Africa. Another problem associated with the practice is quality of seed and seedlings and land ownership rights in Africa (private versus collective forms of ownership). It is argued that most local farmers do not have access to the right quality of seed and seedlings to support the smooth implementation of conservation agriculture. This is further exacerbated by land litigations bothering on communal, familial and individual land tenure systems on the continent (Mrabet et al., 2003; Suleimenov & Akshakov, 2004). All these militate against the smooth implementation of the initiative in one way or another at different stages of the implementation process. The success of conservation agriculture in Africa would depend on how well some of these challenges are addressed through the supply of the farming inputs at an affordable prices, training of local farmers modern farming methods and swift resolution of land litigations at local levels. Conservation agriculture is both human and financial capital intensive and therefore requires consented effort from various stakeholders.

3.7.4 Changes in crop and animal varieties and planting patterns

As a short-term climate change adaptation measure, some analysts believe that rural farmers in poor continents should be trained to cope with the immediate effects of climate change rather than committing all resources to predicting the long-term severe impacts of climate change on livelihood in general. Thomas (2008) argues that changing cropping patterns through earlier sowing, planting shorter duration crops, crop rotation, mixed cropping, or better still, crop and animal breeding, are prudent means of increasing yields in the face of unpredictable weather conditions. Crop or plant or animal breeding refers to a direct selection of some environmental and weather resistant crops, animals and plants as a means of mitigating the impacts of climate conditions on plants, animals and crop production (Ceccarelli et al., 2004). In other words, it is the act of directly selecting a specific range of crops and animals for climate adaptation purposes. Crop or plant breeding saves time, material and financial costs, and also boosts yields compared to other traditional agricultural practices (Ceccarelli et al., 2004). According to Mangion et al., (2006) crop or plant breeding provides variability to the ever-increasing extreme climatic conditions as well as providing an awareness of the range of genetic variations in various plants.

Fischer et al., (2005) support the above view with what they term ‘farm-level’ adaptation and the adjustment of global and regional market trends. Farm-level adaptation to climate change impacts can be plausible by changing crop calendars and crop systems to suit the new global climate and market trends (Fischer et al., 2005). In the eastern part of Africa, for instance, one of the most widely used adaptive strategies among small-scale farmers, (whose year-on-year seasonal yields and incomes keep dropping due to changing climatic conditions) is switching between livestock and crop production under different climatic conditions. During high precipitation seasons, when livestock production becomes comparatively unprofitable, small-scale farmers reduce their livestock holdings in favour of crop prouction in order to cut down costs and still maintain revenue levels and a good livelihood (Kabubo-Mariara, 2009).

With respect to livestock breeding as climate change adaption strategy, in Nigeria for example, the Bunaji or White Fulani cattle breed is the preferred choice among small-scale pastoral and settled farmers from the northwestern to the southwestern parts of the country (that is, areas around Kaduna, Gusau, Katsina, Kano, Ibadan, down to Lagos States). Local farmers in those States prefer the Bunaji breed to any other breed because the Bunaji cattle are perceived to be superior to any other breed in resisting different diseases under different climatic conditions (Blench, 1999). Similarly, small scale livestock farmers in far north of the country (Sokoto State) prefer the Sokoto Gudali cattle to all other kinds of breeds because the Sokoto Gudali breed can withstand the arid and semi-arid conditions of the north and graze less as compare to other breeds (Blench, 1999). Livestock breeding is common among farmers in the Sahelian regions of the continent (that is, areas around Senegal, Mali, Niger, parts of northern Nigeria, Chad, Sudan through to Ethiopia) with arid and semi-arid vegetation (Clemens & Wollny, 2001).

Based on the ecologically diverse and climatically contrast nature of the continent, purposive selection of different breeds as well as cross breeding of livestock is seen as a prudent climate change adaptation strategy. Some of the advantages of livestock breeding in Africa in the context of climate change adaptation are that, livestock breeding allows local farmers to select animal breeds that are more resistant to climate-induced diseases; multiply fast; graze less; and graze on different variety of vegetation. Again, it helps particularly pastoralists to select and keep animals that can travel long distances under different climatic and weather conditions as a way of escaping total stock lost due to climate change (Blench, 1999; Clemens & Wollny, 2001; and Liu et al., 2008)

Even though experts believe that changing cropping patterns and crop and animal can be a good adaptation strategy to climate change, others are quick to add that changing cropping dates and breeding systems can only be prudent mechanisms if they are supported by an increase in investment in research and modifications (Liu et al., 2008). In the cotnext of modification of agriculture (the introduction of modern technology) to

counter climate change impacts in Africa; the hi-tech in agriculture approach to mitigating climate change impacts brings to fore a new form of vulnerability which is mostly ignored by policy makers. The use of technology such as sophisticated farming equipment, chemicals, breeding criteria and other forms of advanced agricultural practices to mitigate some of the numerous impacts of climate change in Africa advanced by scholars such as Dietz and Verhagen (2004) and Thomas (2008) and other international bodies has ignited another argument. Thus, addressing climate change impacts through advanced and sophiscated agricultural practices pose a challenge to the socio-economic development of rural and poor farmers in Africa. Critics of such approaches are of the view that, even though some of these hi-tech approaches would increase productivity over a period of time, however, the rural poor and marginalised are further rendered vulnerable and exposed to the menace of climate change. This is so because rural residents in Africa generally belong to a social cluster with low human and financial capital to access some of these 'advanced' technologies and 'complex' agricultural practices thereby alienating them from modernity in agriculture.

3.7.5 Carbon sequestration

Scholars argue that carbon sequestration is another good strategy widely used, whether knowingly or unknowingly, to sidestep some of negative impacts of climate change. Carbon sequestration refers to the absorption or trapping of carbon dioxide (CO_2) in plant biomass or soils (Thomas, 2008). Carbon sequestration helps in enhancing soil fertility and resilience as the organic and inorganic carbons in soils are critical in the productivity levels of soils. Again, it regulates the carbon cycle of the globe and its environmental functioning (Boko et al., 2007). Controlling and utilising soil organic carbon (SOC) as well as atmospheric carbons is very important and special in the various climate change impact mitigation strategies. Soil and atmospheric science researchers show that the current net fluctuations between soil and atmospheric carbons are low. However, such fluctuations are expected to rise in the coming decades

to recover the lost SOC stock (Aguilera et al., 2013). Smith et al., (2008) show that 89 percent of agricultural related greenhouse gas mitigation measures relies on carbon sequestration. Thus increasing the SOC content through sequestration is relevant in climate change adaptation as it improves the chemical, physical and biological quality of the soil which boosts and sustains agricultural yields in environments where climate conditions are extreme (Smith et al., 2008; Lal et al., 2011; Aguilera et al., 2013).

Many other adaptation methods, especially those that reduce soil erosion and conserve moisture, depend on the amount of carbon trapped in the soil through plant biomass. The savanna and arid regions of western and northern Africa, for instance, have adopted carbon sequestration as a means of controlling soil erosion and maintaining soil fertility by increasing the cultivation of more creeping plants (groundnuts, sweet potatoes, etc). Based on this, it will be prudent for climate change mitigation and adaptation strategies to include various agro-ecosystems to sequester carbon dioxide. Taking into account the view that soils can act as both sources and sinks of carbon dioxide, increasing the resilience of agro-systems to climate change through water management, soil, and crops can be a good mitigation and adaptation measure.

Some of the main challenges of carbon sequestration in Africa are discussed as follows. At a small-scale level (farm level sequestration), the approach is challenged by the quality of land available and the prevailing land use practices (thus the type of farming practices on the land) and lack of technical knowledge relating to carbon issues on the part of local farmers. For instance, dry lands that are heavily tilled for farming purposes sequester less carbon as compared to wetlands (Jindal et al., 2008). This therefore makes small-scale carbon sequestration initiatives in Africa comparatively productive in the tropics than in the savanna and arid areas of Africa. At the bigger-scale (i.e. funded forestry-based carbon sequestration projects), land ownership systems in Africa remain one of the key challenges to sustainable carbon sequestration initiatives on the continent. Most Africa countries have multiple land tenure systems whereby several land users may have access to different resources on the same piece of land, especially

family or clan lands (Lund, 2000). Under such situations, there exists duality between customary and statutory land rights. In Africa, records show that, carbon sequestration projects situated in areas where land and property rights are not properly defined lead to all manner of problems (Lund, 2000). Another problem associated with long-term carbon sequestration projects in Africa is the issue of volatility and unpredictability in the governance systems of the continent. Most carbon sequestration projects have long gestation periods (particularly forestry-based sequestration projects) (Jindal et al., 2008). However, most African countries are faced with volatile and unpredictable political systems; making huge capital investment in carbon sequestration projects a risky venture to international development partners and multi-national corporations.

To address some of these challenges, there is the need to build strong systems and institutional capacity in Africa in order to improve the continent's share in global carbon trading through large-scale carbon sequestration. Again, a comprehensive framework is necessary to support carbon trapping capacity initiatives from local to national levels. Finally, land and political conflict resolution procedures should take a centre-stage in climate change adaptation discussions in Africa.

3.7.6 Indigenous adaptation practices

Oweis and Hachum (2003) argue that efforts to help the rural poor in Africa to adapt to climate change with documentation and dissemination of indigenous knowledge practices which fall outside the scope of the modern way of doing things will be as crucial as modern technology itself. The term indigenous knowledge is generally defined to include 'local knowledge,' 'traditional knowledge or practices,' 'peasant knowledge' and 'traditional environmental knowledge' (Sillitoe, 1998; Mavhura et al., 2013: 39). Despite its multiple meanings, indigenous knowledge represents a body of knowledge existing within, constructed or acquired by local people over a reasonable period of time and transferred from one generation to another. Arguing in support of this notion

Shaw et al., (2009) indicate that indigenous knowlegde in most cases is locally bound, culturally rooted and context-specific. Thus indigenous knowledge refers to traditional local knowledge or local know-how accumulated across generations (Agrawal, 2003). In other words, it is learned and applied within a specific locality or cultural group (Nkomwa et al., 2014). By its cultural background and local specificity, indigenous knowledge is non-formal and orally transmitted and closely linked to the survival and subsistence of particular local or cultural group (see Mavhura et al., 2013).

It may thus be posited that indigenous knowledge constitutes the ideational capital of local residents in climate change discourses. Ideational capital, as used in this context, refers to indigenous knowledge about how to cope with adverse environmental conditions (see Akpan, 2011). In other words, indigenous knowledge can be a useful resource in climate change coping and adaptation drive in Africa, particularly in the agriculture sector, taking into account the rich cultural diversity of the continent. Arguing in favour of the positive role of indigenous knowledge in climate change adaptation strategies in Africa, Mavhura (2013 :38) notes that “Indigenous knowledge has been an inherent component of traditional disaster management systems where over centuries; people have adjusted their lives, agricultural systems and livelihoods to adapt to changing context”.

Agriculture remains critical to people’s livelihoods and national economies in Sub-Saharan Africa. Despite the huge contribution of agriculture to the growth and development of individual households and national economies in Africa; due to its heavy reliance on rains and other natural events, the sector in Africa is highly vulnerable to climate change because of the relationship between climate change, rainfall patterns and other natural events (IPCC, 2013). This makes most indigenous practices and local knowledge in Africa tuned towards agriculture and other forms of rural livelihoods as means of saving lives against climate change. In Swaziland for example, in order to minimise the impacts of prolonged dry weather conditions on soil organic matter and crop yields, local famers plant on different farmlands at different times as a means of

reducing the risk of total crop loses. Additionally, furrows are dug to direct water to farming lands; water conserving and soil binding plants are planted on farmlands; gullies are filled with stones to conserve water in mountainous farm areas; while farmlands are ploughed across – not down the slopes - (Stringer et al., 2009).

In Malawi and Zambia, local and small-scale farmers adopt changing of crop types and varieties; planting of more than one seed per station to boost germination rates; shorter duration crop varieties; cultivation of drought resistant or tolerant crops and shifting cultivation as some of their local climate change impacts mitigation and adaptation strategies (Nkomwa et al., 2014). Moreover, local farmers in parts of West and East Africa use switching between varieties of animal and crop species as a climate change adaptation strategy. In times of prolonged droughts for instances, small-scale livestock keepers in arid and semi-arid rangelands in parts of West Africa (e.g. Mali, Burkina Faso, Ghana, Niger and Togo) and parts of East, notably in Uganda, Kenya and Tanzania switch from cattle to small ruminants such as sheep and goats in order to manage with the little forage available (Thornton et al., 2010). Similarly, more drought resistant crops like millet and sorghum become the preferred choice of local farmers when below-average annual rainfall is anticipated (Thornton et al., 2010). All these and many more are done by local farmers across Africa in order to keep soil moisture and fertility, conserve water, avoid soil erosion and land degradation, increase local agricultural productivity and sustain rural livelihoods in the face of changing global climatic conditions.

Despite the positive contributions of indigenous knowledge towards climate change adaptation in Africa, particularly in the agriculture sector, the approach is saddled with a number of challenges. To begin with, indigenous practices are local, culturally rooted and context-specific (see Shaw et al., 2009) and largely applicable in subsistence farming communities. This therefore makes the application of indigenous adaptation strategies limited in scope and space. Again, lack of input and support from national

governments in Africa inhibits the proper dissemination of indigenous agricultural adaptation mechanisms among local farmers (Nkomwa et al., 2014), which makes indigenous knowledge a 'dying asset' in the context of climate adaptation discourses. Furthermore, the media and systems of transmitting indigenous knowledge from one generation to the other and subsequently integrating indigenous farming knowledge with modern science are slow in Africa (Nkomwa et al., 2014). This makes the contribution of indigenous approaches to climate change adaptation at global level minimal. Finally, even though some of the indigenous farming practices (for example shifting cultivation and pastoral farming systems) allow farming and grazing lands to fallow and regain their fertility over a period; they sometimes pose a threat to biodiversity and ecosystems conservation in local communities as most land reserves are turned into farming and grazing lands. This sometimes leads into the total extinction of certain indigenous plant and animal species in Africa. Mainstreaming indigenous knowledge into formal science is one of the composite approaches to address some of these issues.

3.7.7 Migration as an adaptation strategy

Migration is, and always has been an integral part of interaction between humans and their environment. In climate change discussions, migration is perceived as both individual and household strategy to secure sustainable livelihoods in climatically conducive environments. Arguing in support of this view, Frayne et al., (2012) note that mobility or migration is a key strategy in households and individuals asset adaptation and therefore should form an integral part of climate change policy planning. In an event of climate-induced disasters; where individuals, households and communities' asset capitals are not able to sustain livelihoods any longer, individuals and sometimes households adopt migration as the next adaptation option. This offers them the opportunity to resuscitate their livelihoods through asset accumulations elsewhere. It is however noted that, climate induced events cannot be solely responsible for human migration in general as socio-economic and political factors play a key role in migration. Again, migration is not the only coping and adaptation option available to victims in an

event of climate disaster, as some victims might even be too poor to migrate (Kniveton et al., 2008).

However, there is a considerable body of scholarship to suggest a link between climate impacts on livelihoods and migration. The European Union (EU) highlights that the continuous increases in drought events, intense tropical cyclone activities, changing precipitation patterns and extremely high sea levels due to climate change are likely to lead to increased vulnerability and population movements across district, provincial, national and regional borders in the years ahead (EU, 2013). Arguing in support of this view, Tacoli (2009) indicates that there is growing evidence suggesting that migration is an important strategy to reduce vulnerability to environmental and climate risks (Tacoli, 2009 cited in Frayne et al., 2012: 83). Experts indicate that migration does not only increase ones resilience to immediate climate-induced risks, but it also enables individuals and households to accumulate assets in order to adapt to future climate events. According to Kates (2000), among the poor population of the world, the lack of capacity (both financial and material) at household and community levels to adapt to climate and environmental risks or hazards leads to large-scale migration as an adaptive strategy. Thus, if a given community's institutions and systems are unable to cope with the prevailing climatic and environmental conditions; vulnerable individuals and households resort to migration as their own adaptive strategy (McLeman & Smit, 2006). Arguing from a sustainable livelihood perspective, migration can be classified as one of the bundles of climate change adaptation strategies as it increases and diversifies individuals and their households' sources of income and livelihood and reduces their vulnerability to climate risks. Similarly, the contributions of migrants through transfer of "knowledge and skills upon return can also significantly strengthen the resilience of families and communities against climate change adverse effects" (International Organisation For Migration (IOM), 2009: 2).

In Africa, studies show that predominantly, rural populations in drought and flood prone areas adopt migration as a coping strategy. In western parts of Sudan for instance, male household members migrate to the urban areas in search of wages when times of

low rainfall hinder agricultural production (Afolayan & Adelekan, 1999). Similar strategy is adopted in the dry areas of Ethiopia and Tunisia among the youth, after other adaptation mechanisms have failed (Ezra, 2001). In East Africa (particularly in Kenya and Tanzania), where thousands of pastoralists herd livestock in the semi-arid and arid areas, farmers, mostly among the Massai and Turkana tribes, migrate with their livestock from one location to the other in search of forage during drought seasons (Galvin et al., 2004). This helps farmers to maintain production levels and avert stock loses to climate variability. Also, among the Fulani herdsmen in northern Nigeria, Niger and Benin Republic, seasonal migration from one vegetation zone to another is deployed to avoid deterioration and reduced productive capacity of their livestock (Blench, 1999).

In summary, migration is not a mere adaptation strategy to climate change, but also a key avenue of broad asset adaptation by helping individual, household and community assets to multiply. Again, migration as an adaptive strategy to climate change promotes knowledge and experience transfer from one place to the other, which further enhances individual and societal resilience against future climate variability. Despite the significance of migration as climate adaptation strategy, there are some challenges associated with the approach. Migration sometimes reduces the social capital and networks of migrants; thereby increasing their vulnerability to the effects of climate change. Concerning pastoral migration, rising human populations along with many land tenure and land-use changes have squeezed pastoral livestock onto land areas that are too small to be sustainable for pastoral production. This is therefore gradually making migration ineffective for pastoralists as a climate adaptation mechanism. Again, climate change-induced events could create a new set of refugees who may migrate into new settlements in search of new livelihoods. The net impact of this kind of migration is that, it put extra burden on the existing infrastructure and resources leading to scuffles between migrants and natives. Some of such scuffles sometimes escalate into protracted inter-tribal wars. Brown and Crawford (2009) note that, migration itself is not inherently problematic; and indeed, it can be an important way of adapting to some of the adverse impacts of climate change. However, literature shows that migration can increase the likelihood of conflict both in transit and in destination communities through

the scramble for resources and ethnic clashes. To address some of these issues, the onus lies on all stakeholders in development to build and strengthen other adaptation strategies in order to lessen the rate of environmental migration across countries and regions. The next section of this chapter looks at climate change and conflict situations.

3.8 Climate conflicts due to adaptation failures

Experts argue that long-term trends of desertification and short–term natural disasters such as flooding, droughts, landslides, hurricanes and cyclone activities damage livelihoods, disrupt economies and reduce the available supply of natural resources and subsequently generate mass migration out of affected areas (Salehyan, 2008). In the developing world, it is indicated that deterioration in local climate and ecology could lead to a mass migration and series of conflict situations because of the huge numbers involved (Parry et al., 2007). According to Brown (2009) over 200million climate refugees are expected globally by the year 2050 if the current trend of changing climatic conditions continue. A climate refugee (climate migrant) is a person displaced by climatically induced environmental disasters. Thus, climate refugees are people who are forced to leave the comfort of their homes temporarily or permanently due to climate disasters that risk their lives (Frayne et al., 2012). Such disasters, according to experts, result from incremental and rapid ecological change, resulting in increased droughts, desertification, sea level rise and frequent occurrence of extreme weather events (Salehyan, 2008).

As part of the general climate adaptation discourse globally, there is an ongoing scholarly debate around whether people displaced by climate change or other forms of environmental issues should be considered as refugees or not, based on the nature of movements involved (sometimes internal movements and not international) and the right to return when environmental situations improve. Despite the contestations around the definition and categorisation of climate refugees or migrants, available literature suggests climate induced-movements (whether local or international) contributes to conflict situations in a number of ways (see Reuveny, 2005; 2007 and Salehyan, 2008).

The argument in favour of the connection between climate change and conflicts boils down to the issues of resource scarcity, competition over means to sustain livelihoods and the struggle for ethno-cultural hegemony and or autonomy.

Conventionally, the arrival of large number of climate migrants within a short space of time can over-burden the economy and other resources of the destination community (for example, competition over land and jobs). It is noted that the native-migrant competition over economic and natural resources could generate tensions between the competing parties (Reuveny, 2005). This indicates that unregulated population movements due to climatic conditions and stiff competition over limited resources could undermine peace and security in the affected areas. In such situations, conflict could emerge when the competition over resources get stiff and can lead into cross-border or inter-tribal fighting. A classic example under such situations is the long-standing land conflict between the Turkana and the Pokot tribes of Kenya (see Awour et al, 2008). However, this is not to underestimate the fact that natural resources abundance, rather than their scarcity, can also lead to civil conflicts through rebel activities over resource exploration issues.

Another possible source of conflict associated with climate-instigated migration is through ethno-tribal clashes. When large climate migrants and residents belong to different ethnic or tribal groups, the arrival of newcomers in large numbers within a short space of time and the struggle for authority could provide fertile grounds for conflict (Reuveny, 2005; 2007). In most cases, the local residents particularly feel threatened and insecure under such situations; and therefore resort to armed defense mechanisms and attacks, which sometimes lead to widespread violent attacks. For example, when environmental conditions deteriorated in Bangladesh in the 1970s, many people lost their sources of livelihood, and their quality of life declined significantly (Reuveny, 2005). The victims (mostly Bengalis) left their homes in search of a more hospitable environment for better lives. Their arrival in neighbouring India brought about violent clashes between migrants and residents killing thousands of people, due to competition

over resources and religious and ethnic differences. This cross-border climatically instigated conflict continues to date, albeit at lower intensity (Reuveny, 2007).

Even though these forces discussed above could also promote conflict from ordinary migration situation; the scope and spread of migration differentiates the two. In other words, when migration flows are small and slow (ordinary migration), the receiving communities can absorb migrants smoothly without any violence as compared to huge and fast migration (climate-induced migration). To address the issue of climate migration and its associated problems, sustainable climate change adaptation programmes and policies through innovation is the solution. This will help curb climate conflicts emanating from mass migrations. Again, governments of both migrating and destination communities can assist in smoothly integrating migrants into communities by providing financial resources and alleviating distrust.

3.9 Conclusion

From the literature presented so far, it is clear that Africa is highly vulnerable to climate change. The negative impacts of climate change on Africa cut across almost all the major aspects of the socio-economic life of Africans. Some of the sensitive and vulnerable aspects of African societies to climate change are: water resources, agriculture (crop, livestock, and fish farming which influences food security), coastal and marine life, health, infrastructure and transport, energy, urban planning and management, tourism, biodiversity and ecosystems, environmental degradation and land desertification. Different communities in Africa adopt different coping and adaptation strategies to circumvent some of the negative impacts of climate change on their citizenry depending on the nature of such impacts and resources available. Coping and adaptation strategies to climate risk and vulnerability include both short-term responses and long-term adjustment in human, political, socio-economic, and to some extent natural systems in response to actual or expected climate stimuli or their effects

on livelihoods. Among such coping and adaptation strategies adopted in most parts of Africa are: climate change awareness campaigns; efficiency in water usage and general improvement in water technology; conservation agriculture; changes in crop and animal varieties and planting patterns; carbon sequestration; indigenous knowledge systems (IKS) and migration.

The collective contribution of the various coping and adaptation strategies mentioned above have helped to some extent in promoting modern agricultural practices among local farmers; boosting soil fertility, soil moisture and gricultural productivity; reducing soil erosion; conserving water in water-scarce areas; and preserving biodiversity and ecosystems in Africa. However, the complete success of these strategies in Africa is challenged by a number of issues. Among such challenges are: poor infrastructure; lack of modern agricultural facilities, equipment and seedlings; low level of technical knowledge on modern agricultural practices on the part of local farmers; improper land tenure systems and land use practices; lack of integration between local knowledge and formal science and volatility and unpredictability in political systems on the continent.

The chapter has demonstrated that vulnerability to climate in Africa differs from one community to the other and from one sector to the other, and therefore coping and adaptation strategies cannot be common across communities due to idiographic nuances. It has again shown that, indeed, coping and adaptation strategies of climate change depend on the nature and degree of vulnerability as well as the resources available. The evidence presented in this chapter would shape and guide the next chapter in the sense of how to assess locale-specific risks and vulnerabilities to climate change, the available coping and adaptation strategies based on the available resources and the appropriate theoretical and conceptual framework(s). The next chapter looks at the theoretical engagement of the study.

CHAPTER FOUR

CLIMATE CHANGE AND IMPACT MITIGATION: A THEORETICAL ENGAGEMENT

4.1 Introduction

This chapter traces the loci of theoretical debates and insights on the subjects of risk, vulnerability, coping and adaptation with specific reference to the global challenge of climate change. Equally important, the chapter discusses the theoretical framework adopted for the study, with specific highlight on the amendments made to the traditional conceptual ingredients that make up of this framework.

4.2 Theorising and operationalising risk, vulnerability, coping and adaptation

In order to understand and apply the concept of vunerability appropriately in different disciplines and contexts, Hufschmidt (2011) opines that experts of various disciplines should analyse vulnerability from a risk perspective. Risk can be categorised into three different components, namely; the elements at risk, hazards to the elements at risk, and vulnerability to the risk factor (United Nations Disaster Relief Organisation - UNDRO, 1982). *Elements at risk* are objects, people, property, infrastructure or economic activities that are potentially and negatively affected by an event (UNDRO, 1982). *Hazard*, on the other hand, refers to a condition that shows the probability of a damaging event occuring with a specified magnitude within a defined time period and area (UNDRO, 1982; Crozier, 1993). In the context of climate variability, risk refers to the magnitude and frequency of climate-related events such as earthquakes, floods, droughts, tropical cyclones and hurricanes. At the same time, different scholars have interpreted vulnerability differently.

Adger and Kelly, (1999) define vulnerability as the ability or inability of societies to cope with and adapt to any external stress placed on their livelihoods and well being. While ,

Moss, Brenkert, and Malone (2001) see vulnerability as the propensity of a society, economic sector or ecosystem to experience damage or disruption as a result of climate-related and other hazards. For Eriksen and Kelly (2007), vulnerability means a set of socio-economic, political and physical factors that determine the amount of damage a given event will cause (Eriksen & Kelly, 2007: 499), while Hufschmidt (2011) sees vulnerability as "the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of a community to the impacts of hazards" (Hufschmidt, 2011: 623). Hufschmidt's assertion corroborates Blaikie et al.,'s (1994) submission that vulnerability must always be linked with a specific hazard or set of hazards so that vunerability and exposure in the context of climate change become inseparable. The IPCC (1996) posits that the extent to which climate change may damage or harm a system depends not only on a system's sensitivity but also on its ability to adapt to new climate conditions. Sensitivity in this sense means the degree to which a system will respond either negatively or positively to changing climatic conditions (Kelly & Adger, 2000).

Looking at the history and classical application of the *vulnerability* concept, Kelly and Adger's (2000: 328) definition of the concept is more appropriate and operational for this thesis. According to Kelly and Adger (2000: 328) vulnerability is the "ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to any external stress placed on their livelihoods and well-being". This means that vulnerability to climate change and other environmental related events are socially, economically and politically constructed and not natural. Social construction of vulnerability as used here refers to how different socio-economic and political characteristics, processes or trends influence levels of vulnerability (Kelly & Adger, 2000: 329). By implication, vulnerability is therefore the extent to which a natural system is susceptible to climate change. It is a function of the sensitivity of a system to changes in climatic conditions (i.e. the degree to which a system will respond to a given change including both beneficial and harmful effects) and the ability to adjust the system to enable it cope and adapt to changes in climate (CSIR, 2011).

Adaptation as used here then means the adjustment in human, and to some extent natural systems in response to actual or expected climate stimuli or their effects, which moderate harm or exploits beneficial opportunities (IPCC, 2001: cited in SADC & UNEP, 2010: 25). Such adaptive systems include adjustment in structures to influence processes and practices that can help to counterbalance or moderate the dangers caused by climate variability and finally take advantage of such damages for growth. Coping, on the other hand is defined as a short-term and immediate response to unusual climate or weather events (Berkes & Dyanna, 2001). According to Davies (1993), coping mechanisms and strategies are a bundle of people's immediate responses to adverse effects of climate-induced events. Such mechanisms and strategies often take the form of 'emergency' and 'panic' individual and household responses to 'abnormal' weather and or climate induced events.

The key distinction between coping and adaptation, in the context of climate change discourse is that coping, by definition and application, is a temporary response to climate-induced impacts on livelihoods without any fundamental or structural changes to systems and institutions. Adaptation, on the other hand, entails long-term strategies and permanent structural changes to sources of livelihoods as a means of forestalling future adverse effects of climate change on livelihoods (Davies, 1993). Again, coping mechanisms emerge at individual and household levels and at smaller spatial scales due to differences in asset endowments. Adaptive strategies on the contrary emerge at larger spatial scales partly because of their relationship with broader societal variables such as norms and cultural values (Berkes & Dyanna, 2001).

Coping with climate change adverse effects therefore means acting to survive in the context of prevailing climate condition; while adaptation entails changing of socio-economic systems, institutions and productive activities to protect livelihoods from future climate events. The two kinds of responses (coping and adaptation) may overlap in one

way or the other, but their primary separation point is that, in most cases coping mechanisms develop into adaptive strategies.

The adoption of an operational definition of *vulnerability* and an explanation of coping and adaptation as given above, would help the researcher to present a robust discussion on climate change and its related impacts on various aspects of livelihoods of the study communities, make recommendations that are of policy relevance, justify the conceptual frameworks adopted by the study and finally draw conclusion regarding vulnerabilities and adaptation strategies that are of both short- and long-term significance. In order to give readers a visual understanding of the asset accumulation framework and ideational capital (indigenous knowledge systems) and what they entail, the diagram below gives the various strands of the concepts as adopted in this study.

Table 4. 1 Diagrammatic representation of asset accumulation framework

Capital	**Description/Definition**
i. Physical capital	The stock of plants, equipment, infrastructure, and other productive resources owned by an individual, a household, a community, or a nation.
ii. Financial capital	The financial resources available to people, such as savings and supplies of credit.
iii. Human capital	Investments in education, health and nutrition of individuals.
iv. Social capital	Rules, norms, obligations, reciprocity, and trust embedded in social relations, social structures and societies' institutional arrangements.
v. Natural capital	The stock of environmental assets such as soil, atmosphere, forests, minerals, water and wetlands.
vi. Ideational capital	Indigenous knowledge about how to cope with adverse environmental conditions.

Source: Akpan (2011); Moser et al., (2012)

4.3 Vulnerability and adaptation: Asset Accumulation Framework

This section thoroughly examines the main arguments of the Assets Accumulation Framework; discusses the five different categories of assets or asset portfolios and evaluate how the availability of any of these five asset portfolios can help ameliorate various climate change impacts and vulnerabilities; and subsequently leading to efficient adaptive strategies at individual, household and societal levels. Moser (1998) and Frayne et al (2012: 12-13) define asset as a stock of financial, human, natural or social resources that can be acquired, developed, improved and transferred across generations. The development aspect of assets bothers on increasing investments into productive ventures and activities that enhances the stock of each of the asset portfolios available to individuals, households and communities. Improvement in asset capital on the other hand, centres on the conversion, sustenance and extension of the frontiers of the existing resources for the benefit of present and future generations. Assets are defined as transferable in the sense that, they constitute resources that are either inherited or acquired as individuals, households and communities; and are kept, utilised and finally bequeathed to future generations. It is further argued that asset or capital endowments can be both tangible and intangible and can be owned by individuals, households, communities, or nations depending on the asset type (Sen, 1997; Frayne et al., 2012).

Moser (1998) and Frayne et al., (2012) identify two components of the asset accumulation framework which serve to simplify and operationalise the theory and link it with contemporary environmental issues like climate change. These components are; an asset index and asset accumulation policy. An asset index as defined by Frayne et al., (2012), quantitatively and qualitatively measures the accumulation or erosion of different assets over time and further clarifies the interrelation between different assets. An asset accumulation policy on the other hand, is defined as an associated operational approach that focuses directly on creating opportunities for people to accumulate and sustain complex asset portfolios (Frayne, et al., 2012). The asset accumulation framework contributes to the development of more appropriate climate change

analytical tools from an endowment perspective and the subsequent development of adaptive strategies based on available asset capitals (Moser, 1998). Moser (1998) further argues that analysing risk and vulnerability does not only involve identifying threats, but also the 'resilience' or responsiveness in exploiting opportunities and recovering from the negative effects of changing climatic conditions (Moser, 1998: 24). Therefore, the absence, erosion, or under-utilisation of assets poses a risk and renders a given community vulnerable to climate change impacts.

One of the resistance tools to climate change impacts are assets and entitlements that individuals, households and communities can organise to handle climate change hardships. Climate change vulnerabilities are therefore strongly related to asset ownership. Individual and household well-being is multi-dimensional and directly linked with available asset portfolios (Moser, 2006). Additionally, individuals, households and communities' accumulation and utilisation of various asset capitals are influenced by external forces like climate change and its associated risks and vulnerabilities (Heltberg, et al., 2009). Chambers (1989) highlights two different dimensions of vulnerability; the internal and the external. The external dimension comprises the potential damage caused by climate events, whereas the internal dimensions encompass people's capacity and means to withstand or adjust to such damages or losses. The various dimensions of vulnerability to climate change which this study addresses focus on both the internal and external vulnerability dimensions. The study examines how assets and institutions are affected by external shocks or threats caused by climate events and how the same assets are used by individuals, households and communities to cope and adapt to climate change impacts. In so doing the study takes cognizance of the fact that the greater the erosion of people's assets, the greater their insecurity. Similarly the more numerous and diverse the characteristics of the assets people have, the less vulnerable they are to climate change (Frayne, et al., 2012).

The interface between climate change risks, vulnerabilities, accumulated assets and policy directions define individuals and community resilience to climate change. Moser (2006) argues that individuals and communities are vulnerable to climate change

impacts, partly because they have limited quality and quantity of assets. For instance, social exclusion and marginalisation of minority and disadvantaged social groups; spatial disadvantage and remoteness; economic insecurity and inaccessibility to market facilities, and limited job opportunities, are some of the features of various asset groupings which make certain individuals, households and communities more vulnerable to climate change (Moser, 2006; Heltberg et al., 2009 :91). In times of climate disasters, individuals and households with enough accumulated asset stocks fall on their reserves to mediate the impacts of such disasters (Moser, 2006). The adaptive capacity of vulnerable individuals and communities depend on their asset endowments and available institutions and processes to initiate and shape various strategies aimed at circumventing climate induced impacts on livelihoods (Dulal et al., 2010). In this way, climate change adaptation outcomes depend on the availability of different asset portfolios and the degree of vulnerability of a given individual, household or community. This means that capital assets play a significant role in enhancing adaptive capacity and reducing risks and vulnerabilities of individuals, households and communities to climate change.

Drawing on Amartya Sen's (1981) essay on entitlements and deprivation, Moser (1998) categorises assets of individuals, households and communities into five sets, namely; physical capital, financial capital, human capital, social capital, and natural capital. To these assets, the researcher has added ideational capital (Akpan, 2011), specifically local knowledge. Local Knowledge can be defined as people's local or traditional knowledge regarding methods of coping with adverse environmental conditions. Local knowledge widens the asset scope in rural and peri-urban East London and Port Elizabeth communities.

4.3.1 Human capital

According to Moser (1998; 2006) human capital refers to investments in education, health and nutrition of individuals. Moser (1998) links labour and health status to investment in human capital and argues that health status influences people's capacity

to work; while skills and education determine the returns from their labour. Relating human capital development and its utilisation to climate change discours Muttarak and Lutz (2014) argue that the extent to which climate related events will increase human misery in the future, partly depends on people's knowledge about climate change and individuals and societies preparedness to invest in education and health. To build a long-term resilience against the dangers of climate change, the onus thus lies on individuals, families, societies and nations to strengthen human capacity through education; which can help to improve health status and eradicate extreme poverty (Muttarak & Lutz, 2014). Human capital, which centrally revolves around education, can thus play a crucial role in ameliorating some of the negative impacts of climate and extreme weather events both directly and indirectly change.

As Lutz and Skirbekk (2013) argue, formal education is one of the direct primary ways through which individuals and families acquire knowledge, competencies and skills that boost their adaptive capacity in the context of climate change. Experts believe that literacy, general life skills and abstract thinking obtained through education give better understanding and the ability to internalise risk information about weather forecast and warning messages (Mileti and Sorensen, 1990 cited in Muttarak & Lutz, 2014: 43). Furthermore, Ishikawa and Ryan (2002) assert that formal education equips individuals and families with problem solving skills. Thus when disaster occurs, (in this case, climate related disasters like storms, floods, tsunamis and tropical cyclones) educated individuals might be more ready to respond and act upon the event than their uneducated counterparts.

Burchi, (2010) indicates that education increases the acquisition of knowledge and selection of priorities. This enhances one's ability to plan for the future and improves one's sense of judicious allocation of scarce resources – one of the key elements in climate change adaptation strategies. For instance, educated families and individuals have fundamental knowledge on basic health and nutrition practices, which can assist in averting food insecurity and diseases during drought and flood seasons. The last direct benefit of education as part of human capital in fighting some of the adverse impacts of

climate change is the influence of education on people's risk and vulnerability perceptions. If people perceive their risk to climate related disasters to be real by virtue of their education they are more likely to plan for the occurrence of such risks and cope accordingly when they do occur. Risk awareness through education can contribute immensely towards climate change risk and vulnerability reduction (Burchi, 2010).

Apart from the direct benefits of education in mediating climate change impacts, Cotten and Gupta (2004) argue that education can indirectly help mitigate climate change risks and vulnerability through various means. This argument is further advanced by Muttarak and Lutz (2014) who assert that education enhances ones socio-economic status and generally increases ones prospective earning potential (Muttarak & Lutz, 2014 :44). With an increase in earnings and command over other forms of resources through education, individuals are able to afford quality housing in low risk areas as well as disaster and evacuation insurance. Additionally, education as an aspect of human capital indirectly widens ones social capital, social support and other forms of social networks (Cotten & Gupta, 2004; Muttarak & Lutz, 2014). Airriess, et al., (2008) believe that social capital and social networks can increase the propensity to evacuate victims of disaster, facilitate their relocation process, and hasten the recovery of lost livelihoods. Individuals who are connected to large and well-established social networks and friendship groups, by virtue of their educational associations, have a higher chance of receiving climate disaster warnings and to engage in quicker responses to natural disasters (Airriess, et al., 2008). Finally, education can promote a reduction in an individual's vulnerability to climate related disasters through increasing socio-economic resources, facilitating access to information and enhancing social capital. At a societal level Lutz et al., (2008) and Lutz et al., (2010) conclude that societies with a higher level of education enjoy greater economic growth and a higher degree of democracy. Educated societies will therefore have greater economic and institutional capabilities necessary for successful climate change adaptation.

4.3.2 Social capital

Moser (1998; 2006) define social capital as an intangible asset consisting of the rules, norms, obligations, reciprocity and trust embedded in social relations, social structures, society's institutional arrangements as well as the rules and regulations governing formalised social institutions. Social capital predominantly occurs at a micro-institutional level (in households, families, clans and communities). As part of those strategies aimed at addressing climate change impacts, social capital (social systems, institutions and relations) is relevant in adaptive capacity building as one of the fundamental conceptual principles (Pelling & High, 2004). At both the household and community levels, the revival of working social relations and networks, trust in social institutions and norms and reciprocity, as part of the theoretical principles guiding climate change discussions, unite people and bring resources together.

Putnam (1995) maintains that social relations, networks, norms and values which constitute the core variables of social capital enable individual residents in a community to act together more effectively to pursue shared objectives. Putnam (1995) and Moser's (1998) argument validates the fact that with social capital acting as a cohesive force binding local communities, greater material interventions aimed at minimising people's vulnerability to climate change both at household and community levels can be achieved. Examples of such material interventions include the building of communal water conservation dams to ensure the availability of water during drought periods and communal labour systems for fighting climate change impacts.

Pelling and High (2004) argue that social capital can be used to address or respond to background climate stress. This can be achieved through investment in youth and children's education to enhance their human and social capitals as a means of boosting familial and societal resilience to future climate risks (Pelling &High, 2004: 312). With individual and collective contributions towards youth education, experts believe that public participation in procedures and processes of collective decision-making towards

climate change, resilient policies would be enhanced (Putnam, 1995; Pelling & High, 2004).

Szreter and Woolcock (2004) proffer a more coping oriented approach. They give three distinct ways in which social capital can be a useful asset in coping with and mediating some of the adverse impacts of climate change. The first area identified is support networks and relationships through trust, values and norms (Szreter & Woolcock, 2004). They argue that the reciprocity embedded in social relations and networks and the trust in the associated norms and values can be helpful in offering assistance to flood, storm, drought and many other forms of climate disaster. The second avenue as identified by Szreter and Woolcock (2004) is social capital working towards reducing social and economic inequalities through individual and community support systems. Wolf et al., (2010) corroborate Szreter and Woolcock's (2004) view by indicating that a reduced social and economic inequalities through various support systems can help enrich residents' stock of other asset portfolios (especially financial and physical capital). The third avenue according to Szreter and Woolcock (2004) is social capital being a channel through which people can have access to other resources, which were previously lacking. Drawing on the three scenarios, it can be suggested that there is a positive link between social capital and climate change impacts mitigation at individual, household and community levels.

4.3.3 Physical and natural assets

Physical capital refers to the stock of plant, equipment, and other productive resources owned by individuals, community, the business sector or the country itself (Moser, 1998; 2006). Natural capital on the other hand refers to the stock of environmentally provided assets such as soil, atmosphere, forests, minerals, water, and wetlands (Moser, 1998; Frayne et al., 2012: 13). Based on the stock of resources categorised under physical and natural assets, Traldi et al., (2013) argue the two asset categories can be seen as physical structures that serve as strong buffers against extreme climate induced weather events both directly and indirectly. In order to engage in effective and

sustainable productivity to boost other asset portfolios (e.g. financial and human capitals, which have their separate roles in mitigating climate change impacts), individuals and communities need physical resources such as land, equipment, machinery and other forms of infrastructure for production purposes (Scoones, 1998). Thus, physical capital allows people to develop strategies that can improve their resilience and adaptive mechanisms in the face of various climate change impacts. Dulal et al., (2010:12) argue that a group of persons, families, or a society with no or limited physical capital is at high risk of being severely affected by climate related disasters partly because of weak resilience.

Natural capital on the other hand complements the contributions of other asset categories in mitigating risks and vulnerabilities of climate change on the livelihoods of individuals and communities. Rural dwellers in developing countries for instance mainly depend on natural capital for their livelihoods due to low levels of infrastructural development (Dulal et al., 2010). The ability to protect the natural and physical capital stock of various communities from irreversible depletion and damage can serve as a vital coping and adaptation strategy against climate induced impacts (Dulal et al., 2010). For example, the availability and proper utilisation of fertile soils for agricultural purposes; water from rivers, streams and lagoons for irrigation, domestic consumption and fishing for consumption are some of the guaranteed methods for averting food and water insecurity in rural settlements (Traldi et al., 2013). The conservation and restoration of coral reefs and mangroves; or the construction of sea walls and drainage canals can protect coastlines and coastal residents and property from sea level rise and coastal storms (Yang-jie, et al., 2014). Similarly, the preservation of natural resources does not only enrich the natural capital portfolio of local communities but also reduces the depletion of plant and animal species (i.e. ecosystems and biodiversity conservation). Traldi et al., (2013) and Yang-jie et al., (2014) argue that combining individual and community endowment in physical and natural capitals effectively can ensure food availability for all at all times, by diversifying crop production and distributing food through appropriate distribution channels. Individuals and communities with large fertile agricultural lands can mitigate the impacts of drought on agricultural

yield by diversifying their crop production whilst efficient transport infrastructure would increase the distribution of food to all communities including remote and isolated settlements (Yang-jie et al., 2014: 692). Dulal (2010) concludes that individuals and communities with a lower physical and natural assets stock are more susceptible to climate change impacts while those with higher endowments are more resilient to climate induced impacts.

4.3.4 Financial capital

According to Moser (1998) financial capital refers to financial resources available to people, such as income, remittances, savings and supplies of credit. Financial capital is critical in combining various types of coping and adaptation strategies available to people. It thus draws together other forms of asset capitals (e.g. social capital, human capital and physical capital) required for successful coping and adaptation strategies in high climate risk areas. Access to financial and credit facilities from wages, remittances, savings, banks and other microfinance institutions improves people's adaptive capacity and reduces their vulnerability levels to climate induced events (Dulal et al., 2010). Without adequate financial capital, underprivileged individuals and families are more likely to live in poor housing and climate disaster prone areas with high-risk mortalities from disasters like flooding, storms and associated diseases (Muttarak & Lutz, 2014). Additionally, the low-income groups in society are generally slow in responding to, and recovering from climate shocks as their low financial capital status does not allow them to regain their lost livelihoods in as timely as those from affluent communities. Lutz et al., (2008) argue that, even though both poor and rich individuals may suffer the same losses due to climatic disasters, victims with relatively well-endowed financial capital are more likely to recover quickly from such losses than their less endowed counterparts. In a nutshell, individuals and households with higher earnings have more financial capital to subscribe to costly, but effective and efficient disaster precautionary and protective measures and policies, than lower earning households (United Nations Development Programme (UNDP), 2007).

4.4 Vulnerability and adaptation: Ideational capital (Local knowledge)

The debate around indigenous knowledge systems is a contentious one; starting from what constitutes 'indigenous' to whose interests are being served by the documentation of such knowledge (Nakata, 2002, cited in Akpan, 2011:16). It is however acknowledged that if well harnessed, indigenous knowledge systems can help in empowering local communities in the fight against climate change related issues and become a useful tool in general development (Akpan, 2011: 121). Due to the broadness and complexity of indigenous knowledge systems, this study adopts indigenous knowledge system or ideational capital to mean local knowledge. Traditional local knowledge refers to the knowledge and know-how accumulated across generations (Agrawal, 2003). It is learned, identified and applied within a specific locality or cultural group (Nkomwa, et al., 2014). Thus, it is situated in specific locales that reflect expertise and understanding of local phenomenon (Raymond, et al., 2010). Local knowledge on ecological issues concerns how to cope with local adverse environmental conditions (see Akpan, 2011). Because of its local specificity Nkomwa, et al., (2014) argue that local knowledge is relevant for effective climate change adaptation actions at local levels as it localises policies and interventions; a key theoretical aspect the asset accumulation framework fails to adequately address.

Exploring an individual and community's knowledge on local events is crucial in determining their beliefs, norms and values surrounding the impacts and adaptation to climate change (Retnowati et al., 2014; Hiwasaki et al., 2014). Berkes (1999) argues that the way local people develop their own climate knowledge through the understanding of their local environmental and ecological indicators by virtue of observation and experiences, is important in climate change impacts mitigation. Hiwasaki, et al., (2014) note that although scientific and western approaches to climate change impacts mitigations are somewhat yielding positive results globally, such approaches need to be complemented by local actions generated from local knowledge to address some of the underlying socio-cultural issues surrounding climate risks. This idea is firmly supported by Ellen (2007) who asserts that local knowledge combined with

“outside” knowledge can increase the resilience of communities in managing environmental crisis. The resilience of local communities to climate change impacts can thus increase when relevant aspects of deep-rooted local knowledge are combined with modern scientific knowledge (Ellen, 2007). Furthermore, it is widely recognised that integrating local knowledge with scientific knowledge can lead to successful disaster aversion strategies (Mercer, et al., 2010). On the issue of integrating modern scientific knowledge with local knowledge in the fight against climate change impacts, Kettle, et al (2014) maintain that the integration of both local and scientific knowledge is crucial, because scientific understanding of local climate risks and possible impacts, is often generalised, neglecting complex characteristics of local settlements including basic infrastructure. Ideational capital with its various localised practices and beliefs is critically needed to complement other forms of assets and scientific knowledge in the development of locally relevant and sustainable adaptation strategies.

4.5 Theoretical framework of the study

Critics of the asset accumulation framework reviewed above are of the belief that the framework has fundamental flaws and that its operationalisation and application should be exercised with caution. One such criticism relates to differences in cultural values and traditions. This makes the application of certain aspects of the framework problematic in certain communities, particularly issues concerning social relations as part of social capital. Again, critiques have raised a ‘red flag’ on the conceptualisation and categorisation of the various asset groups (Lutz & Skirbekk, 2013). The issue is about ‘overlapping’ in the groupings of the various assets. For instance, aspects of physical capital overlap aspects of natural capital (e.g. land). Finally, critics argue that not all aspects of human life are covered under the categorisation of asset groups, for example, civic and psychological issues are not sufficiently catered for by the current form of the asset accumulation framework (Lutz & Skirbekk, 2013). This study fills these theoretical gaps (criticisms) by adding a sixth asset capital (ideational capital) which defines and localises customs, traditions and other cultural values to make the operationalisation of the concept locally applicable in different settings. Despite these

criticisms, this study upholds the virtues of the framework and applies it in this study. The Assets Accumulation Framework (Moser, 2006) and the concept of indigenous knowledge systems (ideational capital) are the theoretical paradigms used in this study. The key arguments of these concepts or theories act as apt frameworks for assessing people's awareness levels about climate change; their risks and vulnerabilities to the phenomenon as well as examining the extent to which various asset categories can assist in mitigating some of the impacts of climate change.

The argument is that, the assets accumulation framework's incorporation of indigenous knowledge systems provides a viable conceptual basis for examining the extent to which people are able to cope and adapt to climate change impacts. The triangulation and application of these frameworks further enabled the researcher to examine exactly how the availability of assets (or lack thereof) affects people's risk perceptions and their actual physical risk and vulnerability to climate change in rural and peri-urban East London and Port Elizabeth.

4.6 Conclusion

Vulnerability to climate change is the ability or inability of socio-economic systems of individuals, households and communities to respond to, in the context of cope with, recover from or adapt to any external stress placed on their livelihoods and well-being by climate variability. This means that risk and vulnerability to climate change and other environmental related events in Africa are socially, economically and politically constructed and not natural. Coping with adverse climate change impacts mostly entails short-term temporal measures; while adatpting to such impacts mostly involves long-term permanent measures. This chapter has shown that, Caroline Moser's asset accumulation framework, in conjunction with indigenous knowledge systems (ideational capital) is the ideal conceptual framework for this study. The asset accumulation framework provides an insight into how various kinds of assets can be drawn together to build a formidable buffer against various forms and degrees of climate change impacts on livelihoods and ecosystems. The framework identifies five distinct categories

of assets also referred to as asset capitals. These categories of assets are: natural capital, physical capital, human capital, social capital and financial capital. These capitals can be owned or accessed by individuals, households and communities. Local knowledge is identified and adopted as ideational capital to complement the asset accumulation framework, making it the sixth asset capital used in this study. Local knowledge (ideational capital) provides an in-depth local understanding and meaning of climatic issues. The asset accumulation framework argues among many other things that the adaptive capacity and resilience of any given community greatly depends on the asset stock of that particular community. The combination of various resources under these six different asset capitals, if well harnessed and utilised judiciously, can provide an invaluable relief to local residents of any given community in the face of climate change impacts. Finally, the erosion of the asset base of an individual, household or a community renders such an individual, a society or a community highly vulnerable to various forms of climate change impacts.

CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 Introduction

As mentioned in chapter one of this thesis, the focus of this study was first to assess local residents' awareness of climate change and how such awareness (if available) is reflected in community-level discourses. Second was, to find out the risks (both perceived and actual) and the communities' vulnerability to climate change according to available meteorological data. The final focus was to evaluate how specific community 'assets' mediate some of the impacts of climate change on local residents in selected rural and peri-uban communities in South Africa's the Eastern Cape province. This chapter details the research methododology and methods that were used. To properly connect the research methods with the overall aim of the study, it is more prudent to first highlight the key research questions which guided this study. The three question guiding the inquiry were articulated in chapter one as follows:

i. What is the level of climate change awareness among residents of Port Elizabeth and East London peri-urban and rural communities, and how is it articulated in community level discourses?
ii. What are the actual risks associated with climate change in peri-urban and rural Port Elizabeth and East London according to available South African meteorological data and to what extent are communities aware of these risks?
iii. To what extent do residents' assets mediate actual risks, their perceptions of risk and vulnerability to climate change?

To answer these three questions effectively, semi-structured in-depth interviews, key informant interviews, focus group discussions (FGDs), and a cross-sectional mini-survey were the data collection methods utilised. Though not mentioned as one of the main data collection methods, visual sociology (photographs of relevant scenes, objects, and features) was also used to give more credence to the data collected through the methods mentioned above. A pilot study of the study communities was

carried out between March and May, 2013. The aim of the pilot study was to assess the socio-economic, cultural, and political characteristics and activities of the study communities; interact with residents during such visits; and finally test suitablility of different research methods. This investigation therefore allowed the researcher to settle on semi-structured in-depth interviews, key informant interviews, focus group discussions (FGDs), and a cross-sectional mini-survey as they were the most appropriate methods for achieving the research objectives.

The remainder of this chapter is dedicated to presenting, describing, explaining, and justifying the data collection methods adopted in this study, in addition to the rational for the selection of the selected communities for the study. The chapter gives a description, in the context of society and its environmental interaction, of the settlement characteristics, demographic dynamics, relevant socio-economic indices, and some of the salient physical ecological characteristics of the Eastern Cape Province, This chapter also discusses the study communities, sampling techniques used, how the trustworthiness of the research data was ensured, ethical principles followed and some limitations and restrictions of the study. This will help readers to understand the empirical chapters more comprehensively.

5.2 The Eastern Cape in perspective

The study was conducted in selected rural and peri-urban communities (see section 5.3) in and around East London and Port Elizabeth in the Eastern Cape Province. Selected East London and Port Elizabeth communities were chosen for this study, due to the cosmopolitan nature of some of the communities and their geographical locations. The peri-urban communities, especially those in Port Elizabeth, are inhabited by people from different cultural and socio-economic backgrounds. Even though the proportions of the various population constituents in the communities vary, the issue of local population dynamics was relevant in uncovering how social and ideational capital mediated climate change discourses at the local level.

Geographically, the two research sites (East London and Port Elizabeth) are located in the Agulhas Bank, which is an extensive South Coast continental shelf of the South African coastal plain which extends from the Cape Point in the West to East London (an area that includes Port Elizabeth) of the South coast (Carr, et al., 2006). The study area also falls under the subtropical high pressure belt which is a region of high pressure that encircles the globe around the latitudes 30 degrees South in the Southern Hemisphere, and 30 degrees North in Northern Hemisphere (DST, 2011; 2 - please see the maps below for the exact locations of the study sites, beginning with the map of Africa showing South Africa, followed by the map of South Africa showing the Eastern Cape province, and the map of the coastal belt of the Eastern Cape highlighting the study sites is then presented).

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Map 5. 1 The map of Africa with South Africa indicated.

Source: www.places.co.za

Below is the map of South Africa showing the Eastern Cape, followed by a map of the coastal belt of the Eastern Cape highlighting the study areas.

Map 5. 2 Map of South Africa indicating the Eastern Cape.

Source: www.places.co.za

Map 5. 3 Section of the coastal belt of the Eastern Cape Province indicating the two research sites.

Source: Google Earth.

This defined region (see maps 5.2 and 5.3 above), by virtue of its geographical location, is noted for its continuous fluctuations in rainfall patterns, a transition in wind speed and direction, variations in sea-surface temperatures, and extreme 'unpredictable' weather conditions, partly due to cold and warm currents from the Agulhas and the Southern

Benguela regions respectively (Shannon, et al., 2003; SAWS, 2014). The Benguela region covers the shelf region to approximately 500m in depth, extending from 29 degrees South (in the vicinity of the Orange River mouth, the boundary between Namibia and South Africa) southwards along the West coast and East to 28 degrees East. The area covers 220 000 square kilometers and includes the West coast, the Agulhas Bank and the South coast (Shannon et al., 2003). The risks posed by such unpredicatable climatic conditions (in the face of changes in global climatic conditions and communities' vulnerability, and in the context of the socio-economic livelihoods of residents in rural and peri-urban communities in the Eastern Cape) warrant East London and Port Elizabeth as apt research sites for this study. A cursory look at some of the socio-economic and other geographical charcteristics of the Eastern Cape province will furhter elucidate the reasons for selecting these study sites.

The Eastern Cape province is one of the poorest regions among the nine provinces of the country (Government of SA, 2013). The province falls within Latitudes 30'00 – 34'15 S and Longitudes 22'45 – 30'15 E (Afolayan, et al., 2014: 221; SAWS, 2014. It is bounded by the Indian Ocean in the South; Kwazulu Natal province and Lesotho in the East; Free State and Northern Cape provinces in the North; and the Western Cape province in the West. Lying on the Southeastern part of the South African coast, the Eastern Cape is a province of great natural beauty, gifted with rugged cliffs; green bush along the Port St Johns stretch (the Eastern coastal parts of the province, known as the Wild Coast and rough seas of the region) (Jacobs & Punt, 2009). The province's diverse climates and landscapes range from "dry and desolate land in the Great Karoo region; the bush forest of the Wild Coast; the Langkloof region known for its rich apple harvests; and the moutainous southern Drakensberg region at Elliot" (Government, 2013:5). One of the remarkable geographical features of the province is its spectacular coastline lapped by the Indian Ocean. With long stretches of natural and unspoilt sandy beaches, rocky covers, secluded lagoons and towering cliffs, the coast is the province's main tourist attraction and a source of livelihood to some of the coastal dwellers (Government, 2013).

The population of the province according, to Statistics South Africa (Stats SA, 2011), is 6,562,053. Out of this total population, 78.8 percent are black isiXhosa-speaking people (amaXhosa), 10.6 percent are Afrikaans-speaking people (Afrikaners and Coloureds), 5.6 percent are English-speaking people (mostly Whites), and the remaining 5 percent constitutes other minority ethnic groups including foreign nationals residing in the province (Government, 2013:5). The total population of the province constitutes 12.7 percent of the total population of the Republic of South Africa. In terms of land space, the Eastern Cape has an area of 168 966 km^2, representing 13.9 percent of the total South African land area. This makes the Eastern Cape the second largest province in the country after the Northern Cape province in terms of land area (Stats SA, 2011).
Ecologically, the eastern interior parts of the province are dominated by grassland areas, the Karoo habitat in the northern inlands, while the western-central plateau is a savanna bushveld (Benhin, 2008). Climatically, the province has varying climatic zones. The coastal areas (which include East London and Port Elizabeth) fall between the mediterranean conditions of the Western Cape province and the subtropical conditions of the Kwazulu Natal province (SAWS, 2014). While the inland and northern areas are characterised by rivers and their corresponding wetland flora and fauna (Kemm, 2010). Areas of the northeastern parts of the province (the wild coast region) are noted for long hot and balmy conditions with comparatively high volumes of rainfall, whilst the Karoo region (areas around Graaff Reinet) are credited with long hot summers and moderate winters (SAW, 2014). Areas close to the Free State and Lesotho borders experience cold and long winters due to comparatively higher altitudes (Kemm, 2010).

Apart from the Karoo region and areas close to the Lesotho border, most parts of the province do not experience intensely cold winters nor searing hot summers. During winter, for example, the temperature of the coastal plains ranges from 6 to 20 degrees Celsius; while summer temperature ranges from 16 to 26 degrees Celsius, albeit with a few extreme cases (DST, 2011; Government, 2013: 4). By virtue of differing vegetation and ecological zones, informed by different climatic zones, the Eastern Cape is endowed with various plant and animal species, especially in the ancient forests around Keiskammahoek, Dwesa, and Port St Johns which by implication makes the province

extremely sensitive to changes in climatic conditions as different plant and animal species survive under different conditions (Government, 2013).

Economically, apart from agriculture, both commercial and subsistence (which is found mostly in the rural areas), the rest of the provincial economy centres around Port Elizabeth and East London. The metropolitan economies of Port Elizabeth and East London are based primarily on manufacturing, with the most important being automotive manufacturing. The Eastern Cape is thus the hub of South Africa's motor industry. Ford Motor Company of Southern Africa, Volkswagen South Africa and General Motors South Africa have manufacturing plants in Port Elizabeth, while Mercedes Benz South Africa, have assembly plants in East London. Several automotive components manufacturers can also be found in the two cities. They manufacture components such as tyres, batteries, catalytic converters and car upholstery.

Despite its bouyant manufacturing sector, unemployment remains one of the most challenging economic problems facing the Eastern Cape. Unemployment currently stands at approximately 35.8 percent as compared to the national unemployment rate of 25.5 percent (Statistics South Africa, 2014). The relatively high unemployment rate in the province is partly explained by the fact that the manufacturing and service industries, which control the provincial economy, require a highly skilled labour force, wheras the Eastern Cape is dominated by semi-skilled and unskilled labour due to comparatively low literacy levels (DEDEA, 2010). Apart from manufacturing, agriculture has become another major economic activity of the province. The province can boast of fertile agricultural land and an environment conducive enough for both crop and animal (mostly livestock) production at subsistence and commercial scales. This makes agriculture one of the major sources of livelihood among most rural inhabitants of the province.

5.3 The study sites

The study area falls within Latitude 32' 47 – 33' 46 S and Longitude 25' 29 – 27' 59 E. This area covers Port Elizabeth to East London – an estimated distance of about 360 kilometers. The study communities around East London were: Jongilanga, Zozo,Tuba, Phindweni, (all these are separate hamlets in the Kwelera Location), Phumlani, and the *Ncera* villages (villages 2-7). In Port Elizabeth, the selected communities were Kwanobuhle, Tireville Lapland, and Vastrap. Despite the vibrant manufacturing economy of the province discussed earlier, the economic life of residents in the study communities, particularly those in the rural areas, shows an opposite scenario compared to the urban centres. The majority of the residents in the rural communities depend on subsistence agriculture and social grants for survival, while few 'lucky ones' depend on remittances from relatives in the cities (like East London, Port Elizabeth, Cape Town, Johannesburg, etc).

The researcher encountered abject poverty depicted by deplorable living conditions ranging from substandard accommodation, food, road network and water, to poor health conditions. Apart from the 'few lucky' households in the peri-urban settlements who live in government provided Reconstruction and Development Programme (RDP) houses, and those with some degree of economic resource to build their own block houses in the villages, the majority of the residents live in mud-thatched houses, shacks built with boards and aluminium sheets, or scrapped metals from the factories, and abandoned commercial farm buildings (see plate 5.1 below).

Apraku, 2013

Plate 5. 1 Substandard dwellings in the study communities.

With regard to infrastructure, the peri-urban settlements, which are seen as an extension of the main urban areas, enjoy decent road and railway facilities, relatively clean drinking water; ample telecommunication facilities, and comparatively better medical facilities. On the contrary, their rural counterparts cannot boast of the same facilities. The road network linking the rural areas of Kwelera and Ncera to the national, provincial and municipal roads is an eyesore. During the research period, the researcher had to use a four-wheel drive (4WD) vehicle in order to manage the potholes and the 'unmotorable' terrain. Despite using a 4WD vehicle, tyre punctures and vehicle breakdowns became a routine experience for the reseacher. Access to adequate healthcare facilities was another major socio-economic necessity lacking in the rural communities. Even though the researcher and his assistants did not fall ill during their entire stay in the rural areas, it was revealed to them that the rural communities depended almost solely on mobile clinics for healthcare. Health officials (mostly nurses) with their van clinics visit the communities at most twice a week to offer health services to the residents. Any other form of emergency or critical health problem faced would mean the patient has to be transported to East London, either in a public or private transport vehicle, as there are no ambulance services or permanently stationed health workers in these villages.

5.4 Rural and peri-urban communities in a South African context

The terms ‘rural’ and ‘peri-urban’ are frequently used in development literature and policy discussion yet, the definitions and interpretations are principally situational and case-specific. The definition and application of rural and peri-urban disparity are based predominantly on the geographical proximity to urban areas and the level of infrastructural development. This thesis adopts definitions of rural and peri-urban which will allow readers to see the relationship between such societies, and their environment, as well as their social interactions, and what informs the types of social organisations available. The socio-ecological approach, to the definition of rural and peri-urban will also enable the author to look at climate change vulnerability and adaptation strategies in the study communities from different angles, bringing to the fore the available forms of assets relating directly or indirectly to environment.

The Rural Development Framework (RDF) of the South African Government (South African Government, 1997) defines ‘rural’ as areas or human settlements that are sparsely populated and in which people farm or depend on natural resources for their livelihood. The RDF points out that apart from smallholder agriculture, the economies of rural areas depend predominantly on remittances from relatives, social grants and other forms of external transfers (South African Government, 1997). From a more encompassing perspective, Tsakani (2012: 10) indicates that “rurality refers to a life, a state of mind, and a culture which revolves around land, livestock, cropping, use of natural resources”, social relations and communal solidarity. From Tsakani’s definition of rurality, one can conveniently say that in rural South Africa, life is ecology, and ecology is life, since all that constitutes ‘rurality’, according to his definition, is the direct outcome of ecology.

Peri-urban communities, on the other hand, refer to settlements found on the periphery of the main urban areas which need substantial, urgent social and infrastructural rehabilitation (South African Government, 1997). These settlements are close to urban areas and in most cases, are in the process of being absorbed physically and socially

into the main cities by virtue of the growth and expansion of modern cities (Iaquinta & Drescher, 2000). They are thus more urban in nature, due to their proximity to urban areas and the influence of migrants from the city centres. In a more socio-economic context, in most developing countries, especially in Africa, peri-urban settlements serve as cheap labour hub for the industrial sector in the cities. Peri-urban settlements also serve as the migration endpoint or 'haven' for both city out-migrants (returnees from the central urban areas) and rural in-migrants (first time migrants from the rural areas (Iaquinta & Drescher, 2000). Furthermore, peri-urban areas are, in most cases, densely populated and socially compressed with a primarily non-agricultural labour force.

5.5 Research approaches

The nature of a study largely influences the type of methods one needs to adopt in order to fully answer the research questions with sufficient evidence. The present study set out to assess climate change awareness and the risk and vulnerability levels of selected rural and peri-urban communities in the Eastern Cape, and to discover how specific community 'assets' help to mediate the various impacts of climate change on livelihoods. A qualitative study methodology was triangulated with a quntitative approach to enhance the validity of the research findings. Qualitative research refers to a type of research that produces descriptive data about people's spoken and observable conduct (Adler & Clark, 2011). Qualitative methodologies draw on phenomenology as a paradigm, which sees human behaviour as a process of making sense of their world by continuously creating, defining, interpreting, justifying, rationalising, and giving meaning to actions or words (Babbie and Mouton, 2001).

The positive contribution of qualitative studies in understanding social phenomena allowed for it to be one of approaches utilised in this study, supported by a quantitative approach in the form of a mini-survey. Qualitative studies seek to examine the qualities of a phenomenon rather than quantify it. The qualitative approach helps to describe, interpret, verify, and evaluate a phenomenon (Babbie and Mouton, 2001; Blanche et al., 2007). By its descriptive nature, qualitative studies help to reveal the nature of certain

situations, settings, processes, relationships or even the social nature and behavioural patterns of people (Blanche et al., 2007). Leedy and Ormrod (2010: 136-137) argue that:

> "qualitative research approach enables a researcher to gain new and more insights about a particular phenomenon; develop new concepts or theoretical perspectives about the phenomenon; and/or discover the problems that exist within the phenomenon (interpretation). With its verification and evaluation virtues, qualitative approach allows a researcher to test the validity of certain assumptions, claims, theories, or generalizations within real-world contexts, as well as providing a means through which a researcher can judge the effectiveness of a particular policy, practices or innovations".

The descriptive and interpretive nature of the qualitative approach is not solely based on validating information, but also precisely interpreting data through the various research methods used. The main distinction between qualitative and quantitative studies as separate research paradigms is that quantitative studies pedominantly focus on controlling the various components of the study (Babbie, 2013). Thus the research variables are controlled and guided by the researcher, which makes it impossible for the research subjects to express themselves freely beyond the established instruments of the research. On the contrary, in qualitative studies, the research subjects or 'variables' are not controlled because the absolute freedom and natural behaviour of the research subjects (in this case people) is the soul of the qualitative study (Babbie, 2013). In other words, qualitative research is naturalistic in its approach, in the sense that studies are carried out on people in their natural setting. Qualitative studies therefore assist in describing and understanding a phenomenon rather than explaining human behviour (Babbie & Mouton, 2001).

Further advantages of qualitative studies include:

(i) It focuses on process rather than outcome.

(ii) It approaches issues from the actor's perspective (the 'insider' or *emic* perspective) and not from the 'outsider' perspective (the *epic* point of view).

(iii) It focuses on understanding social actions in terms of its specific context (idiographic motive) rather than attempting to generalise to some theoretical population.

(iv) In qualitative research, the research process is often inductive in its approach, where the researcher develops insights and concepts resulting in the generation of new hypothesis and/ or theories.

(v) It allows the researcher to assume the role of the 'main instrument' in the research process.

(vi) Qualitative research is humanistic in nature. Thus, it does not reduce people to statistics when studying them, but rather tries to know them personally and experience what they experience on a day-to-day basis.

(vii) Validity and trustworthiness of the data collected is essential in the entire research process (Babbie & Mouton, 2001: 270-271; Blanche, et al, 2007: 272) .

The combination of quantitative and qualitative approaches in this study helped the researcher to collect data appropriate enough in providing empirical answers to the research questions of the study. In order words, a mixed method approach (although predominantly qualitative) helped the researcher to delve into people's understanding of climate change and how such knowledge, if any, is shared among residents of various communities. Again, from an *emic perspective,* the researcher was able to ascertain the risks and vulnerability levels of people to climate change and suggested plausible ways of mitigating the impact of climate variability on livelihoods. Supported by a mini-survey, the researcher was able to establish, to some extent, people's level of awareness about climate change, as well as their perceptions about its causes and impacts in a cross sectional way (from rural to peri-urban).

Combining qualitative approach with a mini-survey (quantitative) helped the researcher to obtain an in-depth knowledge and a clearer insight into local understanding and interpretations of climate change, in the context of rural and peri-urban Eastern Cape communities. This methodology helped to analyse the actual and perceived risks and vulnerabilities of the study communities to climate change, as both local narratives and

scientific weather and climate projections were incorporated into the study analysis. Finally, the methodology helped in arriving at pragmatic policy oriented recommendations tailored towards mediating the adverse impacts of climate change on developing societies, based on the various asset categories mentioned in the research problem (see research objective three). The table below shows a detailed description of the methods and techniques used in addressing each of the research questions. As shown in table 5.2 below, the qualitative methods adopted in the study were semi-structured in-depth interview, key informant interview, focus group discussion and visual sociology, while a questionnaire survey was the quantitative method used. The ways in which they were utilised are elucidated in the next few subsections.

Table 5. 1 Research methods linked to the research questions.

Research Question	Research method(s) adopted and justification(s)
1. What is the level of climate change awareness among residents of Port Elizabeth and East London peri-urban rural and communities, and how is it articulated in community level discourses?	A combination of in-depth semi-structured interviews, and focus group discussions (FGDs) with selected members of the communities, and a questionnaire survey helped the researcher to elicit rich qualitative and quantitative data from respondents on the subject of climate change awareness through interaction, questioning, discussions and observations. The mini-survey enabled the researcher to gauge community awareness of climate change from a cross section of residents (from rural to peri-urban).
2. What are the actual risks associated with climate change in rural and peri-urban East London and Port Elizabeth, according to available South African meteorological data, and to what extent are communities aware of these risks?	Through In-depth semi-structured interviews, FGDs and a mini-survey, the researcher was able to gather enough evidence pertaining to some of the immediate perceived impacts of climate change on the livelihoods of local residents. Most of these perceived impacts and the various risks posed by the continuous changes in global climatic conditions were validated through key informant interviews with the South African Weather Service (SAWS) officials and municipal risk, environment and disaster management officials.
3. To what extent do residents' 'assets' mediate their actual risks, their perceptions of risks, and vulnerability within the context of climate change?	The researcher again used semi-structured interviews, FGDs and a mini-survey to gather the relevant evidence. Through interaction, questioning, discussions and observations, the local practical application of some of the defined asset categories was identified.

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5.6 Semi-structured in-depth interviews

According to Leedy and Ormrod (2010), a semi-structured in-depth interview is a flexible and interactive method of data collection, where an interviewer (the researcher) asks questions and seeks answers from the interviewee (the respondent) guided by an informal interview guide. It is a face-to-face encounter between the researcher and the informant (respondent) through which the researcher seeks to understand the respondent's perspective, experiences, or even circumstances of a phenomenon, as expressed in the respondent's own words (Adler & Clark, 2011). The flexibility and face-to-face nature of the whole research process allow both parties (the researcher and the informants) to seek clarification on issues that are not understood. The semi-structured nature of the interview affords the researcher the opportunity to seek knowledge pertaining to issues that are not listed on the discussion guide but related to the study. The use of an interview guide assists in keeping the interview on track without veering away from the focus of the study (Babbie, 2014).

Semi-structured in-depth interviews allow the participants to express themselves at length and provide an in-depth explanation to questions asked, as well as offering the researcher further opportunity to ask more probing questions aimed at seeking detailed responses. The central purpose of a semi-structured in-depth interview is therefore to get in-depth knowledge about the respondent's viewpoint and experience of a particular phenomenon through an extended face-to-face interaction session. As mentioned in the introductory section of this chapter, the aim of this study was to assess and understand the awareness, as well as the risks and vulnerability levels to climate change, of rural and peri-urban communities in the Eastern Cape and further explore how different asset categories can help mediate or mitigate the impacts of climate change on livelihoods. As the nature and process of semi-structured interview suggests, through its use, the researcher was able to elicit rich data on the level of awareness among rural and peri-urban communities around East London and Port Elizabeth, and explored how this knowledge (the awareness levels) is articulated in community level discourses. Additionally, it helped the researcher to ascertain the perceived risks and

vulnerability levels to climate change from the residents' perspective and experiences. The semi-structured in-depth interview technique also accorded the researcher the opportunity to measure the availability and utilization of the various categories of assets (see: Moser, 1998; Moser et al., 2011; & Akpan, 2011) among local residents in mediating their risk and vulnerabilities in the context of climate change.

Despite its efficiency in gathering qualitative data, Babbie (2014) argues that in-depth interviews are time consuming and expensive, especially when the respondents are scattered over a large geographical area, as was the case for this study (from Kwelera to Kwanobuhle spans over a distance of about 360kms). The distance per se was not a problem as the study was fully funded by the Department of Science and Technology (DST) and the National Research Foundation (NRF), the major difficulty was meeting the right respondents, in their homes. In the rural areas for example, days in the week are spread over various activities starting from traditonal ceremonies, family meetings, funerals and travelling to the urban areas for groceries and medical appointments. However, through community leaders, the research team was able to secure appointments with all the relevant people and the necessary data was obtained.

The second major disadvantage of semi-structured in-depth interviews, as identified by Babbie (2014), is the issue of quality of interaction and the quality of data obtained from the interaction. According to Leedy and Ormrod (2010), the uniqueness of each interview in the context of respondents, setting and interaction produces different quality of responses, which if not well checked can affect the research findings. In the case of this study, this problem was well catered for through an ethnographic practices (staying in the study community over a reasonable period of time). During the data collection period, the researcher and his team of reasearch assistants stayed in the rural communities involved in the study. The extended stay in the rural communities helped build trust and a good rapport between residents and the research team which led to quality interactions. With quality of continuous interaction, the researcher was able to counter-check the information obtained through participation and observation. The plate

below shows a paricular incident where the research team interacted extensively with a local peasant farmer in her garden.

Apraku, 2013

Plate 5. 2 Interaction between a local farmer in Kwelera (Jongilanga) and the research team.

Another disadvantage of the semi-structured interview technique echoed by Blanche et al., (2007) is the issue of respondents withholding some vital information or providing information which he/she thinks is more favourable for the situation. This issue sometimes arises because of lack of proper understanding of the questions asked by the researcher or a lack of trust. In such situations, the onus lies on the researcher to build a trustworthy relationship with the research community first, and during the interview process use simple and flawless language (as much as possible) when asking questions. This language should be devoid of all forms of technicalities which will cause the interviewee to not seek further clarification.

In this study, the researcher was cognisant of the of the fact that respondents could withhold information or even misunderstand a question being asked. This issue was well addressed by explaining climate change related concepts in basic English and aligning them with the daily life activities of residents. This made it easy for them to respond to all questions appropriately (see appendix I for a copy of the interview guide. Moreover, staying in the study communities for a reasonable period of time enabled the researcher to use observations to confirm the information received. Finally, through triangulation techniques and methods (Focus Group Discussions – FGDs, a mini – survey, and key informant interviews) coupled with the researcher's many years of teaching experience in both rural and peri-urban areas of the Eastern Cape province, the issue of misinformation did not arise, as the researcher was able to structure and coordinate all interviews towards the purpose of the study. All these processes helped to enhance the quality of the empirical data and the credibility of th study.

The final disadvantage of semi-structured interview techniques to be discussed in this section, is the issue of interviewer bias (i.e. the tendency towards the misinterpretation of participants responses), which can be associated with interviews where the interviewer is paid for or volunteers his or her services. Fortunately for the researcher in this study, envrionmental challenges in the communities were so glaring as to be almost self-evident as shown by different photographs throughout this thesis. This notwithstanding, the researcher eliminated interviewer bias by, first, avoiding all forms of leading questions (see appendix I) which could lead to obtaining pre-determined responses; secondly, through objectivity and conducting the interviews himself (with the help of research assistants); and, finally, electronically recording all the interview sessions himself. This enabled the researcher to have access to verbatim statements from the respondents which corresponded to the questions on the interview guide, to ensure that appropriate answers were given to the various questions.

In total, 100 semi-structured interviews were conducted, accompanied by detailed field notes and photographs to capture the true state of the climate change 'story' in rural and peri-urban areas of the Eastern Cape. All responses were audio-taped to ensure

that no vital information was neglected during the analysis stage. The respondents consisted of males and females whose ages ranged from 25 to 85 years. Sixty out of the 100 interviewees were rural residents whilst the remaining 40 were peri-urban dwellers. The majority of the respondents were peasant farmers and factory workers whose monthly incomes were less than R3000. Details regarding sampling methods and procedures, and income dynamics, are discussed under sampling and income bracket dynamics respectively in the subsequent sections of this chapter.

5.7 Key informant interviews

To effectively assess both the perceived and actual risks and vulnerability levels to climate change, of rural and peri-urban communities in the Eastern Cape, it was imperative for the researcher to engage professionals and other relevant officials who have vast knowledge and experience on the climatic conditions of the province and the effects of such climate conditions on livelihoods. Key informant interviews allowed the researcher to confirm the perceived risks and vulnerabilities highlighted by the local residents, from a more scientific and professional point of view. This category of officials and professionals, by virtue of their positions and responsibilities in some specific institutions and departments, constituted the key informant cluster of the respondents. Much like the semi-structured interviews, with the help of interview guides, the South African Weather and Meteorological Services officials, and relevant municipal officials, from units that deal with climate, environmental, and disaster management issues, were interviewed.

In total five key informant interviews were conducted. The first point of call for the researcher was the regional director of the South African Weather Services (SAWS) in Port Elizabeth, who placed his invaluable knowledge, experience, and assistance at the disposal of the researcher. Piles of documents and current publications on the weather and climate patterns of the province were given to the researcher at no charge. Next was the metropolitan directors of risk and disaster management at the NMBMM and

the BCMM respectively. Finally, one senior official from each of the metropolitan directorates of environmental affairs offices – NMBMM and BCMM were interviewed.
As the key informant interviews were conducted after the semi-structured in-depth interviews, the researcher was able to seek 'confirmation' regarding most of the issues raised by community members, especially issues relating to public awareness on changing climatic conditions and early warning signs, and some of the actual impacts of climate change on human and biodiversity. The positive relations and interactions between the researcher and the various officials mentioned above made the key informant interviews insightful and interesting. In line with known advantages of key informant interviews, the cordial relationship with officials accorded the researcher the opportunity to discuss a wide range of issues within a relatively short space of time. However, to avoid being distracted by these informants, whose responses were sometimes geared towards advancing their own agenda or 'blowing their own horns', the researcher counter-checked information given, by comparing and contrasting them with other secondary sources of information (for example, assessment reports of the IPCC, CSIR and the DST), especially those relating to climate figures and their risks and vulnerability projections. Finally, triangulation (verifying data through the use of other methods, in this case through FGDs, cross-sectional surveys, and in-depth interviews) was used to avoid the problem of deviating from the focus of the study through the emotive statements of key infromants.

5.8 Focus group discussion (FGD)

Another important data collection method adopted in this study was the FGD. The FGD is one of the data collection methods used in qualitative studies, where the researcher gathers several people (not less than 5, and not more than 12) to discuss a particular issue or range of issues over a reasonable period of time (Leedy & Ormrod, 2010). Babbie (2014) sees the FGD as a form of 'interview' where individuals homogeneous to what is under study, are brought together in a private comfortable environment to engage in a guided discussion of the issue(s) under study (Babbie, 2014 : 329). During the FGD, the discussion process is controlled by a moderator or a facilitator who only

introduces the topic or issue of discussion, and acts as a referee. The moderator does not take active part in the discussion and keeps the individuals focused on the topic or issue of discussion. Leedy and Ormrod (2010: 148) note that, FGDs are useful when:

> "The researcher is dealing with limited time, especially students who need to finish their studies within a specific period of time. Secondly, they make people feel more comfortable talking in a group than alone as interaction among participants may be more informative, than individually conducted interviews".

Even though different scholars prescribe different FGDs, it is noteworthy that the number of participants is principally determined by the nature and the scope of the study, vis-à-vis the issues to be discussed. The number of participants in focus group dicussions vary from one study to another depending on the nature of the study. Arguing from its comfortability and interactive nature, Babbie (2014: 330) notes the following positive aspects of the FGD:

(i) The technique is a socially oriented research method capable of capturing real life data in a social environment.
(ii) It is a flexible technique which allows the researcher to ask and seek clarification on a variety of issues.
(iii) It has high face validity.
(iv) It has speedy results; and
(v) It is a low cost method.

In his discussion, Babbie (2014) adds that group dynamics frequently bring out aspects of the topic that would not have been anticipated by the researcher and would not have emerged from interviews with individuals. In other words, FGDs help to bring out participants' attitudes and perceptions, as well as encouraging a great variety of communication from participants, leading to the identification of certain norms and practices, social processes and even the discussion of 'difficult' or 'embarrassing' subjects (for example, loss of lives or property in the context of climate change) with

ease. Thus participants knowledge, awareness, and factors that influence individual's state of mind regarding the subject of discussion is easily revealed.

Unlike individual interviews, FGDs give the researcher the opportunity to observe participants' interactions with one another and the bodily and facial reactions and expressions of each other when expressing their view on the topic under discussion. Such spontaneous reactions and responses to fellow participants' views and submissions according to Leedy and Ormrod (2010) help to validate the information provided by participants. FGDs were therefore suitable for this study as they assisted in eliciting the knowledge of local residents, in the context of awareness levels about climate change and their perceived risks and vulnerabilities to climate change. In addition, FGDs assited in exploring how well residents use the available resources (various asset categories) in mediating both their perceived and actual risks and vulnerabilities to climate change. Using the spontaneous reaction to response feature of FGDs, as mentioned by Leedy and Ormrod (2010), the researcher could observe the lack of knowledge and low levels of awareness among rural residents regarding climate change which contradicted their physical responses as almost all participants were seen nodding their heads in approval of the negative impacts of the ever-changing climatic conditions on their agricultural yield.

Notwithstanding the advantages mentioned above, FGDs have disadvantages, some of which Babbie (2014 : 330) identifies below:

(i) FGDs afford the researcher less control over the process than individual interviews.
(ii) FGDs data is difficult to analyse.
(iii) The moderator requires special skills in order to handle the different personalities as well as guide the discussion.
(iv) During discussion times, differences between groups and individuals can be troublesome.

(v) FGDs are in most cases difficult to assemble due to the number of participants involved and their different time schedules.

(vi) Discussions must be conducted in a conducive environment.

To handle these difficulties and ensure that they did not emerge to negatively affect the quality of data obtained, the researcher took full control of all discussion sessions, in terms of coordination and moderation, and ensured that no personality clashes occurred, while the researcher simultaneously ensured and maintained freedom of discussion and expression of views. When tempers flared they were calmed with momentary anecdotes. Luckily, climate change issues are not generally emotive in nature. One particularly negative incident occurred when a particular ward councillor was accused of distributing government funded flood relief items to only his political faithfuls in Kwanobuhle. This accusation caused tempers to flare, but these tempers were easily calmed down through well-crafted jokes and the introduction of less sensitive, but equally important aspects of the study.

Having visited the communities on several occasions and having had prior knowledge of FGDs as a teacher, the researcher took control over all discussion sessions with ease without allowing one person or a particular group of people to dominate any of the discussion sessions, as this could deter other members from participating actively. The difficulty in analysing FGDs data was made relatively easy – even though it took a heavy toll on the researcher – by tape recording all discussions, reviewing and transcribing them. This analysis was supported by detailed notes taken by both the researcher and his research assistants. This process made it possible to not miss out on any important information. All FGDs were either conducted in the homes of some of the community leaders or in community halls which were comfortable and conducive for thorough discussions. In total, five FGDS were held: one in Kwelera (Zozo); one in Phumlani; and one in Ncera village six. These communities are located around the East London area. In Port Elizabeth, two FGDs were held in Kwanobuhle and Tireville Lapland respectively. The FGDs comprised of 5 – 9 participants (both male and female). Participants were aged between thirty and eighty years. Since climate norm

can only be established over a period of thirty years or more (see WMO, 2014). Special attention was paid to the age of the participants. The younger generation (the under-thirties) did not have enough experience to report on climate trends, however, they were needed to measure the awareness level on climate change. The younger group of individuals also assisted in measuring how individuals from such an energetic age bracket is articulating climate change issues in their local conversations. The over fifty years olds helped in cementing the 'perceived' climate trends. Similar to the individual interviews, a discussion guide was used for all the FGDs.

5.9 Visual sociology

Blanche et al., (2007) argue that in contemporary studies, photography (sometimes called visual sociology) is fast becoming one of the modern trends in social science research and a vivid way of communicating findings. This is supported by a common and a lay maxim that, '*a picture is worth thousand words'.* By implication, a picture can sometimes better describe or explain a scenario than words can express, or convey. Relating this to research work, pictures can present scenes, behaviours, features, and moments that cannot be narrated verbally, hence pictures are useful in collecting, presenting, and illustrating research findings. Even though not listed as one of the major data collection methods of this study, photography was used as a technique to depict the environmental characteristics of the study communities, interesting climate related scenes, and other important moments of the research process were documented, to provide contextual meanings to different idiographic discussions. The photographs used in this thesis were not manipulated in any way. They are presented as they were taken, and are therefore accurate representations of issues under discussion.

5.10 Survey

The survey is one of the oldest research techniques and arguably, still one of the best research methods, available to modern researchers (Babbie, 2014). It is a research design used by researchers interested in collecting original data on a phenomenon that

affects too large a population to be observed directly, with the purpose of understanding, describing and explaining the phenomenon (Babbie and Mouton, 2001). Research experts believe that in a survey study, a carefully selected sample provides a group of respondents whose characteristics may be taken to reflect those of the larger population (Leedy & Ormrod, 2010). A properly constructed and standardised questionnaire will provide data in the same format for all respondents and by implication represents the larger population (Blanche et al., 2007; Babbie, 2013). In simple terms, a survey research involves acquiring information about one or more large groups of people, about their characteristics, opinions, attitudes, and previous experiences (Leedy and Ormrod, 2010).

Despite its age long existence and usage, some scholars (see Strauss and Corbin, 1998; Kelly, 2006) still hold reservations about how surveys should be used and under what context (relating to the nature of variables under study). One such reservation is that survey studies capture a fleeting moment in time just as a photo camera captures a single-frame of a photograph of an ongoing activity (Babbie, 2013; Babbie, 2014). Meaning, by drawing conclusions from one transitory set of data, one stands the risk of extrapolating about the state of affairs of those variable, over a long period of time. However, experts argue that surveys still remain one of the surest methods through which researchers can generalise what they see or observe, since no given population can be interviewed wholly (Adler & Clark, 2011).

The problem of drawing conclusions based on transitory data or extrapolation did not manifest in this study because of two predominant reasons. Firstly, the mini-survey used in this study was adopted to validate or give credence to data obtained through other methods (interviews, FGDs, observations, etc), and not as the sole study approach. This therefore excluded the issue of extrapolation and the drawing of conclusions based on transitory data collected on an ongoing phenomenon. Secondly, climate change trends take time to be established (thirty years or more), and if established, such trends are backed by statistical data which is constantly reviewed and updated by globally accredited institutions. This argument is confirmed in the next

chapter (chapter six) where the impacts of climate change on the socio-economic lives of residents in rural and peri-urban communities, as found by the study, are duly corroborated by the IPCC, SAWS, CSIR and DST through various scientific publications.

Another problem associated with survey studies is the reliance on *self-report* data (Babbie & Mouton, 2001). Babbie and Mouton (2001) believe that people's memories of events are often distortions of reality. Thus what people think happened, is not what always did happen since people's description of events and opinions on some phenomena are constructed on the spot (in most cases, respondents do not really think about certain issues until the researcher arrives to pose a question). Like the weaknesses of other methods, the *self- report* issue was eliminated through observations and triangulation. The survey incorporated in this study was called a 'mini-survey' because of the size of the sample used (300). Conventionally, surveys deal with a relatively large sample size (sometimes running into the thousands). The small size of the sample used in this particular survey therefore earned it the title of 'mini-survey'. It was called cross-sectional because the respondents were spread over all the communities – from rural to urban – and the analysis was not done on the basis of rural and peri-urban comparison.

The most commonly used data collection instrument in survey studies is questionnaire. There are three main methods for administering survey questionnaires to a sample of respondents. These methods are: a *self-administered questionnaire* (a situation whereby respondents are asked to complete the questionnaire themselves); an *interviewer-administered questionnaire* (a situation whereby questionnaires are administered by an interviewer in a face-to-face encounter with the respondents); and *telephone administered questionnaire (*a situation whereby questionnaires are administered by the researcher by placing telephone calls to the respondents). Each of these methods has its own merits and limitations.In this study, the researcher used self and interviewer administrated questionnaire methods. In a survey, having a

questionnaire administered by an interviewer rather than the respondent him/herself has advantages such as the following:

(i) It gives a higher response rate than questionnaires answered by respondents themselves.
(ii) Respondents find it more difficult to turn down an interviewer standing at their door-step than to throw away a deposited questionnaire.
(iii) The presence of an interviewer generally minimises the number of " I don't knows" and " no answers" as the interviewer can explain questions further to respondents, thereby obtaining the most appropriate and relevant answers.
(iv) The interviewer can observe respondents as well as ask questions. For example, gender and living conditions can be observed without necessarily asking questions.

The above mentioned virtues of an interviewer-administrated questionnaire enabled the researcher to achieve a high response rate, as well as observing most cross-cutting (rural-urban dynamics) climate related issues and events. These advantanges notwithstanding, there are some disadvantages associated with interviewer administration questionnaire method worth mentioning:

(i) The quality of data collected through questionnaires administered by interviewers other than the principal researcher is sometimes 'questionable' especially when the enumerators (interviewers) are paid for the number of questionnaires administered per day.
(ii) Interviewer bias is sometimes higher as the interviewers may tend to record their own thoughts and not the exact thoughts or responses of the respondents.
(iii) The interviewers' competency or proficiency in the academic discipline of the study and his/her familiarity with the structure and content of the questionnaire may sometimes affect the research findings (Babbie and Mouton, 2001; Blanche et al., 2007; Babbie, 2014).

Self-administration of questionnaires similarly has the following advantages and disadvantages. Positive aspects of the self-administered question are:

(i) There is always high objectivity and quality in the data collected through self-administered questionaires as the respondents answer the questionnaire at their leisure and privacy without the interference or influence of a second party (an interviewer in this case)
(ii) The absence of an interviewer helps to eliminate the issue of interviewer bias.
(iii) Respondents get the chance to answer questions according to their own understanding.

The negative aspect of the self-administration questionnaire is that:

(i) There is a low response rate in most cases as some respondents may even decide to throw the questionnaire away.
(ii) The questionnaire sometimes gets answered by the wrong 'people'. This happens when people ask their assistants or even children to answer the questionnaire with an excuse that they are too busy to attend to trivial issues like the answering of questionnaires.
(iii) The absence of an interviewer to offer further clarification can lead to the wrong interpretations of questions; and consequently leading to providing wrong answers.
(iv) Observations cannot be made to validate the data given by respondents (Babbie and Mouton, 2001; Blanche et al., 2007; Babbie, 2014).

The combination of the two methods (self and interviewer administrated questionnaires) in this study, made it possible for one method to compensate for the other's shortcomings, since the strengths of the self-administrated questionnaire become the inadequacies of the interviewer-administrated method. To effectively manage the

various flaws associated with each method as mentioned above, the researcher ensured that the questionnaires used in the survey were carefully constructed and devoid of all forms of bias and negative terms, which include double barrellel questions or which could lead to the wrong interpretations of questions. Simple and straightforward sentences combined with both closed and open ended questions were used (see appendix II). This made the entire questionnaire easily understandable to both the interviewers and the interviewees. Furthermore, the research assistants who administered the questionnaire were well trained first, on the focus of the whole study, including the research objectives and the kind of data needed, secondly on the content of the questionnaire, and finally on the ethics surrounding questionnaire administration. This helped mitigate problems of researcher bias and lack of literacy, competency or proficiency regarding climate change related concepts. The interviewers were neither paid for the number of questionnaires administered nor were they volunteers. They were rather fully employed and paid monthly by the National Research Foundation (NRF), which eliminated the issue of trying to make more money, which could thereby lead to the omission of important information. They were also not left alone throughout the survey process, but were duly supervised and monitored by the principal researcher who continuously checked their administration of the questionnaire to ensure that the right procedures were being followed. Despite the various weaknesses associated with the various data collection methods used in the mini-survey, the researcher managed to secure an 89.3 percent response rate for the survey (268 out of the sample size of 300) and a 90.23 percent response rate for the entire study (388 out of the total sample size of 430). The sample size of the survey was based on 95% confidence, while the margin of sampling error (for non-finite population) was ±5.7%.

5.11 Sampling

According to Durrheim and Painter (2006), sampling is the process of selecting cases to observe and make inferences regarding a broader category of people or things, from the observations of a smaller subsection of that category. Babbie (2013) sees sampling as a procedure and process of selecting units of observation with the purpose of

drawing conclusions about the entire population from which observed units were selected (Babbie 2013:124). He further identifies two main sampling methods (probability and non-probability sampling). Probability sampling refers to a selection process whereby all members or units of the larger population have an equal chance of being selected (Babbie, 2013). It is mostly associated with quantitative and survey studies. Non-probability sampling which refers to a selection procedure where a sample is determined based on special characteristics of some members or units of the larger population, is closely associated with qualitative studies (Babbie, 2013).

In qualitative studies, the issue of sample size selection, or determination is not as clear-cut as it is with quantitative studies where selection of the sample size is determined by established statistical methods and procedures. No such statistical procedures and methods exist in the determination of sample size in qualitative studies. As a way of justifying the non-mathematical process of selecting sample sizes in qualitative studies, Strauss and Corbin, (1998: 212) argue that, an appropriate sample size for a qualitative study is reached at a point when, what Strauss and Corbin term as 'theoretical saturation' is achieved. They note that, such a 'saturation' occurs when the researcher establishes that no new or relevant data seems to be emerging from the respondents, and that enough applicable information has been gathered to satisfactorily answer all the research questions. Even though there are no stringent rules in determining the sample size in a qualitative study, it is however highly recommended that researchers should guide themselves against going beyond the boundaries of the research objectives when deciding on the sample, and the entire data collection process Strauss and Corbin (1998).

In most cases, the sample size in qualitative studies is a small number in relation to the larger population from which the sample was selected, but it gives in-depth data about the entire population. As a mixed method study (but primarily qualitative in nature), the principle of 'theoretical saturation' guided the determination of the sample size of the semi-structured in-depth interviews and the mini-survey. A theoretical saturation was reached at 100 and 300 respondents for semi-structured in-depth interviews and the

mini survey respectively. Households constituted the sampling units of the semi-structured in-depth interviews and the mini survey respondents. In situations where individuals were interviewed, such individuals spoke on behalf of their households. Households were therefore the units of analysis. The sampling methods adopted in selecting the respondents were both probability and non-probability sampling methods. Through purposive sampling based on gender, age, expertise and roles in local community leadership (a non-probability sampling method); participants were selected for the semi-structured in-depth interviews, key informant interviews and FGDs. Respondents for the mini-survey were selected through a simple random sampling method (a probability sampling method). Table 5.3 below gives the various categories of the respondents and their selection methods.

Table 5. 2 Categories of respondents and sampling method(s) used.

Category of respondents/participants	**Number of respondents/participants**	**Sampling method(s)**
Semi-structured in-depth interviewees	100	Convenience/purposive sampling (non-probability)
Key informants	5	Convenience/purposive sampling (non-probability)
Focus group participants	25- in 5 FGDs	Convenience/purposive sampling (non-probability)
Survey respondents	300 Confidence level: 95%. Confidence interval: ±5.7%	Simple random sampling (probability)
Total sample size	**430**	

Apraku (2015)

The data collected from the above categories of respondents through various methods was first transcribed and tabulated (in the case of variables like age, gender, income levels and level of education), organised into themes in line with the research questions, and then finally thematically organised data was subjected to a content analysis. The

data on age, income levels, gender, and educational levels of respondents was presented through basic statistical tools like pie charts, histogram, and bar charts, while the rest of the data was presented through verbatim and interpretive reporting.

5.12 Trustworthiness of the research data

Trustworthiness of the data collected in research is crucial in authenticating or validating the final research findings. It is therefore incumbent upon every researcher to take realistic measures in ensuring that the data collected is sufficiently trustworthy. In the case of this study, several of such measures were taken to ensure the trustworthiness of the research data. Below is the elaboration of the measures which were taken.

As mentioned in section 5.1 of this chapter, from March to May of 2013, a pilot study was conducted in all the research communities. The purpose of the pilot study was first to get a feel of the research sites and build a good network with the participants, as well as give the researcher the opportunity to familiarise himself with the leadership of the communities and the communities members as a whole. Additionally, during the pilot study, the researcher pre-tested the main research instruments that were finally used for the actual data collection, which assisted in validating the instruments suitability for this study. This helped to ensure that all aspects of the research questions were well covered and that the instruments correctly measured what they were designed to measure. Moreover, during the actual data collection phase detailed field notes were taken, proper administration of questionnaires was ensured, and all forms of interviews and FGDs were electronically recorded. This ensured that appropriate and accurate data were collected.

The triangulation technique was used to verify the data collected. Triangulation entails collecting material in as many different ways and from as many diverse sources as possible (Kelly, 2006). This can help researchers to establish a better understanding of a phenomenon by approaching it from several different angles – in this case collecting data through four different methods (in-depth interviews, FGDs, key informant

interviews and a mini-survey) (Kelly, 2006 :287). Finally, constant contact and consultation with the researcher's thesis supervisors; SAWS officials; and other scholars in the climate change field was maintained in order to enhance the validity and reliability of the research data.

5.13 Limitations and delimitations of the study.

Just like any other study, the present study encountered certain limitations which will be addressed below. The study could not cover all corners of the Eastern Cape province taking into account the different climatic zones of the province. This milestone could not be achieved because of time and financial limitations (as a PhD student, the whole project had to be finished within a specific time frame and had a controlled budget). The findings of the study can therefore not be used to draw blanket conclusions regarding climate change in the whole province. Again, a class based level of awareness as well as risks and vulnerabilities to climate change could not be established due to time and financial constraints. Community-by-community levels of endowments in the various categories of assets could also not be tabulated to show how mediation levels of climate change impacts varies from one community to the other, depending on which categories of assets are available or deficient. Additionally, a rural-peri-urban comparison could not be established in the context of climate change awareness, impacts, and adaptation strategies.

Another important problem the researcher and his assistants faced, especially in the peri-urban settlements, was crime. Shockingly, the researcher and his research team became victims of crime during one of their visits to the Vastrap community in Port Elizabeth. Within five minutes after our arrival, our car keys were stolen. It took the intervention of police officers through the community leaders, before the keys were finally retrieved. Police escorts were therefore arranged by the community for all our subsequent visits to the community. The ripple effects of such high levels of criminal activities is that, researchers, policy advisors, and other categories of development stakeholders are scared away from the communities, thereby not having the opportunity

of assessing the socio-economic development needs of the people from a first-hand perspective or experience.

Despite the various challenges, some of which are mentioned above, what worked to the advantage of the researcher and his team was that having stayed, worked and studied in different parts of the province for more than eight years and building a team of experienced research assistants who were natives of the province, most aspects of the lifestyle, as well as the socio-cultural practices in the research communities, were not new to the researcher. Again, the researcher's past experience of conducting different research projects in the province enabled him to establish very important contacts during some of those studies which proved invaluable during the current study. Notable among such contacts were the offices of the municipal managers of the Buffalo City Metropolitan Municipality (BCMM) and the Nelson Mandela Bay Metropolitan Municipality (NMBMM) respectively. The others were: the regional offices of the South African Weather Service (SAWS) located in Port Elizabeth, the municipal offices of Disaster Management BCMM and NMBMM respectively. These contacts did not only help the researcher to obtain useful information and documents pertaining to this study, but also helped in locating and having access to key officials of various institutions and directorates as well as community leaders.

The ethical clearance certificate issued by the University of Fort Hare, an introductory letter issued by the Sociology Department of the University of Fort Hare, and the research permits issued by the municipal administrations (see appendix IV, V and VI) worked as an added advantange in having access to the communities, institutions and the appropriate respondents. Finally, even though the researcher was not a native of the province which is predominantly Xhosa speaking (78 percent - see Stats SA, 2011) and by extension does not speak the native Xhosa language fluently, the research assistants provided by the National Research Foundation (NRF) through its Risk and Vulnerability Science Centre (RVSC) at the University Fort Hare made the issue of language barrier irrelevant. The research assistants were final-year undergraduate and first year postgraduate students who were natives of the province and could speak

both the English and Xhosa languages fluently. This made communicating with non-English speaking respondents (mostly the elderly), easy. These limitations notwithstanding, judging by the issues covered in the study, the sample size of the study, the nature and population composition of the study communities and the context in which the study was carried out, the data collected are reliable and scientifically credible enough to make the findings useful for theory development and pragmatic policy formulation.

5.14 Ethical considerations

Generally, the focus of this research (climate change risks and vulnerabilities assessment) does not touch much on the privacy of respondents. However, the researcher remained conscious throughout the study regarding all research ethical considerations and took the necessary steps to protect and uphold the community and individuals' rights to voluntary participation in the interviews (all forms of interviews) and FGDs. Respondents right to privacy, anonymity, and confidentiality as well as respect for all forms of cultural practices were observed. The researcher thus obeyed all ethical rules that guide social science research such as: respect of informants' voluntary participation, informed consent, rights to privacy, confidentiality, and anonymity (see Appendix VII).

Moreover, the research aim and objectives were fully and comprehensively communicated to the respondents. The researcher further ensured that no false promise or assurance was made to the communities regarding the immediate implementation and benefits of the research findings. Additionally, the research team ensured that no harm was caused to any informant, community or corporate interest. All individuals will have access to articles and book chapters that will follow the completion of the study, through various accredited academic journals and publication houses, both locally and internationally. Finally, the field research only commenced once the researcher had duly sought the permission and approval of community leaders and institutional heads (in the case of municipalities). Both written and oral permissions were

granted (see Appendix VI). All these were preceded by an ethical clearance certificate allowing the researcher to begin the field work, which was granted by the University of Fort Hare Research and Ethics Committee (UFHREC) and an introductory letter from the department of sociology (see appendix IV-VII).

5.15 Conclusion

A qualitative research approach supported by a mini-survey was adopted in this study. The main data collection methods used were: semi-structured interviews, FGDs, key informant interviews and questionnaires. A sample size of 430 respondents were selected through various probability and non-probability sampling methods. Through their flexibility and interactive nature, semi-structured interviews and FGDs helped the researcher to elicit rich data on community level awareness about climate change and how this knowledge is shared among community members. The same methods helped in identifying some of the perceived risks and vulnerabilities to climate change according to residents' knowledge and experience as well as some of the local impact mitigation strategies. The use of key informant interviews helped in confirming some of the local perceived risks and vulnerabilities to climate change according to available climate and meteorological data. The combination of semi-structured interviews, key informant interviews and FGDs helped in measuring the availability and role of various categories of assets in mediating local impacts of climate change on livelihoods. The mini-survey aided in validating the findings of the other research methods used within the study communities. The trustworthiness of the research data was achieved through the use of triangulation, detailed field notes, a well-conducted pilot study, electronic recording of all interview and FGD sessions, the use of well-trained research assitants, close contact with thesis supervisors, SAWS officials and strict adherance to standard ethical research policies. The trustworthiness of the data collected was ensured through an initial pilot study of the study communities, detailed field notes, triangulation, electronic recording of respondents, and constant consultation with thesis supervisors and other relevant officials.

The data collected was presented through basic statistical diagrams (such as pie charts, bar charts and histograms), and content analysis according to the order of the research questions. All ethical considerations (such as voluntary participation, informed consent, rights to privacy, confidentiality and anonymity of respondents), which guide social science research, were strictly observed throughout the study. Finally, the necessary ethical clearance from all institutions and bodies concerned (specifically the university, municipalities and local community authorities) were sought before the commencement of the study.

CHAPTER SIX

CLIMATE CHANGE AWARENESS: RESEARCH FINDINGS

6.1 Introduction

Current global, continental, and local discussions on climate change are hugely dominated by the nature and degree of climate change impacts on communities, as well as the various adaptation strategies available to mitigate such impacts (Parry et al., 2004 and Voigt et al., 2004). According to the available literature, the missing link between climate induced impacts and their mitigation strategies championed so far, especially in the developing world, is the lack of idiographic elements in climate change mitigation policies. Such idiographic nuances could cover, among other things, the local knowledge and practices in handling some of the impacts of climate change in local settings. This thesis goes beyond the orthodoxies of climate change science, especially the dominant dicourses pertaining impact mitigation. This is achieved by first gauging the level of awareness of climate change among less developed communities, as well as assessing the risks and vulnerability levels of these communities to climate change. An analysis of the role of specific assets in mediating perceived impacts. Finally, the study privileges the role of ideational capital, especially local knowledge, in the impact-mitigation practices and experiences of community members. This chapter is devoted to an analysis and presentation of the field data relating to the first of the three research questions outlined in section 1.3 of this thesis. Research questions two and three are handled in chapters Seven and Eight respectively. The data presented in these chapters (Six, Seven and Eight) are derived from semi-structured interviews, focus group discussions, key informant interviews, and a mini-survey conducted. They are supported by visual images (photographs) which further contextualise the local narratives. Even though verbatim quotes from respondents are used extensively throughout the data presentation and analyses chapters, the respondents' right to anonymity is strongly upheld in line with standard social science research ethics.

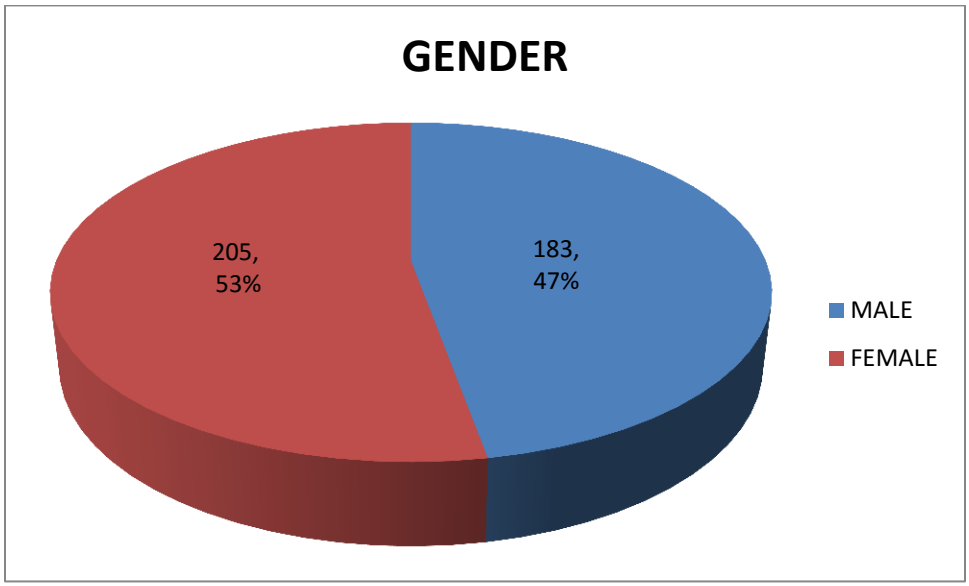
Before addressing the three research questions, it is important to clarify the gender and age characteristics of the of the study sample. As mentioned in section 5.10 of chapter

5, the response rate of this study was 90.23 percent (388 out of the sample of 430). The data in this chapter and beyond, are based on responses from the 388 respondents.

6.2 Gender distribution of respondents

The figure below gives a graphical image of the gender dynamics of the respondents.

Figure 6. 1 Gender percentages of respondents.



Source: researcher's fieldwork.

As shown in figure 6.1 above, of the 388 respondents who participated in the study, 205 of them, representing 53 percent, were females, while the remaining 183, representing 47 percent, were males. The percentages allocated to males and females in this study were determined by two factors. First, the national and local population compositions of male-female ratios; and secondly, the socio-cultural characteristics of the study communities. According to the 2011 South African population census report (Stats SA, 2011), the total population of South Africa stand at 51 770 560. Out of this total population, 25 188 791, representing 48.7 percent, are males; whilst the remaining 26 581 769, representing 51.3 percent, are females. At the municipal levels (the BCMM & NMBMM where the study was conducted), the same 2011 census report indicates that, of the total population of 755 200 in the BCMM, 392 704, representing 52.5 percent

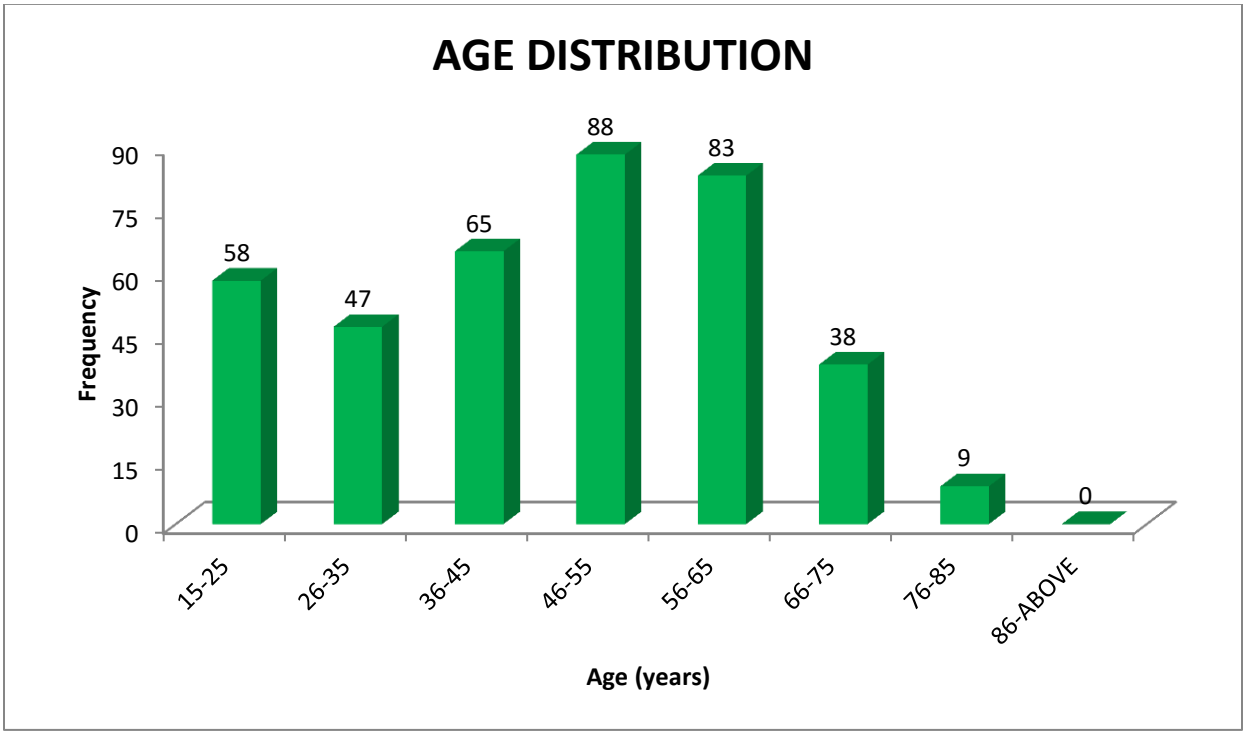
are females; while the remaining 362 496, representing 47.5 percent, are males. This female majority is also confirmed at the NMBMM. The municipality has a total population of 11 521 15, with 52 percent of the total population being females; while the remaing 48 percent are males (Statistics South Africa, 2011).

Because women are the majority in the national and municipal populations, the researcher deemed it appropriate to sample more women than men in the study.The statistical reason provided for allocating 53 percent to women respondents is further supported by the fact that the study was conducted in communities that are predominantly characterised by 'traditions' and entrenched socio-cultural practices (Iaquinta and Drescher, 2000; Kepe, 2010). Some of these entrenched traditional practices – especially those relating to land and property ownership – relegate women to the background in terms of socio-economic development opportunities. In a climate change study such as this, where the impacts of the phenomenon (climate change) on agriculture and livelihood form part of the central discussion points, privileging the voices of women could create a necessary balance in the climate change story in rural and peri-urban Eastern Cape communities. Kepe (2010) concludes that in most cases, women and children are the ones who work on the farmlands (in direct contact with climate variability) as a means to feed their respective families.

6.3 Age distributions of respondents

The figure below gives a grphical representation of age distributions of the respondents.

Figure 6. 2 Age distribution of respondents.



Source: researcher's fieldwork.

As shown in figure 6.2 above, 236 (61 percent) of the total number of respondents were aged between 36 and 65 years; while those below 36 years amounted to 106 (representing 27 percent). The remaining 47 respondents, (12 percent) were above 65 years of age. The 36-65 age group comprised the majority of the respondents by virtue of the fact that they were the majority in the study communities and are also viewed as the 'energetic' working group who appear to be involved in most of the community activities. Those below 36 years comprised the second largest proportion.

The final group of respondents comprised people aged 65 and above. This group constituted 12 percent of the total respondents. Their percentage is relatively low because of their equally relatively low percentage within the population of the study communities. Their contribution was significant in validating most of the observed

climate trends as they have lived for more than six decades, and have experienced an average of more than one climate norm (30 years or more per climate norm). They therefore assisted in identifying a perceived trend in climatic conditions and their related local impacts over a long period of time.

6.4 Climate change awareness and associated local discourses

The first research question for the study was as follows:

- What is the level of climate change awareness among residents of rural and peri-urban Port Elizabeth and East London communities, and how is it articulated in community level discourses?

Climate change awareness, in the context of this thesis, refers to local residents' knowledge (through observations, experiences and information from various sources) about changes in local and global climatic conditions and the impacts of these changing conditions on their livelihoods. As the scope of this study could not cover every aspect of climate change relating to local events, as well as people's knowledge surrounding such events, the first research question focused on the level of climate change awareness among local residents (section 6.4.1), local conceptions about climate change (section 6.4.2) and local 'misconceptions' about climate change (section 6.4.3). These three themes guided research question one in all discussions and analysis in this thesis. Data on these three themes are presented below.

6.4.1 Climate change awareness levels among local residents

Table 6.1 below provides a simple breakdown of the level of awareness among local residents about climate change and its related issues. When residents were asked whether they had heard of the term 'climate change' before and had shared their knowledge about it with fellow residents, these were their responses:

Table 6. 1 Climate change awareness among local residents expressed in percentages.

RESPONSES	MALE	FEMALE	TOTAL	TOTAL PERCENTAGE
YES	62 (34%)	77 (37.6%)	139	35.8
NO	121 (66%)	128 (62.4%	249	64.2
TOTAL	183	205	388	100

Source: researcher's fieldwork.

Table 6.1 above looks at gender specific responses on climate change awareness before examining the issue of awareness among the entire group of respondents. Of the total of 183 male respondents, 121 (66 percent), answered in the negative to having heard of the concept 'climate change'. The remaining 62, (34 percent), said they had heard about climate change before and shared their understandings and interpretations of climate change. The female component of the respondents also confirmed the trend of awareness levels present among their male counterparts. The majority of the females (62.4 percent) said they had not heard about climate change before, even though they had noticed changes in their local climatic conditions over the years. While the remaining 37.6 percent said they had heard about it before.

In total, 35.8 percent of the respondents answered ***'yes'*** to having heard about climate change before; while the overwhelming majority (64.2 percent) said they ***had not*** heard of climate change before as a concept, but had observed changes in intra- and inter-seasonal weather conditions over time (which is the major interest of this section). Even though the study could not empirically establish the reasons for the high percentage of women having an awareness about climate change compared to the men in the study communities, what could be inferred through observation was that the women's relatively greater level of climate change awareness could be as a result of some of the traditional roles assigned to women. In most of the study communities, women are traditionally seen as the home-keepers, especially in the rural areas, while men occupy themselves with local politics and customary issues. The local, traditional duties of

women as home keepers (within the study communities) constantly keep them either on the farmlands or in grocery stores, where changes in climatic conditions directly affect crop yields and prices of food respectively. Generally, the level of climate change awareness within the study communities is good as residents indicated that have observed changes in local climatic conditions.

That notwithstanding, the percentages of respondents who had heard, or had not heard of climate change as a concept before, is not the major issue of concern here, since all respondents indicated that they had noticed general changes in climatic conditions in one way or the other. Looking at the generally low levels of education in the Eastern Cape Province, where less than 15 percent of the total provincial population has an educational level higher than secondary school (Stats SA, 2011), scientific knowledge about climatic issues is equally expected to be low. An important question here is: what is it that the 35.8 percent of the respondents who claim to have heard of climate change know about the phenomenon? In other words, what is it that they know about climate change or what are some of the local narratives and conceptions about climate change? Do they (local residents) share their knowledge or experiences about climate change with fellow residents? If yes, how? And if no, why not? Do local narratives on climate change conflict with 'scientific' interpretations of climate change? The findings on these are presented next.

6.4.2 Local conceptions of climate change

The study revealed that residents of rural and peri-urban communities in East London and Port Elizabeth see and understand climate change from different angles and perspectives. The understandings, definitions and interpretations, as given by respondents, are grouped into ten points, as summarised below. Local residents see climate change as:

(i) A phenomenon linked to erratic precipitation and rainfall patterns accompanied by an unexplained wind speed and decreased annual rainfall volumes.

(ii) A new weather pattern with glaring inter and intra-seasonal weather variations. The distinction between winter and summer for example, is no longer clear-cut. The conventional summer rainfall region is becoming more wet during the winter season, while summer seasons are becoming drier.

(iii) A ‘new’ climate pattern noted for its warm weather conditions and less rainfall due to industrial fumes and all other forms of emission (particularly vehicular emissions and fossil combustions in thermal plants) into the atmosphere.

(iv) A ‘new trend’ of climate characterised by extremely cold weather conditions during winter and extremely hot temperatures during summer. Residents view climate change as a ‘new weather pattern’ marked by extreme weather events.

(v) A ‘new’ climate phenomenon causing a drastic decrease in local agricultural productivity. Such observed decline in agricultural yields are recorded both in crop and livestock productions.

(vi) A ‘new trend’ of changes in climate patterns caused by deforestation and destruction of some of the main carbon sinks (soil and plants) all in the name of development through construction and settlement expansions.

(vii) A ‘new’ weather pattern causing the extinction of plant and animal species. To some, climate change is about new climatic conditions which are killing some local plant and animal species that have traditional, medicinal and cultural significance.

(viii) A ‘new’ climate trend, which is characterised by extended dry weather conditions and prolonged droughts resulting in the drying up of water bodies.

(ix) A ‘new’ phenomenon, which has shifted the local agricultural calendar.

(x) A climate pattern known for surges in heavy storms and floods.

The majority (88 percent) of the 35.8 percent total respondents who responded to having heard of climate change before, cited the above meanings, understandings,

interpretations, causes and effects of climate change. The remaining 12 percent gave interpretations and explanations which are different from what formal climate science indicates (see section 6.4.3). Specifically, 25 respondents (6.4 percent) of the total sample, defined, explained or interpreted their understanding of climate change as a phenomenon linked with erratic precipitation and rainfall patterns accompanied by an unexplained wind speed and extreme temperature. The annual volumes of rainfall have decreased, while rainfall patterns have shifted, with heavy downpours recorded within a short space of time. According to this group of respondents, climate change is a complex issue which affects every aspect of human life through the continuous change in the annual and decadal averages of various climate variables such as rainfall, temperature, precipitations and wind speed. A 63-year old female respondent, for example, gave her understanding of climate change as follows:

> It is all about erratic rainfall patterns, extremely cold temperatures during winter and extremely hot temperatures during summer. We experience strong winds throughout day and night, which was not the case in the olden days. We even get heavy rains during winter nowadays, and less rains during summer, which was not the case when we were young. We know this area to be a summer rainfall region and not a winter rainfall zone, but things have changed now, why? It is all because of climate change, and that is my understanding (In-depth interview, 10 June 2013).

The respondent quoted above, just like many others, believe that the patterns of rainfall that local communities are experiencing under the current climate dispensation, cannot be explained or understood. Winter and summer-time weather conditions appear to have 'merged', which makes it difficult for residents to differentiate between the two main weather conditions (winter and summer). Echoing this observation, a 48-year old man in Jongilanga stated:

> To me, climate change is about changes in the seasons of the year over a period of time. Look, we are in winter now, but today, they mentioned on television that the temperature is going to be 25 degrees and it is likely to rain later in the day. Come November/December we will be experiencing temperatures around 12 and 14 degrees and there will be no rains to plant our crops in the gardens. We experience summer weather conditions in winter and winter weather conditions in summer.

> This is not what it used to be in the past. I can say all these changes are because of climate change (FGD, 12 June 2013).

The observations and understandings towards climate change, of the two respondents quoted above (and 23 others who expressed similar views and observations), corroborate the DST (2011) and CSIR (2011) assertion that South African climate variables will continue to fluctuate in seasonal and annual averages and reach extremes by the year 2100, if the current climate variability trends persist.

Closely related to the narratives quoted above, were those of another group of 19 respondents who saw climate change as a 'new' weather pattern with glaring inter- and intra-seasonal weather variations. According to this group of respondents, the distinction between winter and summer for example, is no longer clear-cut, as the conventional summer rainfall region is becoming increasingly wet during the winter season instead of during summer. That is, summer seasons are gradually becoming drier and colder, while the winter seasons are becoming wetter and warmer – which is the opposite of what residents were accustomed to dating back to the early 1960s. As a 57-year-old man explained:

> To me, climate change is all about experiencing summer in the traditional winter months (April to September), and experiencing winter during the traditional summer months (November to February). I'm saying this because of the low temperatures we experience during summer and the high temperatures we experience during winter these days, which is not normal; in the olden days there were also some signals attached to each of the seasons, which you cannot see these days. For example, do you know a butterfly? [Asking the researcher]. Now, the appearance of butterflies and the flowering of certain trees like *Umnga* in the olden days were to tell you that summer is coming. However, in your days [referring to the researcher] we don't see butterflies anymore to announce a new season because the butterflies cannot survive the weather conditions we experience these days till the end of October when they (the butterflies) are supposed to start coming at the end of September. The climate indeed has changed (FGD, 12 June 2013).

The sentiments expressed by this particular respondent (and the 18 others who share similar views) speak to the extent of change in climatic conditions that some local residents have observed over a long period. The overlapping weather seasons (caused by changes in global climatic conditions) have become increasingly conspicuous, to the extent that the older generations are detaching themselves from the 'new' trend of climatic events by referring to such events as "events of your days" – the days of the younger generation. Such sentiments expressed by respondents echo those of the SAWS (2010) and the IPCC (2013). Both bodies argue (based on the current trend of events) that estimations indicate that by 2050 the temperature, rainfall and the general weather patterns in South Africa may change drastically. These changes will have negative impacts on human and animal lives, agriculture, ecosystems and biodiversity (SAWS, 2010; IPCC, 2013).

Another interesting definition and interpretation of climate change among some rural and peri-urban residents of the Eastern Cape, is the notion that climate change is a new climate pattern known for its warm weather conditions and smaller annual rainfall volumes. This is due to industrial fumes and all other forms of emissions (especially vehicular emissions and fossil combustions in thermal plants) into the atmosphere. A 69-year-old retired automobile industry worker in the Holomisa section of Kwanobuhle shared his observations and life experiences regarding climate change:

> To start with, there are so many changes in climatic conditions today as compared to when I moved into this community in 1971 as a young man in my mid-20s. What is more worrisome to me is the total volume of rainfall in a year and the pattern. What I have noticed these days is that, sometimes it rains heavily for the whole week causing a lot of damage to houses, shacks, cars, animals, gardens, and even drainage and sewerage facilities. After that, we sometimes wait for more than two months without another rain. Again, I have noticed that the weather is sometimes abnormally warm these days. This was not the case when we were growing up. During our days, when it is rainy season, God made sure that He spread the rains over a reasonable period, which was good for both crop and animal production. However, these days, which you people call the days of civilization [referring to the researcher], things have changed so much including climatic conditions. I believe it is because of these factories, cars and heavy

> machines all over. Sometimes you will wake up in the morning to see a cloud of smoke from the factories covering everywhere. All these are blocking the rains and warming the environment every day, even in winter (In-depth Interview, 15 July 2013).

Despite not being academically enlightened on the contributions of greenhouse gasses to global warming and subsequent changes in climatic conditions, the respondent quoted above, through a long trajectory narrative, was able to give an account of how vividly he has observed changes in local climatic conditions. To him, climatic conditions are changing so significantly these days due to various forms of emissions from fossil fuel combustions in thermal plants, vehicles, and heavy industrial machinery. His observations and experiences were similar to those of a 53-year old community leader in Tirreville Lapland who said:

> Climate change is about the smoke from the factories, which makes the weather hot every day and gives us skin and chest diseases. Look at that company at Motherwell [pointing at the direction of a tyre factory] processing rubber and manufacturing car tyres and the amount of smoke and smell it releases every day. Why won't the climate change if we have more of such factories in the world, considering the amount of smoke and dangerous gases they release in a day? (In-depth interview, 5 August, 2013).

This particular respondent went beyond the contribution of industrial emissions to changes in global climatic conditions, to include the health conditions of local residents, even though it has not been proven scientifically. Sixteen additional respondents across rural and peri-urban study communities shared notions similar to those of the 69-year-old pensioner. This group of respondents believe that all forms of industrial and vehicular gas emissions into the atmosphere influence the amount and pattern of rainfall, as well as the temperature and general changes in climatic conditions that communities are experiencing today. Interestingly their comprehension of climate change is similar to that of scholars such as Bulkeley and Betsill (2003) and Johnston (2008). According Bulkeley and Betsill (2003: 1), climate change is an "increase in mean annual surface temperature of the earth's atmosphere, due to increase in atmosperic concentrations of greenhouse gases, such as carbon dioxide, methane,

chloroflourocarbons, and nitros oxide." Johnston (2008) supports the notion that the increase in the concentration of these gases is primarily due to human activities, such as the combustion of fossil fuels, which is one of the main factors influencing climate change.

The submissions, opinions and understandings of another group of 20 respondents summed up climate change as a 'new trend' of changes in climate patterns caused by deforestation and the destruction of some of the main carbon sinks (soil and plants). According to local narratives, deforestation and damage of carbon sinks are on the increase due to infrastructural development and expansion of human settlements. This group of respondents also believe that climate change is about 'strange' climatic conditions that are killing local plant and animal species that have traditional, medicinal and cultural significance. As a 56-year-old woman in Kwelera stated:

> I think there is climate change because people are cutting down trees without planting new ones. There will be no rains or fresh air if there are no trees. Let me tell you something my son. Trees are very important in our lives as people. They give us fresh air to breathe and shade to hide when the weather is hot. In our culture, we believe that trees and mountains invite rains. Rains are scarce these days and the temperatures are hot because there are not enough trees to invite rains for us and to give us fresh air to breathe. To me, all these are causing the climate to change so much. Our medicinal plants and cultural animals are all dying because of climate change (FGD, 8 August, 2013).

Arguing from a cause-and-effects perspective, the respondent quoted above (along with 19 others who share similar sentiments) attribute the causes of climate change to deforestation, with a devastating impact on the ecosystem and biodiversity. They believe that the quest for more residential areas, due to the continuous growth of the human population and its corresponding demand for infrastructural development, is further depleting the ecosystem. Traditionally and culturally, local residents believe that trees, mountains and other geophysical objects play an important role in the climatic conditions of a given locality. The destruction of these phenomena through various forms of construction, land use, development projects and other forms of human

activities, are disrupting the rainfall and temperature patterns of the various localities, and subsequently depleting the ecosystems (plant and animal species). The natural environment is an integral part of the social and cultural life of the local people. The extinction of the natural environment through climate change would thus cause the extinction of important aspects of the socio-cultural life of the people. Linking local beliefs and narratives to available literature, climate scientists believe that the rapid changes in global climatic conditions are anthropogenically induced through modern manufacturing activities, human settlement, deforestation, and crude farming practices (IPCC, 2013).

Another local definition of climate change was provided by a group of 18 respondents from different communities. These respondents see climate change as a 'new trend' of climate patterns characterised by extremely cold weather conditions during winter and extremely hot temperatures during summer. That is, climate change is a new weather pattern marked by extreme weather events resulting in a drastic decrease in local agricultural productivity. The observed decline in agricultural yields are recorded both in crop and livestock production. A 48-year old man in the Tuba location of Kwelera for instance, had the following to say about climate change:

> I know climate change. I would say it is a disease that is killing all our crops and animals here in the villages. Look at this one [pointing at a lean cow], do you think it will survive until the next week? It will not, all because of climate change. Climate change causes no rains to plant crops in our gardens, and no grass to feed our animals [sic] (In-depth interview,12 July, 2013).

The extent of damage caused by changes in global climatic conditions to local crop and animal production has convinced some rural residents to define climate change as a 'disease' ravaging crops and animals. According to some of the local residents, the extended dry weather conditions and reduced volumes of annual average rainfall has caused a drastic decline in agricultural yield (which is the major source~~s~~ of livelihood to most rural residents). In a similar tone, and in support of the views expressed by other respondents to climate change being a 'pervasive disease' affecting local agriculture, a

51-year old man in Zozo said, “climate is the new problem we have with our farming activities here in the villages. Look at how dry our gardens and farmlands are, yet we are in October.”

Fourteen respondents touched on various aspects of climate change either in the form of signs of climate change, perceived causes of climate change, or impacts of climate. Putting their observations, experiences and submissions together, this category of respondents see climate change as a new weather phenomenon characterised by prolonged droughts (resulting in the drying up of water bodies), a shifted agricultural calendar, heavy storms and floods, hot winter seasons and cold summer seasons. A 73-year old retired public servant at Jongilanga shared his observation and experiences with the researcher, by stating that:

> This whole story about *ukutshintsha kwemoyezulu* (climate change) is very confusing. I know our climatic conditions have changed over a period, but I personally do not know what it is and what has caused it. My son let me tell you an interesting story about what we were experiencing when we were young. Somewhere in the late 1950s, by then I was a teenager, we use to experience rainfalls as early as September until March. This was good for our farming activities and animals. In a particular incidence of the time I mentioned earlier [referring to the late 1950s], there was a heavy downpour and everywhere was flooded, all the rivers, including the big Kwelera River overflowed their banks. The apartheid government has to bring a helicopter to airlift us and our belongings to East London. We were brought back when the water levels subsided. But now, we do not even get enough rains for people to plant in their gardens. I am old, so I do not plant anymore but those with gardens and animals are all complaining. I think all this is because of *ukutshintsha kwemoyezulu* (climate change) (In-depth interview, 3 September, 2013).

The old man’s narration about changes in climatic conditions sum up what most of the respondents described and defined climate change to be, based on both individual and communal observations and experiences. To some of them, climate change is a new weather phenomenon that has shifted the local agricultural calendar due to prolonged dry weather conditions, a delayed rainfall season, and comparatively low annual rainfall volumes to support agricultural output. Others, on the other hand, gave their understanding of climate change as a new condition noted for hot winter and cold

summer seasons interspersed by erratic heavy storms and floods. To buttress the 73-year old man's observation and narration, another 64-year old had this to say:

> To me, climate change has reduced the amount of rainfall we used to have in a year. It is also causing our rivers, streams, and dams to dry up. Temperatures are mixed up nowadays. That is, we experience hot temperatures in winter and cold temperatures in summer nowadays. In the 70s, you could see a clear distinction between the two seasons, but now you cannot tell whether it is winter or summer because the whole climate system is mixed up. When we were teenagers, there used to be good rains during the summer rain season, which supported our local agricultural activities very well. Unfortunately, things are not like that these days. We are in October now, but look at my garden, [pointing at his garden], it is dry and empty because *imvula inqabile* (the rains are scarce) (In-depth interview, 6 October, 2013).

Finally, the relatively younger respondents, perhaps by virtue of formal education and interaction with modern media, gave definitions and interpretations of climate change that are similar to what experts are saying in the textbooks and other scientific and scholarly publications. A 38-year old community health worker in Ncera village described climate change as "a change in the annual average distributions of temperature and rainfall figures over a long period of time and a corresponding rise in sea levels." Her interpretation of climate change, based on changes in the average distribution of climate variables, was supported by 8 other respondents who explained their understanding of climate change along similar lines. Despite the impressive understanding and interpretations of climate change expressed by the 122 respondents presented so far; the remaining 266 held 'misconceptions' and ignorant views towards climate change. The next section presents local 'misconceptions' on climate change as found by the study.

6.4.3 Local climate change interpretations

The various local interpretations of climate change came from both categories of responses shown in table 6.1 above. This refers to a fraction of those who indicated that they had heard of climate change before and have a fair idea about it (17

respondents), as well as those who said they had not heard about climate change before, but have observed changes in climatic conditions over time (217 respondents). In all, 234 of the total respondents attributed the source and causes of climate change to non-scientific issues, while the remaining 32 respondents could not give any form of interpretation at all to climate change. The non-scientific factors mentioned by the respondents as the sources and causes of climate change are what the author has grouped, presented and analysed as 'local interpretations' of climate change. Some of local interpretations of the causes of climate change in local settings, as revealed by this study, pose a major challenge to the successful implementation of most of the climate change adaptation strategies initiated by various stakeholders. This is possibly because most adaptation programmes are at variance with local belief systems and understandings about climate change. As many as 60.3 percent (234 respondents) of the total respondents believe that climate change is caused by issues ranging from superstitions, mysticism and traditions, to neoliberal ideologies. Such 'misconceptions', as found by the study, are organised and presented below.

6.4.3.1 Superstitions and climate change

According to the Concise Oxford English Dictionary (2011:1448), 'superstition' refers to an excessive belief in the supernatural. Thus, a widely held belief in supernatural influences, especially in bringing fortune or misfortune. This study found that despite modern levels of globalisation, with its accompanying rate of knowledge sharing, some people in the Eastern Cape (especially in the rural areas) still believe and trust that changes in global climatic conditions are the work of supernatural force. As many as 68 respondents (representing 17.5 percent of the total sample) attributed climate change and its associated negative impacts on the livelihoods of local residents, to all forms of superstitious beliefs. Views expressed by some of these respondents are quoted verbatim below. As 54-year old woman in Phindweni expressed:

> I have heard about climate change before, and I know it is the one killing our animals and crops. My main problem is not about the effects of climate

> change on our livelihoods, but rather how we as society have refused to accept the source of the problem. You can only solve a problem by first blocking the source of the problem before tackling the effects. My children let me tell you something, we as Xhosa speaking people believe that trees, stones, rivers, streams, dams and many other ecological objects have spirits residing in them. Such spirits according to our belief systems control so many things including rainfall and crop yields. For instance, we believe that the spirits of the rivers, streams, dams and lakes which are mostly females will not allow their children to die out of thirst. That is why in the olden days the streams and rivers were flowing throughout the year while the lakes and dams were always full because the various river and lake goddesses will always call rains for their children. The same thing applies to mountains and trees. Unfortunately, all these spirits are angry with us these days because we no longer believe in them so they have left us to our own fate. Women and children, even these days, defecate into rivers, streams, lakes and dams; why won't the spirits be angry and desert us? (FGD, 11 June, 2013).

Arguing from a similar point of view, a 65-year old traditional leader in Ncera village 6 stated that:

> We are experiencing these funny climatic conditions these days because all the protective spirits around us are angry and they are deserting us. I call the whole climate situation funny because we don't get rains when we need rains, but it rains heavily when we least expect rains. Again, it sometimes gets hot in winter as if we are in summer and gets cold in summer as if we are in winter. All these are signs to show that the spirits are not happy with us. You people are young and stay in the city so you will not know this, but let me tell you this today maybe I will not be alive the next time you visit this village. There is a female spirit or goddess we call *uMamlambo* (the mother of the sea or a river, or a dam, or a lake – depending on where she resides) who takes care of the water needs of all people who depend on such water bodies for water. Unfortunately, the *Mamlambo's* of the world today are now very angry with us because people are now encroaching river bodies, lakes, dams, streams and even the sea for all manner of reasons. That is why there are tsunamis, hurricanes and floods. They are telling us to move away (In-depth interview, 14 August, 2013).

A related view was expressed by a 52- year old man in Phumlani who said:

> Yes, I have observed so many changes in climatic conditions between what we are experiencing today and how things used to be when we were young. My main observations are on rainfall and temperature patterns.

> They are mixed up now. We can no longer differentiate between winter and summer. My conclusions on these funny changes are that, the gods and the supernatural powers are angry with us. In the olden days, there was a traditional practice called *ukukhonga*. *Ukukhonga* was a practice whereby the whole community will go to the mountains to pray to God and offer sacrifices to the gods, the spirits and the ancestors to beg for rains. Unfortunately, *Ukokhonga* does not work these days because the ancestors and the spirits are all angry with us (In-depth interview, 13 October, 2013).

Interpreting local climatic trends from the angle of the African traditional belief system, respondents from various settlements across rural and peri-urban communities (some of whom are quoted above) stated that they have indeed observed changes in patterns and trends in the annual averages of some climatic variables, especially rainfall and temperature. What is of more academic interest, is not their observed changes in climatic conditions, since such changes have already been established by various institutions and authorities as discussed in previous chapters (see: IPCC, 2007; 2013; SAWS, 2010; and DST, 2011). Rather, what is of scholarly interest is the perceived causes that local residents attach to such changes in climatic conditions. As a region still glued to its customs and traditions (Kepe, 2010), some local rural and peri-urban residents in the Eastern Cape believe that the changes in climatic conditions are because of the anger of the gods, goddesses and other supernatural powers. According to these respondents, the relations between supernatural forces and weather events, such as rainfall and sunshine, cannot be understood by an ordinary person and should not be under-estimated. They therefore believe that global climatic conditions are changing because of the anger of supernatural spirits from God, ancestors, river deities and totems; while some hold on to the view that the 'uproar' surrounding climate change is one of the antics of the neocolonialists with their neoliberal ideologies. Thus the 'anger' of these forces will therefore always translate into a change in the trend and patterns of rainfall and temperature, with subsequent consequences such as floods, droughts, tsunamis and hurricanes.

6.4.3.2 Divinity and climate change

The non-scientific and spiritual or religious understanding and interpretation expressed by a group of respondents (as presented in section 6.4.3.1 above) was amplified by another 91 respondents, but from a Christian perspective. Speaking from this Christian perspective, and guided by the teachings of the Bible, 91 different respondents (23.5 percent of the total sample) believe that everything in the universe is part of God's creation and strictly controlled by His powers. Their understanding and interpretation is that climate change is a punishment from God in atonement for the sins, misconducts and immoralities of humankind. A 51-year old woman in Ncera village 3 who combines her subsistence farming with local church activities says:

> Hmmm, this whole issue of prolonged droughts, floods all over the world, tsunamis and hurricanes because of changes in global weather and climatic conditions worries me day and night. Sometimes I go down on my knees and cry to God to forgive us our sins because we do not know what we are doing. My children [referring to the researcher and his assistants], we are experiencing all these funny climatic conditions worldwide because of our sins. If you do not believe me, when you get back to your school, ask your teachers to read the book of the Romans 3:23. The Bible says we have sinned so much to the extent that God's glory is no longer with us (FGD, 21 September, 2013).

Quoting a verse from the Bible, and requesting that the researchers and their supervisors [whom she refers to as "your teachers"] read a verse in the Bible in order to understand the Biblical context of climate change, conveys the deep-seated religious meanings and explanations some local residents attach to climate change. Reading from the book of Romans, chapter three, verse twenty three, as instructed by the respondent, the verse says "all have sinned, and have fallen short of the glory of God (Romans 3:23)". Relating what the Bible says in this particular verse to the submission of the respondent quoted above, and many others who share similar beliefs; 'friendly' climatic conditions are a reward from God to those who live a righteous life, while the 'unfriendly' changing climate is deemed as punishment from God to sinners. Similarly, a 41-year community social worker in Vastrap said:

> I have observed so many changes in climatic conditions. *Iyingxaki into yokuba kuthiwe isimo sezulu sitshintshile kodwa zonke ezizinto zixhome keke kuthoxo Ndicinga ukuba izinto zithshintsha ngenxa yezono zethu* [the issue of climate change is a big problem, but I think God is the one who knows everything. I think things have changed because of our sins] (In-depth interview, 14 June, 2013).

At Kwanobuhle, the research team was provided with further Biblical teachings on climate change. A 58-year old man said:

> Yes, we can all confirm that climatic conditions of the world have changed and they will keep changing until we change our ways and accept God's words. Let me ask you a simple question; are you Christians? Do you remember what happened to people of Sodom and Gomorrha in the Bible? What we are experiencing in the world today is the beginning of our own version of Sodom and Gomorrha. How can a man marry his fellow man; or a woman marry her fellow woman; or a father sleep with his own daughter; a son sleep with his own mother; the list is endless, and still receives God's favour? God is punishing us with all these new climatic trends for the abominable sins we have committed against Him and human dignity. If we want to have solutions to all these climate problems and all other forms of problems facing the world today, then we should change our ways of doing things and pray to God for forgiveness, now all of you close your eyes and let us pray (In-depth interview, 17 July, 2013).

The whole team was stunned by the degree of connectivity established between climate change related issues and all forms of 'social vices' and 'sins' (such as crime, same-sex marriages and incest). According to the respondents quoted above, and 88 others who shared similar views, the solution to climate change and its related impacts lie with one's religious commitment and the preparedness of modern societies to repent from all forms of evil practices, including same sex marriages which are deemed as 'evil'.

Based on their local traditional and cultural belief systems, practices and religious inclinations; majority of the local residents perceive climate change as not real or scientific. These respondents believe that anthropogenic factors and scientific explanation have nothing to do with climate change, but rather climate change is caused by divine authority and some supernatural powers and forces. Influenced by

such ‘weird’ perceptions, most local residents remain impervious to ‘non-spiritual’ and ‘non-religious’ adaption strategies to climate change impacts irrespective of their scientific potency, as such strategies are deemed irrelevant in the eyes of local perceptions. The findings indicate that most residents are willing to accept climate change adaptation strategies that are closely related to their traditional believes and religious doctrines. In other words, most people believe that what causes climate change and the possible mitigation and adaptation measures against the adverse effects of the phenomenon on local livelihoods, lies with divine authority and other supernatural forces.

6.4.3.3 Ancestral belief and climate change

The study found that respondents also struck a link between climate change and ‘ancestral anger’ over the conduct of the living. Some local residents believe that the ancestors are punishing the current generation for neglecting them and for adopting Western traditions and ways. This sentiment was expressed by 48 respondents (12.4 percent of the total sample). According to this group of residents, before the arrival of the Whites in Africa, Africans had their own belief systems and traditions which were respected and observed by all. Polytheism and ancestral worship were some of the main religious commitments of Africans, according to some of those respondents. A 68-year old man in Kwelera mentioned that:

> Before the Europeans came here to invade our land and culture, we respected and worshipped our ancestors and *uQamata* (a traditional ‘God’), and they also took good care of us. Today, we have lost total respect for them because of the White man and his modern civilisation. The question is, how can we have rains when the ancestors and *uQamata* are not happy with us? They are angry with us because we have abandoned them in favour of somebody else’s ancestors. How can we abandon people who lived and ate with us before they died, and accept someone else’s ancestors whom we did not even know when they were alive? Jesus, Moses, Joshua, Abraham and the rest, are they also not ancestors? How can we worship Jewish ancestors and turn back to say ancestral worship is not good? Let them punish us for the neglect (FGD, 12 October 2013).

‘*UQamata*’, according to local vocabulary and belief systems, is a supernatural being close to God who serves as a mediator between the ancestors and the living. In upholding their traditional belief system, some local residents hold a strong notion that the ancestors are releasing their anger on the current generation in the form of climate change for bastardising ancestral worship. According to these residents, the ancestors no longer relay the problems and cries of the living to *uQamata* for redress, due to their anger, hence the prevalence of extreme weather conditions and events. For the interest of the reader, the plate below shows one of the discussion sessions at Kwelera where some of these astonishing local perceptions about climate change were made.

Apraku, 2013

Plate 6. 1 Focus group discussion session at Zozo village in Kwelera location.

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6.4.3.4 Neocolonialism/Neoliberalism and climate change

Arguing from the political history of the country, a group of respondents saw climate change as a new form of colonialism and an extension of neoliberal antics. To them, the whole issue of climate change is another cunning and subtle strategy by the Western powers to subdue poor countries into another form of 'economic colonialism'. In their view, whatever is happening to global climatic conditions today is an issue of cyclical weather events which have happened before, and therefore is not a new phenomenon. Their argument is that a total submission to the 'Western ploy' (being that world climatic conditions are changing and that there is the need to work towards mitigating the impacts of such changes), will result in poor countries being subjected to all forms of economic and political conditions and regulations in the name of climate change adaptation. A former anti-apartheid crusader in Ncera had the following to say:

> Even though I share the same view with all other residents of the village that our climatic conditions have changed as compared to what we used to experience about 30-40years ago, to me, the whole noise about climate change from the international community is another strategy by the whites to get us into a new form of apartheid. They want to rule the world again through climate change stories. All what is happening to our climatic conditions today had happened before. I think it is not as scary as they put it. Climate change [discourse] is another way of getting us back into colonial rule. We are forced to believe and do whatever they tell us to do. They want to put fear in us, and then control us. The only difference between what the European countries are using to rule us now and what they did during apartheid is that, in this their new style, they are not using guns, whereas during apartheid, they used guns. People say the rains are scarce with high temperatures these days because of the smoke from the factories. If that is true, then my question is, who owns the factories? Is it not the Whites? They cause the whole climate change then turn around to scare us with it because they want to control us (FGD, 23 October 2013).

The belief of this respondent was supported by 26 others who express similar views that climate change is a neoliberal and neocolonial message aimed at forcing poor countries into submission, and not a real scientific issue as the world claims.

Finally, 32 respondents (8.2 percent of the total sample) were not sure about climate change and its related issues, despite indicating that they had noticed some changes in both intra- and inter-annual weather conditions. One respondent remarked as follows:

> Things relating to our climate have really changed. As you can see, this is a rural area and we depend mostly on our gardens and animals for survival. Let me tell you something my son. In the 1970s and 80s – I know most of you were not born by then [referring to the researcher] – it was not difficult to get water for our animals and gardens because the rains were falling normally, as a result there was always water in the dams and streams. We could plant and harvest according to our age-old traditional farming calendar. We knew when each weather season would begin and end, but now, you cannot tell whether the whole year is winter or summer. Sometimes it gets extremely cold in summer and extremely hot in winter. Again, there are no rains these days, our gardens are dried even in October, and our animals are dying of thirst. I absolutely have no idea of what is causing all these funny and strange changes. Maybe people like you who are highly educated can tell us what is causing all these changes (In-depth interview, 19 October, 2013).

The view-point in the words quoted above was shared by a 54-year old man at Jongilanga and by a 56-year old woman in Kwanobuhle who said:

> Yes, the climate has changed so much these days. The changes we are seeing today in terms of climatic conditions are far different from what we knew when we were young. During our days, you could easily differentiate between winter and summer. But these days, in winter, the weather sometimes get hot as if it is summer time; and in summer time too, the weather sometimes get cold as if it is winter. I'm sincerely confused and I do not know what is the cause of all these changes in our climatic conditions these days (FGD, 11 November, 2013).

Finally, it emerged that the small proportion of residents who have a reasonable knowledge about climate change, either do not bother to share what they know with their fellow residents, or they do not have the platform to do so. According to some residents, the only time they discussed or commented on climate related issues was when they listened to the news on television and saw the weather forecast. The rest of local discourses on climate change were mostly about complaining to friends, relatives and neighbours about the negative impacts of climate change on their livelihoods. As a

result, the dissemination of knowledge on climate change through local discourses did not seem as vibrant as it should be, as the right platforms were non-existent. A 42- year old teacher in Jongilanga said:

> My brother, it is very difficult to educate people in this community about the realities of climate change. The biggest problem is that most of the people have entrenched beliefs in traditions, superstition and ancestral worship. Their mind-set about climate change and its related issues is strongly built along such 'primitive' belief systems so it is extremely difficult to educate them on the scientific realities of climate change. Another problem is that, this community is too polarised on party political lines. Every developmental issue is tagged with political party colours which makes it very difficult to comment on sensitive issues like climate change without being branded as agent of party 'A' or 'B' and that is why we do not talk about climate change as we are supposed to be doing (In-depth interview, 18 November, 2013).

The interaction between every society and its natural environment makes ample knowledge and awareness on climate change vitally important in the success of various socio-economic projects and programmes. Studies have further suggested an individual or community's level of awareness and perception about climate change and its associated risks are closely related to mitigation actions and adaptive behavioural changes (Wei et al., 2014). Even though there is a small percentage (31.4 percent of the respondents) who are aware of climate change and perceive its risks and vulnerabilities as real, the study found that there are no proper platforms for such individuals to share their knowledge with fellow residents, apart from neighbourhood 'gossip' and 'chitchats'. Thus pervasive misconceptions about climate change and its causes in the study communities supersede scientific realities about the phenomenon.

6.5 Conclusion

This chapter has revealed that residents among rural and peri-urban communities of Port Elizabeth East London, through observations and experiences have noticed changes in local climatic conditions over a period now. The general knowledge among the residents is that, local temperature, rainfall and wind speed patterns have changed.

Over thirty one percent (31.4%) of the total respondents attribute changes in local weather and patterns to issues such as vehicular and industrial emissions of greenhouse gases, deforestation and destruction of carbon sinks through and expansion in human settlements.

However, majority of the respondents (60.3%) believe that climate change or change in local climatic conditions is caused by superstitions and myths ranging from God's anger, ancestral fury, rage of the gods and goddesses, immorality of the youth and neoliberalism. The remaining 8.2%, even though have equally noticed changes in local climatic conditions, still remain confused and totally ignorant on what the possible cause of such changes might be. Finally, the chapter has revealed that the relatively small percent of residents in the study communities with a fair knowledge on climate change do not share their knowledge because of entrenched traditional believes and total absence of appropriate 'knowledge sharing' platforms. This has therefore limited community level articulations on climate change related issues to complaints about the negative impacts of the phenomenon on their livelihoods and neigbourhood 'chit-chats'.

In the discussion chapter (chapter 9) the researcher will utilise these findings to reflect on how local residents in a climate change affected region adapt to the effects this phenomenon and how such adaptation strategies draw on the state of climate change awareness.

CHAPTER SEVEN

CLIMATE CHANGE RISKS AND COMMUNITY AWARENESS: RESEARCH FINDINGS

7.1 Introduction

The second research question was:

- What are the actual risks associated with climate change in peri-urban and rural Port Elizabeth and East London according to available South African meteorological data, and to what extent are communities aware of these risks?

To better understand the various risks associated with climate change in the study communities, the researcher saw the need to first look at the available meteorological data on the province in the context of the country and the sub-region, before looking at the impacts of climate data on rural and peri-urban livelihoods. The analyses and presentation of the Eastern Cape climate and meteorological data will focus on the salient weather events in the province which are influenced by general changes in global climatic conditions. This approach is informed by the argument that the many variations on the average weather conditions, which define a climate, are the collection of weather events which people experience on a daily basis (SAWS, 2010:31). These climate defining factors, according to the SAWS (2010), include a number of fixed geographical features, such as the global latitude and altitude of a country or region, the proportion of land to water, proximity to oceans or mountains and other major geophysical features (SAWS, 2010: 33).

The Eastern Cape province of South Africa is located within Latitudes 30’00 – 34’15 S and longitudes 22’45 – 30’15 E (Afolayan et al., 2014: 221; SAWS, 2014). Given its geographical location and geophysical characteristics, the province has its own peculiar

meteorological and climatological data. It is, however, noteworthy that such established data are not independent of global trends, in the context of climate change and its related data. Globally, the levels of carbon dioxide concentrations in the atmosphere are rising as a result of increasing anthropogenic emissions. Global temperatures are likely to increase by between 1.4 and 5.8 degrees Celsius by the year 2100 (IPCC, 2007). Sea levels are also likely to rise by between 0.1 and 0.9 metres within the same period due to widespread melting of snow and ice; while extreme weather events such as heat waves, severe droughts, hailstorms, hurricanes, tsunamis and landslides are likely to increase in the coming decades (IPCC, 2007: Johnston, 2008:15). As members of the global community, the SAWS and other relevant climate change institutions and experts have identified and projected various meteorological and climate data for the Eastern Cape Province, which are not at variance with global trends and averages. For the purpose of this thesis and policy interventions, the author presents below some of the salient meteorological and climate data of the Eastern Cape Province. These climatic data are presented under two categories, namely; temperature and rainfall. These two weather variables are selected due to their direct impacts on the daily livelihoods of rural and peri-urban residents.

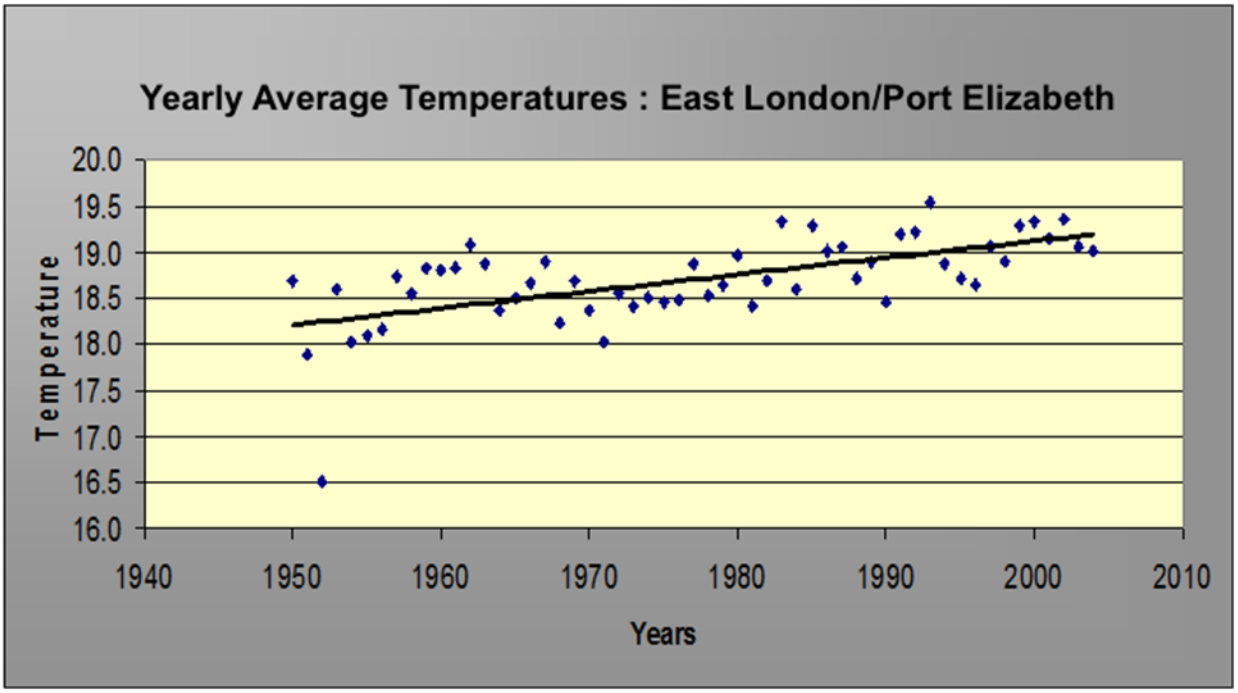
7.2 Temperature

It is widely acknowledged that there has been a detectable fluctuation in global annual and decadal average temperature values for the past five decades due to continuous changes in global climatic conditions and Sea-Surface Temperature variations (IPCC, 2007; IPCC, 2013). Sub-regionally, across the Southern Africa region, the mean annual minimum temperature ranges from 3 to 25 degrees Celsius and a mean maximum annual range of 15 to 36^{o} Celsius (CSIR, 2011). The temperatures along the coastal regions, especially the southwestern and southeastern coastal regions of South Africa (an area which covers the study communities) are influenced by the Benguela and Agulhas ocean currents, as well as the temperature of the adjacent oceans (the Indian and Atlantic oceans). The eastern coastline is warmed by the Agulhas current from the

equator; whereas the western coastline is cooled by the Benguela current which flows northwards from Antarctica (CSIR, 2011:12).

The SAWS (2012) argue that based on current trends of changes in climatic conditions and future projections, the Eastern Cape Province is expected to continue experiencing fluctuations in temperature. Such fluctuations will be characterised by cold days and nights in the eastern parts of the province, while the interior and coastal regions are expected to experience hot days and nights with heat waves becoming more frequent for the rest of the century (SAWS, 2012). The interior parts of the province are estimated to experience an increase in warmer temperatures and decreased rainfall volumes compared to those areas on the coast. The higher latitudinal regions around Aliwal North are expected to experience a higher rate in extreme temperatures and decreased rainfall volumes in the years ahead when compared to the southern coastal belt (DST, 2011; CSIR, 2011). It is imperative to understand, within the context of ongoing changes in global climatic conditions, how the Eastern Cape's temperature may change in the future (especially the coastal cities of East London and Port Elizabeth). In order to do so, this study carefully examined temperature changes in the past, based on past observable records. See the diagram below.

Figure 7. 1 Average temperatures of East London and Port Elizabeth from the late 1940s to 2010.



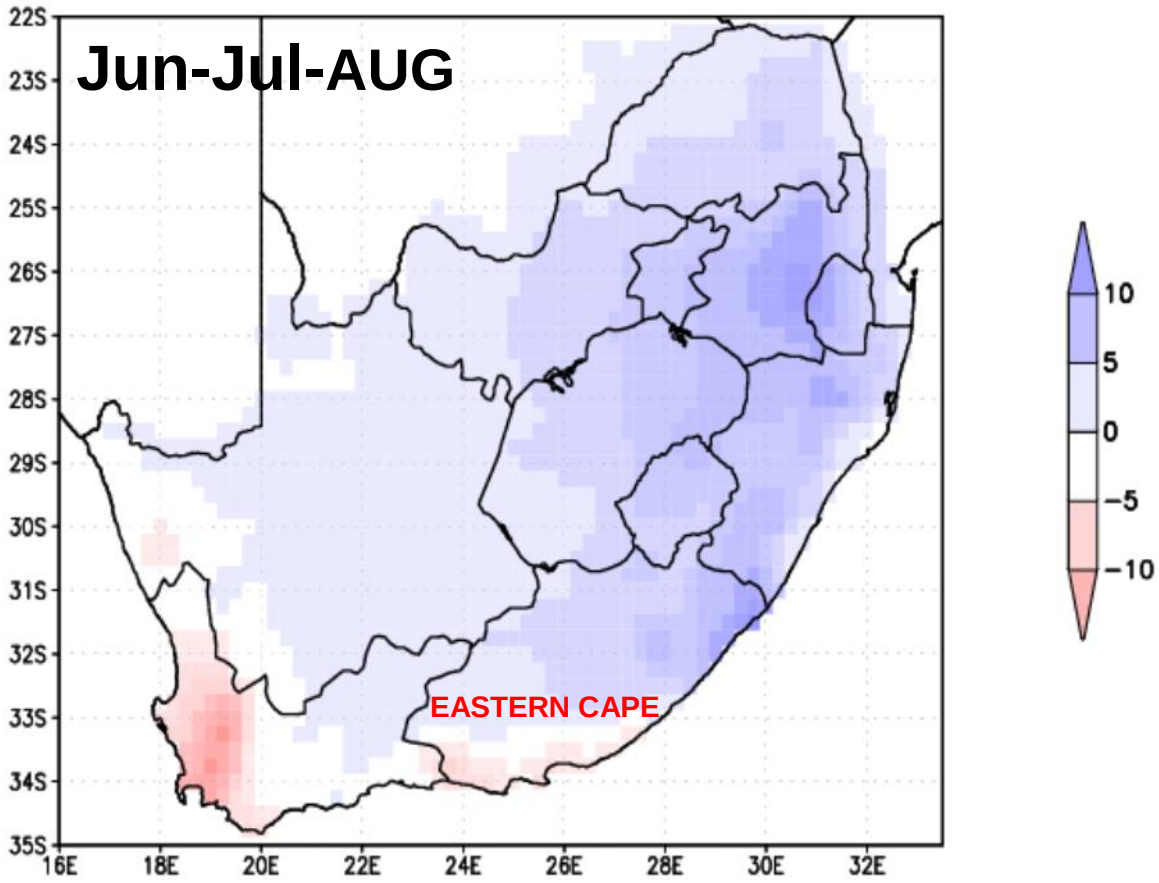
Source: http://www.gfcsa.net/csag.html

7.3 Rainfall

Literature shows that the Southern African region as a whole is predominantly semi-arid with high intra-seasonal and inter-annual rainfall variability and extreme weather events such as droughts and floods occurring frequently (IPCC, 2007; DST, 2011; CSIR, 2011: 8). The average annual rainfall of the region is estimated at less than 1000mm per year (CSIR, 2011:9). Rainfall over most parts of the sub-region is seasonal with summer rainfall areas covering the highest proportion of the sub-regional land cover (CSIR, 2011). The Eastern Cape Province of South Africa, where this study was conducted, falls under the summer rainfall zone of the Southern African sub-region. Rainfall in the Eastern Cape reaches its peak between December and February with some degree of annual variations (SAWS, 2012). Using various Global Circulation Models (GCM) and past rainfall records, the SAWS have forecast that from now until the end of the century, South Africa will experience general all-round warming with less rainfall due to continuous changes in global climatic conditions. Although the entire country is estimated to experience a decreased volume of annual rainfall and warmer conditions,

the summer rainfall region (which includes the Eastern Cape as indicated in figure 7.2 below) will become drier during the June-July-August winter period (SAWS, 2010; SAWS, 2012).

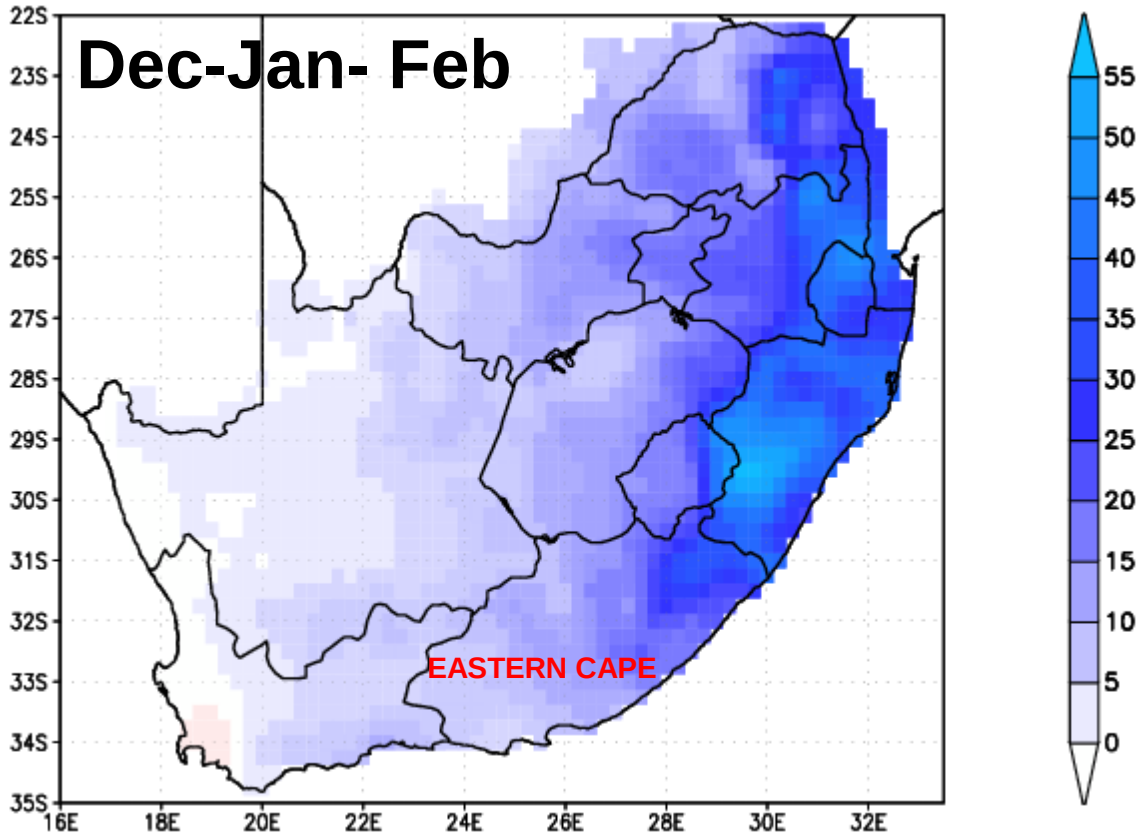
Figure 7. 2 South Africa's estimated rainfall trends up to 2050 during the June-July-August period.



Source: Johnston (2008: 37)

As shown in figure 7.2 above, it is further estimated that the projected decline in annual rainfall volumes will be accompanied by increased levels of evaporation due to an increase in temperature figures (particularly during the Jun-Jul-Aug season); while the southwestern parts of the country are expected to experience an increase in annual flooding incidences (Johnston, 2008). Similarly, the December-January-February rainfall season of the eastern and northern parts of the country are estimated to record a general decrease in decadal rainfall averages; while heavy storms and downpours within a short space of time are expected to continue an increasing trend from now until the end of 2050 (DST, 2011). See the figure below.

Figure 7. 3 Rainfall pattern and estimates for South Africa by the year 2050 during the December-January-February.



Source: Johnston (2008: 37).

As shown in figures 7.2 and 7.3 above, the SAWS, along with climate authorities, estimates that by 2050 rainfall patterns are expected to fluctuate to the extent that human and non-human lives will be affected adversely. It is projected that the southwestern parts of the country will experience extremely cold and windy weather conditions, with an average of 80 percent increase in intense rainfall within a short period of time during the winter rainfall season. The southeastern parts (areas covering the Eastern Cape and Kwazulu Natal) will experience longer dry spells, hot weather conditions and increased droughts, especially during the June-July-August winter seasons, which will threaten the livelihood of the people in these areas (Johnson, 2008:11; Johnston & Schultz, 2010; SAWS, 2012).

7.4 Some local risks associated with climate change in Eastern Cape

According to the Department of Environmental Affairs and Tourism (DEAT, 2000), climate change has altered, and continues to alter, the magnitude and distribution of weather events that produce flooding and prolonged droughts. With direct dependency on the natural environment for livelihood support, especially in rural areas, the impact climate change has on sources of livelihood is detrimental to the South African population. Available literature indicates that persistent changes in global, continental and national climatic conditions will put sustainable livelihood, in predominantly rural provinces such as the Eastern Cape, at risk (DEDEA, 2010). Understanding the risks and impacts that climate change has on rural and peri-urban livelihoods in the Eastern Cape is essential for the design of more prudent and appropriate adaptation and mitigation strategies. Drawing from the available global literature on climate change, as well as national and local meteorological data (as discussed in sections 7.1 to 7.3, including data collected from the field study) this thesis presents some of the major risks and impacts of climate change on key aspects of livelihoods in rural and peri-urban Eastern Cape. Such risks or impacts are presented in two separate categories below, namely 'the perceived risks' and 'the actual risks'.

7.4.1 Perceived risks associated with climate change

While the various occurrences identified under this category may have a connection with climate change, the phrase 'perceived risks' is used in this thesis as it is beyond the competence level of this researcher – a sociologist – to directly and scientifically confirm the 'reality' of climate change, or establish a validated causal relation between climate change and the happenings identified by the study. The perceived impacts or risks associated with climate change, found by the study, are decreased agricultural productivity, water insecurity, settlement insecurity, air and water-borne diseases, the spread of strange and invasive plant species, damaged ecosystems and loss of biodiversity.

7.4.1.1 Decreased agricultural productivity

Local subsistence farmers reported a decline in their agricultural productivity. This situation puts most households at risk of experiencing food insecurity in the near future, as most rural households depend on their farm yields for food. According to the respondents, declining agricultural yields were caused by unfavourable farming conditions associated with extended dry weather conditions, reduction in annual rainfall averages, changed rainfall patterns and temperature fluctuations. Most of the affected farmers attribute their misfortune to uncertainties in weather conditions caused by changes in global climatic conditions. The CSIR (2011) supports this argument as it assert that, a marginal increase in mean temperature between 1 and 2 degrees Celsius could directly lead to a decrease in crop production due to a corresponding increase in evaporation. Moreover, changes in temperature and rainfall regimes could directly affect the length of growing seasons, irrigation, crop yields and harvesting dates. Indirectly, higher temperature values negatively affect organic soil matter, thereby reducing the nutrients and moisture of the soil, and increasing the spread of pests and pathogens (CSIR, 2011 and Katharine, et al., 2011). The plates below paint the picture of the perceived impact of climate change on local agriculture.

Apraku, 2013

Plate 7. 1 A prepared farmland lying fallow in Zozo due to lack of rainfall.

In livestock production, changes in key climate variables like temperature and rainfall directly affect the quality and quantity of forage, and water supply, and increase the prevalence of various kinds of animal diseases (DST, 2011). Additionally, livestock productivity could decrease drastically if temperature values rise above the livestock's thermal comfort zone, which could lead to metabolic and behavioural changes (Katharine et al., 2011). Finally, changes in biodiversity, vegetation structure and increase in incidence of wild fires could be some of the indirect disturbances to crop and livestock production in the face of changing climatic conditions (DST, 2011). See the image of an emaciated cow presented below, for a context illustration and understanding.

Apraku, 2013

Plate 7. 2 An emaciated cow in Ncera village 4.

As the majority of the poor rural and peri-urban Eastern Cape settlements are dominated by agricultural households (see Stats SA, 2011), the study noted that changes in local and global climatic conditions and their corresponding effects on agricultural productivity have become an impediment to food security and sustainable livelihoods of most of the agricultural households in the study communities. Even though the current study could not quantify the seasonal or annual production levels of local farmers in the study communities; through questioning, observations and images like plates 7.1 and 7.2 above, the study was able to establish that rural agriculture and food security are under serious threat in the study communities due to climate change. Locally, climate change is negatively impacting on crop yields, influencing types of crops to be grown, farming calendars, local farming practices and livestock production through prolonged dry spells, erratic rainfall patterns, a decrease in pasture quality, outbreaks of crop and animal diseases and the widespread of pests.

7.4.1.2 Water insecurity

The study found that most rural communities in the study area were at risk of experiencing water insecurity if the status quo did not change. Even though there were community water taps in almost all of the study communities, some rural residents still accessed water from streams, rivers, harvested rainwater and dams for various purposes. Some of the residents complained that the tap water was too salty for drinking or irrigational purposes; hence their continuous use of traditional water sources such as streams, rivers, harvested rainwater and dams. Unfortunately, the availability of water from these 'traditional' water sources are directly dependent on certain weather conditions and are therefore affected by climate change. The perceived risk associated with traditional water sources is that the continuous decrease in annual rainfall averages, alongside rising temperature levels due to climate change, will place the availability of water in rural areas at risk, as these water sources are directly dependent on rainfall. The quality and condition of the already depleted water supply becomes highly questionable as streams, dams and rivers are contaminated or polluted in the midst of the scramble for water by humans and animals.

Moreover, due to an increase in wind speed, dusty roofs contaminate harvested rainwater and conserving tanks. The availability of water for all residents at all times, as well as the quality of this water are some of the key variables that define water security. It is argued that achieving sustainable water security is determined by, amongst other factors; hydrological cycles of given localities and changes in future environmental conditions (climate change), socio-economic parameters, political willingness to invest in resources, and efficient public administration systems (SAWRC, 2014). However evidence gathered by this study suggest that water availability, accessibility and its quality cannot be guaranteed in some rural settlements in the Eastern Cape due to the degree of changes in climatic variables, specifically rainfall, and prolonged dry weather conditions. See plates below for some examples of the water sources available to rural and peri-urban residents, and how such sources are vulnerable to climate change.

Apraku, 2013

Plate 7. 3 Local residents fetching water from a stream in Ncera village.

Apraku, 2013

Plate 7. 4 Rainwater harvesting tanks in Phumlani.

7.4.1.3 Air and water borne diseases

Another perceived risk of climate change, closely related to water insecurity, is a possible outbreak of air and water-borne diseases. The continuous changes in global climatic conditions, accompanied by flooding and increased wind speed, pose a health threat to rural and 'stressed' peri-urban communities in the Eastern Cape. The continued dependence of people on crude or 'unhealthy' water sources, as well as poor sanitation facilities, increase the risks posed to these communities. They are thus far more likely to experience outbreaks of air and water-borne diseases as a result of climate related events. It is not uncommon for animals and humans to share the same water source in some rural communities, which poses a great health risk for these residents.

Another unhygienic practice observed was the bucket-toilet system. This was still in use in some peri-urban communities like Vastrap. In support of the above finding, the IPCC (2007) argue that the health of humans is closely related to their immediate surrounding environment. Building on this argument, the CSIR (2011) believe that the health impacts of climate change on a given settlement or community primarily depend on the local natural environmental conditions, the socio-economic conditions of the societies concerned, and the various adaptation strategies implemented to reduce climate threats. Such adaptation strategies primarily revolve around curbing the spread and increase of the incidence of infectious vector-borne diseases, water-borne pathogens and increasing the security of housing infrastructure (CSIR, 2011: 60). With an estimated increase in flooding and wind speed in some parts of the province coupled with unhygienic conditions, including Port Elizabeth and East London and their environs (SAWS, 2012) in the years ahead, the chances of air and water-borne disease outbreak may be higher due to the spread of pollution by wind and flood waters or through contaminated dams and streams. Plates 7.5 and 7.6 below show water and sanitation scenes with possible health implications in some of the study communities.

Apraku, 2013

Plate 7. 5. Local residents share a dam with livestock in Jongilanga.

Apraku, 2013

Plate 7. 6 Toilet bucket blown away from its original position by strong winds in Vastrap.

7.4.1.4 Biodiversity loss

The study identified the loss of some aspects of biodiversity in the study communities, through damaged ecosystems as another major threat posed by climate change. Some plant and animal species are on the verge of total extinction due to continuous damage of the local ecosystems by wild fires, deforestation and prolonged dry weather conditions. A traditional healer in Tuba location lamented:

> My son, [referring to the researcher] we can no longer treat certain diseases with traditional medicine these days because we cannot find the appropriate herbal plants for such diseases in the bushes. There are some instances when I mention names of certain plants to my nephew who is learning this trade from me, he finds it difficult to recognise such plants because I can no longer find most of these plants in the bush to show him because of bush-fires, people cutting down all kinds of plants for firewood and the generally dry and longer winter seasons we are experiencing these days (In-depth interview, 22 September, 2013).

Further observation showed that previously fertile agricultural lands, which supported the growth of most local plant species, are continuously losing their fertility and biomes through erosion from strong winds and water run-offs. A photographic image of the loss of a sizeable proportion of local biodiversity through various climate induced weather conditions is presented below.

Apraku, 2013

Plate 7. 7 An Eroded farmland with drastically diminished biome at Phindweni in Kwelera.

Relatedly, studies predict that 25-40 percent of mammal species of the African continent could become endangered or extinct by 2080 and that approximately 5000 African plant species will be faced with substantial reductions in areas unsuitable for growth by 2085 (CSIR, 2011; IPCC, 2013). Scaling this scenario down to the Southern Africa sub-region; according to available meteorological data and various studies conducted for instance, if the current trend of changes in climatic variables continues, South Africa as a country could, lose between 51 and 61 percent of its beautiful *Fynbos* and succulent *Karoo* biomes by the third quarter of the century (CSIR, 2011:57; DST, 2011). Interestingly, these unfortunate continental, sub-regional and national observations and projections are consistent with what this study discovered in the participatory communities of the Eastern Cape. The photograph presented below shows the degree of damage caused by wild fires to ecosystems and biodiversity in the study communities.

Apraku, 2013

Plate 7. 8 Burnt local forest reserve in Ncera village 4.

7.1.4.5 Settlement insecurity

Another perceived risk posed by climate change, as identified by the study, is settlement insecurity. As many as 62 respondents (15.9 percent of the total respondents) from both rural and peri-urban settlements lamented that they lived in perpetual fear of losing their houses and personal belongings to weather-related disasters such as frequent storms, flooding and fire outbreaks. With projected rising temperature patterns and erratic rainfall in the coming decades (see SAWS, 2012), poor rural and peri-urban dwellers, living in poorly constructed houses, are at risk of losing their houses and their property to extreme weather related events such as floods, storms and wild fires caused by climate change. Generally, temperatures are estimated to rise between 1 and 3 degrees Celsius over most land areas of South Africa by the year 2060 (CSIR, 2011:35). Temperatures are comparatively expected to increase more towards the arid southwestern parts of the country (which includes the Eastern Cape Province) especially during the June-July-August dry seasons (SAWS, 2012). However,

the coastal regions are generally projected to experience lower temperatures compared to the interior regions, due to the moderating effects of the ocean (CSIR, 2011:35).

Again, changes in annual average precipitation patterns (resulting in decreased annual average rainfall volumes) and higher mean temperature values (resulting in increased evaporations rates) are expected in the coming decades (DST, 2011). With extended dry weather conditions, high temperature figures and strong winds in both coastal and interior regions of the province due to climate change, domestic and bush fire outbreaks are estimated to be on the rise. This scenario leaves compacted peri-urban settlements like Vastrap, as well as overgrown bushy rural settlements highly vulnerable to settlement loss to fire outbreaks and storms. Such settlements are thus most likely to be destroyed by storm or fire in the event of an outbreak, due to the nature of the settlement environments, compounded by dry windy conditions. The plates below show two separate scenes where people are experiencing settlement insecurity due to extreme weather related events possibly propelled by changing climatic conditions.

Apraku, 2013

Plate 7. 9 Homeless women sitting outside their storm-damaged house at Holomisa section of Kwanobuhle.

Apraku, 2013

Plate 7. 10 A small boy trying to control a wild fire from razing his family home in Ncera.

7.4.1.6 Spread of 'strange' and invasive plant species

The last perceived risk associated with climate change, found by the study, is the spread of 'strange' and invasive plant species. The study found the emergence and rapid spread of strange and invasive plant species known in local parlance as *Lantane*. Local residents associate the strange *Lantane* species with the 'Lantana' (an ornamental evergreen bush flower from tropical America) due to their resemblance in nature and flowering similarities. The *Lantane* is a thicket of homogeneous plants with thorns and fast spreading deep roots. According to local residents, the *Lantane* multiply very fast through the roots, seeds and flowers during the dry winter season, making it possible for them to absorb the little moisture and nutrients left in the soil. Local small-scale farmers indicated that the 'strange' *Lantane* plants were taking over fertile agricultural lands and gardens in most rural communities due to the difficulty in controlling them. Even though the locals could not mention the source and origin of this

'new' vegetation and other 'monster plant species', most of them believed that the seeds of these plants may have been blown in from somewhere by strong winds. The invasion of fertile lands by *Lantane* further exacerbates the risk of food insecurity as farmers are being gradually robbed of their farming lands. The plate below shows a garden being 'colonised' by *Lantane* in the *Zozo* location of *Kwelera*.

Apraku, 2013

Plate 7. 11 A garden taken over by Lantane.

7.4.2 Actual risks or impacts of climate change

According to available literature, the risks or impacts of climate change on livelihoods in the Eastern Cape Province and South Africa as a whole, cut across a range of issues and aspects of life. The data presented from section 7.4.1.1 to 7.4.1.6 above are validated by bodies such as the DST, CSIR, the IPCC and other climate science authorities through various assessment reports as the some of the actual risks of climate change. Below are some of the major actual risks and impacts of climate

change on livelihoods in the Eastern Cape, as identified by different local and international bodies.

Johnston (2008) and Johnston & Schultze (2010) argue that based on changes in local and global climatic conditions, the Eastern Cape Province, by the middle of the 21st century, is at risk of experiencing:

i. up to 10 percent reduction in run-off water due to decrease in annual averages of rainfall and increased evaporation;
ii. approximately 10 to 20 percent reduction in suitable cattle farming areas due to soil erosions, reduced rainfall volumes and extended dry weather conditions;
iii. about 38 to 55 percent reduction of the area covered by the current biomass as a result of wild fires, desertification and drought;
iv. approximately 10 percent increase in fire intensity due to extremely dry weather conditions;
v. a decline in existing terrestrial biomes, of about 40 percent, due to erosion, wild fires and extremely dry weather conditions; and
vi. 44 percent of plant and 80 percent of animal species undergoing a significant alteration to their geographical ranges (Johnston, 2008; 46-47; Johnston & Schultze 2010).

The DST, CSIR and the IPCC corroborate the projections of Johnston (2008) and Johnston & Schultze (2010) by indicating that, should the current trend and rate of changes in climatic conditions continue, by the year 2100 South Africa as whole is very likely to experience:

i. increased pests, invasive plants and health problems due to vector borne diseases;
ii. changes in the suitability of land for different types of crops and pasture due to soil erosion and reduced rainfall volumes;
iii. the conversion of grasslands to shrub lands and invasion by alien plants and other organisms;

iv. loss of arable land due to increase in aridity and associated salinity, groundwater depletion, the rise in sea levels and changes in the distribution of good quality water for crop, livestock and inland fish production;
v. changes in annual average precipitations, higher mean temperatures accompanied by more hot days and heat waves, longer dry spells and increased likelihood of severe droughts;
vi. elevated atmospheric carbon dioxide concentration;
vii. increased storm severity and more intense rain accompanied by extreme weather events; and
viii. incidences of major floods, wildfires, wind speeds and increase in cyclone activities (DST, 2011; CSIR, 2011; IPCC, 2007; IPCC, 2013).

The combination of the perceived and actual risks of climate change in the study communities as presented from section 7.4.1 to 7.4.2 of this thesis pose a major threat to livelihood sustenance in the Eastern Cape, particularly in the rural areas. As discussed in chapter six, even though residents are somewhat aware of the changing climatic conditions of their local communities; people's awareness on the risks pose by such changes is generally low. This is partly because of entrenched belief in superstitions and traditions which contravene the underlying scientific facts about climate change and its associated impacts. Finally, community engagement between the SAWS and the various municipal administrations on climate awareness campaigns is low; this therefore paves way for community ignorance on climate change and its related risks to fester.

7.5 Conclusion

Available meteorological data and evidence gathered during the field study showed that climate change poses major risks to the livelihoods of rural and peri-urban residents in the Eastern Cape. Just like most parts of the country and Africa as whole, inconsistencies in climatic variables like rainfall, temperature and wind speed pose major threats to the socio-economic growth and development of the Eastern Cape,

particularly in the rural and peri-urban communities. Among the most highly vulnerable sectors are; agriculture, water resources, health and sanitation, ecosystems and biodiversity, human settlement and infrastructure. These sectors are at high risk to climate change due to: decrease in annual averages of rainfall and increased evaporation; reduction in suitable crop and livestock farming areas due to soil erosions; reduced rainfall volumes and extended dry weather conditions; reduction of the area covered by the current biomass as a result of wild fires, desertification and drought; and increased pests, invasive plants and health problems due to vector borne diseases, which are all associated with climate change. As people's general knowledge about climate change is pervasively low, their awareness about the risks posed by climate change is equally low.

CHAPTER EIGHT

COMMUNITY 'ASSETS', RISK PERCEPTIONS AND LOCAL VULNERABILITY: RESEARCH FINDINGS

8.1 Introduction

The third research question was articulated in chapter one as follows:

- To what extent do residents' assets mediate actual risks, their perceptions of risk, and their vulnerability to climate change?

An asset-based approach to addressing socio-economic phenomena and propelling development in a given society is relevant in contemporary development procedures, as it affords policy makers the opportunity to identify the exact and critical aspects of society in which to invest resources. According to Moser (1998) and Frayne et al., (2012) an asset is a stock of financial, human, natural or social resources that can be acquired, developed, improved and transferred across generations (Moser, 1998; Frayne et al., 2012:12). Different kinds of assets, based on their significance in the growth and development of individuals and their societies are sometimes classified as 'capitals'; a classification adopted in this thesis (despite the economistic ring of that term).

The data below are presented according to the Moser (1998) and Frayne et al., (2012) categorisation of assets into physical capital, financial capital, human capital, social capital, natural capital, and what Akpan (2011) refers to as 'ideational capital'. In their submissions, Frayne et al., (2012) indicate that ownership of assets can be both individual and collective in nature. This means that assets can be owned by individuals, households, communities, or the entire society depending on the asset type. Asset capitals are used in this chapter to measure communities, households and individual's climate change risk perceptions and vulnerabilities. More detailed discussion on the role

of the various asset portfolios in mitigating climate change impacts in the study communities is given in chapter nine of this thesis. The data presented in this chapter covers all the various kinds of ownership and possessions (individual, household and communal ownerships). This study pays particular attention to ideational assets – especially local/indigenous assets as these are those that the dominant climate discourse do not adequately emphasis or privilege.

8.2 Physical capital

Physical capital refers to the stock of plants, equipment, infrastructure, and other productive resources owned by an individual, a household, a community, or a nation (see Moser 1998; Frayne et al., 2012). According to the nature and location of the study communities (rural and peri-urban), the availability of physical capital, as defined above, varies between rural and peri-urban communities. The study found that the peri-urban communities are endowed with marginally more physical capital in terms of water, road, education, health, housing and communication infrastructure than their rural counterparts. This is possibly due to the proximity of peri-urban communities to the more developed urban areas - except in the Vastrap settlement which does not host a single brick house or even a 'descent' toilet facility. The study identified that the peri-urban communities have better and more functional infrastructural amenities (which form part of their productive resources) compared to the rural communities. The rural communities are characterised by bad roads, poor housing, health, education and water facilities and the total absence of modern farming equipment to support agricultural livelihoods. Focusing on water infrastructure, for example, despite the availability of communal taps in both the rural and peri-urban communities, the majority of the rural residents still draw water from dams, streams and rivers for both irrigational and domestic purposes. The study further found that water resources such as dams, rivers and streams in the rural areas are shared by animals and human beings.

A 44-year old woman in Ncera said:

> here in the village, we still fetch water from the dams and streams and boil it for hours before drinking it because the tap water is too salty for drinking or cooking. It is not even good for the gardens as the salt content affects our crops (FGD, 25 September 2013).

This narration on water infrastructure, as part of physical capital, highlights the level and danger of water insecurity as discussed in chapter nine. The poor nature of rural physical capital in the study communities, affects agriculture – the major source of livelihood in the area.

Another major infrastructural deficit, which forms part of the physical capital portfolio in both rural and peri-urban study communities, is sanitation. The researcher found that the bucket toilet system, as well as poor waste disposal systems, were still used in peri-urban communities like Tirreville Lanpland; while their rural counterparts utilised open pit latrine systems. The health implications or risks of such unhygienic toilet systems exacerbated by poor drainage and sewerage infrastructure, are severe, particularly in the face of climate change and associated wind speed and flooding (see plates 8.1 and 8.2 below).

Apraku, 2013

Plate 8. 1 The dominant housing and road infrastructure in most of the rural study communities.

Apraku, 2013

Plate 8. 2 Housing and sanitation infrastructure in the peri-urban settlements.

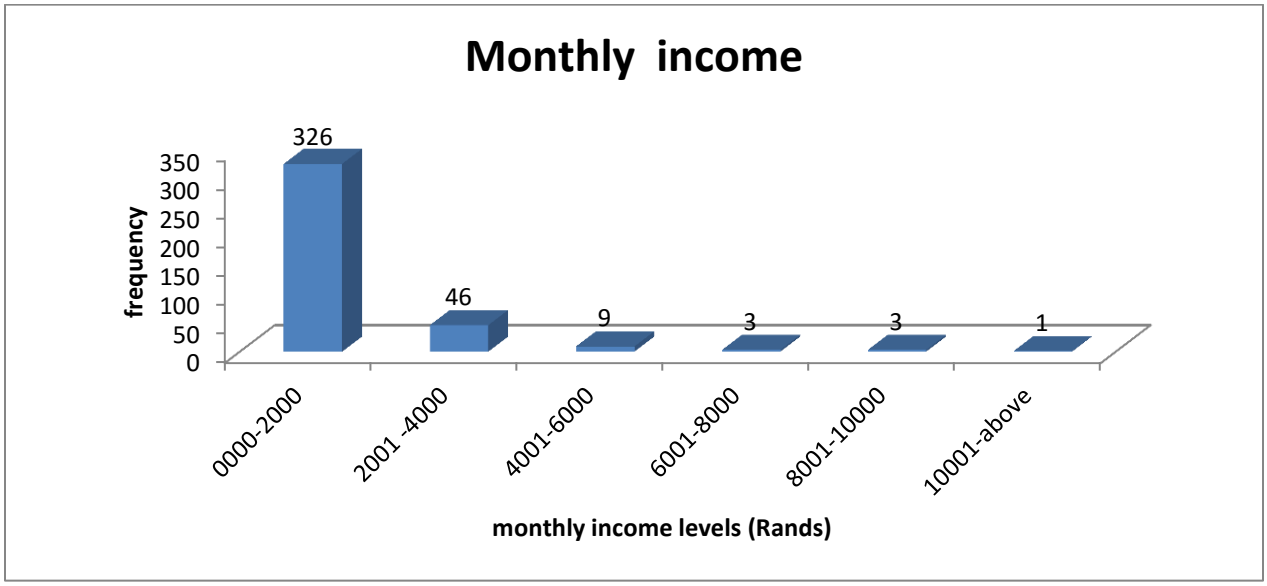
Plates 8.1 and 8.2 above depict the state of physical capital in most of the study communities in terms of road infrastructure, housing and sanitation. In the context of climate change, local residents of these communities' resilience to climate change-associated impacts, using their physical capital, would always be low due to the poor state of that particular asset portfolio.

8.3 Financial capital

Financial capital refers to the financial resources available to people, such as savings and supplies of credit (Moser 1998; Frayne et al., 2012). According to the Department of Economic Development and Environmental Affairs (see DEDEA, 2010) the Eastern Cape Province is one of the poorest regions in the country, with more than 60 percent of the province being rural. The poverty picture painted by the DEDEA was confirmed by this study, as it emerged that the financial capital of residents in the study communities was very low. The study found that most residents of the study communities lived in

abject poverty with little or no access to financial or credit facilities, apart from government social grants and remittances from relatives. The level of poverty among various households in the study communities and its impact on their access to financial resources is presented in the diagram below.

Figure 8. 1 Monthly income level of respondents



Source: researcher's fieldwork.

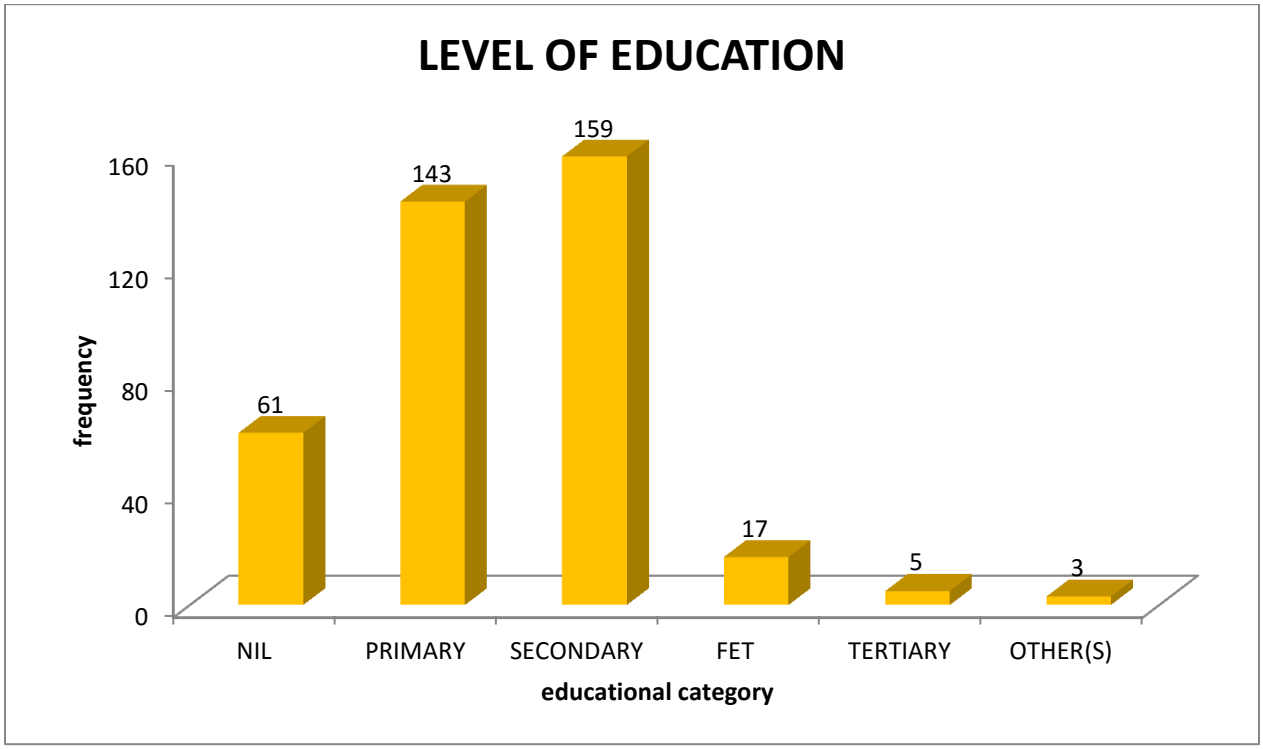
As shown in figure 8.1 above, of the total 388 respondents, 326 of them (84 percent) reported incomes of equal to or below R2000 monthly. As mentioned in section 5.2 of this thesis, the main source of such meager earnings, especially among the rural respondents, is government social grants and remittances from relatives in the cities; while most of their peri-urban counterparts indicated that they depended on government grants and menial jobs from the manufacturing sector in the cities for survival. Only 46 respondents, representing (11.9 percent of the respondents of the study) earned between R2000-R4000. Only 16 out of the 388 respondents (4.1 percent) earned more than R4000 a month. In line with the poor financial standings of the respondents, the study noted that most people in the study communities did not have access to bank loans and other forms of credit facilities. They also did not save part of their earnings,

which makes them susceptible to various risks of climate change particularly food insecurity.

8.4 Human capital

Human capital refers to investments in education, health and the nutrition of individuals (Moser 1998; Frayne et, al., 2012). According to Statistics South Africa (Stats SA, 2011), approximately 40 percent of the total adult population of the Eastern Cape have only primary school level education, while more than 20 percent are estimated to have no education at all. Confirming such statistics, this study presents the educational level of the 388 respondents below.

Figure 8. 2 Educational level of respondents



Source: researcher's fieldwork.

As established by Statistics South Africa in its 2011 census report, data from this study (despite not covering the whole province or a sample size large enough to draw a

general conclusion) confirmed that the illiteracy rate in the Eastern Cape is comparatively high. Of the 388 respondents, 61 (15.7 percent) had no formal education at all; while 302 respondents (77.8 percent of the total) had either a primary school or secondary school education. Only 6.4 percent of the respondents had an educational level higher than secondary school level. The lower levels of education among the respondents may explain the low levels of earning presented earlier. Most of the local residents lacked the necessary academic qualifications and technical skills to meet the rapidly growing technological global labour market. Moreover, due to low-income levels (mostly from social grants and remittances), the majority of the respondents (341 out of 388) depended on public health facilities for healthcare as they could not afford installments on medical aid schemes which would allow them to access private health facilities. This is an indication of low investments in health related issues due to high levels of poverty.

Again, the study found that the staple foods of most of the respondents include rice, maize meal, potatoes, bread, African salad (locally called *Umvubo* or *Umpokoqo*), eggs, samp and beans (locally called *Umngqusho*), pumpkin and different kinds of vegetables. The study found that only an insignificant minority of the respondents could afford balanced diet, as most people (especially among rural residents) literally ate to survive with no choice between different kinds of foods at all. Parents and 'breadwinners' of various households fed their dependents with what was available, based on their financial resources, and not what they desired or deemed nutritiously 'rich'. As many as 184 of the total 388 respondents (47.4 percent) indicated that they ate twice a day (breakfast and supper); while another 118 (30.4 of the total respondents) indicated that they ate a 'full meal' once a day with 'dry' bread and fizzy drinks for breakfast. Only 86 respondents (22.2 percent) indicated that they ate three times a day. Eating three square meals among residents of the study communities is the privilege of those defined as 'rich' in the local context.

It is noteworthy that the researcher did not have the competency to scientifically measure the nutritional levels of the foods people eat in the study communities or

discern if these foods meet their dietary needs. However, measuring the data collected against Moyo's (2010) submission on food security, one can conclude that there is pervasive food insecurity among most of the respondents, particularly among the rural residents, due in part to poor human and financial capitals. A 54-year woman in Tirreville Lapland stated that:

> My children and I eat twice a day. Sometimes we eat rice and vegetables as supper for the whole week without changing because that is the only meal I can afford. We only eat meat once a week, and that is on Sundays. Even with that, it depends on if I have money to buy (In-depth interview, 12 October 2013).

Finally, the study noted that the low level human capital, to the greater extent, influences people's knowledge and general perception about climate change and its associated repercussions. Thus, educated individuals in the study communities see climate change as real and are always prepared for its effects on their livelihoods; while the uneducated ones see climate change as a myth and are therefore taken by surprise anytime climate-induced disaster strikes.

8.5 Social capital

Social capital refers to rules, norms, obligations, reciprocity, and trust embedded in social relations, social structures and societies' institutional arrangements (Moser 1998; Frayne et al., 2012). Based on the description of social capital by Moser (1998) and Frayne, et al (2012), the social capital of the study communities is embedded in chieftaincy and traditional institutions, kinship relations, churches, *stokvels* (local financial support groups) and local funeral support schemes, small scale farming corporations, sporting organisations and political party organisations. The study found that trust and adherence to the rules, norms and values of social institutions and relations varies from one institution to the other. For example, obligations and reciprocity to local chieftaincy institutions and kinship relations are found to be high due to people's commitment to their cultural practices and customs. Churches and other forms of religious institutions are trusted, revered and strictly preserved because of

people's commitment to their religious beliefs and tenets. On separate occasions and in different locations, respondents shared their understanding about the degree and utility of their social capital. At Ncera village 4, a 48-year woman said:

> I attend all my church, clan or family and traditional council meetings because it is my responsibility as a member of the church, clan or family and the village to obey and uphold our values and contribute my part to keep such institutions functional. I trust, respect and believe in the kind of support one gets from the clan or family, church and the traditional council anytime one is in need (In-depth Interview, 14 September 2013).

The issue of one's strong attachment, trust and commitment to all social relations and institutions, as well as their associated rules, norms and values in the context of religion, kinship and traditions was expressed by over 80 percent of the total respondents. Regarding the issue of local funeral support schemes and *stokvels*, a 51-year old unemployed father of five mentioned that:

> Some of us cannot afford funeral policies from the "big" insurance companies like Sanlam and Old Mutual. We have therefore formed our own local funeral support schemes like the *Masakhane* (let's help each other) funeral support scheme and *Delihlazo* (know no shame) funeral support scheme and so many other forms of *stokvels* in this township. I belong to *Delihlazo* local funeral support scheme. *Delihlazo* literally means something or somebody which or who knows no shame. Death knows no shame and can come anytime. You and your family therefore need the support of your community both in kind and cash and that is why we formed that support scheme about 20years ago. It has been very helpful to us as a community. Some of us again belong to different support groups in our churches, which are also very helpful and trustworthy (FGD, 29 August 2013).

Similar to the respondent quoted above, 54 other respondents mentioned different forms of local support schemes and *stokvels* with both social and economic benefits to the members and their immediate families.

Local sporting organisations also form an integral part of social capital in the study communities. The study not only found that local sporting associations unite local

residents for a common cause (recreation, entertainment and fun), but they also keep most young men and women away from criminal activity and drug use, especially in the peri-urban settlements (at least these were the common sentiments expressed). Members of these sporting associations, along with their communities, appeared to trust and believe in the values and operations of such associations. A local youth leader in Kwanobuhle of Port Elizabeth said:

> As youth in the township, we have a sporting association we call Youth Sports and Fun Club which caters for most of the known sporting codes in the country. We play fun games every two months. Our main aim is to unite all the young men and women across all racial groups in our township under one big sporting umbrella for entertainment and health purposes as well as keeping young people away from crime and drugs. People trust and respect the leadership of the organisation and hugely patronise any programme we organise (In-depth interview, 22 October 2013).

Unlike organisations such as the one described in the quote above, political parties and their affiliated organisations were found to be the least trusted, with low levels of reciprocity among their members. Although political institutions can be a strong social binding force if well managed, especially in local settings, this study found that local residents saw political institutions as benefit-seeking institutions (even though they played the vital role of leadership building). Therefore, membership of political institutions and related bodies was seen as an avenue to receive direct monetary and material benefits and not as a platform to foster unity. The study found that the issue of intra- and inter-party political rivalry appeared to rob all political institutions of their social capital significance as well as their role in social capital formation in rural and peri-urban Eastern Cape. The over-politicisation of critical local development programmes and issues appeared to have widened the social gaps between people from different political divides. The local residents lamented that political parties, as social institutions, were election winning ‘vehicles’ whose values and norms could not be trusted with social transformation or as a platform for climate change discussions, because they became dormant after elections.

When asked how effective political parties were in their role as social bonding institutions in the study communities, a 54-year old community leader in Phumlani said:

> My children [referring to the researcher and his assistant] politics can unite us as people and at the same time divide us. It all depends on the leadership of the various political parties from national to local levels. If the leaderships of the various political parties are united with a common goal of developing the nation, then we their followers can also be socially united and bonded despite the differences in our political ideologies. However, if they [referring to political leaders] continue to fight among themselves and share national resources along political party lines, then their followers at the grassroots will never be united and will never support or care for one another (FGD, 4 November 2013).

The study found that through social relations, networks, traditional rules, norms, values, customs and other forms of religious principles; local residents offer and receive assistance from individuals, institutions and households in times climate change induced disasters like drought, floods and fire.

8.6 Natural capital

Natural capital, as used in this thesis, refers to the stock of environmental assets such as soil, atmosphere, forests, minerals, water and wetlands (Moser, 1998; Frayne et al, 2012). By this definition, the study area is gifted with natural assets ranging from relatively moderate weather conditions, fertile agricultural lands, a serene coastal belt, diverse flora and fauna and various kinds of water bodies. The study communities are located along the province's spectacular coastline, lapped by the Indian Ocean (see map 5.3). With such long stretches of natural and unspoiled beaches, the role of the coast as a tourism destination and for fishing (both commercial and subsistence) gives most local coastal dwellers a sustained source of livelihood (see Government, 2013). The harbours located on the East London and Port Elizabeth coasts also provide many forms of employment opportunity to local residents (DEDEA, 2010).

Ecologically, the area is predominantly savanna grassland, with isolated forest areas characterised by both subtropical and Mediterranean weather conditions, as well as

fertile agricultural land for livestock and crop production. The study area is endowed with streams, rivers and dams which provide water for agricultural and domestic purposes. For example, communities like *Ncera* and *Kwelera* are named after the *Ncera* and *Kwelera* Rivers respectively. With such a wide range of environmental characteristics, the study communities are home to an extensive variety of flora and fauna, an aspect of the area's natural capital that allows for the number of nature reserve parks around East London and Port Elizabeth (both privately and publicly owned). The study observed that residents use proceeds (in the form of income and agricultural yield) from the natural capital to mediate some of the key impacts of climate change like water and food insecurity.

8.7 Ideational capital

Ideational capital in the context of this study refers to indigenous and /or local knowledge about coping with adverse environmental conditions (see Akpan, 2011). Although the definition provided by Akpan (2011) covers a wide range of indigenous knowledge and practices, this thesis uses the term 'ideational capital' to mean local knowledge and practices common to the various cultures within the study communities. The restriction of the definition and application of ideational capital is necessary due to the fact that socio-culturally, the indigeneity of a particular practice cannot easily be established due to historical barriers. The 'restricted' definition of ideational capital therefore makes the local application of the concept plausible.

This study found a wealth of ideational capital in the study communities, with a great deal of significance in mitigating some of the impacts of climate change. The relevant aspects of ideational capital found by the study are presented below as local agricultural practices, community support systems, local beliefs and traditions, local traditional medicines, and local building technology.

8.7.1 Local Agricultural practices

The study found that local residents, especially in the rural areas, have diverse agricultural practices. Local narratives indicate that most agricultural practices play a positive role in increasing crop yields and general agricultural productivity under different climatic conditions. Among the agricultural practices identified by the study are stock and seedling leasing, seeds preservation mechanism, local manure preparation, and animal feed. Some local subsistence farmers indicated that during adverse weather conditions such as severe droughts; certain crops and animal species were leased to farmers in neighbouring villages (with relatively favourable farming conditions or resources) without any financial reward involved. This practice, according to the local residents, was not only a sign of good social relations between the parties involved in the transaction, but also helped to circumvent the extinction of certain crop and animal species that could not withstand certain weather or climatic conditions. It again helped to resuscitate poor households as these crops and animals are brought back to their original owners whenever the situation improves, and so cannot easily go into extinction.

Moreover, to support good crop yields, the researcher learnt that local farmers had their unique ways of preserving grains and seeds for the next planting season, as well as preparing manure. Local manure is prepared from household refuse, cow dung, poultry droppings, and post- harvest residues from the gardens. A 48-year old woman in Tuba said:

> We as rural people do not have enough money for large scale farming or to buy fertilizers and other inputs. We have our own ways of preparing our local manure as you can see over there [pointing at a compost preparing site] and keeping seeds for the next planting season called *Iziswenye* (a traditional way of preserving seeds and grains for the next planting season). We also lease out our animals especially cattle to other farmers in other villages when the environment is too dry and there is no grass for them to graze on (In-depth interview, 18 September 2013).

Locally, post-harvest residues such as corn husks, stovers and chaff from grains are used for both compost preparation and feeding of farm animals. Through a variety of local knowledge and practices, small scale farmers are able to sustain their farming activities and control their yields in the face of changes in global climatic conditions. Plates 8.3 and 8.4 below show compost preparation and *Iziswenye* (a local way of keeping grains and seeds for the next planting season through smoking).

Apraku, 2013

Plate 8. 3 Local compost under preparation

Apraku, 2013

Plate 8. 4 Grains preserved through Iziswenye.

8.7.2 Pervasive communalism (Ubuntu)

Pervasive communalism, as used in this thesis, refers to a local practice, custom and tradition of communal living, ownership, support and a high degree of loyalty to one another. The study found that this local practice or custom allows residents to live as a common social entity and support one another in times of need, especially during weather related disasters such as flood, fire and drought. A 51- year old man in Ncera said:

> We as Xhosa speaking people believe in keeping one another in times of need, and that is exactly what our spirit of *Ubuntu* is all about. We also help each other with food, shelter and clothing. We do so because we believe in the practice of *Singabamelwane*. We support one another as individuals and as a community in difficult times because an injury to one is injury to all (FGD, 16 October 20130.

The above sentiment was also expressed by several other respondents in the different communities. The researcher learnt that through local *Ubuntu* practice, a high degree of mutual loyalty is upheld. *Ubuntu* is a local practice which defines local communal ownership, living and support for one another. For example, a communal labour system (as part of the *Ubuntu* practices) is used in de-silting dams and waterholes to ensure a continuous flow of water for both irrigation and animal rearing purposes. Similarly, by means of local neighbourhood support system local residents offer temporary accommodation to flood and storm victims and further help them to re-build their homes. The images presented below show the personal belongings of a victim stored by a neighbour in Vastrap and neighbours helping a storm victim to rebuild his lost house in Kwanobuhle, respectively.

Apraku, 2013

Plate 8. 5 Ubuntu in reality at Vastrap.

Apraku, 2013

Plate 8. 6 Ubuntu in reality at Kwanobuhle.

8.7.3 The nature-culture nexus

Traditional belief system is one of the defining characteristics of most African societies (see Iaquinta & Drescher, 2000; Kepe, 2010). Traditions, customs and local belief systems are revered and preserved as sacred across different cultural groupings in Africa. This study found that among the Xhosa speaking people of the Eastern Cape Province, certain indigenous plants, animals and some selected water bodies are purposefully not tampered with, as they are deemed sacred and have cultural, traditional and agricultural significance. A traditional leader in Phindweni location said:

> Who we are as people, and Africans as a whole is defined by our traditions, belief systems and practices. We as Xhosa people whether rich or poor, we are guided by our traditions and believe to live in peace with others and our environment [sic] (FGD, June 14 2013).

Several other respondents reiterated a similar notion. It was revealed that certain animals, such as frogs, are not killed or harmed because of their traditional significance in announcing new farming seasons; while the *Majola* snake is not killed as it represents a particular clan. Similarly, areas defined as ancestral groves, and lakes preserved with

hedge plants are not disturbed as these places are believed to be the resting places of the ancestors. Most of these traditional belief systems indirectly help to conserve water bodies for emergency purposes in the face of changing global climatic conditions as well as preserving certain plant and animal species. The pictures presented below show a ‘sacred’ lake and a ‘non-sacred’ lake in the context of the impacts of climate variability on water availability in rural Eastern Cape and the significant role of local traditions.

Apraku, 2013

Plate 8. 7 A 'sacred' late with well-kept water conserving hedge plants.

Apraku, 2013

Plate 8. 8 An almost dried up 'non-sacred' water body without hedge plants.

8.7.4 Traditional medicine

A significant finding of the study – one that clearly demonstrates the salience of traditional environmental conservation – is local traditional medicinal practices. The use of traditional medicine for the treatment of all kinds of human and animal diseases was still very much in evidence, especially among the rural residents. Some plant species were properly conserved for their medicinal and cultural significance. The table below shows some of the common medicinal plants mentioned by respondents and the various diseases they treat.

Table 8. 1 Local plants and their medicinal significance.

Local name of plant	**Part used**	**Usage/treatment**.
Intelezi (a herb)	Leaves	For treating scabies, eczema, and all forms of skin rashes.
Imbuya (a herb)	Leaves	For face cleansing.
Inqwebeba (a herb)	leaves	For treating wounds
Umnga (a shrub)	bark	For treating ringworms and softening facial skin.
Umhlaba (a herb)	leaves	For treating wounds, ringworms, pimples, boil eczema and burns.

Impepho (a herb)	leaves	For treating boils.
Iphuze (a herb)	leaves	For treating insect bites.
Ibholo (a shrub)	leaves	For softening facial skin and sore throat.
Ubushwa (a herb)	leaves	For treating boils, pimples ringworms, insect bites and wounds.
Umemezi (a tree)	fruits	For skin rashes, cleaning teeth and softening of hair.
Ityolo (a creeping plant)	leaves	For wrinkles and soft skin.
Ijongilanga (a herb)	leaves	For treating boils, insect bites, wounds and pimples.
Umhloyane (a herb)	leaves	For treating flu and fever.
Ikhala (Aloe)	fronts	Skin diseases and stomach problems in human beings; and a wide range of livestock and poultry diseases.
Iqwili	leaves	For chest pains and asthma.
Intolwane	leaves	For treating diarrhoea.
Ichalakhulu	leaves	For treating excessive vomiting.

Source: Researcher's fieldwork, 2013.

The pictures presented below show some of the common traditional medicinal plants well-kept for their medicinal purposes.

Apraku, 2013

Plate 8. 9 Ikhala (aloe) and Mhloyane.

An important issue associated with the fast depletion of ecosystems and biodiversity in the study communities is the gradual loss of cultural identity, particularly amongst rural inhabitants. The Xhosa speaking people, who constitute 78 percent of the total population of the Eastern Cape Province (see Stats SA, 2011), identify themselves with most of their old-aged cultural practices. Among such cultural traditions is *Ulwaluko* (a traditional practice and process of initiating young men into adulthood). The success of this culturally significant practice among the Xhosas greatly depends on the availability of certain plant species, land cover and weather conditions, as the process involves the circumcision and treatment of the wound of the initiates under 'traditional' conditions with traditional herbs. The continuous extinction of some of these medicinal and culturally significant herbs (see table 8.1 for some of these plants and their uses), as well as unpredictable weather conditions due to climate change, is gradually putting the health of the young initiates at risk. Thus the prevailing climatic conditions do not support the strict adherence to the rules of an important cultural practice like *Ulwaluko.* This could lead to the gradual loss of the cultural identity of the indigenous Xhosa people of the Eastern Cape in the future, because of climate change

8.7.5 Local building technology

Equally important, local residents in the rural areas have their own housing styles known as *rondavels. Rondavels* are locally constructed houses with conical roofs, cylindrical shaped walls, mostly plastered with cow dung and ceiled with spear grass or corrugated iron sheets (see plate 8.0 below). *Rondavels* are the most common type of building structure in rural compounds due to their affordability and ability to accommodate more people; while residents living in block houses often build *rondavels* in their compounds as an additional facility. Apart from providing shelter for residents, r*ondavels* have both cultural and traditional significance. Culturally, the researcher learnt that, 'young men' (*Abakhwetha*- young initiates) are first housed in *rondavels* straight from the initiation schools. Here, they complete the training and life orientation process before they are finally 'out-doored' to the general public in a special ceremony called *Umgidi.* Also, new brides (*Makoti*) are kept in *rondavels* and taught marital skills

and lessons by the elderly women for weeks before they are taken to the groom's house. Lastly, various forms of local traditional practices, with some level of spiritual inclination, such as fighting witchcraft and appeasing the ancestors are done in *rondavels.* This may, in part, explain why almost every household in the rural study communities (whether rich or poor) has a *rondavel*. By virtue of its physical features and construction materials, the *rondavels* style and technology of building, as part of the ideational capital of rural communities, has some climate change impacts mitigating significance. For instance, the cylindrical shape of *rondavels* makes them aero-dynamic which help them to control wind speed and avoid storm-related disasters. The conical roofing style, on the other hand, facilitates fast drainage during heavy downpours; while the grass ceilings and cow dung plastering help to regulate internal temperature and give occupants some comfort during difficult weather conditions.

The picture below shows a collapsed block house in *Kwelera* village due to storm; while a *rondavel* in the same yard proved equal to the task and remained undamaged.

Apraku, 2013

Plate 8. 10 The 'strength' of a rondavel in the face of storms and other extreme weather conditions.

Whilst there could be other factors which contributed to the collapse of the house, it is assumed that the local engineering style of the *rondavel* was one of the positive factors that kept it standing.

8.8 Conclusion

This chapter has shown that, the availability of the various categories of asset capitals vary from individual to individual, household to household and community to community. The degree of stock of an asset capital an individual or household or community possesses influences the said individual or household or community's resilience level to climate change impacts. The chapter further highlights that, people use class-based

asset categories such as education, access to financial resources, social relations, proper infrastructure (including housing), and many others to mitigate some of the impacts of climate change like food, water and settlement insecurities. Human capital (particularly investment in education), is critical in determining climate risk perception among residents of the study communities. Contrary to uneducated residents, the educated individuals in the study communities are much aware of climate and its associated risks and therefore put all other assets into proper use in mediating climate change impacts. Finally, the chapter has shown that the most widely used asset portfolio among both rural and peri-urban folks in the Eastern Cape is local ideational capital. Various local socio-cultural practices, norms and values are utilised efficiently to lessen some of the immediate impacts of climate change on their livelihoods, property, water resources, ecosystems and biodiversity.

In the next chapter, the researcher draws on the findings presented in this chapter – and those presented earlier – to answer the questions that guided the study. More importantly the findings are used to respond to some of the silences and misrepresentations in the literature with regard to the role of local/indigenous knowledge in climate science generally and climate change impact mitigation in particular.

CHAPTER NINE

SUMMARY, DISCUSSION AND CONCLUSION

9.1 Summary of key findings of the study

This chapter presents the key findings of the study in the same order as the research objectives.

1. The first objective of this thesis sought to assess the level of climate change awareness among rural and peri-urban East London and Port Elizabeth communities and how climate change knowledge (if any) is articulated in local level discourses.

The main findings under this objective are the following:

i) Awareness on climate change as a concept among residents was found to be relatively low, with only 35.8 percent of the total respondents found to have some degree of scientific knowledge about climate change as a concept; however, all respondents indicated that they could observe changes in local climatic conditions.

ii) The majority of the respondents (60.3%) attributed changes in global and local climatic conditions to religious and political factors such as anger of the gods, God's punishment for humankind, ancestral fury over neglect and neocolonialism.

iii) The general low level of climate change awareness in the participatory communities and local climate change interpretations have negatively impacted people's perceptions on climate change risks and vulnerabilities as well as mitigation strategies.

iv) Local discussions on climate change take the form of neighbourhood conversations about the impacts of climate change on individual households and the community as a

whole, with no formal channels or platforms for residents to share knowledge on the scientific realities of climate change related issues.

2. The study also aimed at analyzing the actual risks associated with climate change in rural and peri-urban Port Elizabeth and East London areas, according to available meteorological data, and the extent to which communities are aware of these risks.

The main findings under this objective are the following:

i) Local agriculture and other weather dependent economic activities in the study communities are negatively affected by climate change. Local subsistence farmers are experiencing declining trends in their farm yields due to 'unfavourable' farming conditions associated with climate change.

ii) Climate change negatively impacts water security in parts of rural Eastern Cape in terms of the availability of good standard and healthy water for crop production, human and animal consumption. This is because of the direct relationship between water resources and climate variables like rainfall, temperature and wind speed.

iii) The study communities are fast losing a greater proportion of their current ecosystems and biodiversity to climate change through an increase in the incidence of veld fires and extended dry weather conditions instigated by climate change. Various forms of animal and plant species in the study communities, especially in the rural communities, are undergoing a significant alteration or even total extinction due to changing climatic conditions and their associated 'unfavourable' weather events.

iv) With regard to settlement security, poor residents perpetually lose their houses and property to climate related 'disasters' like storms, floods and droughts. Residents of poorly constructed houses or shacks get their shelter washed away by flood waters, damaged by storm winds and gutted down by fire.

v) Even though residents were aware of some of the risks associated with changing local and global climatic conditions (by virtue of their experiences and observations); most residents tended to deny the reality of the risks associated with such phenomena. This was partly as a result of the widespread religious and mystical beliefs held about such phenomena. This therefore makes it increasingly more difficult for people with such beliefs, to accept the risks posed by climate change, and to accept appropriate mitigation and adaptation strategies thereof.

3. The study finally sought to examine the extent to which residents' assets mediate their actual and perceived risks to climate change within their vulnerability context. Assets, as used in this context refer to residents' physical capital, financial capital, human capital, social capital, natural capital and ideational capital (local knowledge).

The main findings under this objective are the following:

i) Residents use available natural and financial resources, physical infrastructure, level of formal education and various forms of social relations and networks in different ways to mediate the impacts of climate change.

ii) The construction of proper housing units for poor and needy households, proper drainage and sanitation infrastructure, and decongesting and re-locating settlements (particularly in the peri-urban settlements around Port Elizabeth) was found to be helpful in saving lives and property from the adverse effects of floods and storms.

iii) Individuals and households with higher levels of education and improved knowledge and awareness, have better defense mechanisms and response strategies against climate related disaster. They perceive climate change as real and not as consequence of the gods being angry.

iv) Local knowledge is deployed in key areas like agriculture, water resource management, ecosystem and biodiversity conservation and traditional medicine.

v) Local knowledge is part of the culture of the people with climate change impacts mitigation and adaptation significance. Local knowledge was found to be an integral part of how local people conducted their lives; however, it had profound significance for climate change impact mitigation and adaptation.

9.2 Discussion of key findings

Three main discussion points emerged from the key findings of the study which comprehensively answer the three research questions. These main points are; (1) the gap between local climate change perceptions and scientific realities, (2) the negative impacts of climate change on key sectors of the study communities, and (3) the significant role of assets (particularly local knowledge) in mitigating and adapting to climate change impacts

9.2.1 Local perceptions and climate realities

It emerged that there is a big gap between locally held perceptions about climate change and what the realities of the phenomenon are. Existing climate literature attributes climate change to natural and anthropogenic activities through emission of greenhouse gases (see for example IPCC, 2007; Pittock, 2009; DST, 2011 & IPCC, 2013). Contrary to the scientific realities of climate change, the majority of respondents (60.3%) saw climate change as a physical calamity caused by spiritual forces (for example ancestral rage, totems, anger of the gods, goddesses and God). This has allowed local interpretations about climate change to be transmitted from the elderly to the younger generations, particularly in the rural areas where there are lower levels of formal education and media coverage. Lack of appropriate climate change education platforms and the entrenched spiritual meanings attached to climate change limit residents' awareness on the realities of climate change and its associated impacts, as well as their adaptive capacity. Local awareness, people's perceptions vis-à-vis climate change and proper climate knowledge dissemination are critical in climate impacts

mitigation and adaptation. For one thing, they are the key components of climate adaptation policies in local settings, as they fundamentally compel or constrain political, social and economic actions to address local climate change risks. For instance, good awareness of climate change and its related issues guide local farmers in making certain decisions relating to when to plant crops and what to plant. Similarly, in flood and storm prone areas like Port Elizabeth (see SAWS, 2012), knowledge and awareness about climate change is critical in determining settlement patterns and styles, as well as how various economic activities are organised in those communities (see Moser, 1998).

The findings of this study therefore suggest that, either the SAWS is defaulting on its constitutional mandate of conducting education and awareness programmes on weather and climate related issues, or the organisation's educational message on climate change is not reaching the target audience as the level of climate change 'misunderstanding' among residents is still high in the study communities.

9.2.2 Impacts of climate change

The study found agriculture, water resources, human settlement and health, biodiversity and ecosystems as the key sectors highly affected by climate change in the study communities. Agriculture in the Eastern Cape plays a key role in the province towards sustaining livelihoods as well as ensuring local and regional food security (CSIR, 2011), however, it directly depends on climatic variables like temperature and rainfall, which makes it (agriculture) a key victim of climate change. It emerged that local food production is a key factor in ensuring food security in the study area, especially amongst rural communities. Changes in climatic variables like temperature and rainfall however alter agricultural productivity significantly in the study area, especially food crop production. Projected decrease and fluctuations in rainfall volumes and patterns in the province (see SAWS, 2012) due to climate change means a potential fall in agricultural productivity among local farmers due to the relationship between agriculture and climate change. Consequently, a decline in production levels of local farmers means a decline

in people's access to food, hence a potential situation for food insecurity due to climate change.

Another key sector of the study communities highly affected by climate change is water resources. The study found that the sources of water and its 'quality standards' in the study communities are suspect, from a health point of view (see SAWRC, 2014). Most rural residents of the study communities still access water from dams, rivers, lakes, rainwater, and streams for varied domestic and non-domestic purposes. Even so, water reserves in streams, rivers, dams and other water bodies for irrigation, human and animal consumption are diminishing day-by-day due to a decrease in annual rainfall volumes and increased evaporation levels associated with climate change, which poses a great threat to water security in the affected areas. The risk of water insecurity posed by climate change to local residents of the study communities further exacerbates the issue of declining agricultural productivity and its subsequent effects on food security in the region due to high dependency on rainfall for crop and livestock production by local farmers.

The next impact identified by the study is loss of ecosystems and biodiversity. In corroborating global evidence on the impacts of climate change on ecosystems and biodiversity (see DST, 2011; CSIR, 2011; & IPCC, 2013), this study found that most parts of the rural study communities are fast losing a large proportion of their previously rich ecosystems and biodiversity. Some local medicinal plants (see table 8.1) and culturally significant animal species (for example the majola snake, frogs and butterflies) can no longer be found in their previous traditional homes due to changes in local vegetation cover. This is partly so, because the little forest cover, which used to be the habitat of such animal and plant species, is rapidly depleting due to decrease in annual rainfall volumes, amongst many other factors. This finding is in line with the DST (2011) prediction that the Eastern Cape Province is at risk of losing between 35 to 55 percent of its areas currently covered by biomass, while existing terrestrial biomes could shrink by 40 percent by the middle of the 21st century (Johnston and Schultz, 2010; DST, 2011). This suggests that, if the current rate of ecosystems and biodiversity destruction

continues without prudent measures; the province is likely to lose a substantial proportion of its ecosystems to climate change in the years ahead.

The last key climate change impact identified by the study and closely related to improper infrastructure was human settlements insecurity. Most of the rural and peri-urban settlements of the province lack proper housing infrastructure and settlement layout. These expose residents to various risks in the face of changing local and global climatic conditions. For instance the poor nature of residential facilities (mostly shacks and poorly constructed houses, as shown in Plates 7.5 and 7.6) in some of the peri-urban communities (particularly around Port Elizabeth) make such communities prone to settlement insecurity as houses are either washed away by floods or blown away by storms or gutted down by fire due to extreme weather events associated with climate change (see SAWS, 2010).

9.2.3 Assets and climate change impacts mitigation

Adaptation strategies towards the biophysical impacts of climate change cannot be universally implemented due to variations in the degree of such impacts on the livelihoods of different localities, as well as different resources available to individuals and households. This means that measuring and assessing the impacts of climate change does not only depend on the nature of climate change, but also on the basic socio-economic characteristics of the places and people that experience those changes (Katharine et al., 2011). Such factors include the natural and physical characteristics of the locality concerned, as well as the economic, social and traditional characteristics and practices of the said locality. This study found that residents of the study community use their various capitals (physical, natural, financial, social and human) to mitigate the negative impacts of climate change on their livelihoods. For instance, the provision of low cost houses with acceptable infrastructure (physical capital) to families who were previously living in shacks, as well as the building of proper drainage facilities in congested peri-urban settlements, have helped, and continue to help save lives and property from climate related effects of floods and storms in the beneficiary

communities. This type of adaptation strategy is what Dietz and Verhagen (2004) and Bryan et al (2009) refer to as planned adaptation. It is classified as planned adaptation because it involves conscious effort and policy decisions to lessen the adverse impacts of climate change on local livelihoods of local residents.

Another important asset in the field of climate impacts mitigation in the study area is natural endowments. This study found that residents make use of various components of their natural capital for various mitigation and adaption purposes. For example, local farmers make use of available arable lands for crop farming which help them to avert food insecurity in the face of changing climatic conditions. Social capital is another important pillar in adapting to climate change adverse effects in the study area. The social values embedded in social capital allows communities to operate as a unit in times of climate related disasters like drought, storm and flood; and at the same time allow individuals to offer assistance to one another through reciprocity. Thus, social relations (both at familial and institutional levels) and networks are used as capital resources by residents to offer each other assistance and comfort in times of need. For instance, individual and organisational support and solidarity embedded in social relations and networks allow disaster victims (especially flood, storm and drought victims) to quickly resuscitate and re-build lost livelihoods.

Additionally, it was found that people with a relatively good stock of human capital (especially education) have a better socio-economic status in the participatory communities, which further enhances such individuals and their household's command over other asset capitals (for example financial and social capital). Apart from increasing the economic fortunes of people, human capital provides people with fundamental knowledge and awareness on climate change and its impacts. It further equips people with basic knowledge on health and nutrition practices which help them to avoid the impacts of food insecurity and diseases during drought and floods. These give individuals and their families strong climate change mitigation and adaptive systems as they are able to strengthen their resilient levels.

Finally, it emerged that residents with adequate financial resources have equally strong buffers against climate change impacts. For example, the few affluent individuals in the study communities are able to afford good homes in less disaster prone areas, ample food, medical care and subscription to costly, but efficient and effective disaster related insurance policies and products. All these assist in protecting the beneficiaries against climate related impacts like food insecurity, settlement insecurities and the incidence and spread of climate change related diseases. The way local residents use their natural endowments, social capital, human capital (particularly education) and financial capital in the context of climate change impacts mitigation and adaptation is what Dietz and Verhagen (2004) and Bryan et al (2009) term as autonomous adaptation. It is called autonomous because local residents make use of their capitals to live their normal lives and unconsciously respond to climate change impacts as they occur.

The major challenge to this class-based asset approach to climate change impacts mitigation is climate change itself. This is so because holders of all the capitals discussed above are themselves victims of climate change. This means that the stock of these capitals available to people are fast diminishing due to climate change. This means the continuing adverse effects of climate change on individuals and their communities would lead to their capital stocks reaching their elasticity point, hence the unsustainability of the asset-based approach alone to climate change impacts mitigation in the study area.

9.2.3.1 Ideational capital (Local knowledge)

Local knowledge about local weather and climatic conditions and traditionally established coping mechanisms are critical for the existence and survival of local residents. The contextualisation of climate change impacts and tackling such impacts from a local knowledge perspective is very important as local understanding, practices, beliefs and interpretation of climate change influence local residents' preparedness to accept or reject certain adaption strategies. It emerged that some specific aspects of local knowledge of the study communities are significantly used for local climate

impacts mitigation and adaptation in key sectors like agriculture, ecosystems and biodiversity conservation, water resource management and traditional medicine.

In order to minimise the impacts of climate change on their agricultural practices, residents through local knowledge, deploy local agricultural practices, which help them to maintain or boost their year-on-year agricultural yields in the face of changing local climatic conditions. Among such practices is the preparation of local manure from household refuse, post-harvest residues and poultry droppings, and grains preservation for planting purposes. These traditional practices support soil fertility and moisture for crop production purposes and also protect grain kernels from destructive beetles like weevils for planting purposes. Similarly, elements of indigenous permaculture practiced by local farmers by using post-harvest residues like corn husks, corn stovers and chaff from grains to feed animals helps to sustain livestock during extended dry weather conditions. In the field of biodiversity conservation, certain species of indigenous plants and animals and water bodies are not tampered with because of their cultural and medicinal significance among the Xhosa speaking people of the Eastern Cape Province. They are deemed sacred and are preserved for their cultural and medicinal significance. For example, frogs are not killed or harmed because of their role in inviting rains and announcing new farming seasons. In a province characterised by entrenched believe in traditions and customs (see Kepe, 2010) the ‘definition’ and ‘classification’ of some water bodies as sacred and ancestral groves and certain species as medicinal plants help to keep encroachers away from such places and plant species. As a result, most indigenous plant species and aquatic lives around such areas (sacred lakes and ancestral groves) are to some extent protected through traditions. The significance of this aspect of ideational capital in local climate change impacts mitigation is that, upholding local traditional practices and beliefs helps to preserve certain plant and animal species for future generations, hence, ecosystems and biodiversity conservation.

It also emerged that some aspects of local beliefs and practices have water and aquaculture conservation significance. Most locally defined sacred lakes are preserved with hedge plants which allow them (the lakes) to conserve water and aquaculture

during extended dry spells. This is as an indirect way of mediating water insecurity as residents can access water from such ‘sacred’ lakes during critical times of severe water shortages. When accessing those water reserves, the performance of certain rituals to appease the gods and ancestors is imperative. The findings demonstrate that local knowledge and practices play a significant role in reducing community risk and vulnerability to climate change. People put their ideational capital into effective use to defend their livelihoods against the adverse effects of climate change. This approach (indigenous knowledge systems) to climate change impacts mitigation by local residents can be classified as a combination of anticipatory and autonomous adaptation strategies (see Dietz and Verhagen, 2004; & Bryan et al., 2009).

9.3 Contribution to knowledge

Based on the above, this study contributes to knowledge in the following ways. The study provides an important theoretical contribution to the discourse on climate change, especially on mitigation and adaptation strategies, by highlighting and extending the application of the assets accumulation framework in specific local cases. The study has shown that vulnerability of a given community to climate change is not about the intensity or frequency of the occurrence of climate related weather events, but the readiness and ability of a community to effectively and judiciously make use of local resources to lessen the ‘pain’ caused by such climate events. The study has demonstrated how different asset categories of different local communities ranging from natural resources, physical infrastructure, social relations and networks, access to financial resources and education, can be used either separately or collectively, to build formidable buffers against various climate change risks and vulnerabilities in local communities.

Most importantly, the study makes a significant theoretical contribution to the discourse surrounding Indigenous Knowledge Systems (IKS), also called local knowledge systems, as a concept, and its role in climate change impact mitigation, particularly in

Africa. The study highlights the silences and misrepresentations in the literature with regard to the role of local/indigenous knowledge in climate change science generally, and climate impact mitigation, in particular. The study demonstrates the relevance of local knowledge in climate change impact mitigation in an African setting, and the need to combine modern 'formal' approaches with local knowledge and institutions to better handle climate related issues. The role of local knowledge in climate science, as highlighted in this study, will give a new 'twist' to climate change discourses at the local, national and possibly continental levels. The use of local knowledge in mediating climate change impacts has proven effective, to some extent, in the study area and therefore qualifies to be recognised as an essential asset category in climate change mitigation strategies, particularly in Africa.

At policy level, the study has provided an in-depth analysis of peri-urban and rural communities' risk perceptions and vulnerability (within the context of climate change) which can assist policy makers to design and operationalise appropriate strategies to help communities better adapt to climate change. Additionally, it highlights how the formulation of appropriate policies on resource utilisation can help households and communities to protect themselves and/or recover from the negative effects of severe weather conditions associated with climate change. Moreover, the study has shown that, given the differences in vulnerability to climate change in different communities, there is a need to first examine and compare the vulnerability of one society to another, and any other socio-economic problems which come with climate change in vulnerable communities, before designing specific local adaptive mechanisms and policies in order to avoid blanket generalisations**.** Finally, it indicates to policy makers that, local knowledge about climate change and its mitigation strategies is important, and should therefore be incorporated into climate change impact mitigation policies.

9.4 Policy implications and recommendations

From the findings of the study, the following policy recommendations are made:

9.4.1 Establishing and sustaining public awareness campaigns

Local narratives from the participatory communities of this study indicate that individual and household awareness and perception on climate change are closely related to their mitigation actions and adaptive behavioural changes. This suggests that proper awareness creation through both formal education and public awareness campaigns can help residents in rural and peri-urban Eastern Cape communities to accept climate change and its associated risks and vulnerabilities as scientific realities, and therefore act accordingly. It is recommended that the Department of Education, through its curriculum system, should include climate change issues in the syllabi of the compulsory learning areas. This will create a solid platform for climate change awareness campaigns through schools. This strategy will give learners improved knowledge regarding climate change at a tender age, who will then act as agents of climate change awareness campaigns in their respective households and local communities. Again, school level campaigns should be complemented by community forums to help disseminate scientific information on climate change and debunk some of the long held local 'misconceptions'.

9.4.2 Diversification of local agriculture

To counter the impacts of climate change on local agricultural activities, particularly in rural communities of the Eastern Cape and many other communities with similar ecological and climatological characteristics, the diversification of local agriculture in the form of the introduction of new animal and crop breeds and planting patterns is highly recommended. Changes in crop varieties, planting seasons and patterns can serve as an antidote to the adverse effects of climatic events, such as drought and unpredictable rainfall patterns, on local agriculture. As part of the diversification, new and 'scientific' breeds of animal and crop species are highly recommended as they will be able to adapt to, and withstand 'harsh' weather conditions differently and increase yield accordingly. Additionally, the introduction of drought resistant animal and crop breeds, water conserving plants, crops with shorter maturity periods, early planting, and the

promotion of some important traditional farming practices, could be some of the possible ways of combating the effects of climate related uncertainties on agriculture in poor communities. In support of this idea, (Moonga & Chitambo, 2010) indicates that well adapted local crop and animal breeds are most likely to play a significant role in mitigating climate change risks relating to agriculture.

9.4.3 Improving spatial planning and settlement layout

The study recommends that city management and settlement planning at various levels of government should pay closer attention to climate related issues in order to avert future cost and loss of lives. Spatial planning should include the identification and labeling of 'red map zones' and all forms of socio-economic activities in such areas should be strongly prohibited. Thus rural and peri-urban development strategies in the Eastern Cape should include improving housing quality and settlement layouts to make them more resilient to climate change related events, particularly storms, floods and fire. This will help to address both structural and chronic settlement vulnerability to climate change in the study area, and other settlements with similar characteristics. This strategy requires a multi-sectorial approach as climate change and its associated ramifications are not just environmental issues, instead a phenomenon that cuts across all aspects of development.

9.4.4 De-politicisation of climate change issues and platforms

Climate impacts have no racial boundaries, cultural limitations nor political colours. Therefore, climate change discussions, particularly, mitigation and adaptive planning, conservation of natural resources, and the provision of climate related infrastructure, should be devoid of political party colours. Although the focus of this study was not on 'politics and climate change impacts mitigation', observations and scores of events in the participatory communities indicate that provision of some agricultural inputs (for example, seedlings) and equipment to boost productivity has some degree of political

influence. The inclusion of any form of climate impact mitigation issue in political manifestoes should be discouraged in the local communities, so that change in political power in a particular electoral area will not affect the 'fight' against climate impacts on local livelihoods. Similarly, religious platforms should be efficiently used to disseminate climate change issues as religious gatherings tend to have higher attendance levels and committed followers ready to listen and obey their leaders.

9.4.5 Increased investment in 'asset' accumulation strategies

All categories of resources defined as assets in this thesis are all significant in combating climate change impacts in the study area, and therefore require an increased investment in their accumulation strategies. Given the significantly low level of people's awareness on climate change in the study area, together with high poverty levels, low levels of education, and diverse social relations in an environment with varied climate zones; investment in the accumulation of various asset capitals (particularly, financial, human, and physical capital) can be an effective strategy for combating the long term effects of climate change on rural and peri-urban livelihoods in the Eastern Cape. Although no particular asset category is considered more important than the other, in the context of climate change impact mitigation, increased investment in improving existing infrastructure to 'modern' standards and diversifying local agriculture practices for instance, without an accompanying development in knowledge and human capital to operate such facilities and systems, will not yield any positive results in the context of climate change impacts mitigation. A knowledgeable and empowered society will be able to maintain and sustain all other forms of available assets.

9.4.6 Integration of 'local' and formal 'scientific' knowledge

Evidence presented in this thesis indicates that, one of the key asset capitals that can help increase the resilience of poor communities in the Eastern Cape, against climate change impacts, is their rich local knowledge (ideational capital). This thesis has

demonstrated beyond every doubt that, when 'local' knowledge is combined with 'outside' knowledge, the outcome can help manage various crises related to climate change, as local practices can bring people together to act as a unit, either in preparation towards a projected disaster or to respond to the aftermaths of a 'harmful' climate event. Thus, tapping into local beliefs and practices cross-culturally, refining the positive aspects of such beliefs and practices, and then combining them with 'modernity', could be a cost effective and communally acceptable way of adapting to climate impacts in the Eastern Cape, and South Africa as a whole.

This thesis, therefore, strongly recommends the integration of local knowledge into 'modern' scientific research, planning and policy making to help poorer communities, who possess 'rich' local knowledge, to increase their resilience and adaptive capacity against climate change impacts. Combining 'old' techniques (local knowledge) with 'new' techniques (modern scientific knowledge) will not only help local communities in their preparation towards anticipated climate related disasters, but can also offer scientists, community leaders and decision-makers, an important knowledge base of local understanding of climate related issues.

Despite the potency of the above recommendations in helping combat the impacts of climate change on the livelihoods of the rural and peri-urban poor, the researcher is aware and understands that the evidence and recommendations provided in this thesis will not immediately change the entrenched priorities of politicians and other stakeholders of the province, to start looking at climate change issues from the perspective of this thesis. However, the study has managed to put local climate change issues on the table, for policy consideration by stakeholders.

9.5 Conclusion

With a high degree of certainty, this study concludes that individual households and communities have different degrees of vulnerability to climate change, depending on asset portfolios and, and how well such assets and knowledge are used in mitigation

and adaptation. Residents use available natural and financial resources, physical infrastructure, level of formal education and various forms of social relations and networks in different ways to mediate the impacts of climate change on their livelihoods. In addition, local knowledge (ideational capital) is one of the key climate change impact adaptation tools in study area and should be given the necessary attention by policy-makers. Local knowledge is deployed in key sectors like agriculture, water resource management, building technology and traditional medicine as part of the mitigation and adaptation strategies.

People's perceptions about climate change in the study area deviate from the scientific realities of the phenomenon. This is due to low level of awareness about climate change and different local interpretations. Climate change is perceived by majority of the residents as a physical problem with spiritual causes. These beliefs and interpretations of climate change make people to deny the risks associated with it, and are therefore less prepared for them when they occur.

Agriculture, water resources, human settlements, ecosystem and biodiversity are the key sectors highly affected by climate change in the study area. Residents are experiencing declining yields in agriculture year-on-year; water reserves for both domestic consumption and agricultural purposes are diminishing; people continually lose their shelter to floods and storm related events and substantial proportions of plant and animal species are undergoing alteration and complete extinction in the study area all because of 'unfavourable' weather conditions associated with climate change.

The above findings of the study bear important suggestions for further research. The first is, given the significance of local knowledge in climate change impact mitigations in the study area, it is suggested that further studies be conducted into steps and procedures towards merging local belief systems, traditions, customs and practices with meteorological science. This will afford communities the opportunity to tackle African climate change issues and problems from an Afrocentric approach. It is also suggested that, as a way of tackling climate change impacts from different angles, further studies

should be conducted into gender roles and climate change impacts mitigation. This will help to ascertain whether increased investment in the empowerment of women and girl-child education, can be one of the prudent ways of mitigating the impacts of climate change impacts in the Eastern Cape. These two key areas will constitute the foundation of the researcher's postdoctoral research career.

-END-

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APPENDIX I - INTERVIEW GUIDE FOR SEMI-STRUCTURED INTERVIEW

SECTION A – DEMOGRAPHICS AND ASSETS

1. How long have you being living in this community?
2. How old are you?
3. Do you have any form of formal education?

4. Do you have monthly source of income apart from government grants? What is it if you have?
5. Do you sometimes receive money from relatives – children, grandchildren, brothers, sisters, etc.?
6. If yes, where do such relatives stay and work?

7. Do you save part of whatever money you get every month?

8. Do you have access to a bank loan or any other form of credit?

9. How many times do you eat in a day?

10. What do you eat in the morning (breakfast)?
11. What do you eat in the afternoon (lunch)?
12. What do you eat in the afternoon (dinner)?
13. Who do you stay with?
14. Who owns the house you live in?
15. (a) Do you own any property? YES [ ] NO [ ]

    (b) If yes, what is it?

16. (a) Do you belong to any social organization or association in your community?

    (i) If YES, name it

    (ii) Why did you join that organization or association and mention some of the benefits you get from it
    (b) If you answered **NO** to question 14, then why don't you belong to any association? Give reasons.

RQ1: What is the level of climate change awareness in the communities and how is it articulated in community level discourses?

17. Over the past ten years or more, have you observed any changing pattern the weather conditions of your community? (Whether good or bad)?

18. If **YES**, mention what you have observed.
    (a) Rainfall [ ]
    (b) Temperature [ ]
    (c) Other (specify)

19. In your opinion, to what will you attribute the observed change(s) in weather conditions if any?
20. Have you ever shared your observation in weather changes with other members of your community?

21. (a) If **YES to question 19,** what aspects of weather have you shared?

    (b) If **YES to question 19,** in what kind of social setting(s)? (E.g. church, club meetings, community gatherings, funerals, etc.)

22. If **N0 to question 19**, why not?

23. To the best of your recollection, how will you describe the weather of your community in recent years as compared to some years back?

RQ2: ***What are the actual risks associated with climate change in peri-urban Port Elizabeth according to available South African meteorological data and to what extent are communities aware of these risks?***

24. (a) Has your community or any of the nearby communities in recent years experienced flood, drought, fire, or any other weather related problems?

(b) If YES, what was it ?

(c) Who or what was affected and how?

25. What will you, your household, and the community as a whole do to cope anytime there is;

(i) A flood
(ii) A drought
(iii) An extremely cold winter
(iv) An extremely hot summer

RQ3: ***To what extent do residents' 'assets' mediate their actual risks, their perceptions of risks, and vulnerability within the context of climate change?***

26. (a). Do you own livestock (e.g. sheep, goats, cattle, pigs, etc.)?**YES [ ] NO [ ]**

(b). If yes, how do you feed and take care of their livestock:

(i) During winter?

25(a). Have you or any member of your community ever lost animals, crops, house, or any form of property before because of drought or flood? **YES [ ] NO [ ]**

(b). If YES, name what you lost

26.(a) If **YES to question 25(a),** did members of the community help you or the person concern to replace or restore the lost item(s**)? YES [ ] NO [ ]**

27. Sources of water and water sources maintenance.
28. Biodiversity and ecosystems maintenance through culture and traditions.

28. Before today, did you ever hear the term**, "CLIMATE CHANGE?**"

APPENDIX II- SURVEY QUESTIONNAIRE

Dear respondent,

Please, be advised that this questionnaire is purposely designed for academic work and that all your responses will be used purely for academic purposes and nothing more. Kindly ***tick*** the appropriate options from the list given, where applicable and provide ***written answers*** to the open ended questions where necessary. Thank you for your support and corporation.

QUESTIONNAIRE IDENTIFICATION

Enumerator's name :	
Date:	
Village/site:	
Questionnaire reference number:	
GPS coordinates	

SECTION A – DEMOGRAPHICS AND ASSETS

1. What is your gender?
   Male [ ] Female [ ]

2. What is your age bracket?

   15 – 25yrs
   26 – 35yrs
   36 – 45yrs
   46 – 55yrs
   56 - 65yrs

66 – 75yrs
76 – 85yrs
86 – 100yrs

3. What is your level of education?

   Nil
   Primary school
   High school
   FET College
   University – Certificate Course
   University – Diploma
   University – Bachelor's Degree and above
   Other (specify)……

4. What is your monthly income bracket?

   R1 – R2000 [ ]
   R2001- R4000 [ ]
   R4001 – R6000 [ ]
   R6001 – R8001 [ ]
   R8001 – R10, 000 [ ]
   R10, 001 – and above[ ]

5. Do you save part of your monthly income?
   YES [ ] NO [ ]

6. Do you have access to a bank loan or any other form of credit?

   YES [ ] NO [ ]

7. How many times do you eat in a day?

   1 time [ ]
   2 times [ ]
   3 times [ ]
   More than 3 times [ ]

8. What do you eat in the morning (breakfast)?
   ……
   ……
   ……
9. What do you eat in the afternoon (lunch)?
   ……
   ……
   ……
10. What do you eat in the afternoon (dinner)?
   ……
   ……
   ……

11. Who do you stay with?
   .....
   .....
   .....
12. How many bedrooms are in the house you live in?
   ……
   ……..
13. Who owns the house you live in?
   ……
   ……..
14. (a) Do you own any property? YES [ ] NO [ ]

   (b) If yes, name it
   ……
   ……

15. As a household, where do you get water from for domestic use?
   ……
   ……
16. (a) Do you belong to any social organization or association in your community?
   YES [ ] NO [ ]

   (i) If YES, name it
   ……
   ….

(ii) Why did you join that organization or association and mention some of the benefits you get from it

……
……
……
……
……
……

(b) If you answered **NO** to question 16, then why don't you belong to any association? Give reasons.

……
……
……
……
……
……

RQ1: What is the level of climate change awareness among Port Elizabeth peri-urban communities and how is it articulated in community level discourses?

17. Over the past ten years or more, have you observed any changing pattern the weather conditions of your community? (Whether good or bad)?

    YES [ ] NO [ ]

18. If **YES**, mention what you have observed.
    (d) Rainfall [ ]
    (e) Temperature [ ]
    (f) Other (specify) …….

19. In your opinion, to what will you attribute the observed change(s) in weather conditions if any?

……
……
……
……

……
……

20. Have you ever shared your observation in weather changes with other members of your community? **YES [ ] NO [ ]**

21. (a) If **YES to question 20,** what aspects weather have you shared?(i)……
……(ii)……
……...(ii)……
……..

(b) If **YES to question 20,** in what kind of social setting(s)? (E.g. church, club meetings, community gatherings, funerals, etc.)
……

22. If **N0 to question 20**, why not?
……
……
……
……

23. To the best of your recollection, how will you describe the weather of your community in recent years as compared to:

a.) 5yrs ago:…….
b.) 10yrs ago:…….
c.) 15yrs ago:…….
d.) 20yrs ago:…….
e.) Longer than 20yrs ago…….

RQ2: ***What are the actual risks associated with climate change in peri-urban Port Elizabeth according to available South African meteorological data and to what extent are communities aware of these risks?***

24. (a) Has your community or any of the nearby communities in recent years experienced flood, drought, fire, or any other weather related problems? **YES [ ] NO [ ]**

(b) If YES, what was it ? …….....

(c) Who or what was affected and how?E.g.

(i) Crops …….
(ii) Animals …….
(iii) Human ……..
(iv) Property…….
(v) Others (specify) ……..

25. If **NO to question 24(a)**, in case there should be a flood, drought or any other form of weather related problem in your community, how do you think it will affect the lives of people, animals and crops and other forms of property in your community?
……
……

26. What will you, your household, and the community as a whole do to cope anytime there is;

(v) A flood
……
……
(vi) A drought
……
……
……
……
……
(vii) An extremely cold winter
……
……
……
(viii) An extremely hot summer
……
……

RQ3: ***To what extent do residents' 'assets' mediate their actual risks, their perceptions of risks, and vulnerability within the context of climate change?***

27. (a). Do you own livestock (e.g. sheep, goats, cattle, pigs, etc.)?**YES [ ] NO [ ]**

(b). If yes, how do you feed and take care of them:

(ii) During winter?

……
……

(ii) When there is drought or flood?……
…… 28. If **NO to question27(a),** as a member of the community, how do you think owners of livestock feed and take care of their livestock:

(i) During winter?

……
……
……

(ii) When there is flood or drought?

……
……
……

29.(a). Have you or any member of your community ever lost animals, crops, house, or any form of property before because of drought or flood? **YES [ ] NO [ ]**

(b). If YES, name what you lost……

30.(a) If **YES to question 29(a),** did members of the community help you or the person concern to replace or restore the lost item(s**)? YES [ ] NO [ ]**

(b).If NO to question 29(a),why do think people refuse to help one another in your community?

.....
.....
.....

31.(a). Have you ever shared food with your neighbour, or has your neighbour shared food with you before without necessarily expecting a payback? **YES [ ] NO [ ]**

(b). If **YES**, why do you share food with one another and how do you call the practice of sharing food with one another in your community?

……
……

32. Apart from food purposes, is there any special purpose for plants like banana trees, avocado trees, etc being grown in your community? **YES [ ] NO [ ]**

(b) **If YES,** what is this special purpose?

……

33. Before the extension of tap water into this community, where were people getting water from?

……
……

34. How were or are such water sources maintained?

……
……

35. Have you ever heard of the term**, "CLIMATE CHANGE**" before? **YES [ ] NO [ ]**

(a) If **YES**, what is your understanding of that term?

……
……
……

THE END,
THANK YOU VERY MUCH FOR YOUR PRECIOUS TIME.

APPENDIX III - INTERVIEW GUIDE FOR KEY INFORMANT INTERVIEWS

1. What is your position in the municipality/SA weather service?

2. What does your job entails (roles, duties and responsibilities)?

3. Judging from the meteorological and other forms of weather data at your disposal, can you establish a trend in the weather pattern in Port Elizabeth /East London and its environs? **YES [ ] NO [ ]**

4. If YES, explain the trend. If NO, explain the consistency.

5. Has the municipality in conjunction with the SA weather services being able to identify some “red map” zones in the context of climate change?

6. If yes, what are the criteria of identifying such areas?

7. From a professional point of view, how do you think the perceived variability in weather events pose any form risk to society?

8. If so, which aspect(s) of society is (are) more vulnerable to such weather changes and why?

9. What effort has your outfit make so far to educate the public about climate change and its related dangers?

10. What do you think individuals, households, communities, the South African weather Service, and the municipality can do to mitigate the risk and vulnerability levels of peri – urban and rural communities to climate?

11. Looking at the risks posed by climate change as identified earlier, do you know of any traditional or cultural practice from the olden days that can be of importance today in mitigating the impacts of climate change?

12. If you know of one, what is it? How important will it be in the context of climate change impacts mitigation?

THANK YOU VERY MUCH FOR YOUR TIME AND PATIENCE

APPENDIX IV- ETHICAL CLEARANCE CERTIFICATE

University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE
REC-270710-028-RA Level 01

Certificate Reference Number:	AKP021SAPR01
Project title:	**Assessing risk perceptions and vulnerability in the context of climate change: The case of rural and peri-urban communities in East London and Port Elizabeth, South Africa**
Nature of Project:	PhD
Principal Researcher:	Amos Apraku
Supervisor:	Prof W Akpan Dr P Moyo

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

APPENDIX V- DEPARTMENTAL INTRODUCTORY LETTER

Department of Sociology and Industrial Sociology

Block E
Office No.204
East London Campus

Ph: +27 43 704 7082| Fax: +27 86 628 2108
Email: lmdangayi@ufh.ac.za

University of Fort Hare
Together in Excellence

24 April 2013

To Whom It May Concern

Dear Sir / Madam

DATA COLLECTION – REQUEST FOR ASSISTANCE

This letter serves to confirm that **MR AMOS APRAKU** with Student No**:(201214424**) is a registered **PhD** student in the Department of Sociology and Industrial Sociology at the University of Fort Hare, East London campus.

He/she is currently collecting empirical data to enable him complete a research project, which is a major requirement for the degree.

We would greatly appreciate whatever assistance you can offer to enable him/her to successfully fulfill this important aspect of the degree requirements.

Please be assured that the data collected are strictly meant for academic purposes.

Many thanks.

Yours sincerely

DR. PHILANI MOYO
Head of Department

APPENDIX VI – MUNICIPAL RESEARCH PERMIT

+BUFFALO CITY METROPOLITAN MUNICIPALITY

MEMORANDUM

Date: **16 OCTOBER 2013**

From: **MANAGER: KNOWLEDGE MANAGEMENT, RESEARCH AND POLICY**

To: **MR AMOS APRAKU**

Our ref:	Please ask for	Your ref:
	DR T NORUSHE	
	(043) 705 9706	

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN BCMM: MR AMOS APRAKU

It is hereby acknowledged that **Mr. Amos Apraku, a PhD Candidate** in **Sociology** at the **University of Fort Hare**, has met the prerequisites for conducting research at Buffalo City Metropolitan Municipality (BCMM) for fulfillment of his degree. He has provided us with all the necessary documentation as per the BCMM Policy on External Students conducting research at the institution.

With reference to the letter to the City Manager, dated 21 August 2013, permission was requested to conduct research at BCMM for his Dissertation entitled **"Assessing Risk Perceptions and Vulnerability in the Context of Climate Change: The Case of Peri-Urban Communities in East London and Port Elizabeth, South Africa"** This request was acknowledged and signed by the Office of the City Manager, and forwarded to the Knowledge Management and Research Unit for further assistance. Mr. Apraku was asked to provide the Unit with the necessary documentation, which he subsequently did. The relevant Officials to assist in the research were identified and duly informed about the research, and the fact that Mr. Apraku has met the prerequisites. Their contact details have also been provided to Mr. Apraku and he was informed to contact them directly for assistance.

Wishing you good luck in your studies.

pp

DR T F NORUSHE
MANAGER: KNOWLEDGE MANAGEMENT, RESEARCH AND POLICY

APPENDIX VII: CONFIDENTIALITY AND INFROMED CONSENT FORM

University of Fort Hare
Together in Excellence

Ethics Research Confidentiality and Informed Consent Form

Please note:

This form is to be completed by the researcher(s) as well as by the interviewee before the commencement of the research. Copies of the signed form must be filed and kept on record

(To be adapted for individual circumstances/needs)

The Department of Sociology at the University of Fort Hare is asking people from your community- **(sample)-** to answer some questions, which we hope will benefit your community and possibly other communities in the future.

MR APRAKU AMOS from the **SOCIOLOGY** Department is conducting research regarding **CLIMATE CHANGE**. We are interested in finding out more about **LOCAL COMMUNITIES' AWARENESS LEVEL ABOUT CLIMATE CHANGE AND ITS RELATED RISKS AND VULNERABILITIES.** We are carrying out this research to help **SUGGEST SOME MITIGATION AND ADAPTIVE MECHANISMS WHICH WILL HELP SHAPE FUTURE POLICY DIRECTIONS**.

Please understand that you are not being forced to take part in this study and the choice whether to participate or not is yours alone. However, we would really appreciate it if you do share your thoughts with us. If you choose not take part in answering these questions, you will not be affected in any way. If you agree to participate, you may stop me at any time and tell me that you don't want to go on with the interview. If you do this there will also be no penalties and you will NOT be prejudiced in ANY way. Confidentiality will be observed professionally.

I will not be recording your name anywhere on the questionnaire and no one will be able to link you to the answers you give. Only the researchers will have access to the unlinked information. The information will remain confidential and there will be no "come-backs" from the answers you give.

The interview will last around **10 – 15 minutes** and **25 – 30 minutes for the focus group discussions.** I will be asking you a questions and ask that you are as open and honest as possible in answering these questions. Some questions may be of a personal and/or sensitive nature. I will be asking some questions that you may not have thought about before, and which also involve thinking about the past or the future. We know that you cannot be absolutely certain about the answers to these questions but we ask that you try to think about these questions. When it comes to answering questions there are no right and wrong answers. When we ask questions about the future we are not interested in what you think the best thing would be to do, but what you think would actually **happen to livelihood if the current trend of climatic conditions continue.**

If possible**, the department of sociology at the university of Fort Hare** would like to come back to this area once we have completed our study to inform you and your community of what the results are and discuss our findings and proposals around the research and what this means for people in this area.

INFORMED CONSENT

I hereby agree to participate in research regarding **climate change and its related impacts on society**. I understand that I am participating freely and without being forced in any way to do so. I also understand that I can stop this interview at any point should I not want to continue and that this decision will not in any way affect me negatively.

I understand that this is a research project whose purpose is not necessarily to benefit me personally.

I have received the telephone number of a person to contact should I need to speak about any issues which may arise in this interview.

I understand that this consent form will not be linked to the questionnaire, and that my answers will remain confidential.

I understand that if at all possible, feedback will be given to my community on the results of the completed research.

……..
Signature of participant **Date**:……..

I hereby agree to the tape recording of my participation in the study

……..
Signature of participant **Date**:……..