RESILIENCE OF RURAL COMMUNITIES TO THE EFFECTS OF CLIMATE CHANGE IN THULAMELA MUNICIPALITY OF SOUTH AFRICA

By

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DECLARATION

I, Pertina Nyamukondiwa, hereby declare that this Masters in Rural Development (MRDV) dissertation submitted to the Institute for Rural Development at the University of Venda has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all reference material contained therein has been duly acknowledged.

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To God be the glory

ABSTRACT

The effects of climate change are felt throughout the world, especially in rural communities of Africa. Often, they fail to adapt due to high poverty rates, lack of access to government resources, dependence on climate-sensitive sectors such as agriculture and fishing, and lack of relevant education. Although this is the case, conventional conceptualisation of this challenge and understanding of resilience to climate change lacks the rural community voice. Thus, this study was undertaken to assess the resilience of rural communities to the effects of climate change in Ward 40 of Thulamela Municipality in Vhembe District of Limpopo Province. Community-perceived definition of climate change, its causes and effects were explored. Moreover, the characteristics of communities that are resilient to the effects of climate change were investigated. The various strategies that communities in Thulamela Municipality used to cope with the effects of climate change were explored. Lastly, possible solutions for mitigating and adapting to the effects of climate change were recommended.

A mixed methods approach was used. Data were collected through focus group discussions and questionnaires that required responses on a scale of 1-4 (strongly disagree) to 17-20 (strongly agree). Data were analysed using the Statistical Package for Social Sciences (SPSS) version 22.0 for Windows (SPSS Inc: Chicago, Il, USA). Chi-square tests were carried out to determine whether distance from urban service centres affected community resilience to the effects of Climate Change (CC).

Rural community members were found to be aware of the weather variables considerably affected by climate change. Some of them admitted that they were not aware of the causes of climate change. Perceived causes were embedded in traditional beliefs such as human wickedness, breakdown of tradition and not performing rain-making rituals or ceremonies. Perceived effects of CC included destruction of crops, shortage of water to drink and death of cattle and even people. The various coping strategies used included selling livestock, firewood and home-brewed alcohol. Community perceptions of the effects of distance on resilience were grouped into four themes namely access, affordability, support and diversity. In general, the perceptions of the youth, adults and the elderly were the same ($P > 0.05$) except with respect to "Food is cheaper in the city", "Government intervenes faster for instance, in providing temporary tents in urban areas during disasters compared to where we live (rural communities)", and "They get water easily, so they can do gardening and water their plants". The results revealed that the youth, adults and the elderly were of the view that the further a community was located from urban service centres the less resilient to CC it became. It was concluded that distance from urban service centres negatively affected community resilience to the effects of CC. The need for involving rural communities in climate change conversations was also confirmed in this study.

Key words: climate change; distance; effects; resilience; rural communities

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ABBREVIATIONS AND ACRONYMS

AUC	African Union Commission
CDW	Community Development Workers
CC	Climate Change
COP	Conference of Parties
CO_2	Carbon dioxide
DEAT	Department of Environmental Affairs
EEA	European Environmental Agency
ETS	Emissions Trading Scheme
EU	European Union
GCF	Green Climate Fund
GHGs	Greenhouse gases
GLOF	Glacial Lake Outbursts Floods
HDR	Human Development Report
IDP	Integrated Development Planning
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goal
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programmes of Action
NASA	National Aeronautics and Space Administration
NCCRS	National Climate Change Response Strategy
NEPAD	New Partnership for Africa's Development
ODI	Overseas Development Institute
OXFAM	Oxford Committee for Famine Relief
SADC	Southern African Development Community
SIDS	Small Island Developing States
SLA	Sustainable Livelihoods Approach
SSA	Sub Saharan Africa
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WMO	World Meteorological Organisation

CHAPTER 1: INTRODUCTION

1.1 Background

Although there is reported change in climate throughout the world since the beginning of time, the rate and intensity at which this is being experienced now is alarming (Blignaut and Van der Elst, 2009; Molnar, 2010). Climate Change is understood to be mainly manmade. It is associated with greenhouse gas emissions and the use of fossil fuels (Molnar, 2010). Scholars such as Mckitrick (2005) and Bays (2009) still do not believe that the current changes in climate are abnormal and human-induced. There is considerable scientific evidence (Blignaut and Van der Elst, 2009; Molnar, 2010; Ramana, Iniyanb and Goicc, 2011; Zane, 2011) confirming that climate change (CC) is happening and global greenhouse gases caused by human activities are mainly responsible for this. The Intergovernmental Panel on Climate Change (IPCC) in its report released in 1995 concluded that the balance of evidence suggested "a discernible human influence" on the earth's climate. By 2007, the IPCC had concluded that it was more than 90 % likely that humanity's emission of greenhouse gases (GHGs) had been responsible for the modern-day accelerated CC (Nhamo, 2009). Holtzhausen (2006) argues that CC will continue to occur in the foreseeable future even if the GHGs are curtailed significantly in the short- to medium-term. Thus, there is urgent need to act in both mitigation as well as reinforcing adaptation to CC.

Many of the scholars from different parts of the world (Desanker, 2002; Adejuwon, 2006; Schmidhuber, Tubiello and Easterling, 2007; Wlokas, 2008; Vermeulen, Aggarwal, Ainslie, Angelon, Campbell, Challinor, Hansen, Ingram, Jarvis, Kristjanson, Lau, Thornton and Wallenberg, 2010; OXFAM, 2011) have tended to focus on the projected impacts of climate change, for example, on the environment, human health and water resources. Other scholars (Phillipe and Singh, 2008; Aylett, 2010; Rouault, Pohl and Penven, 2010) have shown interest in the hard science of greenhouse gas emissions and climate patterns.

There is another pool of scholars (Droogers, 2004; Wall and Marzall, 2006; Valdivia, Seth, Gilles, Garcia, Jimenez, Cisicanqui, Navia and Yucra, 2010; Biesbroek, Swart, Carter, Cowan, Henrichs, Mela, Morecroft and Rey, 2010; McDowell and Hess, 2012) that has concentrated on adaptation and mitigation measures for CC. Various reports on CC have drawn attention to the implications on human security. Advocates of the link between CC and general human security include Schwartz and Randall (2003), Busby (2007), the German Advisory Council on Global Change (2007) and the International Alert (Smith and Vivekana, 2007). This information is useful because it assists in building a better understanding of CC, its effects and implications of the latter. However, climate change has already caused significant impacts on water resources, food security, hydropower and human health, especially in Africa (Ziervogel, 2008; Kang, Khan and Ma, 2009; OXFAM, 2011). According to McCusker (2010), there is consensus among scientists that climate change is already occurring and will continue into the future. This makes it imperative to move away from the excessive focus on projections and examine what is actually happening on the ground. Given the complexity of the CC phenomenon, it is necessary to ensure that such studies adopt a multifaceted approach with a deliberate bias on the human dimension (Vogel, 2006).

According to Aylett (2010), it is increasingly recognized that it is not enough to apply only the hard sciences and climatic patterns when dealing with the CC phenomenon. Socio-political and economic relationships contexts of emissions also require attention. This implies that the involvement of the people affected by CC, for example, through the application of participatory practices, is crucial. So far, participatory approaches have assumed a small but increasingly significant role.

Tschakert (2007) challenges the sectoral perspective of such focus on agriculture only, and the tendency to regard adaptive responses as predominantly technical solutions. The author argues that such a narrowly defined approach downplays the sensitivity of people and vulnerable populations, mostly small-scale resource-constrained farmers to the impacts of climate change. This is mainly due to the fact that it robs them of their agency to mediate hazards and successfully cope with and adapt to adverse impacts.

Taking into account the arguments presented above, this study aimed to extend the boundaries of the climate change discourse by drawing attention to the currently overlooked communities in rural areas. The study entailed "putting the vulnerable first" as first advocated for by Paavola and Adger (2006) and Tschakert (2007). Giving the residents of rural areas the opportunity to engage and clarify what they perceive to be the meaning, causes and solutions to CC was regarded as enabling decision makers and change agents to plan and implement more effective adaptation and mitigation strategies.

Although CC is a global challenge, Africa has been one of the most vulnerable to its impacts. This emanates from the continent's low human adaptive capacity to anticipated increases in extreme events, resulting from widespread poverty, heavy reliance on rain-fed agriculture and lack of economic and technological resources, among others (Reid and Vogel, 2006). In the developed world, most rural communities are well-placed to reorganize themselves and adapt, which makes them seem to be resilient (McIntosh, Stayner, Carrington, Rolley, Scott and Sorensen, 2008). However, the rural communities especially in sub Saharan Africa (SSA) are mostly vulnerable. They might become environmental refugees mainly because of lack of food, drinking water, adequate sanitation and health services.

In South Africa, rural areas depend almost entirely on agriculture, which is directly and negatively prone to the effects of CC. Approximately, 44 % of the country's population lives in rural areas (Traynor, 2011). This means that a significant proportion of the agriculture-dependent population bears the brunt of exposure to the negative effects of CC. Moreover, since 1990 South Africa has been the 14th highest emitter of carbon dioxide in the world (Winkler, 2007). According to this author, per capita emissions have been higher than those of many European countries and more than 3.5 times higher compared to the average for developing countries. Therefore, South Africa must balance mitigation and adaptation measures at an accelerated pace, in order to avoid future catastrophic consequences.

Bearing in mind that vulnerability and adaptation to CC are variable and linked to social contexts and places (Tschakert, 2007), emphasis in this study was placed on the importance of valuing rural communities' perceptions. Appropriate use of the perceptions on various dimensions of CC is likely to best inform adaptation and mitigation strategies. This argument originates from the realization that traditional coping strategies for rural communities seem inadequate, in particular if the expected long-term effects of CC are taken into account. Improvements in traditional coping and adaptive strategies would help the resilience of rural communities to the negative effects of CC. Therefore, an assessment of the resilience (of rural communities in Thulamela Municipality of South Africa to the effects of CC) was carried out.

1.2 Statement of the Research Problem

Although CC is now a reality with its adverse effects witnessed mainly in rural communities (Letete *et al.*, 2009), available literature tends to mainly focus on either projected adverse impacts or possible coping strategies for the negatively affected people. The negative impacts are far worse for developing countries, especially in rural areas of Africa (Ziervogel *et al.*, 2006). This is because of systemic poverty, reliance on climate-sensitive sectors such as agriculture, lack of education, limited use of technology and inadequate or inappropriate infrastructure, poor health and food insecurity, among others. All these factors erode rural communities' adaptive capacities because they aggravate climate change. This situation highlights the importance of extending the focus to include what is actually happening at grassroots community levels.

In both global and local (South African) discourses relating to climate change, the voices of those who are most affected, in particular the rural poor are seldom heard. This emanates from use of top-down approaches that invariably exclude the most affected people. Borrowing from the Lobo (2011) argument, climate change should be viewed as locally experienced for instance, in rural communities. This makes it proper to address climate change by engaging local interest groups. Bryan and Behrman (2013) support this view when they add that climate impacts, appropriate responses, and to some extent, adaptive capacity are location specific. Bays *et al.* (2012) extend this argument when they contend that there is limited knowledge regarding how rural residents conceptualize CC. Since community perceptions of CC influence how they respond to it, understanding this is an important step towards boosting adaptation and ultimately, resilience.

It has been argued (Wade *et al.*, 2010) that communities' historical coping strategies might not match the actual projected effects of long-term CC. For these reasons, it is imperative to assess rural communities' resilience so as to support and supplement those applying weak coping strategies. Currently, little is known about what rural communities regard as climate change, its causes and effects. At the same time, not much has been written about gender dimensions in relation to CC. Men and women tend to be affected by CC differently due to their differential roles in society. Yet, this information is required to develop effective mitigation and adaptation measures. All these facts highlight the existence of a limited understanding of resilience to CC mechanisms that rural communities use.

1.3 Research Objectives

The aim of this study was to assess the resilience of rural communities in Thulamela Municipality to the effects of climate change in order to suggest relevant mitigation and adaptation measures. In doing this, the specific objectives were to:

a) determine what rural communities regarded as climate change, its causes and effects;

b) determine the characteristics of communities that are resilient to the effects of CC;

c) determine if distance from urban service centres affected community resilience to effects of CC; and

d) explain the strategies that the rural communities in Ward 40 of Thulamela Municipality use to cope with the effects of CC.

1.4 Research Hypothesis

a) Distance from urban service centres does not negatively affect community resilience to the effects of CC.

1.5 Operational Definitions of Key Terms and Concepts

There is no universally accepted definition of *climate change*. According to the IPCC (2007) and the World Meteorological Organization (WMO, 2005), CC refers to the fluctuations in the state of climate that can be identified by variation in the mean and/or variability of its properties persisting for an extended period. This change could be due to natural variability or human activity. The United Nations Framework Convention on Climate Change (UNFCCC) defines CC as a modification in climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is, in addition to natural variability observed over comparable periods (Sharma, 2007). The Climate Change Fact Sheet of 2010 reveals that CC is a long term shift in the climate of a specific location, region or planet. This shift is measured in terms of changes in features associated with average weather, for example temperature, wind patterns and precipitation. According to Spence (2012), CC is a term that describes alterations in global weather patterns such as temperature extremes, timing and distribution, and humidity concentrations. This affect precipitation, drought, and other extreme weather events, all averaged over time. Based on the definitions given above, it can be concluded that CC is observed over a long period of time. It also has an effect on average weather conditions.

As is the case with CC, *vulnerability* to it means different things to different people. Shewmake (2008) provides a detailed comparison of definitions from a wide range of disciplines. For instance, geographers refer to *vulnerability* as what Leichenko and O'Brien (2002: 3) have defined as "the extent to which environmental and economic changes impact on the capacity of regions, sectors, ecosystems and social groups to respond to various types of natural and socio-economic shocks". Economists view *vulnerability* as a measure of well-being, reflecting the prospects a household faces in future (Dercon, 2001; Heitzman *et al.*, 2002; Skoufias and Quisumbing, 2008). All these definitions put across two common components of *vulnerability,* namely exposure to risk, and a low capacity to cope with adverse outcomes. This study will adopt the IPCC (2007a) definition of *vulnerability* as a baseline definition that is, the degree to which a system is susceptible to, or unable to cope with the adverse effects of CC, including increased variability and extremes.

Adaptation means the process of designing, implementing, monitoring and evaluating strategies, policies and measures intended to reduce CC-related impacts and to take advantage of opportunities (Ebi and Semenza, 2008). By extension, *adaptive capacity* refers to the ability to cope with CC, and climate variability and extremes, in order to moderate potential damages. It also entails taking advantage of emerging opportunities, as well as coping with its consequences (Reidsma *et al.*, 2010). *Adaptive capacity* can also be defined as those characteristics of an individual, household or population group which enable it to alter or structurally reorganize its activities to diminish present threats to survival, while enhancing its ability to address new risks (Mc Cathy *et al.*, 2001 in Waal and Marzall, 2006).

Resilience means the ability of groups or communities to adapt in the face of external social, political or environmental stresses and disturbances (Adger, 2006; Norris *et al.*, 2008). According to Tompkins and Adger (2004), societies must, in general, demonstrate the ability to buffer disturbance, self-organize, learn and adapt, in order to be resilient.

Mitigation, in the context of CC, means reducing the sources or enhancing the sinks of greenhouse gases (Locatelli, 2011). The main greenhouse gases are carbon dioxide, methane, sulphur hexafluoride, nitrous oxide and two groups of gases, namely hydro fluorocarbons and per fluorocarbons (Jobodwana, 2011).

Various scholars (Lockie and Bourke, 2001; McIntosh *et al.*, 2008) have recognized that it is difficult to reach consensus on what *rural* means. Different definitions tend to reflect the special concerns of disciplines. For example geographers, demographers and planners are more concerned with population densities defined as the spatial temporary grouping of rural inhabitants (Humphries, Crowey and Rolley, 1996). Hogg and Carrington (2006) note that economists tend to treat land use primary production and particularly agriculture as being of central importance. Political scientists on the other hand are more likely to be interested in the administrative coding and government structures of rural localities (Hogg and Carrington, 2006). These competing definitions of *rural* each capture some characteristics of rurality rendering the search for a simple, singular definition of a rural community fruitless. However, for the benefit of this study a *rural community* is a community characterised by low population size and density, is far from urban areas and has a low degree of urbanization.

The word *effects* simply mean results or outcomes. It means something brought about by a cause or agent. In this research, the cause or agent is CC.

1.6 Organization of the Dissertation

The dissertation is made up of seven chapters. Chapter 1 introduces the study covering the background and rationale, statement of the problem, objectives, hypotheses, and operational definitions of key terms. In Chapter 2, literature on the major features of climate change, its perceived causes and effects are reviewed. Apart from these, the relationship between the resilience of rural communities and CC, are reviewed. The theoretical framework underpinning this research is also presented in this chapter. Chapter 3 is devoted to unpacking CC as a concept outlining its features, causes as well as effects. This chapter also presents a description and discussion of results on perceptions of CC. In Chapter 4, resilience as a concept is discussed outlining characteristics of resilient communities. In addition, different measurement approaches are also discussed. This chapter also presents a description and discussion of results of community perceptions on resilience to effects of CC. Chapter 5 specifically focuses on results on the effect of distance on community resilience to effects of CC. The general discussion, recommendations and conclusions drawn from the study are covered in Chapter 6. References and appendices occupy the last pages of the dissertation.

CHAPTER 2: REVIEW OF LITERATURE

Serious doubts on the warming of the earth and that human emissions of greenhouse gases such as carbon dioxide (CO_2) are the primary cause of it are disappearing with the growing body of evidence from around the world (Lobell and Burke 2010). Global and regional shifting of climate patterns and their potential effects on the biophysical and human systems has become an important topic over the recent decades. It is widely argued by most climate scientists, a large number of academic and non-academic international institutions, as well as many well-known politicians that the bulk of the changes resulting from global climate change are, and will be, adverse in nature (UNFCCC, 2007; The Human Development Report, 2008; Ziervogel, 2008; Overseas Development Institute (ODI), 2009; Climate Change Science Facts, 2010; OXFAM, 2011). A Report on Food Security by De Capua (2011) actually warns that while the effects of climate change are already seen today, there is more to come. High temperatures, droughts and floods which are becoming more frequent will become more severe, leading to really difficult social, economic and ecologic consequences.

Climate change is regarded as an inequitable phenomenon (Fisher *et al.*, 2010). Africa is expected to suffer disproportionately to the effects of CC. Taking a look at SSA as an example, it accounts for only 2 % of global carbon dioxide emissions, but is expected to suffer the most from the negative impacts of global climate change (United Nations Development Programme UNDP, 2007). Currently, the African continent is believed to be warming at the rate of 0.05˚C per decade and the IPCC predicts that the rate of increase in mean temperatures will be -0.5˚C per decade by 2020. This shows that Africa's geographical location puts it at a huge disadvantage in as far as climate change is concerned. Newell (2007) notes that the poorest countries of Africa who have the most vulnerable citizens (especially those in rural communities) will suffer the earliest and most damaging setbacks regardless of the fact that they have contributed the least to the problem. However, looking into the future, no country - wealthy or powerful - will be immune to the impact of CC. All corners of the earth will be affected albeit to different degrees. It is vital to note that CC effects will not be uniform in different parts of the world.

2.1 Understanding Climate Change

Climate change is increasingly occupying space in media circles. Despite this trend, many people are still not aware of what the meaning of CC is. This justifies providing a simple explanation of what it is and why it is happening.

2.1.1 Definition of climate change

The climate of the world varies from one decade to the next and a changing climate is natural, continuous and expected (Nhamo, 2009). Energy from the sun drives the global climate system. Gases in the earth's atmosphere, which trap this energy and, thus, warm the earth, are called greenhouse gases and the process is known as the greenhouse effect. Without this process, there would be no life on earth. However, since the late 19th century, scientists have hypothesized that the industrial age, characterised by coal burning, combined with the clearing of forests, has resulted in an increased concentration of GHGs in the atmosphere.

Sivakumar (2011) reiterates that since the start of the industrial era (about 1750), the overall effect of human activities on climate has been a warming influence with a possible implication that the role of greenhouse gases has been greater than that of the aerosols and clouds. According to this author, scientists' observations also indicate that atmospheric concentrations of greenhouse gases (for instance, carbon dioxide, methane, nitrous oxide) now far exceed pre-industrial values determined from ice cores spanning many thousands of years (IPCC, 2007a).

There have also been increases in the concentrations of some non-greenhouse gases (for example, nitrogen oxides, carbon monoxide), which nevertheless play a role in the atmospheric chemistry and have led to a significant increase (about 40 %) in tropospheric ozone, a greenhouse gas, since pre-industrial times (Sivakumar, 2011). Among others, human activities have resulted in emissions of four principal greenhouse gases namely, carbon dioxide C_{O2}, methane $_{CH4}$, nitrous oxide $_{N2O}$, and the halocarbons (a group of gases containing fluorine, chlorine, and bromine).

These gases accumulate in the atmosphere, causing concentrations to increase with time. Significant increases in all these gases have occurred in the industrial era, and all of these increases are attributable to human activities (Nhamo, 2009). This is likely to lead to more solar radiation being trapped, which in turn will lead to the earth's surface warming up. This is known as the enhanced greenhouse effect, and the potential impact can be catastrophic (The Royal Society, 2014). In the first United Nations Conference on the environment convened in 1972, CC was hardly registered on the agenda. It was not until 1988 that the IPCC was formed to collate and assess evidence on CC. In 1995, the IPCC concluded that there was enough evidence to suggest human influence on the earth's climate (Forster *et al.*, 2007; Nhamo, 2009).

Despite these observations, there have and continue to be debates and discussions (about CC, both on the causes and its occurrence by some scholars) (Mckitrick, 2005; Bays, 2009).

Sivakumar (2011) explains the reasons for this situation. Firstly, the complexity of the climate system and the multiple interactions that determine its behaviour impose limitations on our ability to understand fully the course of the global climate. Secondly, there is still an incomplete physical understanding of many components of the climate system and their roles in CC. Thirdly, there are key uncertainties, including the roles played by clouds, the cryosphere, the oceans, land use, and linkages between climate and biogeochemical cycles. In addition to these, another criticism against the global climate change is that the roughly two centuries of the industrial era are an insignificant period of the Earth's history. Some scientists, therefore, argue that any changes in climate could just be attributed to the natural cycle of events (Sivakumar, 2011).

This author contends that the two centuries of the industrial era can in fact, also be used as a basis to argue in favour of the exorbitant contributions to atmospheric concentration of greenhouse gases and thus, to climate change. However, with our inadequate understanding of the climate system and the associated uncertainties, criticisms on the climate change issue must not be ignored. A documentary on CC by the British Television producer Martin Durkin called the Great Global Warming Swindle (GGWS, 2007) also argues against conventional scientific understanding of the degree and cause of recently observed CC. It denies that global warming is largely due to an increase in atmospheric greenhouse gases resulting from increased industrialization during the last 100-150 years.

Durkin (2007) asserts that global average temperature decreased between 1940 and 1980, and so could not depend on atmospheric concentrations of greenhouse gases, which increased over this period. The author also points to volcanic activity and solar activity among others, as possible causes of CC. He therefore argues that recent global warming is neither significant nor due to human activity. According to Jones, Wtkins Braganza and Coughlan (n.d), the GGWS does not represent the current knowledge in climate science. Many of the hypotheses presented in the GGWS have been considered and rejected by due scientific process. Nonetheless, the argument the GGWS puts across is not whether climate is changing or not, but about the CC causes or drivers.

Since science is motivated by argument and debate, such criticisms should not be ignored. In light of this, it appears that the current perception among the majority of scientists is that the issue is mostly settled. As a matter of fact, most people around the world (not just scientists, but also others, including politicians) have already moved beyond asking if climate change is occurring and if it is human induced. Rather, people are now talking about the magnitude and type of impacts CC is causing though it will be difficult to predict the exact impacts. Table 2.1 gives an overview of literature on climate change as a concept. It should be noted that only a few research articles were selected for the purpose of the study, just to show the kind of CC data that is available.

It is clear from Table 2.1 below that much of the available literature gives projections of the effects of CC. This is important information which gives us the general picture of what to expect. However, since some effects are already noticeable on the ground, it is important to now look at what is happening today. Scientists have agreed that rural communities of the developing countries will suffer the most from the effects of CC. This warrants studies to focus on building rural communities' resilience through strengthening their adaptive capacities. This, however, cannot be possible without knowledge of how communities have been coping to climate stresses, thus the need to use a community centred approach.

It is important to know community perceptions on the causes and effects of CC as well as their coping strategies. From the above definitions CC is defined in terms of changes in the earth's system. However, CC is not only about changes in the earth's system. It is also about the impact of these changes to vulnerable communities. It is therefore expected that communities would give a different definition from the ones given by scientists and researchers; it is the knowledge and perceptions of communities about CC that will influence the way they respond to climate mitigation and adaptation policies.

Table 2.1 Summary of the major features of climate change

Source	Definition	Signs or observational evidence	Effects	Identified gaps
Abeygunawardena *et al.* (2003)	Any change in climate over time, whether due to natural variability or as a result of human activity.	Projections; changes in average climatic conditions, climate variability, the frequency and magnitude of extreme events, rise in sea levels,	Reduced access to drinking water, negative effects on health of poor people, food insecurity, famine and migration,	The study focuses on expected effects yet there are visible effects on the ground.
Miraglia *et al.*, (2009)	A change of climate which is attributed to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1994).	Projections; temperature increases, variation in precipitation, increased rate of droughts and increase in atmospheric carbon dioxide.	Health risks; toxic trace elements in plants, contamination of food via pesticides, presence of environmental contaminants in water, food or air etc.	Rural communities have their own perceptions of CC, its causes and effects. They have not been given much attention despite being the most vulnerable.
Manyatsi *et al.*, (2010)	The long-term significant change in the “average weather” that a given region experiences.	Reported signs of climate variability included drought, poor rains, change in rainfall pattern and increase in temperature.	Inadequate food supply, poor crop yields, poor performance of pastures, poverty, death of livestock, and sicknesses.	There is lack of rural communities' role in enhancing their resilience to CC effects
Macchi (2011)	Adopted the UNFCC 1994 definition above.	Communities experienced an overall decrease in rainfall and trend of longer dry spells, temperature increases, warmer winters and less snowfall.	Overall decline in agricultural activities, drying up of springs, lack of fodder and water for animals, land becoming less productive.	Despite the study being community centred, the assessment of resilience is however not community centred.
Spence (2012)	Changes in global weather patterns such as temperature extremes, timing, and distribution, humidity concentrations affecting precipitation and drought; and other extreme weather events.	Disruption of ecosystems, shifts in crop productivity, sea level rise, higher concentrations of air pollution and infectious diseases, shifts in precipitation causing both floods and droughts.	Food insecurity especially in SSA, exacerbation of poverty, reversing progress in achieving MDGs, water scarcity, health risks, migration.	Effects of CC will not be uniform, thus, the need to investigate different regions and communities' adaptive capacities to strengthen resilience.

2.1.2 Causes of Climate Change

The question of what causes CC has been debated a lot, because climate change can be "due to natural variability or as a result of human activity" (IPCC, 2007) and because the climate system is very complex. There is however, stronger evidence that most of the warming over the last 50 years is due to human activities. Ice cores taken from deep in ancient ice of Antarctica show that carbon dioxide levels are higher now than at any time in the past 650,000 years. More carbon dioxide in the atmosphere means warming temperatures. In its 2007 report to the United Nations, the IPCC concluded that it is more than 90 % likely that the accelerated warming of the past 50-60 years is due to human contributions

Greenhouses gases, such as carbon dioxide, trap heat in the atmosphere and regulate our climate. These gases exist naturally, but humans have been adding even more carbon dioxide by burning fossil fuels for energy (coal, oil, and natural gas) and by cutting down forests. Because more greenhouse gases trap more heat, average temperatures around the world are increasing. At the same time, the Earth's oceans are also absorbing some of this extra carbon dioxide, making them more acidic and less hospitable for sea life. The earth is just close enough to the sun to receive a lot of energy, but far enough not to be scorched. According to Smith (2012), it is in what can be called the "Green Belt" or habitable zone, where the conditions are just right for life as we know it. This layer keeps the globe warm like a blanket, shielding it from the cold universe – commonly referred to as the greenhouse effect. Jensen (2009) maintains that while not being the most potent greenhouse gas, CO_2 is the main driver for the greenhouse effect.

In nature, CO_2 is exchanged continually between the atmosphere, plants and animals through photosynthesis, respiration, and decomposition, and between the atmosphere and ocean through gas exchange. A very small amount of CO_2 (roughly 1% of the emission rate from fossil fuel combustion) is also emitted in volcanic eruptions (US Environmental Protection Agency, 2012). This is balanced by an equivalent amount that is removed by chemical weathering of rocks. According to this source, the CO_2 level in 2012 was about 40% higher than it was in the nineteenth century. Most of this CO_2 increase has taken place since 1970, about the time when global energy consumption accelerated. Measured decreases in the fraction of other forms of carbon and a small decrease in atmospheric oxygen concentration (observations of which have been available since 1990) show that the rise in CO_2 is largely from combustion of fossil fuels.

Smith (2012) adds that deforestation and other land use changes have also released carbon from the biosphere where it normally resides for decades to centuries. The additional CO_2 from fossil fuel burning and deforestation has disturbed the balance of the carbon cycle, because the natural processes that could restore the balance are too slow compared to the rates at which human activities are adding CO_2 to the atmosphere. As a result, a substantial fraction of the CO_2 emitted from human activities accumulates in the atmosphere, where some of it will remain not just for decades or centuries, but for thousands of years.

The cause of climate change is the unlimited burning of fossil fuels - coal, oil and natural gas - releasing CO_2 in the atmosphere at an ever increasing rate. Because of this the layer of greenhouse gas gets thicker, which in turn makes the Earth warmer. Coal is the biggest climate polluter is the global power sector, and it generates around 40 % of all global electricity from coal. According to the International Energy Agency the power sector is responsible for 37 % of all man-made (CO_2) emissions. It creates about 23 billion tonnes of CO_2 emissions per year – in excess of 700 tonnes a second (Smith, 2012). In turn, this CO_2 continues to heat up our planet and pose an unprecedented threat to us and the environment. Generating electricity through the burning of fossil fuels, in particular carbon-heavy coal has a greater impact on the atmosphere than any other single human activity.

The Royal Science (2014) contends that changes occurring in the sun itself can affect the intensity of the sunlight that reaches Earth's surface. The intensity of the sunlight can cause either warming (during periods of stronger solar intensity) or cooling (during periods of weaker solar intensity). The Sun also provides the primary source of energy driving Earth's climate system, but its variations have played very little role in the climate changes observed in recent decades. However, solar activity has been relatively constant, aside from the 11-year cycle, since the mid-20th century and therefore does not explain the recent warming of Earth. Similarly, changes in the shape of Earth's orbit as well as the tilt and position of Earth's axis affect temperature on relatively long timescales (tens of thousands of years), and therefore cannot explain the recent warming.

Apart from C_{O2}, other GHGs that contribute to CC are methane, nitrous oxide and fluorinated gases. According to Jensen (2009) methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Fluorinated Gases are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes (EPA website, 2012).

2.1.3 Effects of climate change in the developing world

Developing countries will bear the brunt of adverse consequences largely due to high poverty rates, high vulnerability levels and low adaptation capacities. Ringler *et al.* (2010), add that rural populations of developing countries for whom agricultural production is the primary source of direct and indirect employment income will be most affected because of agriculture's direct exposure to climate change. Among developing regions of the world, the ones that are expected to fare worst are Latin America, Asia, Small Island states and Africa (Ringler *et al.*, 2010; Watkins, 2007).

It is worth noting that besides being victims, rural communities also play a role in causing CC. Although rural communities in developing countries are believed to have contributed the least to CC (Gwimbi, 2009), their contribution should not be ignored. Three quarters of the world's one billion extremely poor people live in rural areas and depend on agriculture and related activities for their livelihoods (IFAD, 2008). Desertification and land and forest degradation are rife in rural communities, which mostly depend on wood as a key source of energy. This has resulted in high concentrations of carbon dioxide in the atmosphere which has contributed to climate change. Van der Hoeven *et al.*, (2005) claim that agriculture and deforestation together contribute up to 30 % of all GHG emissions. Bond (2006) postulates that in rural areas of South Africa, approximately 3 million households burn fuel wood for their energy needs, causing deforestation and reduction of carbon sinks. This shows that rural communities' poverty situations force them to play a part in causing CC. Heltberg *et al.* (2012) maintain that rural communities contribute significantly to CC and, thus, must be a significant part of the effort to address it. Tables 2.2 and 2.3 show a summary of the major effects of CC in both developing and developed regions of the world.

Table 2.2 Summary of major effects of climate change in developing regions of the world

Region of the world	Major effects
Africa	*Agricultural production* - A decrease in the area suitable for agriculture - Decrease in the length of growing seasons to affect yield potential. - Shortage of water due to reduced rainfall and high temperatures *Extreme weather events* - Increases in droughts, floods, storms add stress to water resources, human health and infrastructure, thereby constraining development (Ringler *et al.*, 2010). - Changes in rainfall and intensified land use would exacerbate the desertification process particularly in Western Sahel, northern and southern Africa. (IPCC, 2007) *Health* - Increase in prevalence of diseases including Malaria, Tuberculosis, Rodent-borne diseases, Meningococcal meningitis, Ross River virus and Rift Valley fever, and diarrhoea (Guernier *et al.*, 2004)
Small Island States	*Sea level rise* - Linked to observed temperature increases and widespread melting of snow and ice (Gray, 2010; Mimura *et al.*, 2007). *Extreme events* - Increased risk of hurricanes and storm surges and flooding displacing millions of people (UNFCCC, 2005) *Coastal erosion* - freshwater supplies will be contaminated by sea water (Rubenstein, 2011)
Middle East	*Temperature increases* - Southern and Eastern Mediterranean will experience greater warming trends than the global annual mean warming (Evans, 2008; 2009) *Reduced rainfall* - Significant reduction in precipitation in much of the Mediterranean Africa, northern Sahara and the Eastern Mediterranean, ranging from 10-30 % by the next century. (Sowers *et al.*, 2010) - Changes in timing, form and intensity of rainfall and snowfall will be observed. *Sea-level rise* - Already observed throughout the eastern Nile of the Mediterranean basin and other low lying areas for instance Egypt and Tunisia Edi et al., 2007; Sower *et al.*, 2010

Table 2.3 Summary of major effects of climate change in developed regions of the world

Region of the world	Major effects
United States of America	*Extreme weather events:* - Increased frequency and intensity of especially in the last three decades for instance the 2005 hurricane Katrina , 2012 tropical storm Sandy (Emmanuel, 2013). *Sea-level rise* - Caused by thermal expansion of the existing water in the world's ocean and the addition of water from land-based sources, mainly the shrinking of ice sheets and glaciers (Dunlea, 2011) - US coasts are highly vulnerable to sea level rise, erosion, storms and flooding especially in the more populated low lying parts of the US coast along the Gulf of Mexico, Mid Atlantic, northern Alaska, Hawaii and Island territories (Burkett and Davidson, 2012).
Asia	*Extreme weather events* - tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms and severe dust storms have increased in frequency and intensity (Fan and Li, 2005; Cruz *et al.*, 2007) - Damage caused by intense cyclones has risen especially in India, Japan, China, Vietnam, Cambodia and Tibetan Plateau. (ABI, 2005; GCOS, 2005a, b) *Sea-level rise* - serious implications for coastal populations, - Low lying regions to be affected by salt water intrusion rendering agricultural land unproductive. (Van der Hoeven *et al.*, 2005)
Europe	*Sea level rise* - A direct threat to productive infrastructures and to the residential and natural heritage zones (Ciscar *et al.*, 2010) *Extreme weather events* - heat waves, floods and droughts have caused rising damage costs across Europe in recent years (Gaydazhieva, 2012). *Human health* - Premature deaths due to extreme heat waves, tropospheric ozone; and transmission of diseases like Malaria (the main cause of the Nile fever) and sandflies (Sinico, 2009).
Latin America	*Melting of glaciers:* - loss of water reservoirs leading to serious water shortages (Sinico, 2009) greater risk of drought and serious flooding, melting glaciers also resulting in sea-level rise affecting coastal settlements (Arctic Climate Impact Assessment, 2005) High incidences of vector and water borne diseases (Haines and Patz, 2004)

The situation described above highlights the need for rural communities to play an active role in both enhancing their adaptation and mitigation efforts. Resource-limited people in rural areas could also play a major role in mitigating climate change through sustainable management of land, forests and other natural resources. CC mitigation policies can represent a historic opportunity to acknowledge and remunerate them for providing environmental services that benefit us all. This, however, cannot be successful if rural communities are continually ignored. This is a crucial drawback which may result in objectives (related to addressing climate change) not being fulfilled. There is need for governments and institutions to depart from seeing rural people as helpless victims. Instead, they should see them as powerful agents in their own recovery whose capacities should be acknowledged as a source of strength.

2.1.4 Climate change situation in South Africa

The climate of South Africa is also affected by the changes in the global climate. Over 20 million or about 44 % of South Africans live in rural areas (Gopaul, 2009). South Africa is also itself a contributor to the global climate change problem. South Africa contributes about 1.8 % of total GHGs, making it one of the top contributing countries in the world (Bond, 2006). Being the largest emitter of GHGs in Africa, South Africa is responsible for 39 % of the continental total making emissions in the Southern Africa Development Community (SADC) region, relatively higher than other regions in Africa (Nhamo, 2007; Myers, Young, Galloway, Manyike, and Tucker, 2011).

South Africa has a warm climate and much of the country experiences average annual temperatures above 17°C. The warmest areas are the coastal areas of KwaZulu-Natal, Mpumalanga, the Limpopo valley and the interior of the Northern Cape (Davis, 2010). Projections for South Africa show that provinces like Gauteng, Limpopo and Mpumalanga will have consistent increases in temperature (Archer and Tadross, 2009). In fact, recent studies for the Country Studies Project predict that climate change will cause mean temperature increases in the range of between 1°C and 3°C in South Africa by the mid-21st century. Specifically, South Africa's coastal regions are projected to warm by around 1-2°C by about 2050 and about 3-4°C by about 2100. The country's interior regions will warm by around 3-4°C by about 2050 and 6-7°C by about 2100 (United Nations, 2011). Notably, the highest increases will be experienced in the most arid parts of the country.

A broad reduction of rainfall in the range 5 - 10 % has also been predicted for the summer rainfall region. Significant changes in rainfall patterns coupled with increased evaporation will result in significant changes in respect to water availability, for instance, the western side of the country is likely to experience significant reductions in the flow of streams in the region. This is likely to be accompanied by an increased incidence of both drought and floods, with prolonged dry spells being followed by intense storms. A marginal increase in early winter rainfall is predicted for the winter rainfall region of the country (Archer and Tadross, 2009). According to Benhin *et al.* (2010), a significant proportion of South Africa's surface water resources have already been fully allocated and large parts of South Africa already have low and variable rainfall. Therefore, a general decline of water availability due to rising temperatures and reduced rainfall will have a devastating impact on the country's already scarce water economy as well as people's basic livelihoods.

A rise in sea level is also predicted - perhaps by as much as 0.9 metres by 2100 (Archer and Tadross, 2009). Like in most countries that are surrounded with seas and oceans, South Africa will suffer the consequences of sea level rise. These include loss of land suitable for agriculture, salinization of fresh water sources, destruction of infrastructure as well as effects on the fish industry (diminished fish catches) among others. According to Theron and Rossouw (2008) the most vulnerable coastal areas of South Africa that have been identified are Northern False Bay, Table Bay, Saldanha Bay area, the South Cape Coast, Mossel Bay to Natures Valley, Port Elizabeth and developed areas of KwaZulu-Natal Coast. Tol (2004) posits that by 2100, South Africa would lose some 11 % of its wetlands due to full coastal protection measures and structures erected to mitigate sea level rise impacts, making it potentially the 5th most vulnerable country worldwide in terms of wetland loss.

With its already poor health profile, South Africa is specifically vulnerable to new or exacerbated health threats resulting from CC. The increased temperatures and changes in rainfall patterns can be expected to bring about some general health impacts, including an increase in the occurrence of strokes, skin rashes, dehydration and the incidence of non-melanoma skin cancers. Climate Change may also bring about indirect health impacts (such as an increase in the incidence of water-borne diseases such as cholera) as a result of ecosystem changes. Furthermore, an increase in the incidence of vector borne diseases such as Malaria is to be expected. These, coupled with the interrelated effects of HIV/AIDS are feared to increase mortality rate in the country.

South Africa's rainfall is erratic in distribution and highly variable between years. Thus much of the country is arid and subject to droughts and floods. Furthermore, the impact of CC could exacerbate desertification, which is already a problem in the country. Rangelands will become more arid and agricultural output can be expected to decline in the absence of corrective measures being applied. Thus, food production, which needs to increase to meet the needs of a growing population, is directly threatened by CC (Department of Environmental Affairs and Tourism, DEAT, 2005).

Subsistence farmers in dry lands are most vulnerable to CC and although intensive irrigated agriculture is better off than these farmers; irrigated lands remain vulnerable to reductions in available water. Predictions also suggest that maize production in summer rainfall areas and fruit and cereal production in winter rainfall areas may be badly affected. It is vital to note that South Africa is a net exporter of food so CC could also affect food security in the Southern region. For example, 50 % of the maize (the main staple) in the Southern African Development Community (SADC) region is produced in South Africa (Kurukulasuriya and Rosenthal, 2003). Adverse effects of CC in South Africa could thus destabilize not only South Africa but the whole region. Commercial forestry is also vulnerable to an increased frequency in wild fires and changes in available water in south western regions.

For landlocked countries, it is a blessing since they won't have to face the effects of sea level rise for instance, and many other effects associated with having contact with seas and oceans. This means that these countries will have to face effects such as erratic rainfall, droughts, temperature rises and associated impacts. But for South Africa and other countries that have contact with great water bodies, the effects of CC will be double. This means that South Africa must have rigorous mitigation and adaptation campaigns if it is to cope with the looming effects of CC.

Depending on resources, some municipalities will be more sensitive to effects of CC. According to Benhin *et al.* (2010) many municipalities in South Africa may not have the capacity to adapt due to existing developmental challenges. These include low incomes, weak institutions, low levels of education and primary health care, lack of markets and infrastructure, and already-degraded ecosystems. In their study which explored the vulnerability of municipalities to CC in SA, Benhin *et al.* (2010) discovered that overall adaptive capacity was highest for the more developed metropolitan municipalities and most of south-western municipalities. Adaptive capacity was particularly low in the eastern half of the Eastern Cape, northern KwaZulu-Natal and parts of Limpopo and North West. Rural municipalities were significantly more vulnerable than other non-metro municipalities and Thulamela Municipality was found to be among the 20 most vulnerable municipalities of South Africa. The authors suggested the need for rural communities and local municipalities to find appropriate and efficient ways of developing resilience to CC through adaptation measures. This is because considering the municipality's existing vulnerabilities; it is wise to start building their resilience now before the effects become overwhelming.

2.1.5 Perceptions of rural communities on climate change

The first and possibly the most important step in achieving adaptation to CC is knowing how communities perceive and understand CC issues specifically the importance they place on this global challenge (Bays, Miller and van Megen, 2012). This is because how the local people perceive it determines how they formulate strategies to cope and adapt to these changes. It is therefore a challenge for one to adapt to CC adequately if he/she does not perceive the current and future CC as a reality (Falaki *et al*, 2013). Stedman *et al* (2012) echoes that audiences that do not accept the validity or the seriousness of CC are less likely to change behaviors or support policies that may help to mitigate effects. In the same vein, perceived causes of CC have a bearing on what communities feel should be done to reduce the effects of CC.

Although not many studies have been done to investigate the rural perceptions on the whole CC phenomenon, a few studies provide some insights on rural communities' psychology. In Manyatsi *et al.*' s (2010) study which focused on rural communities' perceptions on causes of climate variability, a significant number of respondents did not provide any scientifically proven causes. Responses given included the breakdown of tradition, community disobeying God, Biblical manifestations, as well as supernatural powers. A cultural understanding of climate change is also shown in a study by the CSIR report (2009) on the Vhembe Biosphere Reserve. One of the respondents argued that rivers are dry because people are using the wrong vessel (to draw water from the river instead of the Kalabash) (Nortje and Claassen, 2009).

Another study done in the rural Sahel region by Mertz, Mbow and Reenberg (2009) shows that rural communities have a very clear memory of the years dominated by extreme conditions and other significant events leading to disturbances in production. Yet another study done in rural areas of Bangladesh by Haque *et al.*, (2012) indicate that respondents perceived that changes in climate had occurred comparing to the previous ten years. This shows that some communities are aware that the climate is changing. This is a clear testimony that although they might not have scientifically proven reasons for the causes of climate change, some rural people are aware of the climatic changes. This is important knowledge that may inform mitigation and adaptation measures.

In addition, a study by Drew (2012) in India shows the degree to which religious orientations influence the way that many perceive the proper response to states at hand. The author looked at the ways that scientific framings on the Himalayan glacial retreat are offset by regionally circulating knowledge systems and examines the influence of the Hindu framings on the current moment of change. The Gangotri-Gaumukh glacier is a significant body of ice in the Indian Himalayas whose loss due to CC could cause ecological turmoil and disruption of livelihoods. This glacier feeds the Ganges or 'Ganga' river which is considered an integral part of Hindu sacred geography and cultural practice and is also an iconic symbol of religious reverence of nature. They therefore regarded the Ganga River as their goddess.

The Gangotri-Gaumukh glacier is receding due to CC and the continuity of the Ganga's flow could be in jeopardy. During Drew's study, when citing concerns for the glacier and the alarming lack of snow and snowmelt, many respondents refuted the idea that the river and especially its Goddess could completely disappear from the earth. Steps to protect the river in the wake of CC were not being taken because of scriptures predicting the eventual disappearance of the Ganga were influential. Residents explained their thinking on the river's inevitable decline by drawing from Ancient texts such as the Puranas (Drew, 2012). These sources were composed a millennia ago, to confirm that the Ganga's destiny is to one day disappear in the third or fourth phase of époque – a period depending on calculation that can last up to 432 000 years (Drew, 2012). Basing on the source, residents argued that it's still very early to think about the disappearing of their culturally significant river. This is a good example of a society in denial of any role CC is playing on their resources, livelihoods and well-being despite what they see on the ground. These present negative implications for any efforts to adapt to the effects of CC.

There were also several reasons cited for the changing of ice formations upstream. Some respondents pointed out that pollution has grown in the world and that this is a cause of the changes to the regional ecology. Conceptualizations of pollution however, were not limited to plastics, carbon emissions and the brown clouds that cover many of the world's cities. It also included corrupt human nature or internal pollution. Moral degeneracy was linked to the inevitable increase of sin and that people had lost respect for sacred Ganga. According to these residents, the goddess was upset at such sinful behaviour and that the changing ice formations at Gaumukh were a sign of her displeasure. Even though the goddess is associated with the water that flows from the glacier and technically not the glacier itself, many people indicated that she was in command of the glacial mass (Drew, 2012).

In addition, since the goddess Ganga is a powerful agent with a degree of control over her riverine condition and that of the glacier, many asserted that she could revive her physical manifestations if humans were to amend and improve their moral caliber. This shows how some view the glacial recession to be potentially reversible given the context of action and response in which humans and non-human engage. Although people had observed environmental change, they often perceived that those transformations would not lead to significant decline of water in the Ganga (Drew, 2012). This meant that many people viewed the Ganga as an exceptional entity that was independent of the variations in the water cycle that occurred around it. Because of this perception, these people did not perceive the Ganga as being threatened.

Another important study on religious beliefs is that done by Carr *et al.* (2012). The authors' analysis shows how human common belief interpretations contribute to skepticism of human-induced CC for many communities. Some individuals related their views on CC to their eschatological beliefs, namely understandings about the end of the world and events leading up to it. While distinctly a minority view, few respondents in Carr and others' study felt there was no need to worry because this world would end before CC had any serious impacts. When asked whether or not he was concerned about CC, one respondent replied that he thought Jesus is coming back a lot sooner than we have to worry about CC (Carr *et al.*, 2012). In this case, eschatological beliefs left no room for concern about CC at all.

Other participants in Carr and others' study pointed out God's sovereignty. According to the authors, participants who interpreted God's sovereignty were divided on whether or not CC was happening but agreed that regardless, God was in control and humans cannot do much about it. This led to several individuals being dismissive of what they perceived as scientists and politicians claiming that human could control the climate. Beliefs on God's sovereignty were often based on scriptural teachings regarding the relationship between God, human and the rest of the created world. This relationship places God at the top, humans in the middle and nature at the bottom of the hierarchy. Humans were therefore given the responsibility to take care of nature and benefit from it.

Some respondents in the same study suggested human sinfulness as a cause of CC. They explained that if sin enters a person, it influences their ambitions and actions and nature can take a toll because of it. Other respondents argued that if God allows humans to bear the consequences of their sinful behaviours, CC could be human-caused even though God is in control (Carr *et al.*, 2012). This demonstrates the diversity in the perceptions of communities on CC.

In a different study done in Australia about conceptualizing CC, Buys *et al.* (2012) show the divide between skeptics and those who believe in anthropogenic or human-induced CC. The authors report that while rural residents agreed that the environment and local weather were common talking points within the community, there was a clear divide in how these changes were conceptualized. Global changes were labelled as CC by those who believed in anthropogenic or human-induced factors and as 'weather variability' by those who were more skeptical. These rural communities were also split between those supporting reactive responses to CC (choosing the wait and see approach, only prepared to respond when and if they are truly convinced weather events are indeed a sign of CC) and those supporting proactive responses to CC (accept the term CC and apply it to observed weather events, and are willing to adapt). Those who did not believe in the anthropogenic argument regularly referred to past local weather events to dispute the science.

Rural residents need to be convinced that CC is real, and the impacts will be more serious that the climatic variability they have experienced in the past (Donnelly et al., 2009; Fleming and Vanclay, 2009). Though rural farmers in Australia demonstrated a generally high adaptive capacity, not accepting the reality of CC and new weather predictions could impede the uptake, effectiveness and efficiency of new technologies and processes designed to help rural communities mitigate and adapt to the impacts of CC. If rural Australia dismisses CC as not happening and adopts a wait and see attitude, the possibility is that rural regions will miss this limited window of time and opportunity to successfully implement CC resilient strategies and ensure a sustainable future. Though developed countries have better adaptation capacities, these could be improved and skepticism erodes all the chances. The perceptions above show how messages about CC need to be tailored to fit the needs and predispositions of particular audiences, in some cases to directly challenge fundamental misconceptions, in others to resonate with strongly held values (Leiserowitz, 2006).

2.1.6 Climate change mitigation commitments

In response to the dangers and other hazards and risks posed as a result of CC, the nations of the world recognised the need for an objective source of information about the causes of CC (Jobodwana, 2011). The World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. After the IPCC issued its first assessment report in 1990 explaining the human-induced greenhouse effect and predicting future climate change, 195 countries, including the United States of America (USA), adopted the United Nations Framework Convention on Climate Change (UNFCCC). Under the UNFCCC, nations recognized that the global climate is a shared resource affected by GHG emissions, and thus, they agreed to seek "stabilization of the GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (Spence, 2012). The UNFCCC obligates parties to pursue CC mitigation as a policy goal through international negotiations, but does not set any specific numeric limits on GHG emissions or establish any means to achieve mitigation. Essentially, the UNFCCC is an umbrella treaty that contemplates further treaties to specify the means of emissions reduction (Spence, 2012).

The developed countries of the world only seem to take the leadership role on mitigating CC in rhetoric. The highest per-capita emitters USA did not ratify Kyoto protocol while Canada withdrew in 2011. France, Russia, Japan and Canada did not join a second round of carbon cuts under the Kyoto Protocol at United Nations talks in 2011 as US reiterated it would remain outside the treaty. This is a clear indication of lack of cooperation of the developed nations. This has detrimental effects on the future of developing countries especially the African continent, which are disproportionately affected by the effects of CC.

In addition, International agreements for instance the 1997 Kyoto protocol, the 2009 Copenhagen Accord, the 2010 Cancun Conference and the 2011 Durban Conference have not been very successful due to lack of commitment from member states. Under the Kyoto Protocol, participating countries agreed to reduce overall global GHG emissions by at least 5 % below the 1990 baseline levels during the commitment period that ended in 2012. It however, accomplished very little toward the climate change mitigation goal. Its biggest weakness has been its failure to lay out clear terms on how nations should meet the obligation. Spence (2012) argues that the biggest success so far was the Copenhagen Accord of 2009, a legally unenforceable political agreement in which certain countries agreed to 'take note of' reduction obligation targets or actions. This Accord has a weakness of not outlining exactly what 'taking note of' meant and therefore unclear what nations were agreeing to do in order to reduce emissions.

At the Cancun conference, parties recognized the need for deep cuts in global emissions, in order to limit global average temperature rising by 2°C. Parties also agreed to keep the global long-term goal under regular review and consider strengthening it during a review by 2015, including in relation to a proposed 1.5°C target. The Council on Foreign Relations (2011) observed that little progress was made during the COP – 17 meeting in Durban. While parties agreed to extend the Kyoto Protocol until at least 2017, as well as solidified an operating structure for the Green Climate Fund, little was clarified concerning the form of a successor accord to the Kyoto protocol. Similarly, the December 2012 Doha Climate Change Conference is said to have made very little progress and failed to set more ambitious goals for reducing GHG emissions (Munang and Hyvarinen, 2013). The authors lament that that failure increases the risk of a rise in average global temperatures by 2°C by the end of this century. In a broader sense, every failure of these conferences to achieve meaningful agreements means a lost opportunity to both curbing GHG emissions as well as coming up with adaptation solutions. This continually takes a toll on poor developing countries especially their rural populations.

At the national level, policies seem to be made by the government and other institutions in the absence of rural community representatives – for whom the policies are meant to benefit. This approach has led to failure of these policies since they often do not address the real issues. Even at international level, important conferences for instance the Durban Conference of Parties (Cop) 17 conference, people from the very affected communities are not represented – only high level officials; policy makers, businessmen, government officials. There is need to be inclusive when dealing with CC. Since the people on the ground are experiencing the effects already and will be affected the most, they know exactly what needs to be done if they are to become resilient.

Jobodwana (2011) maintains that because of the lag times in the global climate system, no mitigation efforts, no matter how rigorous and relentless, is going to prevent CC from happening in the next few decades. In fact, the first few impacts are already being observed in natural systems. Successful adaptation is, therefore, a necessity. Reliance on adaptation alone could well lead to a magnitude of CC to which affective adaptation is only possible at very high social economic costs. Thus, it is no longer a question of whether to mitigate CC or to adapt to it because both mitigation and adaptation are essential in reducing the risks of CC. Nonetheless, and despite the fact that the UNFCCC refers to both mitigation and adaptation, until recently, national and international climate policies focused mainly on mitigation. This means that mitigation and adaptation measures are equally important and should, therefore, go side by side if the effects of CC are to be effectively dealt with. The IPCC (2009) reiterates that action on adaptation is as urgent as mitigation and that a lot of adaptation options are available but more extensive adaptation than is currently occurring is required to reduce vulnerability to future CC.

2.1.7 Coping strategies to effects of CC

Adaptation means actions taken to respond to the impacts of CC while mitigation means actions taken to reduce the sources of carbon or enhancing carbon sinks. Adaptation and mitigation are both viable strategies to combat damages due to CC. However, they tackle the problem from completely different angles. For instance, mitigation and adaption work at different spatial and timescales. Mitigation is global and long term while adaptation is local and short term. Mitigation provides a global response whereas adaptation provides a local response to anthropogenic CC. For instance, the benefits induced by a ton of carbon abated are experienced irrespective of where this ton has been abated. Inversely, adaptation entails measures implemented locally whose benefits advantage primarily the local communities targeted (Bosello *et al.*, 2009).

In response to CC, people in Gland community in Switzerland often adapt with what they are already doing to new conditions for instance, sow earlier in the rainy season that is; after the first rains have fallen, application of fertilizers etc. other research efforts have shown that farmers in the Sahel already practice precision farming, site specific agriculture or farming by soil (Perez *et al.*, 2010). China has successfully promoted the use of biogas as a source of household energy since the 1980s. Biogas is a fuel produced during anaerobic digestion of agricultural and animal waste. With the biogas technology, waste is stored in specially constructed containers. Methane, which is released from animal manure, is a major GHG. It is second to CO_2 in the amount generated but its global warming potential is 22 times more damaging (IFAD, 2010). Burning bio-methane reduces methane's more damaging global warming effect. Each household involved in the project builds its own plant to channel waste from the domestic toilet and nearby shelters for animals, usually pigs, into a sealed tank. The waste ferments and is naturally converted into gas and compost. In addition to producing energy, the project has resulted in better sanitary conditions in the homes.

By turning human and animal waste into a mixture of methane and CO_2 that can be used for lighting and cooking, the project is directly contributing to climate change mitigation and poverty reduction. Living conditions and the environment have improved and the labour force has more time for agricultural production. Forests are protected, reducing GHG emissions through deforestation. A large amount of straw which was previously burned is now put into biogas tanks to ferment. This further reduces air pollution from smoke and helps produce high quality organic fertilizer (IFAD, 2010).

In Peru, the native people of the high Andes have always had to contend with an inhospitable environment. High winds, sparse ground cover, frozen water and extreme water variations are the norm. As a result of CC, these temperature variations have become even more pronounced, with oscillations of -8°C to 25°C in a single day, compared with -1°C to 21°C 50 years ago (IFAD, 2010). Water shortage as a result of CC has also become a significant problem in the region. Rainfall is less frequent and less abundant. Some glaciers have melted completely, leaving large areas without water. The IFAD-supported Marketing Strengthening and Livelihood Diversification in the Southern Highlands (Sierra Sur) Project is working directly with more than 21 000 villages over an area of almost 78 000km² to help them become more resilient to the impact of CC and improve their management of natural resources.

Water from rain and melting ice is being trapped in pits so it can be used for irrigation. Project participants are diversifying their crops and are cultivating maize, beans, cereals, potatoes and oregano in terraces, separated by stonewalls, on the mountain slopes. The stone walls break the wind and trap soil and water to prevent runoff. The stones also act as heat reservoirs soaking up warmth from the sun during the day and releasing it slowly, which helps control freezing during the cold mountain nights. Planting trees serve as windbreaks and help regulate temperature. They are a source of fuel wood and their roots help stabilize the soil on the slopes. Building double walls to help absorb solar heat and adopting fuel-efficient stoves instead of cooking over open fires (IFAD, 2010).

In Fiji, dredging is viewed as the cheapest and most immediate solution to the flooding problem (as a result of CC) by the government in 2007. Along with the dredging works, other projects like the rehabilitation of the Mulomulo Dam and the construction of a new da in the Nadi watershed and repair of riverbank protection works are in progress (Chandra and Dalton, 2008). According to Hachileka (2008), the main coping strategies that farmers in Kanyangala community in Zambia may consider are contour ridging and ploughing across slopes, piecework in commercial farms, collection of wild fruits and tubers and sale of reeds, mats, crafts and grass. Based on the analysis of these coping strategies, it can be said that while most strategies try to meet community needs during poor harvests, they seem not to be ecologically, socially or financially sustainable in view of the long term CC.

Pastoralists in Ethiopia and Niger have developed their own cut and carry feeding system in response to CC. This is a collective action by community groups that rent carts jointly using money contributed by group members and then distribute the forage within the community (Michael et al., 2010). In addition settlement around water points is another strategy that communities have been using to adapt to the changing climate. In some parts of Somali region of Ethiopia, man-made water resources in the form of below ground cisterns (birkas) are increasing in numbers and are often privately owned. Many pastoralists have to sell some of their animals to be able to pay for water, which becomes very expensive during drought. However, with the help of NGOs and government agencies and sometimes on their own initiative, some pastoralist communities have developed communal sources of water (by harvesting runoff water, digging deep wells or establishing community birkas) (Michael *et al.*, 2010).

Some pastoralists have gone to an extent of settling at least part of their family, often women and children close to the water sources to have free access to water and short travelling distances for their animals kept near homes while other segments of the herd are still moved temporarily to more distant grazing. During periods of scarcity, some pastoralists have started buying different commodities on a credit basis from small shops (often set up by pastoralists) in the settlements and small towns in the pastoral areas. This mutual relationship between people in the urban and rural areas serves as a new form of safety net in the face of high risks (Michael *et al.*, 2010).

McDowell and Hess (2012) note that the concept of adaptation has been criticized for blaming the victim, by putting the obligation on the vulnerable household or social group to adjust, rather than on those social structures causing vulnerability (Ribot, 2010; 2011). Adaptation to CC is not a choice given to vulnerable groups, but an obligation and these same groups are often ignored in adaptation policy decisions (Adger *et al.*, 2006). By centering analysis on access, however, the root causes of vulnerability can be ascertained and adaptation options can be identified at both household and societal levels. This approach gives agency to vulnerable households while putting the burden of responsibility not on the vulnerable but on these institutions and social structure that produce vulnerability. However, empowering communities to also interrogate the institutions and social structures can be a successful way of increasing and improving adaptation.

While there is no single way of mitigating or adapting to the impact of CC, experience shows that measures are most effective when local communities are involved from the start in planning and implementing changes. Only by working with poor rural people themselves can there be hope to reduce the risks associated with CC and make a dent in world poverty and hunger. One opportunity will be to compensate rural people for environmental services through local incentives. Activities like afforestation, reforestation, improved livestock management, rehabilitation of degraded crop and pasture lands have global benefits.

Poor rural people are often custodians of the natural resource base and can play a key role in protecting ecosystems that benefit everyone. However, people who are struggling to feed themselves and their families are often forced to resort to short-term solutions, such as cutting down trees for firewood instead of preserving forests. In order for poor rural people to play an active role in CC mitigation, it is essential that they are compensated for their activities that contribute to mitigation. This is only fair since these activities not only benefit them, but also many residents of the earth. It therefore becomes a win-win situation for their families and for the planet as a whole (IFAD, 2010).

2.2 Understanding Resilience

Resilience is a diverse concept which has been used in different disciplines and sometimes to mean different things. It is therefore important to break resilience as a concept and understand the conceptualizations around it, as well as the different components that comprise it. This will help in pulling out the relevant indicators that will be used to measure resilience.

2.2.1 Definition of resilience

The origins of the word resilience can be traced to the Latin word *resalire* which translates as "walking or leaping back" (Gunderson, 2010). As a concept, resilience was introduced in 1973 by the ecologist Holling (Gwimbi, 2009). This concept later on emerged in literature on psychology, economics, health and sociology (Gardner *et al*, 2007). Shockingly, little is known about the extent to which the concept of resilience can be applied to rural development. That is, although rural areas are facing rapid changes and uncertainties in agriculture, forestry and landscape services that affect their future, little attention has been paid to assess the resilience of these areas (Heijman *et al.*, 2007). In order to understand resilience, there is need to unpack the different dimensions and facets that makes up the resilience concept.

Available definitions of resilience show how the concept has evolved over time to cover a broad array of issues. Originally, resilience most often meant a return to a previous state (Malone, 2009). According to the author, it is when a perturbation or disturbance hit a system and quickly or gradually, the system went back to its original condition. Subsequent work on both ecosystems and societies has identified the potential for multiple equilibria and the possibility of successfully adapting to changed circumstances by developing into a new state. This according to Malone, (2009) is important especially for developing countries in which the original state may not be the desired state to which to return. Thus, it is clear in this case that resilience includes both an element of recovery and an element of change.

A new dimension of resilience is brought about by Folke (2006). The author states that resilience is not merely about the state of a system which is strong and tenacious against disturbances. It is also about opportunities which these shocks and stresses open up. To some systems, resilience means the ability to renew, reorganize, and develop. Disturbances could initiate the process which leads to renewal of the system and the emergency of a new kind of progression. Folke further posits that if the social ecological system is resilient, the disturbances could create possibilities to do new things, innovate and to develop. Building on this argument, systems would be even more resilient if they would take advantage of these opportunities in the advent of shocks.

Resilience has been used in two ways in ecology, one focusing on recovery and return time following a disturbance the other focusing on how much a system can be disturbed and still persist without changing function (Miller *et al.*, 2010). They also acknowledge a shift in emphasis from the former, termed "engineering resilience" (Holling, 1996) to the latter, which is social resilience. In the last decade, the resilience lens has broadened its application to socio-ecological systems emphasizing three critical features of resilience; persistence, adaptability and transformability (Walker *et al.*, 2004; Folke, 2006). Resilience is often defined in terms of the ability of a system to absorb shock, to avoid crossing a threshold into an alternate and possibly irreversible new state, and to regenerate after disturbance (Resilience Alliance, 2009). This clearly makes it difficult to generalize resilience as a concept because of its subjective elements. Drawing from Malone's (2009) definition, a system has to maintain its identity and avoid transforming into an alternate and irreversible state despite disturbances if it is resilient. But that's however, only if this identity is desirable.

Sapirstein (2007) gives the main components of resilience which are response, self-organization, learning and adaptation. The author stresses the importance of learning for community resilience. Sapirstein notes that coming together as a community to discuss lessons learnt after negative and positive events has taken place is sometimes a challenge. People often want to move on and deal with their current stressors. When disasters are believed to be an act of God or fate, rather than a preventable phenomenon, learning is tacitly discouraged, the author explains. The author suggests combining a process of community learning with educational curricula as an important step in empowering children and the community at large, to respond responsibly to natural hazards. The idea here is that communities may be able to respond successfully to disturbances, re-organize and adapt but until they learn from these disturbances, they will not be resilient.

Leslie and Mclead (2009) provide a distinction in conceptualizing socio-ecological system resilience. The authors differentiate specified from general resilience. Specified resilience refers to the capacity of a system to absorb a particular disturbance, or a set of disturbances and continue to remain in a functionally similar state. The system may have high resilience to that particular disturbance, but not others. General resilience refers to the capacity of a system to absorb a broader range of disturbances, including novel or surprising disturbances. General resilience is achieved by investing in adaptive capacity or flexibility, while specified resilience is achieved by investing in the properties of a system that confer robustness against a particular stressor (Leslie and Mclead, 2009).

Investing in general resilience will increase the capacity to deal with a wide range of disturbances, but the capacity to deal with any particular disturbance will be lower than if one had invested in specific resilience toward that disturbance (Nelson *et al.*, 2007). On the other hand, investing in specific resilience may confer high resilience with respect to one particular disturbance but lower the system's capacity to deal with other different disturbances (Walker *et al.*, 2006). Therefore, not all functions or features will be equally valued or valuable. Some features may need to give way in order for others to be maintained. Thus, this makes it a necessity to ask the question: resilience of what to what? It should be noted that both types of resilience are important because attempting to make a system resilient in a particular way may inadvertently result in it being less resilient in other ways.

Pelling's (2003:48) definition of resilience merges proactive and reactive resilience; that is, "the ability of an actor to cope with or adapt to hazard stress…" This definition presents the terms "cope" and "adapt" in the author's explanation of resilience. Resilience includes both coping and adaptive strategies. Coping refers to the actions and activities that take place within existing structures; often short term strategies. Adger (1996) argues that adapting frequently involves changing the framework within which coping takes place and involves a long term change in behaviour patterns. Coping strategies are more likely to emerge at micro-level, while adaptive strategies, which are related to social and cultural values, are long term processes which are more likely to emerge at larger special scales. This distinction between coping and adapting highlights the variation in responses at different scales from smaller to larger. According to Jordan (2009), these responses do not exist at either ends of the spectrum of change, resilience is not a fixed state, and it changes over time, as coping mechanisms may develop into adaptive strategies over time.

Landau and Saul (2004) identify four themes important to community resilience in response to natural disasters or traumas. They include community and social connectedness, collective communication regarding the trauma, getting back to the horse by re-establishing the rhythms and routines of life, and having a positive vision of the future or renewed hope. Mayberry, Hodgins, Pope and Hitchener (2010) compound this when they say that, resilience involves such things as inner strengths like optimism, self-esteem, adaptive copying techniques and relational strengths characterised by having and maintaining quality support and connections. Mayberry *et al.* (2007) highlight connectedness to others through social assets, such as schools and sporting clubs in urban neighbours, as being very important for community resilience. This brings out the importance of supportive relationships apart from other adaptive techniques, as critical in achieving resilience.

However, Cumming *et al.* (2005) put forward a possibility that resilience will be highest when internal and external controls are balanced. The authors contend that although connections allow for exchanges of information, capital and products, they may also suppress diversity, innovation and the development of local capacity. There has to be a balance between what Cummings *et al.* (2005) regard as exogenous and endogenous controls. The authors predict that apart from the obvious positive effect to communities, increasing infrastructure will result in degraded resilience of local systems as – changes in connectivity associated with infrastructure development cause predictable changes in the resilience of our social ecological systems. Nevertheless, social connectedness is an important component of community resilience.

Landau (2007) suggests that individuals, families and communities are inherently competent and resilient. All they need is appropriate support and encouragement, in order to access individual and collective strengths that will allow them to transcend their loss. This shows an opportunity within rural communities that if positively exploited and supported can help communities reduce vulnerability through strengthening their existing adaptive capacity and thus become resilient.

The adaptive capacity of a rural system is a central feature of resilience and it refers to the ability of a system to adjust to changing internal demands and external circumstances (Carpenter *et al*., 2008). However, according to Wade *et al*. (2010), highly adaptive systems do not always enhance resilience. Highly adaptive systems can lead to a loss of resilience through an increase in adaptability in one place, that may lead to a loss of adaptability and thereby resilience in another place. Moreover, increasing adaptability to known shocks, may boost the system for this regime of shocks, but makes the system less resilient to unknown shocks (Walker *et al*., 2006). It is, therefore, of paramount importance to take into account the interactions between and within systems.

2.2.2 Characteristics of resilient communities

The International Red Cross and Red Crescent Societies (IRCRC, 2008) summarizes very well the important characteristics of resilient communities. Firstly, safe and resilient communities understand the disaster risks that they face, and can protect and make themselves safe to minimize losses and damage when a disaster strikes. Secondly, they are able to do much for themselves and can sustain their basic community functions and structures despite the impact of disasters. Thirdly, they can re-build after a disaster and work towards ensuring that vulnerabilities continue to be reduced for the future. More safety and resilience means less vulnerability (IRCRC, 2008). Fourth, they understand that building safety and resilience is a long term, continuous process that requires on-going commitment. In the face of such unknown factors as the effects of CC, or the degree of urban growth or environmental degradation, they understand that there is much that can be done to adapt to future problems and challenges by building on their current knowledge. Lastly, they appreciate the fact that being safe and disaster resilient means that there is a greater chance of meeting development goals which, in themselves, will greatly add to safety and resilience. This is what rural communities should be able to grow into since they are the ones who are more vulnerable and who face the greatest challenge to adapt.

Malone (2009) emphasizes the importance of setting the standards for a resilient society. The author notes that a locale well prepared to adapt to CC would have a healthy environment to start with, and resources with which to manage change. There would be clean air and water. In addition, urban areas would be designed to deliver needed services. A healthy percentage of land would be protected for environmental purposes. This describes a region or community that is not very sensitive to CC. On the social side, a resilient region would have a prosperous economy. It would have financial and institutional resources to cope with or adapt to changes in climate.

A resilient society would also have high income distributed evenly leading to low poverty rates. It would have low crime and high education levels. Gender equity would be the norm in law and practice. It would also be characterized by low energy usage for instance; high public transportation usage and health care would be very accessible. In this society, people would have the ability to choose how to live and their levels of 'healthy', 'adequate', 'high' and 'low' would be defined by the society (Malone, 2009). These standards are helpful in developing and specifying the characteristics that would contribute to societal resilience. They will therefore be used as a yardstick in measuring how resilient societies are to effects of CC.

Resilient communities are also those that suffer reduced or no loss of life and livelihood assets following a disaster, and the ability to build back stronger afterwards. The former are enabled by a greater awareness of hazards and risks, a greater capacity for disaster response and the establishment and maintenance of safe environments. The ability to bounce back is enabled by having access to essential services, resolving the provision of basic needs, particularly among the most vulnerable, and the creation of environment.

2.2.3 Importance of having resilient communities

There is now overwhelming scientific evidence that the world is moving towards a point at which irreversible ecological catastrophe becomes unavoidable (Spence, 2012). Many scientists agree that CC will continue to happen in the foreseeable future even if the global gas emissions responsible for this phenomenon are curtailed significantly in the short to medium term

(Holtzhausen, 2006; Newell, 2007; Challinor *et al.*, 2007; Molnar, 2010 and Frommer, 2011; Spence, 2012). It therefore, becomes imperative for communities to be on guard and to strengthen their resilience and adaptive capacities.

Rural communities are located in areas of high environmental risk and climatic exposure. Their subsistence is largely resource-based and thus depends on the sustainability of vulnerable agricultural livelihoods (Ospina and Heeks, 2012). In spite of the differences that exist between these communities (both among and within countries), they share similar attributes and challenges related to the prevalence of poverty, remoteness and marginalization. These include low levels of education and access to health, weak infrastructure and difficult transportation, as well as exclusion from political decision-making processes (Ringler *et al.*, 2010; Fisher, Chaudhury and McCusker, 2010; Ospina and Heeks, 2012).

Apart from relying on climate sensitive employment, Heltberg *et al.*, (2012) also note that rural populations are made up of a high percentage of seniors who are economically inactive. The lack of livelihood assets, for example economic, human and informational, worsens their vulnerability to climatic impacts. It also undermines their capacity to respond to the challenges and to benefit from potential opportunities derived from CC (Ospina and Heeks, 2012). On the contrary, developed countries that are largely responsible for the emissions of GHGs which are causing CC have the technology to adapt more readily to its effects. This leaves developing countries with adaptation as their first priority and since its adequacy is questioned, there is need to strengthen existing adaptive strategies to become resilient.

Ospina and Heeks (2012) also argue that while the picture is slowly becoming clearer, we are still very far from knowing all there is to know about CC. They add that not much can be done to control the timing and intensity of the expected hazardous events in the short term. All that can be done is to increase the capacity to cope with the projected extreme climatic events, thus strengthening community resilience. Thus it should be made a priority to strengthen the social, economic and environmental resilience of the poorest and most vulnerable against CC.

Debates dominating environmental conferences for instance the Durban United Nations Conference in December 2011, have been centred on how much more funds Africa could gain from carbon trading and whether the main polluters would be willing to reduce their emissions. It seems more practical to start making efforts towards resilience rather than focusing on subsidies from the rich countries. It is obvious that for Africa, prevention should come first. Without appropriate structural provisions, without mitigation management, cities in vulnerable areas could become scenes of total destruction (Nimpuno, 2012). Therefore, resilience strategies should be prioritized instead of lamenting for compensation, and this may go side by side with mitigation measures.

Over the centuries, all societies and economies have developed the capacity to adapt to climate extremes and environmental hazards which they face occasionally. These adaptations include migration, practicing shifting cultivation, adopting new crop varieties and modifying grazing patterns. But today, the speed and intensity of CC is outpacing the speed of autonomous adaptations and is threatening to overwhelm the ability of the poor rural people to cope (Wade *et al.*, 2010). However, according to Van der Hoeven *et al.* (2005), the notion of victimization of African societies tends to downplay accumulated experience in the face of future climatic changes or events. Nevertheless, looking at the anticipated speed and intensity of CC, this experience will be more useful if enhanced by other strategies, thus the importance of having resilient communities.

Valdivia *et al.* (2010) allude that diversity and resilience are closely linked in human and biological systems. The more options available to human populations, the less vulnerable they are to natural disasters. Therefore, current efforts should be on widening these adaptation options. It is important to recognize that not all rural communities of the world are unable to effectively respond to climatic hazards (McIntosh *et al.*, 2008). According to Baum *et al.* (2005) and Baum (2006), some communities are economically and socially well placed to move ahead, prosper and grow, and thus, appear to be resilient although some other places are marked by social and economic disadvantages and are therefore vulnerable. Some have demonstrated that through drawing upon reserves, disadvantages might be overcome or even turned around (Baum, 2006). Therefore, those communities that are less privileged should learn from the successful ones so as to become resilient.

Heltberg, Stegel and Jorgensen (2009) clearly put it that catastrophic and irreversible damage to natural systems from climate change need not result in catastrophic and irreversible damage to humans. In fact, catastrophic and irreversible damage to humans can result even from modest changes in the natural system. It all depends on the effectiveness of societies' adaptive capacity, which is shaped by policies and institutions. Strengthening community resilience entails improving the communities' capacity to resist, recover from climatic disturbances and shocks, as well as adjusting prior to or following changes and disturbances. This study conveys the message that although future climate change effects are projected to be catastrophic and irreversible, strengthening communities' resilience should be the developing (and poor) country's first line of defence. This will reduce the impact of climate change to communities significantly.

2.2.4 Measuring community resilience

Scholars have admitted that resilience is among the notoriously difficult concepts to measure quantitatively (Kallstrom and Ljung, 2005; Cumming *et al.*, 2005; Cutter *et al.*, 2008; Schwarz, Bene, Bennett, Boso, Hilly, Paul, Posala, Sibiti, and Andrew, 2011). Resilience is, for example, recognized to be complex, context specific and consisting of highly dynamic qualities that make it hard to measure through simple proxies (Kallstrom and Ljung, 2005). As a result, despite the apparent appeal of resilience and vulnerability as useful concepts to better understand human environment relations (Smit and Wandel, 2006), natural resource managers have found it difficult to define and use these concepts on the ground (Mills *et al.*, 2011). In order to avoid this weakness, more and different research is needed to develop and field test approaches that enhance capacities to use these concepts in planning and management (Thomas *et al.*, 2007; Turner *et al.*, 2007; Osbahr *et al.*, 2008).

Important resilient features have been noted in the Hyogo World Conference on Disaster Reduction held in 2005 in Japan which identified integrating disaster prevention, mitigation preparedness and vulnerability reduction perspectives into sustainable development policies as vital in building resilience. Increasing local capacity (institutions and mechanisms) for building hazard resilience and incorporating risk reduction into the design and implementation of emergency, preparedness, response, recovery, and reconstruction programmes in affected communities (International Strategy for Disaster Reduction, 2005) were noted as important in building resilience in communities.

Maru (2010) gives useful insights into measuring resilience: (i) noting the use of natural, physical, financial, human and social capital as indicators for mapping relative resilience; and (ii) suggesting a category wherein the likely potential reduction in performance due to a disturbance is used as reference. Resilience, for instance economic resilience, can be measured as the difference between potential and the actual reduction in economic activity given a disturbance (Rose, 2007).

Gunderson and Holling (2001) have given important contributions in the measurement of resilience. They define resilience as the capacity of a system to undergo disturbance and maintain its functions and controls. In their view, it is measured by the magnitude of disturbance the system can tolerate and still persist. This is in contrast with the definition proposed by Pimm (1984), for whom the appropriate measure is the ability of a system to resist disturbance at the rate and which it returns to equilibrium following disturbance.

Pimm's argument connects with that of Sapirstein (2007) who argues that resilience is measured by time which is how long it would take for a community to respond to the event, self-organize and incorporate lessons learnt before returning into a new normal way of functioning. The amount of time it takes to recover from an occurrence of a hazard affects not only the economic viability of a community, but also its social fabric or glue that keeps it together. The longer it takes to recover, the more likely it is that the community will break up because of people leaving economic stagnation, and rampant psychological and emotional distress. Therefore, the longer a community takes to recover, the less resilient it is. Emphasizing the importance of time in the recovery from disasters is also a reflection of the reality that the longer it takes to move from response to rebuilding and reconstruction, the more deleterious and long lasting the negative effects of the disaster will be. Communities therefore need to have the ability to recover quickly so as to minimize damages.

Cumming *et al.* (2005) explain the concept of identity as important in providing a level of generality that can be used to compare a measure of resilience across cases. The maintenance of identity is also related to innovation and self-organization although innovation can also reduce resilience, for instance, cultural revolution may be destabilizing. According to Cumming *et al.* (2005), if system identity is maintained over the time horizon of interest under specified conditions and perturbations, the system is termed resilient. If the identity of the system is lost or modified, the aspects of the system in which we are interested may lack resilience to different degrees. In other words, resilient systems will typically be capable of adjusting to a variety of exogenous conditions without changing their identity.

It is important to carefully look at how other scholars have measured resilience in order to craft a meaningful 'resilient measurement tool'. While numerous research efforts have assessed various dimensions of community resilience, challenges remain in the development of consistent factors or standard metrics that can be used to evaluate the disaster resilience of communities (Cutter *et al.*, 2008). Nonetheless, the study will try to come up with community resilient indicators which are representative, and will be used to assess community resilience to the effects of CC.

There should be an understanding of the processes within socio-ecological systems and the communities' identity before focusing on the assessment of resilience within these systems. From Table 2.4 below, it can be concluded that the major features of resilience are closely linked to the community identity in its natural set up. Resilience rests fundamentally on relationships between the community and its livelihood assets.

Also of importance to note, is the significance of discovering communities' past experiences in dealing with similar disasters. Schwarz *et al.* (2011) focuses on communities' reflection of past experiences and how communities have coped as a way of assessing community resilience. The authors did this in two stages, firstly by identifying past positive and negative events that respondents had experienced. Secondly, for each of the past threats identified, respondents were asked to agree or disagree whether or not the community coped well with this particular event at that time.

Respondents were also asked whether their community had learnt from these experiences, and can now cope better in the future. This however, does not mean that communities that have coped well and learnt from their previous challenges are safe and will cope well with the looming devastating effects of CC. This will help identify active assets to build on in order to strengthen resilience as well as those dormant ones that if activated, have a potential to make communities resilient to threatening CC effects ahead.

Carter *et al.* (2008) developed the Disaster Resilience of Place (DROP) model in trying to assess resilience. The DROP model begins with antecedent conditions including the internal processes at the local, community scale and the factors that come together to create a given socio-ecological system. These inherent characteristics are then enhanced or attenuated based on the actions and event characteristics such as frequency, magnitude, rate of onset of the hazard, to name a few). When a community has pre-determined coping responses, the impacts can vary in intensity that is; they will be more or less disastrous. These pre-determined capacities also influence the degree of recovery because a stronger set of coping mechanisms will allow community to absorb more of the impacts. When the absorptive capacity is exceeded, the community may respond by adaptive resilience strategies. One such strategy 'social learning' can be expressed through policy making and pre-event preparedness improvements which are then incorporated into the next event's antecedent conditions and the cycle continues.

Table 2.4 Approaches to measurement of community resilience

Source	Definition	Major features	Measurement approach	Comments
Valdivia et al. (2005)	The capacity of an ecosystem to absorb disturbance without shifting to an alternative state and losing function and services.	Resistance - the magnitude of disturbance that causes a change in structure. Recovery- the speed to return to the original structure.	Sustainable Livelihood Approach (SLA) - using assets or capital such as social capital, natural capital, physical capital, human capital and financial capital.	This approach covers a broad spectrum of community livelihood assets that may determine the resilience of a community. This can be ideal to use across different disciplines. It is however difficult to define, analyse and measure capital assets.
Antoinette, Brenkert and Malone (2005)	An interactive concept that refers to a relative resistance to environmental risk experiences, or the overcoming of stress or adversity.	Relatively positive psychological outcome despite experiences. Coping mechanism, mental sets and the operation of personal urgency.	The Vulnerability Resilience Indication Prototype (VRIP) – assessing response to climate exposure, expressed as sensitivities to climate, and societal coping and adaptive capabilities	The proxies are not representative enough that the set is incomplete, and/or that the proxies within the set are overlapping.
Cumming *et al.* (2005)	The ability of the system to maintain its identity in the face of internal change and external shocks and disturbances.	Components; relationships, innovation, continuity and components- objects or agents or entities that make up a system.	A surrogate measure for resilience developed with the use of a surrogate system identity. Key components for system identity like innovation and memory use are used to obtain a set of specific focal variables.	Their focus on surrogate variables mainly in ecological case studies could be appropriate empirical measures for resilience. This approach shows the importance of relationships and agents that make up a system.
Cutter *et al.* (2008)	A system's capacity to absorb disturbance and re-organize into a fully functioning system.	Indicators; ecological, social, economic, institutional, infrastructure and community competence.	The Disaster Resilience of Place (Drop) model; shows interaction among the social system, natural system and the built environment and places importance on coping responses, mitigation and preparedness.	Model designed to present the relationship between vulnerability and resilience. It could be adapted to other events such as terrorism or technological hazards, or slow onset natural hazards like drought.
Mayberry *et al* (2010)	Successful adaptation to stressful circumstances	Community and social connectedness, collective communication, re-establishing routines of life and having a positive vision of the future	A strength based approach which focuses on community assets and strengths rather than deficiencies and weaknesses in accordance with the principles of asset based community development.	This approach does not give credit to external forces or assets that play a role in resilience.
Schwarz *et al.* (2011)	The degree to which a specific rural area is able to tolerate alteration before reorganizing around a new set of structures and processes.	Components of the rural-ecological system that make up rural identity; economic, society, environment and government.	Identifying past negative and positive events experienced and assessing how communities have coped, if they learnt from their experiences and can cope better in future.	This approach is too simplified and it will be difficult to use across different disciplines. It underestimates the importance of internal and external drivers of resilience.

The final section of the DROP model determines the range of recovery based on the adaptive capacity threshold. When the threshold is exceeded, there is high recovery potential. When absorptive capacity is exceeded, the adaptive resilience will determine whether there is a high or low rate of recovery. Ultimately, both the degree of recovery and the potential knowledge gained from the adaptive resilience process influence the state of the social, natural or built environment systems and the resultant antecedent conditions for the next event. The inherent resilience portion of the model is determined by ecological, social, economic, infrastructural, and institutional and community components. Each of these components is associated with metrics aimed at measuring resilience (Carter *et al.*, 2008).

Also important as a method of measuring resilience is to look at the time spent to recover. This means that the longer the time spent, the less resilient communities are and vive-versa. This could be a simple and reliable way of assessing their successfulness in adapting to stressful circumstances. Therefore, it is not only important to find the most representative indicators of resilience, but also mastering the assessment of these proxies in order to get valid and reliable results. It is always best to hear how the communities think they fared – thus putting them first.

Another important way of measuring resilience is by use of the Sustainable Livelihoods Approach (SLA). The SLA looks at five types of household assets (or capitals) which are natural, social, financial, physical, and human. The more assets a community has, the more options or strategies available to adapt to change. According to Jordan (2010), this means a 'thicker layer of resilience' to cope with the 'waves of adversity'. Lamichhane (2010) posits that the approach has proven useful for assessing the ability of households to withstand shocks such as epidemics or civil conflict. In the same manner, these assets can be used to assess community resilience to effects of CC. The approach is represented by five main types of capital where natural capital refers to natural resources that are necessary for sustaining all forms of life, services, and livelihoods. It involves endowments and resources of a region belonging to the biophysical realm, including forests (wild foods and fibres), air, aquatic resources, access to arable land, soil, genetic resources, and environmental services (Wall and Marzall, 2006). Natural capital can be measured by air quality, soil quality, wetlands, forests, and the presence of national and local parks (Mayunga, 2007).

Social capital involves networks and connections, relationships of trust and mutual support, formal and informal groups, common rules and sanctions, collective representation, mechanisms of participation in decision making and leadership (Wall and Marzall, 2006). Mayunga (2007) argues that for community resilience, social capital reflects the quantity and quality of social cooperation where the most resilient communities are those that adequately address collective concerns, allow individuals to draw on social resources, and have residents that work together towards a common goal.

Physical capital is a measure of built environment, i.e. the resilience of residential housing, public buildings, commercial and industrial buildings, dams and levees, and shelters. Other examples of physical capital include lifelines such electric power, water, sewer, telecommunications, and transportation systems (Peacock *et al.*, 2010). Policy making and planning has often neglected the needs of the poor, while they are the most vulnerable to climate related shocks and stresses (Wall and Marzall, 2006).

Human capital includes health, nutrition, education, knowledge, skills and general abilities of individuals combined with the availability of 'productive' individuals (Wall and Marzall, 2006). Human capital may be measured through educational attainment, access to health or health insurance, demographic characteristics, housing quality, and access to transportation services (Burton, 2012). Financial capital denotes the financial resources utilized by populations to achieve their livelihoods (Peacock *et al.*, 2010). It covers savings, credit, remittances, pension and wages. While the poor have limited financial assets, there are ways for them to mobilize their own savings and reduce financial risk. The SLA helps to analyze a community's vulnerability and adaptive capacity, as livelihood assets are important determinants of a community's capacity to adapt to CC and to socio-economic change. If the adaptive capacity is high it means a community is resilient to either internal or external chocks.

2.3 Correlations among age, sex and perceptions of CC indicators

Among the many studies that have been done on CC, very few of them zoom into the differences emerging within the responses found. It is imperative to note any emerging patterns in the primary data collected. This will unlock potential solutions to the CC problem in general through identifying different areas in which populations are affected. For instance, examining if sex and age have any bearing on community perceptions on CC will help researchers and ultimately policymakers understand the rural psychology and discovering any knowledge gaps within a community that is; if different members of the same communities are witnessing the same things. This will enable change agents to come up with policies that match with exactly what communities need.

Falaki, Akangbe and Ayinde (2013) have noted a relationship between age and sex and CC indicators when analyzing community perceptions of CC. In their study on rural farmers' perceptions on CC, the authors discovered that the age of household head was found to impact significantly on the perception that the amount of water flow in streams is decreasing. This may be because with age, farmers are better able to identify receding shoreline of streams and rivers and its decreasing depth over the years (Falaki *et al.*, 2013). The authors also inferred that because seasons (dry or rainy) affect these variables of streams and rivers in its circles, it may require experience based on age to identify that the streams or rivers do not return to their previous levels and boundaries after each circle.

In the same study, age of household head was found to also impact significantly on the perception that there are changes in tree flowering and fruiting time. The author inferred that unlike crops, trees require several seasons of growth before flowering and fruiting begins in circles. The interpretation of this is that farmers who perceive a change in tree flowering and fruiting time might have had a different perception if they were older or younger, with all things equal. As Piya *et al.* (2012) have noticed, literature has shown that with age, the ability to perceive (climatic) changes improves (Deressa *et al.*, 2011), basically due to knowledge gained from increasing experiences (Gbetibouo, 2009; Maddison, 2007). According to Stedman *et al.* (2012), though age is traditionally negatively related to concerns about climate change, their analysis revealed no relationship between overall perceived threat, nor specific beliefs about outcomes. However, there was a robust relationship between respondent age and perceived knowledge; younger respondents felt more knowledgeable than older respondents. This clearly shows that age of respondent can be a significant factor affecting perceptions.

In addition, some key differences by gender emerged in Stedman *et al.*'s (2012) research. In their study, women were significantly more likely to perceive negative impacts than were men. This was consistent with previous research studies which had shown that males exhibit lower levels of environmental concern than women (Davidson and Freudenburg, 1996). Moreover, with respect to overall perceived threat of climate change, women were more concerned than men. Self-reported knowledge, however, was higher for men than for women. According to Stedman *et al.* (2012), while this difference was not as stark as for perceived negative impacts and overall risk assessment, it indicates a greater gender gap in perceived risk than perceived knowledge.

Sex of respondents was another thing. Sex of household head had significant impact on their perception that there is occurrence of extinct and shifting plant species. For instance, a key informant in this study confirmed that the presence of weeds not native to some communities has been sighted and reported. By implication, farmers who perceive extinct or shifting plant species might have had a different perception if their sex was different. Sex of household head also had significant impact on the perception that fuel wood is getting scarce by the year. The authors concluded that this is because collection of fuel wood is the exclusive duty of women in rural area (Falaki *et al.*, 2013). It is therefore important to take note of any differences in the communities when analysing climate change information. Assuming that different people have the same knowledge and understanding levels can hinder the appreciation of community dynamics. Avoiding generalisations on the other hand results in having a deeper understanding of a particular community as a whole.

According to Maddison (2007), in the context of rural communities in developing countries, male respondents can perceive changes better, mainly due to their regular contact with outsiders and better access to information sources such as radios. However, some studies show that gender does not necessarily differentiate the ability to perceive climate change. In Gbetibouo's (2009) view, males are also more flexible in terms of their times to listen to radio while females are more involved in household chores and thus rarely find time to listen to radio broadcasts. Similar trends have been reported in farming communities in rural South Africa (Below *et al.*, 2010). The direction of influence of education was also stated, as it contradicts the more usual concept that with education ability to perceive will increase (Gbetibouo, 2009). This point to the fact that sometimes in order to fully understand the community dynamics, more than just one or two factors need to be considered. Other factors that have been discovered to influence community perceptions include access to information, extension services, and social networks, dependency on farm sources of income (Piya *et al.*, 2012); and household incomes *(Vogt et al.*, 2008).

2.4 The Effect of Distance on Community Resilience to Effects of Climate Change

There is a dearth of data on the effect of distance on community resilience to effects of CC. To the researcher's knowledge, this is the first study to examine the role that distance from urban service centres have on community resilience. However, the definition of a rural community uses such criteria as overall population, population density, commuting patterns and/ or distance from other settlements. It is also now agreed that climate change will affect different regions differently depending on the geographical location. It is also true that communities from the same locality will suffer the effects of CC at different levels due to their level of vulnerability and availability of adaptation options. For instance, many rural dwellers do not have access to a personal vehicle to get around. This means there are limited ways of reaching the services and activities essential for a good quality life. The very nature of a rural community; dispersed population, centralized services and long distances to service centres worsen the situation when they have to cope with climatic stresses. This chapter will also unpack other aspects that are useful in understanding rural community-resilience dynamics.

A study done by Weber (2010) provides a picture of the relationship between distance from urban service centres and community resilience. According to the author, farmers residing further away from the nearest input or output market were less likely to perceive that climate was changing than farmers residing closer to the market. In addition, farmers residing longer distances to the nearest market were less likely to adapt than farmers residing shorter distances to the nearest market. These results were in line with an observation made by Maddison (2006) that long distances to markets decrease the probability of farm adaptation in Africa and that markets provide an important platform for farmers to gather and share information. Even Nyangena (2007) made a similar observation that in Kenya, long distances to the markets negatively and significantly influence the adoption of agricultural technologies of soil and water conservation. The picture coming out from these studies is that markets and urban centres provide rural communities with important resources that help them predict and adapt to climate-induced stresses.

2.5 Summary of Review of Literature

CC is a universal threat. All continents of the world are going to feel the effects of climate change from the Americas, Middle East, USA, Europe, Asia and Africa. The difference is that regions will be affected differently and at different levels. For instance, in Asia the issue is agricultural species which will see their yields decline if temperature increases, while in the Maldives rising sea levels are projected to eat away shorelines and entire nations. In coastal areas, increased flooding and salinization of groundwater would be the major problems, while for Africa it is rain-fed agriculture whose yields it is feared would decrease by up to 50 %. South Africa is also not immune to climate change effects. It is a significant contributor to global warming and climate change and has almost half of its population living in rural areas. Although South Africa managed to come up with the National Climate Change Response Strategy, the researcher feels this strategy should be amended so as to cater for the needs of the poor rural people who are affected by climate change the most.

Several regimes have been put in place, in order to foster mitigation and adaptation measures on the effects of climate change. Agreements from the UNFCCC, Kyoto Protocol, Copenhagen Accord and, the latest, Durban Summit among others, have all been efforts by nations of the world to put their heads together to try and deal with CC effects. While these efforts should be appreciated, not much ground has been covered in terms of implementation. Lack of commitment and the dilemma of countries being caught between economic development and reducing industrial emissions, have stalled progress.

Investigating community perceptions on CC issues is important in order to understand their likely adaptation strategies to its long term effects. The perception of CC as a hazard that human beings are contributing towards will lead to communities changing their behaviours, mitigate and implement vigorous adaptation strategies to reduce the effects of CC. On the contrary, not perceiving CC as a threat or perceiving it to be a result of aspects beyond human influence will promote reluctance in doing anything to change the situation. Therefore, knowing rural community perceptions on CC is half the solution of making societies resilient to CC effects. Literature has revealed different but interesting community conceptualizations of CC. For instance, while some community members felt that the climate is not changing, others believed the change is caused by human sinfulness, supernatural powers, breakdown of tradition yet some alluded to eschatological beliefs and religious orientations. This information is important in establishing the starting point when attempting to strengthen community resilience.

The characteristics of communities that are resilient include communities that understand the disaster risks that they face, and can protect and make themselves safe to minimize losses and damage when a disaster strikes. Secondly, they are able to draw from their different capitals or (human, physical, financial, social and natural) assets and can sustain their basic community functions and structures despite the impact of disasters. These are communities that can re-build after a disaster in the shortest period of time and work towards ensuring that vulnerabilities continue to be reduced for the future. Although rural communities have coped to different climatic stresses in the past, they will not be able to cope with more disastrous effects of CC. Autonomous coping strategies will be overwhelmed by the effects of CC. There is therefore need to build on these existing strategies is our communities are to become resilient.

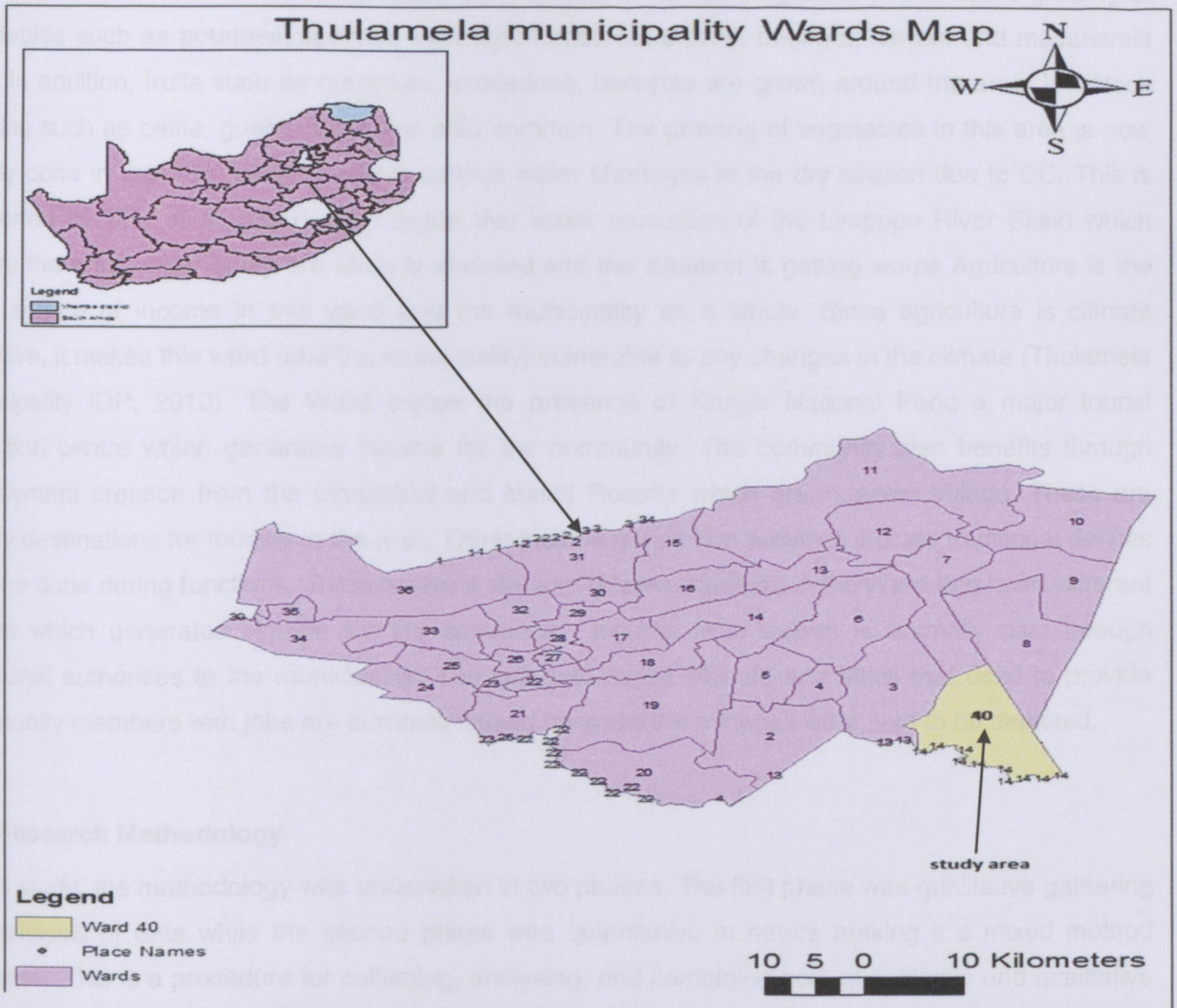

Figure 3.1: Thulamela Municipality Wards Map showing Ward 40 where the study was carried out

One of the economic activities found in this Ward involve small scale agriculture, that is, the growing of vegetables such as potatoes, spinach, cabbage, tomatoes, onions, beetroot, carrots and macadamia nuts. In addition, fruits such as mangoes, avocadoes, bananas are grown around the area. Livestock keeping such as cattle, goats, chicken is also common. The growing of vegetables in this area is now mainly done in the rainy season due to serious water shortages in the dry season due to CC. This is supported by Zhu *et al.* (2010) who argue that water resources of the Limpopo River Basin which covers the area under study are already stressed and the situation is getting worse Agriculture is the main source of income in this ward and the municipality as a whole. Since agriculture is climate sensitive, it makes this ward (and the municipality) vulnerable to any changes in the climate (Thulamela Municipality IDP, 2010). The Ward enjoys the presence of Kruger National Park; a major tourist attraction centre which generates income for the community. The community also benefits through employment creation from the Madzahisi and Malati Resorts which are in Altein Village. These are mainly destinations for tourists in the area. Other income generation activities include traditional dances that are done during functions. There is also a stadium (Merwe stadium) in the Ward that hosts different events which generates income for the community. Income from events is normally paid through traditional authorities to the municipality. The two gold mines Manele and Mtititi that used to provide community members with jobs are currently closed because the minerals were said to be depleted.

3.2 Research Methodology

In this study, the methodology was undertaken in two phases. The first phase was qualitative gathering and analysis of data while the second phase was quantitative in nature making it a mixed method approach. This is a procedure for collecting, analysing, and combining both quantitative and qualitative research and methods in a single study to understand a research problem (Fischler, 2013). The study employed a combination of interviews, site visits and literature review instead of relying on such tools in isolation.

3.2.1 Research Design

This first phase of the methodology was exploratory and descriptive in nature. The study sought to describe the CC phenomenon and its relationship with the living conditions of communities, making it an exploratory study. Exploratory studies are more suitable when the purpose of research is to gain familiarity with a phenomenon or acquire new insight into it in order to formulate a more precise problem. Data collection was done in three villages of Ward 40 which were Mabayeni, Plange and

Altein. In this phase, a qualitative design to consider the experiences of the people in rural areas was employed. Conclusions were drawn from this participant group, focusing on their specific context.

3.2.2 Population and sampling procedures

The research targeted people from the rural areas of the Thulamela Municipality. Ward 40 was identified with the help of municipal officers (judgment sampling) as the one with a low level of urbanization and furthest from a town or city, therefore, the most rural ward in the municipality. In this initial phase, multi-stage stratified random sampling was employed. Ward 40 was divided into three clusters. This was done to find out if distance from the major service points (Thohoyandou, Giyani and Malamulele) had an effect on the resilience of communities to the effects of climate change. One village was randomly selected from each cluster. The sampling procedure is clearly shown in Figure 3.2 below.

3.2.3 Data collection methods and techniques

As explained above, the study adopted a combination of qualitative and quantitative data collection methods. The study was exploratory in nature, with data collection done in three randomly selected villages of Ward 40 of Thulamela Municipality. Ward 40 was purposively identified by the researcher with the help of municipal officers (judgment sampling) as the one with a low level of urbanization and furthest from a town or city, therefore, the most rural ward in the municipality.

Both primary and secondary data were collected. Secondary data were obtained from various sources including journals, books, research publications, government documents and reports, as well as credible sources from the Internet. These were used to get background information (literature review), and a deeper meaning of climate change as a phenomenon, as well as to make recommendations for the study.

Primary data were collected from three randomly selected villages from Ward 40 which were Mabayeni, Plange and Altein. Transect walks were done with key informants in each village, in order to record significant social and physical features of the area, including hazards of all types. Rural community leaders, for instance, headmen and Community Development Workers (CDWs) in each village were then engaged through key informant interviews in the beginning, followed by semi-structured interviews done with community members. In order to answer the research questions of the study, specific questions were designed. Table 3.1 below shows the specific questions developed from the research questions.

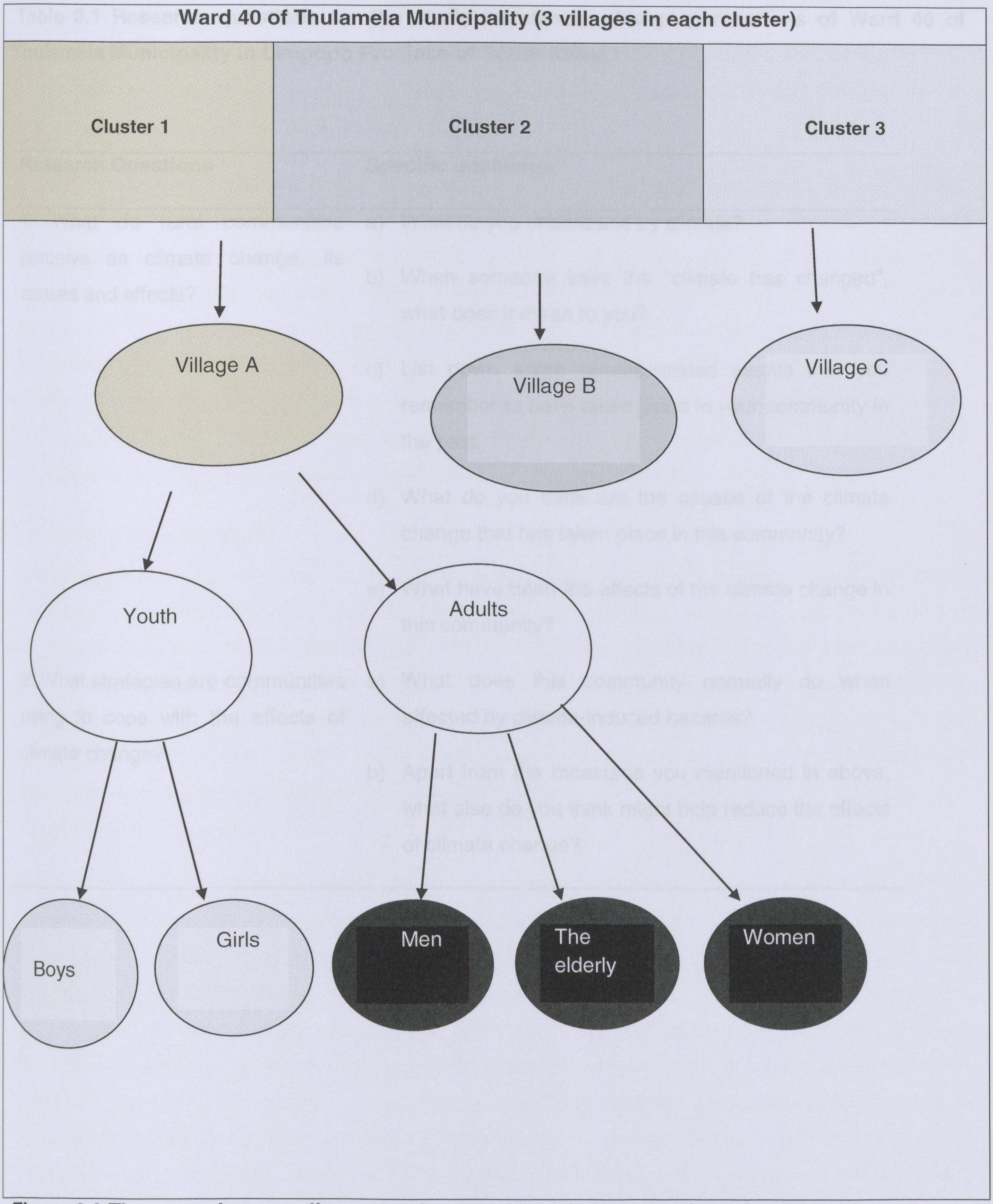

Figure 3.2 The step-wise sampling procedure used to select respondents for the study

Table 3.1 Research questions for the study on climate change perceptions of Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Research Questions	Specific questions
1. What do rural communities perceive as climate change, its causes and effects?	a) What do you understand by climate? b) When someone says the "climate has changed", what does it mean to you? c) List down some climate-related events that you remember to have taken place in your community in the past. d) What do you think are the causes of the climate change that has taken place in this community? e) What have been the effects of the climate change in this community?
2. What strategies are communities using to cope with the effects of climate change?	a) What does this community normally do when affected by climate-induced hazards? b) Apart from the measures you mentioned in above, what else do you think might help reduce the effects of climate change?

Six semi-informal interviews with the key informants were held. Focus groups were also conducted in the 3 selected villages with the youth (male and female), adult (men and women), as well as the elderly. This was done to make sure that responses were complete; all social groups are represented; thus avoiding omission of important information.

Fifteen focus group discussions were carried out in the three villages. In these focus group interviews, there was no predetermined sequence of questions or specific wording. Open ended questions were used, in order to avoid restricting the participants' answers and to give respondents control over what they wish to say and how they wish to say it. The data collected focused on trends in climatic features, definitions of CC, its causes as well as effects. Qualitative data were tabulated, coded and organised into themes using the ATLAS.TI version 6 Software. This software helps to uncover and systematically analyse complex phenomena hidden in text and multimedia data (Morse and Richard, 2002). It has tools that help locate, code, and interpret findings in primary data material; weigh and evaluate their importance of findings; and visualize complex relations among the findings.

3.2.4 Ethical considerations

Ethical clearance was obtained from the University Ethics Committee. Before data collection, permission was sought from traditional and elected institutional leaders. Open invitations were sent to ensure that there was no discrimination on the basis of ethnicity. Interviews were conducted with those willingly volunteered and availed themselves to participate. The respondents were assured that the information collected would be used for the sole purpose of the study, which was explained. Those willing to take part signed consent forms which were stored separately from all the other material associated with the study. Furthermore, respondents were given the chance to ask questions and decide whether to participate or not.

Strategic bias was most likely one of the shortcomings of this study. This is a situation whereby respondents deliberately giving answers that would sway the outcome of the study in their favour. Furthermore, errors in coding were possible given that the data collected from the interviews were thick and rich. Nevertheless, triangulation was adopted as a strategy to help limit this challenge. A review of literature and in-depth interviews coupled with site visits or transact walks were undertaken. A mixed method approach provided more comprehensive answers on the research questions, which offset the limitations associated with a single method approach. Data collection tools were pre-tested before being administered to community members. This was done during the pilot study with the aim of establishing whether the questions were clear and valid. The results and experiences of the pilot phase were then used to revise and finalize the data collection tools.

3.3 Description of Results

Results of focus group discussions were summarised per research question or objective. These were definitions of climate and CC, causes of CC as well effects. Participants also gave their views on the effect distance from urban service centres has to resilience; and also their coping strategies. There was no clear pattern in the perceptions across the three villages so results were consolidated to reflect the perceptions of the four categories namely youth, women, men and the elderly. In addition, because of absence of any clear pattern in the perceptions between female and male youth, these groups were combined into one.

All groups namely; the youth, women, men and the elderly mentioned temperature and rain as constitutes of climate. The youth and women additionally identified wind as another component of climate. The elderly and men identified snow and mist while the youth identified humidity as important components of climate.

Table 3.2 shows community-perceived meaning of climate change in Ward 40 of Thulamela Municipality. Effects-based definitions of climate change were given by community members when asked what CC meant to them. Youth, women and men highlighted heavy storms as evidence of CC. Youth, women and men also mentioned reduced rain during rainy seasons these years compared to the past years, as an indication that the climate has changed. Only youth and women across the three villages viewed current unpredictable weather as evidence of CC.

> "Weather is very unpredictable these days, it can rain any time. In the past, we knew that there is a specific time for rain", the women explained.

> "*Maxelo ya masiku lawa aya ha twisiseki kahle kahle, nkarhi wun'wani u kumaku ka titimela hi ximumu ivi hi xixika kupfa ku hisa ngopfu. Munhu wa mbala jesi nimpundzu kuva ku titimela, mara nihlekani rithlela ri hisa ngopfu*" (The weather is now confusing; it's sometimes cold in summer and very warm in winter. You wear a jersey in the morning because of the coldness but in the afternoon it gets very hot), the youth explained.

Table 3.2 Community Perceived meaning of climate change in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men	Total
Weather Patterns					
a) Heavier storms nowadays days than in the past	✓	✓	✓		3
b) Reduced rainfall	✓	✓		✓	3
c) Unpredictable weather	✓	✓	✓		3
d) Warmer winters	✓	✓			2
e) In the past, the new moon was often followed by rain. Now this does not happen.		✓			1
f) In the past, heavy winds were experienced in July but now this happens in August				✓	1
g) Late onset of rainy season				✓	1
Biodiversity					
a) Some wild fruits are no longer there				✓	1
b) Some animals have disappeared				✓	1

On the same note, men and women explained that

> "...*khale loko dyambu rova ri hisa ngopfu, madyambu ya kona akuna pfula...masiku lawa ro hi hisela mahala na pfula ka hari hava*" (In the past when it got very hot rain would be received the same day but not anymore...these days the sun is just burning us for nothing).

The elderly remembered an incident they experienced, that they had never happened lives.

> "*Ku fana na lembe leri nga hela hi Hukuri aku titimela ngopfu ingaku kova xixika. Leswi hi swona swinga endlaku hi tsandzeka naku rima. Aswi tikise ngopfu hikuva ku titimele nwheti hinkwayo, na tihomu to tala ti file ati tsandzeka no dya hi mhaka ya xirhami*" (We have experienced a very cold weather in November like it was in winter. This made it difficult for us to plough that year. We had never experienced that kind of weather during summer season. It was worse because we experienced it for the whole month and many cattle died because they could not stand the coldness...they could not even eat in that harsh weather), they explained.

Although they could not remember the exact year, they agreed it was somewhere in the 1990s. This showed them that things were changing. Other definitions of CC given included current warmer winters than in the past decades, late rains, and disappearance of some animals and wild fruits. Men also mentioned the disappearance if some wild fruits for instance *Cecenyi, Masalwa and Kwakwa* and also animals such as *Vhodwa* and *Tiphesani*. Also, some bird species were perceived by this group to have disappeared for example, types of birds called *Mbelwanani and Gogosani*

In addition, respondents gave details about the climate-related events experienced in the area. All social groups across villages also pointed out that droughts had been recurrent. They mentioned that droughts had been frequent since 1987 and the situation is getting worse. Other years mentioned to have been drought years were 1992, 2000, 2002, 2005, 2009, and 2011. All four groups also agreed that there had been more heavy thunderstorms than in the past. Floods were also another popular event experienced across the social groups and villages. Participants remembered experiencing floods in 2000, 2009 and in 2013. Only the youth mentioned a veld fire that happened in 2006 and snow and hail that was seen in the area in 2004.

As presented in Table 3.3, the youth, women and men perceived burning of garbage as causing CC. Women and youth recognized deforestation as a cause of CC. The elderly lamented that CC was a way of God's punishment to people especially the youth for breaking his laws.

"Hina hi kurisiwe xi xintu, ahi swi hlonipha naku twisisa nkoka wa xintu eka hina. Masiku lawa loko wo ringeta ku byala vantshwa hi xintu swindla ingaku wo va rhukana" (The way we were raised in terms of our customs, we were obedient and understood the importance of that to us. But nowadays telling the youth of today about our customs is like insulting them), complained the elderly.

They mentioned social ills such as abortion, sex before marriage and drug abuse as against culture and therefore causing CC. They also believed that the climate was changing because the rituals they performed for rain in the past were not done anymore. "In the past when there was no rain, we used to collect old clothes and clean the entire village. We would burn the old clothes and old women would wash themselves in the river and the rain would fall the very same day, we used to call this Gelegele", one elderly woman explained. There were also other perceived causes of CC identified by women and the youth.

As illustrated in Table 3.4, youth, women, the elderly and men mentioned death of cattle due to lack of water and grass as an effect of CC. These groups also stated the destruction of crops by floods and wildfires; washing away of roads and bridges, as well as loss of life as other effects of CC. Shortage of water to drink was cited by all four groups across the villages though the situation was worse in Mabayeni village. All groups stated that they buy water from other people in the community who have boreholes.

"*Hi minkarhi yaku tika, mati yakala…lavanga borha mati hivona vahi xaviselaku hi pondo xigubu xin'we*" (During difficult times, water becomes a critical resource…those who have boreholes sell it for R2 per 25 litre) they explained.

The youth, women and the elderly also cited the collapse of houses due to floods and strong winds as an effect of CC. Many more effects of CC were highlighted by youth, women and the elderly.

Table 3.3 community perceived causes of CC in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men	Total
Contemporary beliefs					
a) Burning of garbage during the day	✓	✓		✓	3
b) Deforestation	✓	✓			2
c) Air pollution/Aluminium pot industry - they burn coal	✓				1
d) Perfumes not ozone friendly	✓				1
Traditional beliefs					
a) We lost touch with our tradition and customs			✓		1
b) We no longer perform rain-making rituals anymore			✓		1
c) Too many vehicles which emit too much smoke		✓			1

Table 3.4 Community perceived effects of CC in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men
Livestock production				
a) Cattle die because of lack of water and grass. Rivers that used to flow throughout the year are now dry most of the time	✓	✓	✓	✓
Crop production				
a) Crops destroyed by floods and wild fires	✓	✓	✓	✓
b) Rivers overflowing and washing away crops			✓	
c) Worsening soil erosion	✓			
Infrastructure				
a) Roads and bridges are washed away	✓	✓	✓	✓
b) People left homeless	✓	✓		
c) Houses are damaged or destroyed by floods and strong winds	✓	✓	✓	
Direct human impact				
a) Shortage of food	✓		✓	
b) People die (especially when we have floods)	✓	✓	✓	✓
c) Food becoming expensive; significant increases in food prices		✓		
d) Diseases e.g. cholera		✓		
e) Shortage of water to drink	✓	✓	✓	✓
f) Fruit trees (e.g. Mango) drying due to lack of water	✓		✓	

Table 3.5 displays community coping strategies to hazards caused by climate change. The most popular response indicated by all the groups across the three villages was that during floods people erected makeshift houses.

> "*Hi zima tiphuphu hi vekela lwangu hi kota ku swekela kona*" (We just erect poles to support roofs and cook inside the shade) they explained.

Youth, women and men also indicated moving to strong buildings; schools, RDP houses and community halls during floods as another coping strategy.

Youth, women and the elderly were thankful to the government for the social grant. They explained that during disaster times, the old people's pension grant and the child grant were used buy food. All groups in Mabayeni village stated fetching water from neighbouring villages for instance Mtititi and Plange and also from Malamulele town for drinking and other household activities. These communities had access to taped water but during disasters the water was not readily available. "…it comes only once or twice per week on the tapes…so we have to supplement", they explained. Men also mentioned that they gathered vegetables from the forest. They cited *Nyerere*, *Theka*, *Guze* and *Mbangala*, which apparently were only available during very dry seasons.

In Table 3.6, respondents gave alternative strategies to reduce effects of climate change. Youth, the elderly and men perceived creating paddocks for grazing as an important way of reducing the effects of CC. Drilling boreholes and provision of cheap electricity and stoves were other ways of reducing the effects of CC mentioned by the youth and women. The later was perceived to reduce deforestation which causes CC. Planting trees, building strong houses and stopping forest fires were other ways of reducing the effects of CC stated by youth and the elderly. The elderly and women felt that being educated about CC would also assist in reducing the effects of CC. Men and the elderly felt that the government should give adequate food during disasters. Asked what role they would play, these two groups mentioned building a big community dam that would store enough water for the community during droughts. The elderly confidently made reference to the importance of their customs when asked about their opinion on reducing the effects of CC.

"*Ahi tivi. Vantshwa ava yingiseli. Hi ku hlamuserini maendlelo ya khale ya xinto ya ku vitana mpfula. Vanhu avaha swi endli…loko swo endliwa mpfula yinga na*" (We don't know. The youth won't listen. We have told you what we used to do to call rain. People are not doing it…if it is done, rain would come), explained the elderly.

Table 3.5 Community perceived coping strategies to climate change in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men	Total
Human capital					
a) Erecting makeshift houses during floods	✓	✓	✓	✓	4
b) Moving to strong public buildings	✓	✓		✓	3
c) Fetching water from other villages	✓	✓			2
d) Continuing with farming despite droughts	✓				1
Financial capital					
a) Buying food to counter drought for both people and livestock	✓	✓			2
b) Selling livestock to generate money to use to buy food for the livestock	✓				1
c) Home-made alcohol brewed and sold to buy food			✓		1
Natural capital			✓		
a) Selling wood to buy food		✓			1
b) Gathering vegetables from the forests				✓	1
Social capital		✓			
a) Accessing and using social grant to buy food	✓	✓	✓	✓	4
b) Collecting money from the community (contributions) to help/support affected families		✓			1
c) Getting assistance (food, accommodation) from the government	✓				1
Physical capital					
a) Drying vegetables and Mopani worms				✓	1
b) Storing pumpkins and prepare traditional meals (Tshopi)				✓	1
c) Making fountains to get water		✓			1

Table 3.6 Community perceived alternative coping strategies in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa.

Responses	Youth	Women	Elderly people	Men	Total
Community members					
a) Creating paddocks for grazing	✓		✓	✓	3
b) Stop cutting trees	✓		✓		2
c) Change in construction style and materials used so as to build strong houses that offer better protection from floods	✓		✓		2
d) Build a big dam in the community especially along the river that passes through the area			✓	✓	2
e) People should stop forest fires	✓		✓		2
f) Reverting to old customs and traditions			✓		1
g) Initiate viable farming projects to supply cheaper foods	✓				1
Government					
a) Government should give adequate food during droughts			✓	✓	2
b) Government to provide cheap electricity and stoves to reduce deforestation	✓	✓			2
c) Educate the local people about climate change		✓	✓		2
d) Drilling boreholes	✓	✓			2
e) Making and mounting water tanks	✓				1
f) Government or NGOs to build strong houses for the poor	✓				1
g) Government to create better job opportunities	✓				1

3.4 Discussion

3.4.1 Definitions of climate

It was clear from these responses that respondents had an idea of what climate entails. All social groups managed to list most of the important components of climate. Temperature, rainfall, wind, snow, mist and humidity play an important role in influencing the climate. Only the youth group mentioned humidity as a component probably because of their exposure as well as access to information from schools where they learn climate in geography studies. Drew (2012), supports this when she mentions the importance of access to information especially from schools with updated environmental studies curricula.

3.4.2 Community perceived meaning of climate change

Like defining climate, it was easy for respondents to explain what climate change meant to them. For starters, all respondents concurred that they had observed some worrying changes in the climate system. Definitions given were largely effect-based. Also interesting were observations of the climate over time for instance, relationship of the moon to rainfall, disappearance of bird species and wild fruits among others. In their study in Australia, Petheram *et al.* (2010) found that participants linked the topic CC with wider problems for instance medical problems, inflation and other economic problems. This link of CC with other day to day challenges simply shows that CC problems are not isolated; they should best be solved as part of the wider economic, social and political sphere of any environment. Petheram *et al.* (2010) reinforce this notion by saying that supporting CC adaptation would require a good understanding of the interconnections and development of strategies that could be used to improve the general adaptive capacity of these communities. Only women have discovered a connection between the moon, rainfall and climate change. This could be related to their day to day activities.

In addition, only men noticed a change in the timing of the windy season, timing of the rainy season and disappearance of wild fruits and some animals. This is possibly because men are the ones involved in activities such as land preparation, hunting and sometimes herding cattle in the forests. This presents Reckien *et al.*'s (2010) argument that perceptions are shaped by exposure, experience and impacts of risk. Weber (2010) emphasized about the importance of distinguishing between learning from experience versus learning from description since the same information about events and their likelihood can lead to very different perceptions and actions. Similarly, other studies have consistently reported late onset of rainfall, as well as disappearance of some plant and animal species (Visser *et al.*, 2013; Chikodzi *et al.*, 2012 and OXFAM GB, 2009) due to climatic changes.

3.4.3 Climate related events experienced from the past

Respondents still had a very good memory of the years dominated by extreme climatic conditions. Similar to Mertz *et al.*'s study results (2009), respondents indicated that in some cases, the same years were characterized by both drought and excessive rains. For instance, community members experienced heavy thunderstorms, floods and droughts in the years 2000, 2009 and 2013. This is in contrast with results from a study done in Tanzania by Mary and Majule (2009) where there were reported decreases in the frequency of droughts. Chikodzi *et al.*'s (2012) study in Masvingo also revealed less common and less severe floods compared to the past. Nevertheless, Boillat and Berkes (2013), Macharia *et al.* (2012) and Chaudhary *et al.* (2011) have all reported more incidences of thunderstorms, floods and droughts due to climate change. With regard to droughts, respondents indicated that in the past, droughts were spaced and more intense but nowadays they are short but happening after every two or three years. Droughts have resulted in drying up of streams affecting livestock production because farmers have to walk their livestock long distances to drink water (Chikodzi *et al.*, 2012). The same has been reported in Ward 40, where respondents also indicated the challenge of having to dig fountains for their animals to drink. They explained that each time they have had to dig deeper in order to reach the water table.

3.4.4 Community perceived causes of CC

Although respondents were aware of the changing climate, many of them indicated they were not very sure of the causes of these changes. According to Petheram *et al.* (2010), it was evident from his study done in Australia that many were unclear about western notions of the concept. The authors also discovered various misconceptions about certain aspects of CC. This was more or less the case in this study. Responses like, burning of garbage, burning of fossil fuels, the effects of aeroplanes, gravel roads, as well as breakdown of tradition were given. However, it was the interpretations attached to these perceptions that were interesting. Although men, youth and women noted burning of garbage, it was the men who gave deeper explanations about how it affects CC. They clarified that in the past, garbage used to be burnt at night when it was still and quiet so the smoke would go directly up in the sky. Nowadays, the burning of garbage even during the day has resulted in smoke becoming uncontrollable, causing CC. On the other hand, women explained that the aeroplanes fly too high in the sky and their smoke is closer to the skies and therefore makes more impact in causing CC. The elderly on the other hand, were so sure that it was because of abandoning traditional practices that the climate was changing while the youth mentioned smoke from vehicles. This is also in line with Drew's (2012) results of a study in the Indian Himalayas where respondents related CC to supernatural powers of the sacred Ganga River, as well as community members' failure to adhere to God's commandments. Other scientifically unproven causes of CC are found in the studies done by Manyatsi *et al.* (2010) and Carr *et al.* (2012). Zooming into the perceived causes of CC according to age groups show that these perceptions are a revelation of the psychology of the age groups which is in turn shaped by their interaction with the environment through their daily life activities (Granderson, 2014).

3.4.5 Community perceived effects of climate change

Study results echo Norje and Claasen's (2011) assertion that CC is a very real fact of life for rural communities. As indicated by all age groups, death of cattle due to lack of water and grass, drying up of rivers, destruction of crops, roads and bridges, shortage of water to drink and death of people, all has directly affected communities' lives and livelihoods first hand. Community members indicated that even though they dug fountains to supplement water shortages, the situation was still tough because water from the fountains would not be enough for ploughing. Severe shortages of water due to CC have also been reported in studies done by Granderson (2014), Visser *et al.* (2014) and Chikodzi *et al.* (2012) among others.

Unlike in this study where respondents were worried about the effects of CC on their daily lives, results of a study done in USA (Leiserowitz, 2006) tell a totally different story. A majority of respondents were concerned about the impacts of CC on people around the world and non-human nature. In the study by Leiserowitz, only 13 % of the respondents were concerned about the impacts on themselves, their family or their local community. Furthermore, in Ward 40, respondents almost never mentioned any positive effect of climate change. This diverges from Buys *et al.*'s (2012) study in rural Australia that recorded some positive effects of climate change for instance better prices due to increased demand of agricultural produce among others. This is a clear testimony that respondents have not seen anything good out of CC.

3.4.6 Community perceived coping strategies

The most common coping strategies noted were erecting makeshift houses, the use of government social grant and moving to strong public buildings. They present the strength of the community in solving their problems (physical and human capital) while at the same time revealing the community's heavy reliance on government grants. Although accessing these grants assisted communities in cushioning them from poverty, relying on this was not a sustainable coping mechanism. Withdrawal of this kind of grant would expose community members making them unable to cope. Respondents also noted gathering vegetables like “Nyerere", “Theka”, “Guze” and “Mbangala” from forests. Fisher *et al.* (2010) also had similar findings wherein respondents mentioned reliance on forest foods during famines. However, Pramova *et al.* (2012) did not find forests as a significant resource in their study. Nevertheless, the authors argue that forests are important for reactive adaptation in rural communities.

A closer look at the perceived coping strategies showed that many of them were both not sustainable and inappropriate for long term adaptation (Fernandez and Gatti, (2010). For instance, selling livestock (also reported in Juana, Kahaka and Okurut's (2013) study) and firewood to generate money to buy food might lead to difficulties in future years. Cattle were a source of draft power for ploughing and also fetching firewood and water. Selling cattle would lead to hiring tractors or failure thereof, reduced manure which would lead to a cycle of food shortages. At the same time, selling firewood would lead to more and more deforestation causing more CC (Manyatsi *et al.*, 2010). Therefore, many of the coping strategies mentioned by community members need to be strengthened if they are to be sustainable.

3.4.7 Alternative strategies to reduce effects of CC

It seemed incomplete to only ask community members about the existing coping strategies and make an assessment based on that. Giving them a change to air their views on what they thought could work better would give room for new unexploited opportunities. This would give insight to change agents as well as let them be the leaders of their own adaptation development. Respondents gave a variety of alternative coping strategies in their different social groups. This highlighted the importance of constituting these groups since engaging only one group would miss some important ideas.

Community members indicated their role in reducing the effects of CC although they indicated the need for support from the government in executing some of the strategies due to lack of funds and sometimes the technical expertise. They explained that creating paddocks for grazing would save community members a lot of time lost in travelling long distances to other villages for greener pastures. Respondents also felt that reverting to old customs and traditions would help reduce the effects of CC. The reasoning was that there is need for people to overcome existing moral shortcomings in order to get closer to God. This would make them escape his punishment believed to come in the form of droughts, floods and very high temperatures. This was consistent with findings from studies done by Manyatsi *et al.* (2010) and Drew (2012).

Also mentioned was the importance of stopping deforestation, drilling boreholes and changing material and style of construction in order to achieve flood and storm resistant houses. Due to a widespread shortage of water especially in Southern Africa, drilling boreholes has proved to be one of the most popular strategies to cope with CC effects (Gandure *et al.*, 2012). Furthermore, communities felt that electricity was expensive which compelled them to resort to firewood. The proposition was therefore that the government should provide cheap electricity to reduce deforestation. Respondents also mentioned the need for government to provide proper job opportunities. This would reduce their vulnerability through diversifying livelihoods therefore becoming less reliant on natural resources which translate into reduced effects of CC. Diversifying livelihoods through off-farm activities was also stated as a coping strategy by respondents from Juana, Kahaka and Okurut's (2013) study.

It was encouraging that despite some obvious differences in characterisation of CC, community members expressed their willingness to be educated about the phenomenon. The same sentiments were expressed in Petheram *et al.*'s (2010) study where some Rangers stressed the need to raise awareness about details of CC among their communities so that people know what to do. Since knowing the problem is half the solution, a good knowledge base about climate change especially its causes would help get communities aware of the appropriate actions to adapt successfully as well as to mitigate CC. A study conducted by IUCN (2009) in Pakistan also emphasized the importance of educating rural communities about CC if they are to cope better. In fact, respondents from a study by Juana et al, (2013) believed that the lack of access to information about CC and adaptation technologies were some of the main barriers to CC adaptation.

3.5 Conclusions

The study set out to investigate rural community understanding of CC. It was clear from the results that community members were aware of the changing climate and its effects on their day to day lives. They were however not very sure about the causes of this phenomenon. Although some responses for instance social beliefs were not scientifically proven, they should not be ignored. Locals' understandings are not necessarily to be taken as misconceptions but as an important indicator of how local people process and make sense of what happens in their surroundings. Therefore, any CC communication for instance, scientific projections would only be relevant to grassroots people when grounded in their day to day experiences and clearly connected to their practices and beliefs. It was also interesting to note that respondents who were adamant about the role of moral degeneration in causing CC were confident that reverting to old customs would be a solution. The noted effects of CC were only negative. This brings out the need for urgent adaptation programmes. Community members have resorted to spontaneous coping strategies, which are unsustainable and inappropriate because of lack of knowledge about the severity of CC. It is however a good sign that study respondents expressed willingness to be educated about climate change. The disparities in climate knowledge between the scientific community and community perceptions especially on the causes of CC gave room for the much needed climate education. In fact, messages about climate change need to be matched to the needs and predispositions of particular audiences in some cases to directly contest vital misconceptions, in others to resonate with strongly held values. It is important to learn about community perceptions on climate change since people frequently act on their perceptions, change their behaviour, and develop coping strategies based on their dynamic and evolving knowledge, regardless of whether they are consistent with meteorological data. This therefore means that different knowledge systems can support complacency, inaction or actually influence change.

CHAPTER 4: DEFINITION AND INDICATORS OF RESILIENCE VIEWED THROUGH THE LENSES OF GRASSROOTS COMMUNITIES

Communities are already suffering from the effects of CC and are doing the best they can to adapt. Winning the adaptation battle, and managing to go back to their normal functions means that they are resilient. This is a bit tricky with rural communities because their adaptation strategies are often autonomous and unsustainable, and sometimes push them deeper into vulnerability. Although community members have experience in dealing with hazards from the past, it is feared that they will not be able to cope with expected severe climate shocks. Now that we have seen a glimpse of what is to come, communities should build their resilience to effects of CC now such that they are better placed to bounce back and continue with their lives should things get worse. Since they know their capabilities and deficiencies, community members should drive CC programmes in their respective areas if they are to be precisely relevant and sustainable. In the same vein, community-driven adaptation programmes that have support from other institutions (government and NGOs) are likely to be successful in making communities resilient.

4.1 Research Methodology

The research methodology used in this chapter was exactly the same as that employed in Chapter 3 above. The only difference is on the data collected. In this chapter, data collected were community perceived definition of resilience, characteristics of a resilient community, resilience status of the community, as well as how distance from urban service centres affect community resilience. Table 4.1 below indicates the research questions and the specific questions used in the data collection.

Table 4.2 demonstrates that the youth, women and men singled out the ability to supplement food to animals as an indication that a community was resilient to effects of CC. Women, the elderly and men stated that the ability to improvise shelter during disaster times was a sign of community resilience to CC effects. Other popular indications of resilience mentioned by women and youth were the ability to secure food from the government, and not migrating during disaster times, among others.

As presented in Table 4.3, all groups across the three villages felt that their communities were resilient to effects of CC due to a variety of reasons. For women and youth, their communities were resilient to effects of CC because they got food from the government during disasters (drought and floods).

Table 4.1 Research questions and specific questions used in the study on resilience of rural communities to effects of CC in Ward 40 of Thulamela Municipality

Research Questions	Specific questions
1. What are the characteristics of a community that is resilient?	a) When someone mentions the word "resilience", what does it mean to you? b) What is it that would convince you in order to conclude that a community is resilient to the effects of climate change? c) Would you say your own community is resilient to effects of climate change? Why do you say so?
2. Does distance from the main service centres affect community resilience to effects of climate change?	a) Do you agree with the view that communities located close to towns for example (Giyani, Malamulele and Thohoyandou) are more resilient to the effects of climate change? Give reasons for your answers.

Table 4.2 Community perceived indicators of resilience in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men	Total
Human capital					
a. Ability to improvise e.g. make shacks or makeshift houses to shelter victims of floods		✓	✓	✓	3
b. Not migrating after disasters (drought, floods)	✓	✓			2
c. Continuing with daily lives even after droughts or floods				✓	1
d. Changing the diet		✓			1
Social capital					
a. Ability to secure food from the government	✓	✓			2
b. Ability to secure social grants from the government	✓	✓			2
Financial capital					
a. Ability to afford supplementary food for animals (cattle)	✓	✓	✓		3
b. Affording to buy maize-meal	✓	✓		✓	3
Physical capital					
a. Access to boreholes and other sources of water during droughts		✓			1

Table 4.3 Community perceived resilience status of the community in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	Youth	Women	Elderly people	Men	Total
Social capital					
a. We get social grants from the government	✓	✓	✓		3
b. We get food from government	✓	✓			2
c. We get family support e.g. remittances	✓				1
Natural capital					
a. We use water from natural fountains	✓		✓		2
b. We fetch water from Shingwidzi River	✓				1
Physical capital					
a. We have borehole water, which means no problems during droughts		✓			1
b. We plant trees using water from boreholes		✓			1
Human capital					
a. We cultivate crops and get food even during disasters		✓			1
b. We dry vegetables to eat during droughts				✓	1
c. We dry Mopani worms				✓	1
d. We re-build houses for ourselves after they are destroyed by floods				✓	1
e. We did not sell our livestock when disasters affected us	✓				1

The youth additionally stated family support and not selling their livestock as reasons for feeling that their communities were resilient to effects of CC. The elderly and youth stated the availability of water from fountains as easing their lives during droughts. However, this was not the case in Mabayeni village. All the groups in this village complained of shortage of water even though they dig fountains.

"*Hi minkari ya dyandza, hi cela swihlovo ku hi kota ku kuma mati yo nwa naku tirhisa swin'wana na swin'wana swa le kaya. Swi fika laha hi tirhisaku mati kun'we na swihari hikuva naswona swi va swiri na torha, kahle kahle mhaka leyi ayi tsakisi*" (We dig out fountains during droughts in order to get water to drink and for other household activities. We end up competing with our animals for water because they are also thirsty…the situation is not pleasant at all), complained the elderly women from Mabayeni village.

The youth from this village added "*…lembe ra dyandza ra tika...hi boheka ku cela swihlovo swi enta ku hi kota ku kuma mati*" (Each drought year is tougher…we have to dig deeper in order to get water from underground). Many more reasons were given to support why participants felt their communities were resilient.

Table 4.4 confirms that most groups across the villages agreed with the view that communities located close to towns (for example Giyani, Malamulele and Thohoyandou) were more resilient to effects of CC than those that are far. The four groups felt this way because communities close to urban centres had easy access to water, did not rely on farming, had better infrastructure, and had better access to every resource compared to communities that were far away from urban service centres. The youth, women and the elderly across the three villages also stated that communities that were located close to urban centres got relief faster compared to them during disaster times. The youth and the elderly singled out the fact that food was cheaper in the city compared to the deep rural areas.

Women and the elderly believed that communities that were located close to urban service centres were exposed to better job opportunities compared to those farther in the outskirts. This is reflected in the words below:

Table 4.4 Effects of distance from urban service centres on resilience to effects of CC in Ward 40 of Thulamela Municipality in Limpopo Province of South Africa

Responses	*Youth*	*Women*	*Elderly people*	*Men*	*Total*
Physical capital					
a) Yes. They get water easily. They can do gardening and water their plants	✓	✓	✓	✓	4
b) People in the city do not rely on farming so they have other options	✓	✓	✓	✓	4
c) Better infrastructure in the city compared to Ward 40	✓	✓	✓	✓	4
d) Better access to almost every resource and services in the cities	✓	✓	✓	✓	4
e) Food is cheaper in the city	✓	✓		✓	3
f) Better job opportunities		✓	✓		2
Social capital					
a) Government intervenes faster e.g. getting temporary tents faster in the event of floods compared to where we live	✓	✓	✓		3
Human capital					
a) Most urban dwellers are educated and rich, meaning they can afford insurance		✓			1

"*Vo tala lava tirhaka emadorobeni va hira ematikweni yale kusuhi. Lavanga na swihlangi va thola vakhegulu tani hi hina, hi sala hi hlayisa vana lava loko vona vari mintirwen…hi kota ku kuma ximalani xo xava swakudya hi minkarhi ya dyandza na ndhambi. Sweswi hilo ti tshamela ntsena, akuna la hinga thoriwa kona*" (Many people working in the urban centres are accommodated in the villages close by. If they have kids, old women like us would get piece jobs for instance, of taking care of their kids whilst they are at work….then we would get money to supplement food shortages during disasters [droughts, floods]. Now we are stuck here, without water and unemployed). "They also have reliable taped water so they can start small gardens and won't have to buy vegetables everyday like we do…they are way better than us", lamented the elderly women from Mabayeni village. "They are better than us…they can also go and sell vegetables or fruits and get money to supplement their livelihoods", added the women.

4.2 Discussion

4.2.1 Community perceived definition of resilience

Scholars like Cumming *et al.* (2005), Sapirstein (2007) and Jordan (2010) have revealed the difficulties in defining, generalizing and operationalizing the term resilience due to the many interpretations given to it depending on discipline. Heijman *et al.* (2008) also admits that little attention has been given to rural resilience despite the fact that they are the ones facing rapid changes and uncertainties caused by CC. It was these loopholes that necessitated the probing of rural community members' definitions of CC in their own words. These definitions would speak to their daily realities. It was interesting to discover that some important elements of resilience for instance, "recovery", "adaptation" and "resistance" were captured in the community perceived definitions. These definitions somewhat resonate with those given by Sapirstein (2007) and Jordan (2010) who define resilience as the capacity of an ecosystem to absorb disturbances while maintaining its behavioural processes and structure, and the ability of a system to better withstand disturbances and adapt to change when required, respectively. Sapirstein's definition above goes well with "Lifestyles and activities do not change even after a disaster", given by the rural community members. When asked what exactly they meant by "Thinking about something", respondents explained that during tough times, the ability to still think about other options for instance, where to find food and shelter during a hazard is an indication of resilience.

The other elements of resilience that were not mentioned by respondents were those that deal with self-organization and learning. Sapirstein (2007) describes self-organization as those activities a community engages in to restore functioning in the pre-event level. These activities can range from emergency response and fostering collaboration among civic organizations and neighbourhoods and maintaining social order. This was never mentioned by respondents which is possibly an indication that it does not exist in their communities.

The author also emphasizes the importance of coming together as a community to discuss what could be done better after negative events have taken place. However, people often want to move on and deal with current stresses that these discussions never happen. When disasters are seen as an act of God or fate rather than a preventable phenomenon, learning is tacitly discouraged, argues Sapirstein (2007). This could also be the case in Ward 40 since a number of respondents felt that climate change was associated with punishment from above [God] for different social immoralities in the community.

In addition, Levina and Tirpak (2006) highlight the degree of anticipatory or proactive adaptation before the event occurs. This was also not included in community-perceived definitions. Instead, respondents emphasized reactive adaptation and coping strategies. This is because they do not have anticipatory adaptation strategies since they lamented about lack of climate change information or warning systems. Nonetheless, all definitions of resilience given by respondents should not be taken for granted since they show community understanding and preferences in terms of adaptation options. In addition, this kind of conversation unpacks the kind of resources or capitals that are available as well as potential opportunities that could be exploited for successful rural community adaptation to effects of CC.

Community-perceived indicators of resilience revealed the different assets that community members drew from during disasters. These are tangible and intangible stocks of wealth used by households and individuals to generate well-being (Morrone *et al.*, 2011).The most popular responses were the ability to provide food for cattle and building makeshift houses (financial and physical assets respectively). This show how important cattle were to the community. Cattle were sold for income during difficult times that's why they were well taken care of. In addition, community members valued the support they got from the government through food parcels. The importance of access to institutional support in ensuring resilience is emphasized by Burton (2012). This author argues that the institutional resilience subcomponent is mainly important for planning and mitigation programs which may reduce potential losses and also cushioning communities from devastating effects of disasters.

Although migration can be a good adaptive strategy, respondents felt that it is a sign of giving up from the challenges of life. They therefore felt that not migrating despite adverse events is an indication of community resilience. Nonetheless, migration continues to be an adaptive strategy for rural communities in response to CC through providing communities with remittances therefore balancing the society (IOM, 2008; Woods, 2012).

4.2.2 Community-perceived resilience status of the community

Respondents were very positive that their community was resilient to effects of CC giving reference to their coping strategies. Nevertheless, a closer look at their coping strategies demonstrated otherwise. Many of these strategies for instance, getting food from government, using water from natural fountains, planting trees using water from boreholes and fetching water from Shingwidzi River proved insufficient to cater for needs of the community during disasters. Respondents showed dissatisfaction with the assistance they got from the government arguing that it either came late or was not enough. Water has also been a burning issue as respondents explained that water from the fountains and boreholes can only be used for household purposes and it has not been enough for gardening. Similarly, the nearby river Shingwidzi which the community used to rely on, was now dry for the most part of the dry season. This clearly shows that although community members take pride in their physical, social and financial capitals, they are just not sustainable. In addition, these coping strategies are only reactive and autonomous therefore weakening their sustainability. This is explained in Pelling's (2003:48) definition of resilience who defines it as "the ability of an actor to cope with or adapt to hazard stress. It is a product of the degree of planned preparation undertaken in the light of a potential hazard, and of spontaneous or premeditated adjustments made in response to felt hazard including relief and rescue."

4.2.3 Effect of distance from urban service centres on resilience to effects of CC

All the respondents felt that communities located closer to urban service centres coped better to effects of climate change compared to those that resided further out. They pointed this to a variety of services and opportunities that they could not access or benefit from. The most popular resources cited were taped water that could be used for gardening, diversity in sources of income, better infrastructure and employment opportunities. This is supported by results from a study by Ndambiri *et al.* (2010) who discovered that farmers residing longer distances to the nearest market were less likely to adapt than those residing shorter distances to the nearest market. Results of this study can also be compared to Madison's (2006) findings that long distances to markets decrease the probability of farm adaptation in Africa, and that markets provide an important platform for farmers to gather and share information. Basically, this shows that the longer the distance from urban centres, the more difficult it gets for a community to cope successfully since almost every resource for coping has to be paid for, or involves travelling long distances.

4.3 Conclusion

Engaging rural community members on resilience to effects of CC is still new ground. To my knowledge, this is the first research study done to solicit community perceptions on resilience as a concept, its components as well as the status of their community. Other studies have assessed community resilience using different models and proxies but there was no community voice. Yet many insights about community vulnerabilities and opportunities can only be harvested by involving rural communities. Results have revealed that rural community members were able to define resilience in a way that makes sense to them. In a way, they voiced out what's important to them in terms of strengthening their adaptive capacities. Although communities were confident that they were resilient, zooming into their coping strategies show that most of them are disorganized, reactive and unsustainable. They are able to continue with their lives for now, but are obviously not going to cope with more devastating effects of CC expected in the near future. There is therefore need for governments and institutions to work with communities to improve on the existing adaptive strategies. Respondents also felt that their location (further away from urban centres) make it difficult for them to cope compared to those residing close to urban areas. Dealing with water shortages, employment, access to information and having to travel for most services has made it even more difficult to cope with climate change effects.

CHAPTER 5: EFFECT OF DISTANCE FROM URBAN SERVICE CENTRES ON COMMUNITY RESILIENCE TO EFFECTS OF CLIMATE CHANGE

It is now a fact that CC is affecting the already disadvantaged communities of Africa. Africa's rural areas are especially affected due to weak adaptive capacities. Rural communities are also highly dependent upon natural resources for their livelihoods and social structures. In addition, these communities face particular obstacles in responding to CC that increase their vulnerability to its impacts. Just like it affects different regions of the world differently, CC will affect communities differently. This will depend on the type of livelihoods they depend on, access to resources, geographical location among others (Rauch, 2009). Consequently, rural communities become sensitive and exposed to different aspects of CC. In the same manner, their adaptation options are limited or expanded by such factors (above). The story is also the same for their intervention strategies.

This Chapter examines distance as a characteristic of *rurality* and its role on strengthening or weakening community resilience. Rural communities face particular geographic and demographic obstacles in responding and preparing for CC risks. To be exact, physical isolation, limited economic diversity and higher poverty rates, combined with an aging population increase the vulnerability of rural communities (Hales *et al.*, 2014). Systems of fundamental importance to rural populations are already stressed by remoteness and limited access (Rauch, 2009). But when looking at rural communities in general, are the characteristics uniform or consistent throughout a community? Are people in that community affected by climate change in the same way? These are the questions this Chapter fundamentally seeks to address. It is not uncommon to find that in the same community, some people are more privileged in some sectors than others. Similarly, some sections of the community will be desperately affected by effects of CC more than others. The way they anticipate and adapt to these climatic shocks determine their levels of resilience.

5.1 Research design

This phase of the methodology was a confirmatory survey. It was done to triangulate the data collected in the first phase. A quantitative approach was adopted in order to simplify the processing and coding of data. The advantage of using a questionnaire is that it covers a larger sample and it is easy to manage. Secondary data, as well as results from phase 1, that is the common responses obtained, were then used to develop a questionnaire. Secondary data were used to craft the instrument which was used to measure community resilience to the effects of climate change. The researcher then designed a questionnaire survey instrument with open and closed ended questions in order to get quantitative data which answered the study's research questions.

5.1.1 Population and sampling procedures

The questionnaire was then administered across all nine villages to establish if the results found in phase 1 applied to all villages in the ward (triangulation). A combination of stratified and proportional sampling was used to randomly select individuals (men, women, the elderly, youth: male and female) per village to complete the questionnaires. This made the responses more representative of the whole population. For purposes of this research, the central urban centre to the study area (Malamulele town) was considered when measuring distance from urban centres and its effect on resilience. This made it easy to analyse data on the basis of distance.

According to Suskie (1996), in order to enhance reliability and validity, a researcher must take certain precautionary steps. A researcher should have people with diverse backgrounds and viewpoints to review the survey before it is administered. This was done to find out if each item was clear and easily understood; if they interpreted each item in the intended way; if the items had an intuitive relationship to the study's topic and goals; and if the intent behind each item was clear to colleagues knowledgeable about the subject. Considering these principles, the researcher had the proposed questionnaire reviewed by a panel of experts.

5.1.2 Demographic information of the participants

At this phase, a total of 340 respondents were involved in the study. 167 of them were male while 173 were female. The previously women and men groups were combined to make one group of adults. This was done after discovering that there were no divergences in perceptions. For the same reason, female and male youth were combined to form one group. A total of 167 respondents were Youth, 113 were adults and 59 were the elderly people. Three distance categories were made. Villages closest to Malamulele, the closest urban service centre were were Halahala, Merwe A and Mabayeni villages. Those falling into the middle category were Jilongo,Lompard and Mtititi and Muhunguti and the furthest were Plange and Altein villages. These are all the nine villages forming ward 40 of Thulamela Municipality. Out of the 340 respondents, almost half (46 %) resided in villages that were at least 57 km from the closest urban area. The next prevalent (36 %) were those residing 34-48 km from the nearest urban area. The rest were from villages that were 49-56 km from the urban area.

5.1.3 Data collection

The results of focus group and key informant interviews as well as secondary data were consolidated into a questionnaire (Appendix 1) which sought responses on modified Likert-type scale of strongly disagree (1-4), disagree(5-8), neutral (9-12), agree(13-16) and strongly agree(17-20). The questionnaire was translated into Xitsonga which is the predominant language spoken in the area. This was done to ensure that respondents who could not understand, read or speak the English language effectively participated in the study. This also helped to reduce errors in data collection due to misinterpretation of the meaning of the questions had only English been used.

Before data collection, the researcher invited a number of youth who had finished matric to voluntarily help as research assistants. 3 youth members per village were then given training on how to collect data. The researcher together with the research assistants went through the questionnaire clarifying any grey areas. Preliminary data collection was also done to make sure that the research questions were clear and that they yielded the required responses. Door to door interviews were then held simultaneously in all nine villages.

In order to adhere to research ethics and ensure that the study conformed to ethical requirements, the aims and purpose of the study, likely consequences and possible risks associated with taking part in the study were explained to the respondents to secure their informed consent. This was done before commencement of data collection. Respondents were also informed of their right to withdraw at any point should they feel uncomfortable. In addition, it was revealed that doing so would not expose them to prejudice or criticism.

5.1.4 Data analysis

In this study, questionnaires were inspected to find out whether each one of them was completed fully and correctly. Data were coded and entered into the computer using the Microsoft Excel software package. Thereafter, data were imported to the Statistical Package for Social Sciences (SPSS) version 19 for Windows (SPSS Inc: Chicago, II, USA) for analysis. This, as argued by Bryman and Cramer (1996) made it possible to score and analyze data quickly. Descriptive statistics such as means and standard deviations were computed to present the overall trends that the non-parametric data displayed. In addition, it provided an understanding of how varied the Likert-type scores were (Cresswell, 2005). Chi-square tests were carried out to determine whether there were differences in perceptions due to age of respondent. The same tests were also done to determine whether distance and distance from urban service centres affect community resilience to effects of CC. Results of Chi-square tests were tabulated to compare differences in perceptions using Chi-square values.

Honesty and professionalism were strictly adhered to in the presentation and analysis of data. Data were not tampered with to suit the interests of the researcher or any other party. Data were presented exactly as it reported by the respondent.

5.2 Results and Discussion

5.2.1 Community-perceived meaning of resilience

Table 5.1 displays various community-perceived definitions of resilience. Significant differences were witnessed due to distance from urban centres for all perceptions. Significantly higher proportions (P < 0.01) of respondents residing mid-way from urban centres agreed with the perception that resilience meant "Recovering and living a normal life after a disaster". In addition, significantly higher proportions (P < 0.001) of respondents residing closest to urban centres agreed more with "Thinking about something" and "It reminds us of what happened in the past" as definitions of resilience while significantly higher proportions (P < 0.001 and P < 0.01) of respondent residing the furthest agreed more with "How people survive after climate change" and "Lifestyles and activities do not change even after a disaster" respectively.

Respondents rated higher on definitions of resilience that they felt are applicable to them. It is difficult to attach a meaning as to how their location from urban centres influenced their rankings. This is because these definitions simply showed how they understood the concept and where their priorities lied. Respondents' priorities were uncovered for instance; the importance of always having options during tough times "thinking about something [during difficult situations]" were clarified as constituting resilience. The range of definitions given was proof that resilience is not an easy concept to define. Even scholars like Gardner *et al.* (2007); Heijman *et al.* (2007); and Wade *et al.* (2010) have acknowledged the difficulties and complexities of defining resilience.

Table 5.1 Distance-based community perceptions on the meaning of resilience in Ward 40 of Thulamela Municipality

Responses	Proportion of respondents in agreement, %			χ^2	Significance
	34-48 km	49-56 km	57 km +		
a) Recovering and living a normal life after a disaster[1]	71^a	86^b	83^b	15.98	**
b) Thinking about something	75^a	40^b	47^b	41.20	***
c) How people survive after climate change	57^a	37^b	80^c	73.09	***
d) It reminds us of what happened in the past	78^a	34^b	56^c	61.34	***
e) Lifestyles and activities do not change even after a disaster	77^a	55^b	82^a	18.57	**

*= P < 0.05, **= P < 0.01, ***= P < 0.001

[1]= where Fisher's Exact test was used

Proportions with similar superscripts are not statistically different from each other

5.2.2 Community-perceived indicators of community resilience

Table 5.2 gives respondents' perceived indicators of community resilience in terms of their assets or capitals (i.e. financial, social, human and physical capital). Significant differences due to distance from urban centres were observed from all perceptions except "Affording supplementary food for animals (cattle)", "Affording to buy maize meal", and "Continuing with our daily lives even after droughts or floods". Significantly higher proportions ($P < 0.05$, $P < 0.001$, $P < 0.01$) of respondents residing furthest from urban centres agreed more with the "Ability to secure food from the government", "Not migrating after disasters (drought, floods)" and "Access to other sources of water during droughts" respectively, as indicators of community resilience to climate-related shocks.

Being the village located the furthest, Altein respondents felt that having government support in terms of food and shelter would make a community resilient although they were a bit sceptical about government interventions during crises. They argued that the government does provide food during disasters but sometimes it's not enough for the people, or the assistance comes very late. This concurs with Middlebeek, Kolle and Verrest's (2014) findings in a study on community adaptation in Trinidad and Tobago. Respondents in their study had a general feeling that action by government was inadequate. Residents needed sustainable support instead of short term responsive actions such as giving food and shelter. Twigg (2009) stresses the importance of institutional support in ensuring resilience since no community lives in isolation. However, sorely relying on this support would undermine resilience since communities should have some level of self-reorganization and doing things for themselves.

Furthermore, Altein was also the village that was most served by Shingwidzi river compared to other villages. This probably made them rank "access to alternative resources for instance, water" higher than the other village categories since they had access to the river water and also digging fountains. Moreover, community members had not seen any members migrating from the village and felt this was an indication of resilience. Yet, migration may be an important coping strategy as it helps the communities with remittances therefore balancing the society (IOM, 2008). According to Woods (2012), migration continues to be an adaptive strategy for rural communities in response to CC. Respondents might have viewed migration as a sign of defeat or weakness. This fall into Farinelli's (2008) argument that views the term rural as attributing to solidarity, self-sufficiency and closeness to nature as the qualities required for sustainability. In this case, viewing migration as a failure to deal with challenges is defensible.

Table 5.2 Distance-based community perceived indicators of community resilience in Ward 40 of Thulamela Municipality

Responses	Proportion of respondents in agreement, %			χ^2	Significance
	34-48 km	49-56 km	≥57 km		
Financial capital					
a) Affording supplementary food for animals (cattle)	75^{a}	84^{a}	83^{a}	7.48	ns
b) Affording to buy maize meal	87^{a}	$81^{a,b}$	76^{b}	8.36	ns
Social capital					
a) Having well-equipped local emergency health services during disasters[1]	87^{a}	66^{b}	80^{a}	29.00	***
b) Having warning systems that alert people before disasters strike	91^{a}	61^{b}	72^{b}	25.47	***
c) Having adequate supplies of food, water, medicine and medical equipment in the community	91^{a}	66^{b}	79^{c}	32.17	***
d) Ability to secure food from the government	$60^{a,b}$	45^{b}	71^{a}	15.70	*
Human capital					
a) Not migrating after disasters[1]	72^{a}	42^{b}	74^{a}	25.70	***
b) Changing the diet	74^{a}	57^{b}	49^{b}	20.66	***
c) Continuing with our daily lives even after droughts or floods[1]	83^{a}	87^{a}	83^{a}	8.00	ns
d) Ability to improvise (makeshift houses)	80^{a}	66^{b}	$74^{a,b}$	12.29	*
Physical capital					
e) Access to other sources of water during droughts	73^{a}	58^{b}	80^{a}	16.0	**

*= $P < 0.05$, **= $P < 0.01$, ***= $P < 0.001$

[1]= where Fisher's Exact test was used

Proportions with similar superscripts are not statistically different from each other

Significantly higher proportions (P < 0.001) of respondents residing the closest to urban centres agreed with the rest of the perceptions which were "changing the diet", "having adequate supplies of food, medicine and other resources stored at safe havens in the community", "having early warning systems" as well as "having well-prepared and equipped local emergency services". Responses have perhaps been influenced by location of the respondents. As explained above, respondents residing closer to urban centres had relatively better standards of living, access to television and newspapers, some work in urban centres and therefore there was increased flow of information even through television programmes on how to cope with climate change effects. This might have influenced their perceptions in this regard. The Hulme (2012) argument about the importance of modern travel and media in allowing for a diverse experience also applies here.

5.2.3 Community-perceived resilience status of their community

Respondents in all nine villages felt that their community was resilient to effects of CC. Table 5.3 displays their reasons for feeling that way. The responses show significant differences due to distance from urban centres for all perceptions except "Availability of borehole water...", "Cultivating crops and getting food" and "Re-building houses for ourselves after they are destroyed by floods". Significantly higher proportions (P < 0.05) of respondents residing furthest and closest from urban centres agreed with "Getting food from government" and "Not selling our livestock when disasters affected us" respectively, as indicators of their community's resilience.

The South African government sponsors social grants to senior citizens (Old people's Pension grant) for caring for a young child (Child support grant) as well as to the differently abled people (Disability grant) among others. All qualifying South African citizens benefit from this grant irrespective of race or location. This has helped a large number of rural community members to cushion poverty, food insecurity and also the negative effects of climate change. A large number of unemployed people residing in Ward 40 indicated dependence on this social grant as a source of income to deal with the effects of climate change. This dependence has also been recorded by Blignaut and Van der Elst (2009) in a study done in Limpopo province. Community members therefore feel a bit secure with a monthly source of income during disasters.

Table 5.3 Distance-based community perceived resilience status of Ward 40 of Thulamela Municipality

Responses	Proportion of respondents in agreement, %			χ^2	Significance
	34-48 km	49-56 km	≥57 km		
Social capital					
a) Getting food from government[1]	55[a]	42[a]	67[b]	14.98	*
Physical capital					
a) Not selling our livestock when disasters affected us	80[a]	76[a]	62[b]	12.20	*
b) Availability of borehole water, which means no problems during droughts	74[a]	63[a]	67[a]	4.21	ns
Financial support					
a) Family support e.g. remittances[1]	65[a]	89[b]	66[a]	19.22	**
Human capital					
a) Planting trees using water from boreholes	68[a]	44[b]	63[a]	14.83	**
b) Cultivating crops and getting food[1]	71[a]	69[a]	73[a]	7.47	ns
c) Drying vegetables to eat during drought periods	80[a]	92[b]	83[a,b]	17.35	**
d) Re-building houses for ourselves after they are destroyed by floods[1]	90[a]	86[a]	91[a]	6.53	ns
Natural capital					
a) Drying Mopani worms[1]	92[a]	73[b]	92[a]	22.94	***
b) Using water from natural fountains	67[a]	40[b]	57[a]	31.23	***
c) Fetching water from Shingwidzi River	88[a]	50[b]	67[c]	44.15	***

*= $P < 0.05$, **= $P < 0.01$, ***= $P < 0.001$

[1]= where Fisher's Exact test was used

Proportions with similar superscripts are not statistically different from each other

Respondents indicated that the government intervenes during disasters although they showed dissatisfaction with the assistance they get. The fact that some and not all respondents mentioned getting food from the government could probably have been an issue of faith or appreciation of the kind of help communities receive during tough times. This is in tandem with Middlebeek, Kolle and Verrest's (2014) findings in a study done in Trinidad and Tobago. The authors found out that community under study felt action by their government was inadequate, and is reactive and unsustainable instead of being proactive and long term. On the other hand, respondents residing closest to the urban centres argued that they had not sold their livestock during disasters probably either because they had access to diverse coping strategies because of their proximity to an urban area, or they generally owned very few or no cattle. This resonates with Madison's (2006) argument that perceptions are shaped by experience and exposure to risk.

In addition, significantly higher proportions ($P < 0.01$) of respondents residing midway between the closest and the furthest points from urban centres agreed with "Family support e.g. remittances", "Planting trees using water from boreholes" and "Drying vegetables to eat during drought periods" , as indicators of their community's resilience to climate shocks. Remittances have also been an important source of income for rural communities apart from the government social grant. Boillat and Berkes (2013) also had similar findings in their study. They noted extensive familial and social networks reaching beyond the community, off-farm labour and out migration as important coping mechanisms employed by the Quechua farmers in Bolivia. Furthermore, respondents noted their efforts to try and plant fruit trees using water from boreholes although they were not very successful. Many of these trees dried up due to lack of water and too much heat. To add more, vegetables like 'muchina', 'theka' and 'guze' were dried and consumed as relish during difficult times.

Significantly higher proportions ($P < 0.001$) of respondents residing closest to urban centres agreed with "drying Mopani worms", "using water from natural fountains" and "fetching water from Shingwidzi River" as indicators of their community's resilience to climate-related shocks. Shingwidzi River passes through the villages in this category (Halahala, Mabayeni and Merwe) and has its greater part serving Altein. Therefore, they had more access to the river compared to other villages. It is surprising that this group mentioned Mopani worms as an alternative source of protein which in turn made the community resilient when in actual fact they resided far from the bushes or forests. It is likely that this is a result of association with other community members that have access to Mopani worms or simply a matter of preference.

5.2.4 The effect of distance on community resilience to effects of Climate Change

All the respondents agreed with the view that communities located close to towns (for example those near Malamulele) were more resilient to the effects of climate change than those far away. In Table 5.4, their reasons are grouped into access, affordability, support and diversity. No significant differences due to distance from urban centres were observed for most of the perceptions except "Food is cheaper in the city", "Government intervenes faster e.g. getting temporary tents faster in the event of floods compared to where we live", and "They get water easily, so they can do gardening and water their plants".

Significantly higher proportions ($P < 0.05$ and $P < 0.01$) of respondents residing closest to urban centres agreed with the perceptions that "Food is cheaper in the city" and "They get water easily, so they can do gardening and water their plants" respectively.

Social interactions and life experiences are some of the factors that form the basis of individual and collective interpretations of perceptions (Hartter *et al.*, 2012). This most likely influenced respondents' perceptions on the prices of food, accessibility of water and the opportunities that came with that. Respondents were in constant association with people from urban centres and often went shopping in the urban centres and therefore aware of the benefits of staying in urban centres when dealing with the effects of climate change.

Similarly, significantly higher proportions ($P < 0.05$) of respondents located mid-way from urban centres agreed more with the view that "Government intervenes faster e.g. getting temporary tents faster in the event of floods compared to where we live". As mentioned above, respondents noted that the government does intervene during difficult times. The fact that some rank this perception more than others is probably a matter of attitude towards the kind of assistance community members are getting compared to what they really expect. Similar sentiments have been echoed in previous studies (Middlebeek *et al.*, 2014).

Table 5.4 Distance-based community perceptions on the view that communities located close to towns (for example those near Giyani, Malamulele or Thohoyandou) are more resilience to the effects of climate change than those far away

Responses	Proportion of respondents in agreement, %			χ^2	Significance
	34-48 km	49-56 km	57 km and above		
Access					
a) Better access to almost every resource and services in the cities[1]	93[a]	92[a]	92[a]	.82	ns
b) Better job opportunities[1]	96[a]	94[a]	92[a]	3.40	ns
Affordability					
c) Food is cheaper in the city[1]	98[a]	90[b]	92[b]	8.78	*
d) Most urban dwellers are educated and rich, meaning they can afford insurance[1]	92[a]	82[a]	85[a]	7.86	ns
Support					
a) Government intervenes faster e.g. getting temporary tents faster in the event of floods compared to where we live[1]	94[a]	100[a]	87[b]	11.07	*
b) Better infrastructure in the city compared to ward 40	93[a]	94[a]	89[a]	3.00	ns
Diversity					
a) People in the city do not rely on farming so they have other options[1]	95[a]	90[a]	92[a]	8.69	ns
b) They get water easily so they can do gardening and water their plants[1]	94[a]	84[b]	90[a, b]	17.67	**

*= $P < 0.05$, **= $P < 0.01$, ***= $P < 0.001$

[1]= where Fisher's Exact test was used

Proportions with similar superscripts are not statistically different from each other

5.2.5 Coping strategies used to combat the effects of CC

In Table 5.5, strategies employed by communities to cope with the effects of CC were also grouped into the five capitals namely, human, physical, natural, financial and social. More than half of the responses show significant differences due to distance from urban centres. Under human capital, significantly higher proportions (P< 0.01) of respondents residing furthest and mid-way from urban centres agreed with "Selling home- brewed alcohol to buy food" and "Changing family diets to cheaper or less preferred foods" as relevant coping strategies. Respondents residing the furthest from the urban centre appeared to suffer more due to longer distances as revealed by their coping strategies. Unlike those staying closer to urban centres, respondents staying further agreed more with switching to cheaper and less preferred foods as well as selling traditional beer as very common strategies. These strategies are similar to those found in studies done by the IUCN (2009), Manyatsi *et al.* (2012) and Chikodzi *et al.* (2012).

For physical capital, significantly higher proportions (P < 0.001) of respondents residing closest to urban centres agreed more with "Keep on farming despite droughts" while significantly higher proportions (P < 0.001) of respondents residing furthest agreed with "Drying vegetables and Mopani worms" and "Storing pumpkins and preparing traditional meals (Tshopi)". Although farming did not produce much in recent years due to reduced rainfall and shorter seasons, some respondents valued the little they harvested. Those residing furthest also ranked higher some perceptions for instance drying vegetables and preparing traditional dishes. This shows a range of coping strategies that community members have. Evidence of this is also produced through the research done by Woods (2012) which emphasizes the highly geographical character of rural experiences of climate change. In their study in Australia, (Nelson *et al.*, 2010a, 2010b) discovered that the impact of climate change on rural communities is spatially differentiated as modelling of rural community vulnerability to CC in that country by economists showed. Such variations reflect social, economic and political factors that influence the adaptive capacity of a community. Since these community perceptions were informed by individual experiences, the differences between them represented the discrepancies in their access as well as exposure to different capitals or assets.

Table 5.5 Distance-based community perceived coping strategies used when affected by hazards caused by climate change in Ward 40 of Thulamela Municipality

Responses	Proportion of respondents in agreement, %			χ^2	Significance
	34-48 km	49-56 km	≥57 km		
Human capital					
a) Erecting makeshift houses	72^a	87^b	$75^{a,b}$	6.43	ns
b) Reducing the size or number of meals a day	45^a	40^a	38^a	3.01	ns
c) Resorting to seasonal migration to find pastures	52^a	57^a	62^a	6.80	ns
d) Spending some days without eating all day	38^a	$27^{a,b}$	23^b	12.73	*
e) Selling home- brewed alcohol to buy food	$75^{a,b}$	66^b	81^a	14.43	**
f) Changing family diets to cheaper or less preferred foods	59^a	60^a	44^b	17.53	**
Physical capital					
a) Moving to public buildings	79^a	66^a	72^a	8.58	ns
b) Keep on farming despite droughts[1]	81^a	45^b	77^a	32.71	***
c) Making fountains to get water	67^a	$63^{a,b}$	55^b	16.87	**
d) Drying vegetables and Mopani worms	83^a	63^b	87^a	21.87	***
e) Storing pumpkins and preparing traditional meals (Tshopi)	79^a	52^b	81^a	23.97	***
f) Selling some household possessions	36^a	39^a	30^a	7.62	ns
g) Consuming seed meant for planting	74^a	87^b	57^b	35.51	***
Natural capital					
a) Fetching water from other villages	82^a	82^a	67^b	14.48	**
b) Gathering vegetables from the forests	$65^{a,b}$	58^b	75^a	12.43	*
c) Selling wood to buy food	79^a	68^a	71^a	14.04	**
Financial capital					
a) Buying food to counter drought for both people and livestock	88^a	89^a	77^b	9.45	ns
b) Selling livestock to generate money	86^a	$79^{a,b}$	75^b	6.07	ns
c) Accessing and using social grants	85^a	77^a	85^a	6.42	ns
Social capital					
a) Collecting money from the community to support affected families	47^a	48^a	44^a	6.69	ns
b) Borrowing food or money to buy food	83^a	81^a	65^b	13.78	**
c) Getting assistance from the government.	43^a	31^a	64^b	25.00	***

*= P < 0.05, **= P < 0.01, ***= P < 0.001

[1]= where Fisher's Exact test was used

Proportions with similar superscripts are not statistically different from each other

As is the case with other results presented above, significantly higher proportions ($P < 0.001$) of respondents located midway from urban centres agreed more with "Consuming seed meant for planting next season, in order to have enough food to eat". Under natural capital, significantly higher proportions ($P < 0.01$) of respondents residing closest to urban centres agreed more with "Fetching water from other villages for example, Mtititi and Plange…" and "Selling wood to buy food". Autonomous and often reactionary coping strategies were evident from the responses given by community members as their coping strategies. These clearly showed how desperate communities already are. These include selling wood and sometimes buying water from other villages. According to Sacramente *et al.* (2013), strategies like selling firewood are based on short term considerations, survival needs, lack of information or imperfect foresight that can worsen environmental degradation and thereby diminish future adaptive capacity and livelihood options. These kinds of coping strategies showed that these communities are not resilient to effects of CC since they take communities deeper into poverty making the situation worse.

Significantly higher proportions ($P < 0.05$) of respondents located the furthest from urban centres also agreed more with "Gathering vegetables from the forests - only there during very dry seasons for instance, *Nyerere*". For social capital, significantly higher proportions ($P < 0.01$ and $P < 0.001$) of respondents residing closest and furthest agreed more with the views "Borrowing food or money to purchase food" and "Getting assistance (food parcels, accommodation) from the government" respectively. As indicated above, the variations in ranking of forest-related activities is directly related to access to forests. Villages located the furthest enjoyed the benefits of their closeness to the forests where they would gather vegetables, fruits and sometimes hunting unlike those that were located far from the bushes. Fisher *et al.* (2010) asserts that forests are an important resource for reactive adaptation. Forests foods are used as substitutes for crops during poor weather events.

Respondents mentioned borrowing from each other as a coping strategy although they explained this is becoming uncommon nowadays. This is in line with findings from Blignaut' and Van der Elst's (2009) study done among the VhaVenda communities in the Vhembe Biosphere Reserve. Respondents in this study indicated that their capacity to help each other as a community was decreasing due to the effects of climate change. They indicated their inability to borrow from each other because each household only had enough for themselves during tough times. The only left option for them was be to wait for the government to provide food parcels and tents when times are tough. These intense life challenges have eroded the rural solidarity that people were used to in the past.

5.3 Conclusion

It is clear from the above discussion that distance from urban service centres is an issue when it comes to resilience to effects of climate change. This was discovered both from looking at community perceptions on the relationship between the distance from urban service centres and community resilience, as well as from a qualitative analysis of their coping mechanisms. Community perceptions have indicated that the further away a community was from an urban centre, the less resilient it was likely to be. This is because in general, the community was far away from various resources and services that it could tap into in order to buffer itself from serious climatic shocks and move on with life. Although the community argued that they were resilient to effects of climate change, an assessment of the coping strategies that they used tells a different story. Coping strategies were either merely just survival strategies that are unsustainable or dangerous enough to perpetuate vulnerabilities. A situation whereby a community solve one problem by introducing another would mean that instead of recovering, it would just go in circles breeding and perpetuating poverty. In addition, the coping strategies showed that there were different concerns and coping mechanisms for different distance groups. This confirms the fact that communities are not uniform; their vulnerabilities are different and so are their coping mechanisms. Generalising intervention strategies will therefore miss inherent risks to particular sub-communities. There is therefore need for area-specific studies on resilience to effects of climate change that takes distance into consideration.

CHAPTER 6: MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The study focused on resilience of rural communities to effects of CC in Ward 40 of Thulamela Municipality. Community members; youth (both male and female), adults (men and women) and the elderly participated in this study. They gave their insights on definitions, causes and effects of CC as well as their understanding of resilience. Participants were also given a chance to evaluate the resilience status of their own community to effects of CC. In addition, their coping strategies were assessed to establish their resilience to effects of CC. The hypothesis that distance from urban service centres does not affect community resilience to the effects of CC was rejected. This chapter will provide a synthesis of the major research findings. Furthermore, recommendations for development practice, policy making or review and research will be drawn from this synthesis.

6.1 Importance of Projecting the 'Community Voice'

Luni *et al.* (2011) discovered that the view of local communities about the on-going changes in climate, its causes and impacts can be entirely different from what science has explained about climate change. This knowledge gap proved to be true in this study especially on the causes of CC. According to Buys *et al.* (2012) research on perceptions enables scientists and policy makers to better understand community attitudes and behaviour and in turn identify and systematically target specific structural and psychological CC understanding, acceptance and adaptation. Without knowledge on community perceptions, it will be difficult for policy makers to come up with targeted intervention strategies that help people cope with climatic stresses. Haque *et al.* (2012) adds that it is important to know these perceptions since people frequently act on their perceptions, change their behaviour, and develop coping strategies based on their dynamic and evolving knowledge. This shows that since coping is a behavioural and emotional response, both local and expert opinions count as valuable leads if communities are to bounce back and become resilient. Table 6.1 below gives a summary of the major findings of the study.

Table 6.1: Major Results of the Study

Research Objective	Major findings	Implications
1. To determine what rural communities regarded as climate change, its causes and effects.	Rural community members were aware of the changing climate and were able to define CC through their life experiences. Perceived causes were mainly negative, and embedded in traditional beliefs for the elderly. For the youth, perceived causes of CC were informed by modern sources of information.	Community perceptions are valuable since they provide important insights for targeted adaptation strategies Water was a serious challenge in the area under study. Any adaptation efforts in this community should first address water problems. Communities should strengthen their adaptation strategies in order to cope successfully.
2. To determine the characteristics of communities that are resilient to the effects of CC.	Respondents characterised resilience with the ability to draw from their different capital assets (financial, human, social, natural and physical capitals). There was evidence of heavy reliance on the government for instance; through social grants, relief food and accommodation.	Coping strategies given are merely survival strategies. Community members are therefore not necessarily resilient but are just managing to get by. Communities need external support in order to become resilient to effects of CC
3. To determine if distance from urban service centres affected community resilience to effects of CC.	Community members perceived that the further a community is from urban service centres, the less resilient it becomes. This is because there is limited access to important livelihood sources for instance job opportunities	Rural communities are failing to cope with climatic shocks and the situation is worse for those rural communities located very far from urban areas since they are far from all the resources that they can benefit from.
4. To explain the strategies that the rural communities in the area under study use to cope with the effects of CC	Most common coping strategies noted were erecting makeshift houses, the use of government social grant and moving to strong public buildings. Accessing social grants has cushioned communities from poverty but is not a sustainable coping mechanism.	Perceived coping strategies were very weak and unsustainable for instance; reducing size or number of meals a day, consuming seed meant for planting next season, selling cattle and firewood. These drive them deeper into poverty while at the same time perpetuating CC

6.2 Recommendations for Development Practice

a) There is need for creating space for civic engagement both horizontally and vertically where relationships and dialogue overtime, across networks and perspectives will be held.

b) Promoting creation of authentic partnerships based on the interests of the community rather than relationships of patronage is also important. Grassroots communities should have a voice or a way to participate in the decisions that affect them and their community. This would allow them to define their own future.

Recommendations for climate change scientists

a) CC information need to be tailored to the needs and predispositions of particular audiences. If information is meant for the rural folk, the language needs to be simplified or translated to local languages in order to invite grassroots people to join the climate change conversation.

b) Climate information should also target rural communities residing the furthest from urban centres since they are affected the most by climate change and can also be part of adaptation and mitigation efforts

Recommendations for policy makers

a) Since there is a huge variation among rural areas, policies need to be addressed and tailored to the situation in a specific rural context involving all actors shaping rural areas.

b) There should be appropriate policy planning committed to respond to community priorities. Government should regard participation not as a moment or process related to specific policies but in terms of planning and implementation.

c) Planning should be integrated into wider development policies since CC challenges are overwhelmingly interconnected with wider community livelihood problems. These should be integrated with emergency response and recovery – not undermining community participation.

d) There is need for climate education; public awareness programmes, knowledge and skills on CC as well as how to mitigate and adapt to its effects. Information management and sharing, education and training should be promoted to also incorporate community cultures and attitudes

e) There should be early warning systems, preparedness and contingency planning, emergency resources and infrastructure so that communities anticipate climate-induced disasters and prepare for them.

Recommendations for further research

a) More and more area-specific studies on community perceptions and resilience to CC since different areas are affected by CC differently. This information will be important for informing policy

b) There should also be on-going monitoring of hazards and risks and updating of assessment skills and capacity to carry out community hazard and risk assessments maintained through support and training. Updating assessment skills will reduce inappropriate adaptation models that could mislead policies.

6.3 Conclusions

This study assessed resilience of rural communities of Ward 40 of Thulamela Municipality to the effects of CC. Although community members thought that their communities were resilient, it was established that not all current local strategies to cope with hazards were efficient or appropriate for long term adaptation and therefore need to be improved. Community members also revealed their perceptions on the climate change, its causes as well as its effects. Although some of their understandings could not be proved scientifically, it is important to know them since it's these perceptions that influence behaviour on developing coping strategies. It is these perceptions that matter the most regardless of whether or not they are consistent with meteorological data. Therefore knowing them would be half the solution for intervention strategies.

Being resilient is more than just ability to bounce back after experiencing adverse event; it is also about anticipating change and having policies and programmes in place that make positive rather than negative outcomes achievable. This anticipation has been lacking in the community under study due to lack of information or awareness programmes. It was also evident from the results of the study that community perceptions varied due to either respondent's age group or location (distance from urban centres). This echoes the argument that people from the same geographical area can be affected by CC to varying degrees depending on access to resources, interaction and exposure to the risk as well as general life experiences. This warrants more area specific assessment studies in order to pick up these complexities. Clearly, a one-size-fits-all approach to CC adaptation will not address all the diverse challenges community members are constantly facing.

Although community resilience entails concentrating on what communities can do for themselves, they cannot fight the battle alone. There is need for all the stakeholders for instance, policy makers, scientists, researchers, NGOs, and development practitioners to each play a role and share the burden of responsibility for adaptation. However, empowering communities to also interrogate the institutions and social structures can be a successful way of improving adaptation.

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APPENDICES

Appendix 1: Questionnaire used for data collection

Resilience of Rural Communities to effects of Climate Change of Ward 40 of Thulamela Municipality, Vhembe District, South Africa

Introduction

My name is Pertina Nyamukondiwa. I am a student at University of Venda registered for the Masters in Rural Development (MRDV) programme within the Institute for Rural Development. I am conducting research focusing on ***Resilience of Rural Communities of Ward 40 of Thulamela Municipality to the effects of Climate Change.*** Through this communication, I am requesting you to participate in this study. Any information you will provide will be treated as confidential and will not be revealed to any other person. Please note that your participation is strictly voluntary. This means you can opt to pull out any time should you feel uncomfortable.

Signature of Researcher ______________________________ **Date**__________________

I……………………………………have read and understood the contents of this invitation to participate in the study. Thus, I hereby voluntarily consent to participate in the research.

Respondent signature __________________________ **Date** ___________________

Section A: Demographic information

Instructions: Please tick (✓) the response that you find most appropriate

Age **1.** 15-18 years **2.** 19-25 years **3.** 26-35 years **4.** 36-60 years

5. 61 years & above

Gender **1.** Male **2.** Female

Village ....

Distance ....

Section B

Please indicate how far you agree with the following responses by using a scale of **1** (totally disagree) to **20** (totally agree) in the boxes below. Note that the higher the score, the greater the level to which you agree with the statement. Use only numbers between 1 and 20.

Q1.1 When someone says the climate has changed what does it mean to you?

Responses	Score
1. Heavier storms nowadays than in the past	
2. Reduced rainfall	
3. Unpredictable weather	
4. Warmer winters	
5. In the past, the first moon was often followed by rain. Now this does not happen	
6. In the past, heavy winds were experienced in July but now this happens in August	
7. Late onset of rainy season	
8. Some wild fruits are no longer there	
9. Some animals have disappeared	
10. Some bird species are no longer seen	
11. Late flowering fruit trees	

12. Change in cultivated crops	
13. Change in cropping calendar (sowing and harvesting times of crops)	

Other, specify

....

....

Q1.2 What climate-related events have been experienced in your area?

Responses	Score
1. Droughts are more recurrent	
2. More heavy thunderstorms	
3. Floods are more recurrent	
4. Veld fires	
5. Snow and hail now experienced	

Others, *specify*

....

....

Q1.3 What do you regard as the causes of climate change?

Responses	Score
1. Burning of garbage	
2. Deforestation	
3. We have lost touch with our tradition and customs	
4. We no longer perform rain making rituals anymore	
5. Too many vehicles which emit too much smoke	
6. Air pollution/Aluminium pots industry - they burn coal	
7. Perfumes not ozone-friendly	

Others, *Specify*

....

....

Q1.4 What effects does climate change have?

Responses	Score
1. Cattle die because of lack of water and grass. Rivers that used to flow throughout the year are now dry most of the time	
2. Crops destroyed by floods and wild fires	
3. Roads and bridges are washed away	
4. People die (especially when we have floods)	
5. Shortage of water to drink	
6. Houses are damaged /destroyed by floods and strong winds	
7. Trees (mango) drying due to lack of water	
8. Shortage of food	
9. People left homeless	
10. Rivers overflowing and washing away crops and animals	
11. Diseases e.g. cholera experienced	
12. Worsening soil erosion	
13. Lower crop yields due to drought or floods	
14. Crop diseases and pests worsening	
15. Livestock diseases and pests worsening	
16. Food became expensive: Significant increase in food prices	

Other, specify

……

……

Q2.1 What do you regard as the meaning of resilience?

Responses	Score
1. Recovering and living normal life after a disaster	
2. Thinking about something	
3. How people survive after climate change	
4. It reminds us what happened in the past	
5. Lifestyles and activities do not change even after a disaster	

Other, specify

....

....

Q2.2 What would show you that a community is resilient to a serious shock?

Responses	Score
1. Ability to provide supplementary food for animals (cattle)	
2. Ability to improvise e.g. make shacks or makeshift houses to shelter victims of floods	
3. Ability to secure food from the government	
4. Not migrating after disasters (drought, floods)	
5. Changing the diet	
6. Affording to buy maize meal	
7. Continuing with our daily lives even after droughts or floods	
8. Access to other sources of water during droughts	
9. Having well-prepared and equipped local emergency health services and trained volunteers during disasters	
10. Having warning systems that alert people before disasters strike	
11. Having adequate supplies of food, water, medicine and medical equipment stored at safe havens and emergency management centres in the community	

Other, specify

....

Q2.3 What shows that your community is resilient?

Responses	Score
1. Yes. We get food from government	
2. We use water from natural fountains	
3. We did not sell our livestock when disasters affected us	
4. Family support e.g. remittances	
5. We have borehole water, which means no problems during droughts	
6. We plant trees using water from boreholes	
7. We cultivate crops and get food	

8. We dry vegetables to eat during drought periods	
9. Dry Mopani worms	
10. We re-build houses for ourselves after they are destroyed by floods	
11. We fetch water from Shingwidzo River (is perennial?)	

Other, specify

………

………

Q3.1 Do you agree with the view that communities located close to towns (for example those near Giyani, Malamulele or Thohoyandou) are more resilient to the effects of climate change than those far away?

Responses	Score
1. Yes. They get water easily. They can do gardening and water their plants	
2. People in the city do not rely on farming so they have other options	
3. Better infrastructure in the city compared to ward 40 (floods, storms)	
4. Better access to almost every resource and services in the cities	
5. Government intervenes faster e.g. getting temporary tents faster in the event of floods compared to where we live	
6. Food is cheaper in the city	
7. Better job opportunities	
8. Most urban dwellers are educated and rich, meaning they can afford insurance	

Other, specify

………

………

Q4.1 Coping strategies: What do members do when affected by hazards caused by climate change?

Responses	Score
1. During floods people erect makeshift houses (erect poles to support roofs and cook inside)	
2. Moving to strong buildings, schools/tents during floods	
3. Accessing and using social grants to buy food	
4. Fetching water from other villages eg Mtititi, Plange (salty water for livestock) and Malamulele as it comes only twice a week	
5. Buying food to counter drought for both people and livestock	
6. Selling livestock to generate money to use to buy food for the livestock	
7. We keep on farming despite droughts	
8. Home-made alcohol brewed and sold to buy food	
9. We make fountains to get water	
10. We collect money from the community (contributions) to help/support affected families	
11. We sell wood to buy food	
12. We gather vegetables from the forests - only there during very dry seasons "Nyerere"	
13. Drying vegetables and Mopani worms	
14. Storing pumpkins and prepare traditional meals (Tshopi)	
15. We get assistance (food, accommodation) from the government.	
16. We reduce size or number of meals a day	
17. We spend some days without eating all day	
18. We change family diets to cheaper or less preferred foods	
19. We resort to longer seasonal migration to find pasture from animals	
20. We sell some household possessions, in order to have enough food to eat	
21. We borrow food or money to purchase food	
22. Sometimes we consume/eat seed meant for planting next season, in order to have enough food to eat	

Other, specify

....

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Q4.2 What else do you think might help reduce the effects of climate change?

Responses	Score
1. Constructing paddocks for grazing	
2. Stop cutting trees since they protect people from windy conditions	
3. Drilling boreholes	
4. Government to provide cheap electricity and stoves to reduce or stop deforestation	
5. Change in construction style and materials used so as to build strong houses that offer better protection from floods	
6. People should stop starting forest fires	
7. Educate the local people about climate change	
8. Government should provide adequate food during droughts	
9. Build a big dam in the community especially along the river that passes through the area	
10. Start farming projects taking advantage of dam water	
11. Making and mounting water tanks	
12. Initiate viable farming projects to supply cheaper foods	
13. Government or NGOs should build stronger houses for the poor (RDP) to cope with effects of climate change	
14. Government to create better job opportunities	
15. Reverting to old customs and traditions such as Kelekele	

Other, specify

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....

Is there anything else about climate change you feel you need to add?

....

....

Is there anything else about resilience to the effects of shocks that you believe you need to add?

....

....

note of' meant and therefore unclear what nations were agreeing to do in order to reduce emissions.

At the Cancun conference, parties recognized the need for deep cuts in global emissions, in order to limit global average temperature rising by 2°C. Parties also agreed to keep the global long-term goal under regular review and consider strengthening it during a review by 2015, including in relation to a proposed 1.5°C target. The Council on Foreign Relations (2011) observed that little progress was made during the COP – 17 meeting in Durban. While parties agreed to extend the Kyoto Protocol until at least 2017, as well as solidified an operating structure for the Green Climate Fund, little was clarified concerning the form of a successor accord to the Kyoto protocol. Similarly, the December 2012 Doha Climate Change Conference is said to have made very little progress and failed to set more ambitious goals for reducing GHG emissions (Munang and Hyvarinen, 2013). The authors lament that that failure increases the risk of a rise in average global temperatures by 2°C by the end of this century. In a broader sense, every failure of these conferences to achieve meaningful agreements means a lost opportunity to both curbing GHG emissions as well as coming up with adaptation solutions. This continually takes a toll on poor developing countries especially their rural populations.

At the national level, policies seem to be made by the government and other institutions in the absence of rural community representatives – for whom the policies are meant to benefit. This approach has led to failure of these policies since they often do not address the real issues. Even at international level, important conferences for instance the Durban Conference of Parties (Cop) 17 conference, people from the very affected communities are not represented – only high level officials; policy makers, businessmen, government officials. There is need to be inclusive when dealing with CC. Since the people on the ground are experiencing the effects already and will be affected the most, they know exactly what needs to be done if they are to become resilient.

Jobodwana (2011) maintains that because of the lag times in the global climate system, no mitigation efforts, no matter how rigorous and relentless, is going to prevent CC from happening in the next few decades. In fact, the first few impacts are already being observed in natural systems. Successful adaptation is, therefore, a necessity. Reliance on adaptation alone could well lead to a magnitude of CC to which affective adaptation is only possible at very high social economic costs. Thus, it is no longer a question of whether to mitigate CC or to adapt to it because both mitigation and adaptation are essential in reducing the risks of CC. Nonetheless,