

**THE IMPACT OF CLIMATE CHANGE: ITS IMPLICATIONS AND THE  
INDIGENOUS ADAPTATION MEASURES FOR SUSTAINABLE LIVELIHOOD IN  
DIKGALE COMMUNITY IN LIMPOPO PROVINCE**

By

**Chikosi Shingai Ernesthart**

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**SUPERVISOR: Prof. SA Rankoana**

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## DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo for the degree of Master of Arts in Anthropology has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution; and that all materials contained herein has been duly acknowledged.

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Surname, initials

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date

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## **ABSTRACT**

Climate change as a developmental problem warrants extensive research to provide information about its implications on the socio-economic and health conditions of rural communities and the types of local adaptation measures they have developed and used to limit its effects. There is evidence that climate change and its negative impacts are mostly felt by poor and rural communities whose economies are dependent upon favourable climatic conditions. Explanations of climate change and its threats to rural communities are among major challenges faced by scientists. Fewer studies prove that these communities are aware of change in climatic conditions and their impacts on people's livelihoods. The present study explored the community's perceptions of climate change, its impacts on the livelihoods of the community and the mechanisms developed and used by community members to adapt to the impacts of change in climatic conditions. Interviews with community members revealed that the members of Dikgale community are aware of changes in climatic conditions and how these changes impact on their livelihood. They are aware of increased temperature and erratic rainfall patterns. These changes have impacted negatively on their cultural activities. However, adaptation measures used to cope with the change are the indigenous knowledge systems which are informed by the culture and world-view of the community.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

The global scale interconnectedness and economic intensity of contemporary human activity are historically unprecedented, as are many of the consequent environmental and social changes. These global changes fundamentally influence a syndrome that reflects the interrelated pressures, stresses, and tensions arising from an overly large world population, the pervasive and increasingly systemic environmental impact of many economic activities, urbanization, the spread of consumerism, and the widening gap between rich and poor both within and between countries (Lee et al., 2012).

Environmental views and perceptions of climate change are related to people's physical surroundings and experiences. People who inhabit places recognized as physically vulnerable to climate change impacts in certain overt ways, for example living in low-lying coastal areas, have been identified as having a heightened sense of personal risk (Brody et al., 2008). Furthermore, there is some evidence that experience of an ecological disaster, for example an oil spill, or an environmental problem, for example drought, can impact environmental views of the local community affected (Dessai & Sims, 2010).

Climate change impact on human and natural systems are severe, far reaching, and affect the most physically and economically vulnerable people (IPCC, 2007). Society can respond to these threats through two distinct strategies: adaptation and mitigation. Adaptation involves preventive measures to avoid, prepare for, or respond to potential impact from climate change. The goal of adaptation is to reduce the associated risk to population health through a wide range of interventions including health behaviors, clinical procedures, or technical/structural measures. Adaptation, which tends to act in the short-term and is intuitive, tangible, and direct

can also involve long-term planning of a public health response to climate change (McMichaels & Kovats, 2000).

South African National Climate Change Response White Paper presents government's vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society. The goal of South Africa's response to climate change is aimed at effective management of inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity. It also seeks to make a fair contribution to the global effort to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner. This response is guided by principles set out in the Constitution, the Bill of Rights, the National Environmental Management Act, the Millennium Declaration and the United Nations Framework Convention on Climate Change.

Although the response strategic approach for South Africa's climate change response is needs driven and customized, developmental, transformational, empowering and participatory, dynamic and evidence-based, balanced and cost effective, and integrated and aligned; it does not address the role of community-based practices, which are culture-specific and could be relevant and cost-effective in coping with climate hazards. However, an African centered approach is used to explore a rural community's perceptions of climate change, its impact and the adaptation practices developed and used by community members to cope with climate change hazards.

The present study explored the community's perceptions of climate change, its impact on the livelihoods of the community and the mechanisms developed and used by community members to adapt to the impact of change in climatic conditions. The study demonstrates the community's awareness of change in climatic conditions in the form of increased temperature and erratic rainfall patterns. The study revealed that climate change had a great impact on community's livelihood patterns, for instance subsistence economy and health conditions are



mostly affected. Adaptation to the impact of change is through the indigenous knowledge systems developed and used by community members to respond to change.

Research on local communities' explanations of climate change and their potential for adaptation to climate change hazards is limited. The present study was necessary to be undertaken in a rural community because recent studies are focused on the causes and impact of climate change in cities, town and rural areas. There is little attention given to the rural communities in which livelihoods are mostly climate-dependent. There are assertions from fewer studies that climate change and its negative impacts are mostly felt by poor and rural communities whose livelihoods are dependent upon favourable climatic conditions (Bhusal, 2009; Chaudhary & Aryal, 2009).

Indigenous societies are largely excluded from climate change policies and decision-making processes as shown in a virtual lack of references to the existing traditional knowledge on climate change in the global, national, and local climate change discussions. To date, valuable insights held by rural communities globally about direct and indirect impacts of, as well as mitigation and adaptation approaches to climate change, remain largely unrecognized. Bhusal (2009) attests to this observation that stressful climatic extremes leave local communities searching for solutions to minimise climatic and social threats to their livelihood (Smith & Reynolds, 2005; Brohan, Kennedy, Harris, Tett & Jones, 2006; Caesar & Alexander, 2006). At the local community level, community members have developed culturally-based mechanisms of coping with harsh weather conditions which negatively affect their subsistence economies, cultural rituals and festivals, health conditions and the natural environment from which they derive their livelihood (IPCC, 2007; FAO, 2007; Jianchu, Shrestha, Rameshananda, Vaidya, Eriksson & Hewitt, 2007).

## **1.2. Problem statement**

There is remarkable increase in warm days, erratic rainfall patterns and ecological variability, as well as decrease in water levels and depletion of biodiversity. The effects of these conditions are already being experienced in various regions of the

world and are predicted to increase due to human factors such as pollution from factories and mines as well as natural factors such as excessive heat, floods, drought, wind and soil erosion (Downing, 1992; Bhursal 2009). Adaptation to changing climatic conditions is a challenge. Anthropological literature on climate change provides that local communities have developed culturally-based mechanisms of adaptation to harsh weather conditions which negatively affect their subsistence economies, cultural rituals and festivals, health conditions and the natural environment from which they derive their livelihood (IPCC, 2007; FAO, 2007; Jianchu et al., 2007).

Scientific studies in the disciplines of Anthropology, Geography and Botany explored areas of knowledge such as the causes of changing climatic conditions, its effects on the economy, natural resources, human health and the mechanisms of adaptation to changing living conditions as a result of climate change (Yohe & Tol, 2002; Adger & Vincent, 2004; Brenkert & Malone, 2005;). Little was researched about the implications of climate change as perceived by the local community and the indigenous adaptation strategies people have developed to sustain their livelihood. Strategies to deal with the implications of climate change within communities are complex and culturally embedded and are not well explored. Available literature on the intersection of the implications of climate change and adaptation measures provides that adaptation to climate change through the use of traditional adaptation measures is limited (Smith et al., 2001; Bhusal, 2009). The present study investigated the local community's understanding of the implications of changing climatic conditions on people's livelihood and the adaptive measures they have developed and use to maintain their lives.

### **1.3 Study purpose**

The purpose of the study was to explore rural community members' perceptions of climate change, its impact on the livelihood of the community and the adaptation measures developed and used by community members to sustain their livelihood. The main objective was to determine the knowledge of Dikgale community about change in climatic conditions. The study also demonstrates the community's awareness of the implications of changing climatic conditions on their socio-

economic and health conditions. Adaptive measures developed and used by Dikgale community members to sustain their livelihood are also examined.

#### **1.4 Significance of the study**

Climate change as a developmental problem warrants extensive research to provide information about its implications on the socio-economic and health conditions of rural communities and the types of local adaptation measures they have developed and used to limit its effects (Stern, 2006). Scientific studies provide little knowledge about local people awareness of the implications of change in temperature, seasonal and rainfall patterns (Richard, 2004; Stern, 2006). Rural communities' understanding of the implications of climate change attracted academics such as Bhusal (2009) and Kruger and Setswe (2012). In South Africa little knowledge and credible evidence on the local communities' awareness of the impacts of changing climatic conditions and adaptation strategies are major limitations (Kruger et al., 2012).

Research about the local perceptions of climate change in the Limpopo Province shows that climatic and ecological changes caused by global warming have caused negative consequences on people's health, economy and cultural activities (Kruger & Sekele, 2004; Seager, 2008). The present study results may contribute knowledge about the potential and observed implications of climate change and the indigenous adaptive measures developed by rural community members to adapt and cope with the impact of climate change.

#### **1.5 Theoretical framework**

Anthropological contribution to the study of climate change brings its core theoretical tenet that culture frames the way people perceive, understand, experience, and respond to key elements of the worlds in which they live. This framing is grounded in the systems of meanings and relationships that mediate human engagements with natural phenomena and processes. It is particularly relevant to the study of climate change, which entails movement away from a known past, through an altered present, and towards an uncertain future, since what is recalled, recognized, or envisaged rests on cultural models and values. Individual and collective adaptations

are shaped by common ideas about what is believable, desirable, feasible, and acceptable (Nazarea-Sandoval, 1995; Rappaport, 1979).

Visual and sensory perceptions are key elements of the folk epistemology of climate (Strauss & Orlove 2003). The human body's senses are important avenues through which people get to know their local climatic conditions in their particular manifestations, such as rain, hail, snow, wind, and temperature. For example, rain may be experienced corporeally and emotionally by seeing, hearing, feeling, and even smelling. In Uganda, farmers might see clouds in the sky and, based on their color and shape, know whether it will rain or not; they may feel the wind and, based on its direction or strength, recognize whether it will bring rain or chase it away; they may hear thunder and see lightning flashes on the horizon and, based on their orientation, predict whether the storm will head their way; they may feel heat at night, and, based on its intensity and the time of year, discern planting time is approaching (Orlove et al., 2007).

According to Broad (2007) and Vedwan (2006) local communities that rely on natural resources for their livelihood are keenly watchful of the landscape and quickly discern climatic anomalies and their effects. It is encouraging that the connection between human activity and climate change is realized, even in rural farming communities. Farmers in the Sahelian region of West Africa for example, point to shrinking water bodies, disappearing plants and crops, and changing settlement patterns as evidence of reduced rainfall over the last three decades of the twentieth century (Tschakert, 2010; West et al., 2007; Roncoli et al., 2002).

The detection of anomalous patterns of wind, rain, hail, snow, frost, and temperature hinges on local understandings of time. By revealing the ways that people organize cyclical and linear time into meaningful segments, linguistic anthropology elucidates the kinds of variations people are able to discern and adapt to (Puri, 2007). Orlove (2003) examined the names and attributes of seasons and their subcomponents. All the language systems in various parts of Africa have names for seasons, which are defined by atmospheric and environmental indicators, though in some areas the notion of the calendar year was a colonial introduction. Even in equatorial regions that register minimal seasonal variation, ethnometeorological knowledge includes a

rich terminology for the cyclical manifestation of climatic events (Sillitoe, 1996). Local predictive systems are relevant to climate change research as they point to the salient parameters and normative frameworks of seasonal variation (Roncoli, 2006). Climate change impacts are extensive on hydrology and water resources, agriculture and food security, terrestrial and freshwater ecosystems, coastal zones and marine ecosystems, human health, human settlements, energy and industry, and insurance and other financial services (Bhursal, 2009).

The present study was informed by the above tenets. Perceptions on climate change and its implications on the livelihood of Dikgale community were investigated in terms of the community's worldviews, understanding of the nature and usefulness of phenomena and processes in the natural environment. This tenet is related to the Afrocentric paradigm that requires Africans to be studied in their own worldviews (Asante, 1993; Mazama, 2003).

## **1.6 Organization of study**

Chapter 2 presents a review of literature. It provides analysis of literature on climate change, its impacts and adaptation measures.

Chapter 3 is about the research design and methodology. It explains the methodologies adopted to collect and analyse data. The chapter also presents information about the study area.

Chapter 4 presents the research results. It provides the informants' responses to the research questions. These include community members' perceptions of climate change, its impact on their livelihood and indigenous practices to adapt and cope with climate change impact.

Chapter 5 presents the discussions, conclusion and recommendation for further research on climate change and indigenous knowledge systems.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Climate change and its indications**

Global climate change is possibly the greatest environmental challenge facing the world this century. Although often referred to as 'global warming', global climate change is more about serious disruptions of the entire world's weather and climate patterns, including impacts on rainfall, extreme weather events and sea level rise, rather than just moderate temperature increases. The developing world faces greater challenges than the developed world, both in terms of the impacts of climate change and the capacity to respond to it (Department of Environmental Affairs and Tourism (DEAT), 2004). Remarkable changes in temperature patterns were reported between the years 1960 and 2009 where the mean annual temperature increased by at least 1.5 times the observed global average of 0.5°C over the past five decades (Intergovernmental Panel on Climate Change [IPCC], 2007). These variations are supported by observations and projections on climate alterations in the form of increased temperatures and erratic rainfall patterns by scientists worldwide. Increased temperature, drying up of soils, increased pest and diseases pressure, shifts in suitable areas for growing crops and livestock, floods, deforestation and erosion are the signs that climate change is happening and represents one of the greatest environmental, social and economic threats (IPCC, 2007).

The Food and Agriculture Organization of the United Nations [FAO] (2007) and Jianchu et al. (2007) reported that as climatic patterns change, habitats change, so also do the spatial distribution of agro-ecological zones, distribution patterns of plant diseases and pests which can have significant impacts on agriculture and food production. The forestry industry could probably tolerate a small increase in temperature, but a decrease in rainfall would reduce the area which can support plantations, and the growth rate of the trees. A positive point is that rising carbon dioxide could help reduce water use by plantations. FAO (2007) predicted that in developing countries, 11% of arable land would be affected by climate change, including a reduction of cereal production in up to 65 countries, about 16 percent of agricultural Gross Domestic Product (GDP), (FAO, 2007). Erratic rainfall patterns, ecological variability, biological change have their adverse effects on human beings. There is observable increase in warm days, unpredictable rainfall, changing seasons, incidents of drought, hail storm, wind and decreasing water sources, changes in flowering and fruiting time, invasion of new plant species and reduction of some indigenous plants (Jianchu et al., 2007).

Fewer studies addressed the local community's experiences and challenges resulting from changing climatic conditions (Seager et al., 2008; Roncoli et al., 2002; Ingold, 2000; Sillitoe, 1996). This may be due to the fact that, while recent research on local ecological knowledge is propelled by concerns about environmental conservation and intellectual property rights, knowledge about climate cannot be managed, transferred, appropriated, or consumed the same as cultural or natural resources. Most South African communities are experiencing challenges such as deforestation, soil erosion, land degradation with desertification as an extreme form, extinction of species of plants or animals, exploitation of productive land for asphalt roads and refuse dumps, and destruction of freshwater supplies are examples of reduction in the indigenous society's wealth (Roncoli et al., 2002).

Perceptions of climate change and its threats to rural communities are among major challenges faced by scientists. Fewer studies prove that these communities are aware of change in climatic conditions and their impacts on people's livelihoods (IPCC, 2007). According to Bhusal (2009) local people share experiences of climatic

conditions, ecosystem function and process and biological systems. Climate change is perceived as increasing warming days, erratic rainfall patterns, ecological variability, biological change and their adverse effects on human beings. Other studies broadly found that warming days are increasing, rainfall pattern is unpredictable, seasons are changing, incidents of drought are increasing, hailstorm occur abnormally and water resources are decreasing.

It is reported that rural communities' explanations of climate change are centered on variations in temperature and rainfall patterns (Jianchu et al., 2007) manifest as rising temperature trends and scarce rainfall. Rural communities are aware that devastating changes in their living conditions such as malnutrition, poverty, water and air contamination, increased risks of disease, floods, soil erosion and depletion of biodiversity are as a result of climate and environmental variability. The increase in temperature has been a major concern for local farmers (IPCC, 2007). Observed change in rainfall and temperature patterns is supported by annotations of drastic increase in temperatures with negative impacts on the livelihood patterns of rural communities. This type of understanding climate change is crucial in planning the adaptation and mitigation measures to address the effects of increased temperature and scarce rainfall for sustainable livelihood (FAO, 2007).

South Africa's weather records over the past six decades indicate that the region's climate is shifting. Analyses of change in climatic conditions in South Africa show that, the country's average temperature is likely to increase by 1-3°C, with the interior experiencing the greatest increase (Kruger & Sekele, 2012). Nevertheless, there are assertions that climatic conditions are changing, and that these reflect trends elsewhere in the world. Observations of regional and seasonal variation at different part of the country resulted high rainfall regions and seasons are recording increases in precipitation and becoming wetter, whereas low rainfall regions and seasons are recording decreases in precipitation and becoming drier (Stern, 2006). The changed intensity and amount of rain positively correlate with the increase in water-induced disasters like floods. The water springs in the area have been drying up in the recent past (Gurung & Bhandari, 2009).



Turpie (2002) provides that South Africans will experience more extremely hot days, resulting in future health problems such as sunstroke and skin cancer. Rainfall and precipitation over the country will also change. Summer rainfall is likely to be delayed and over a shorter period of time. This means more extreme down pours which will affect agriculture, as topsoil will be washed away. Droughts and floods may become more frequent and more devastating in some parts of the country. Temperature inversions are likely to become more severe resulting in increased pollution issues. These effects will negatively impact the country and its citizens (Muhlenbranch, 1992; Karl, 1993; Jones, 1994; Kruger & Shongwe, 2004; Kruger & Sekele, 2012).

Temperature analysis for the Limpopo Province provides a noticeable increase of  $0.12^{\circ}\text{C}$  per decade in the mean annual temperature for the 30 catchments, over the 50 year period. A non-uniform pattern of changes in temperature was evident across the different catchments; 13% of the catchments showed negative trends while 87% showed positive trends in their annual mean temperature. Furthermore, 20% of catchments showed negative trends while 80% of catchments showed positive trends in their diurnal temperature range. Seasonal trends showed variability in mean temperature increase, of about  $0.18^{\circ}\text{C}$  per decade in winter and  $0.09^{\circ}\text{C}$  per decade in summer (Kruger & Shongwe, 2004). The overall consequences of temperature increase include greater water evaporation, plant stress, a decline in quality and availability of surface and ground water, overall drying, increased likelihood of fire conditions, and unpredictability of weather events and seasonal conditions. Plants, in particular, have trouble keeping up with rapid climate change. Small, isolated populations could go extinct as a result. South Africa has about 10% of all the plant species in the world, of which about half occur nowhere else on earth (Kruger & Sekele, 2012).

Kruger and Sekele (2012) attest that rural communities in Limpopo Province observe unusual phenomena such as fast maturity of maize, new types of pests, short stalk of rice and wheat. SAGUN (2009) believes that changes in temperature and rainfall are creating favorable environments for pests, diseases and invasive species to emerge, spread and encroach on agriculture and bush lands. Most people follow traditional cultivation practices that rely on seasonal rain water. Erratic rainfall patterns and hailstorm contributing to soil erosion, soil fertility loss, and crop damage

are having an adverse impact on livelihoods of most of these communities, thus increasing risk to food security. Though drinking water is increasing due to availability of water storage tanks and water pipes, local people are facing more drought periods resulting decrease in natural springs and irrigation water. This may affect agriculture and subsequently food security (Kruger & Sekele, 2012).

## **2.2 The implications of climate change**

The IPCC predictions of increased precipitation in the Southern African regions may lead to more extensive hazards. The impacts of these hazards are accentuated in areas where communities still depend on natural resources for their livelihoods. Flooding leads to soil erosion and results in landslides which cause extensive damage to dwellings and livelihoods. Because of the inconsistency of rain, top productive soil is washed away when it rains heavily. This is the same as in the case of Asian monsoon is sensitive to small temperature changes and stands to wreak havoc across the sub-continent. In July 2005, Mumbai received 37 mm of rain in 24 hours, the largest downpour recorded in an India. Increased incidence of heat waves will result in illness and death, especially amongst the old and very young. Increased storm surges will have a significant impact on coastal settlements (IPCC, 2007).

The implications of climate change are remarkable and identifiable by societies (IPCC, 2007). As a result, global climate change forces people to think innovatively and to develop practical solutions to its challenges and development (Walter, 2006). Development cooperation needs to re-invent itself in order to combine the requirements of development and the necessary respect for the earth. But issues around critical natural capital, the non-material aspects of choice and culture, are effectively excluded from economic analysis. Members of the societies very often are confronted with climate variability causing devastating changes in human living conditions such as changes in food supply, water shortages, energy availability and security, natural resources shortages and poverty.

Climate change longer-term changes and variability, such as periods of drought and flood, may either directly or indirectly, profoundly impact in shaping food security. The potential impacts of climate change on food access in Africa may, be better understood in the light of change in Africa's livelihoods landscape. A course of

diversification out of agricultural based activities is being pushed by climate change scenarios in the rural communities. Less reliance on food production as a primary source of people's food security runs counter to the assumption that people's food security in Africa derives solely (or even primarily) from their own agricultural production (Bryceson, 2000; Bryceson & Fonseca, 2006).

Social and environmental crises have the potential to cause shocks to the global political and economic structures. Climate change and globalization are occurring simultaneously thus some of the indigenous practices are getting sidelined because of the new developing populous cultures which may not promote good environmental, socio-economic and lifestyle choices (Seager, 2008; Bhusal, 2009).

The projected impact of climate change on access to natural resources, heat-related mortality and spread of vector-borne diseases such as malaria, for example, had direct implications for the achievement of several of the Millennium Development Goals (Multi-Agency Report, 2003). There is more confidence that global climate change is a threat to sustainable development, especially in developing countries, and could undermine global poverty alleviation efforts and have severe implications for food security, clean water, energy supply, environmental health and human settlements. Economic diversity increases adaptive capacity by providing people with choice. Economic diversity is especially important for resource dependent communities as the resources, such as forests, are climate sensitive and are therefore likely to undergo changes. A complete reliance on one type of industry may be detrimental to a community and limits the capacity to adapt to change (IPCC, 2007).

The demographic or socioeconomic aspects of rural areas are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children) bring the problems caused by climate change to higher proportioning. A slum environment, where many already economically vulnerable people live in uninsulated, make shift shelters, the associated health risks are exacerbated, it amplifies pre-existing vulnerabilities. Similarly, in the case of flooding or fires, shack dwellers are more vulnerable than communities living in brick and-mortar houses, as is often witnessed in informal

settlements in Limpopo Province where the hot, dry, southeasterly wind often brings devastating fires in summer, while the north-westerly storm fronts bring severe flooding in winter (Roncoli, 2002).

Most African communities are vulnerable to the impact of climate change mainly because of high poverty levels, reliance on rain fed agriculture, lack of access to technology and improved cultural practices (IPCC, 2007). The contribution of natural resources to the local economy in remote indigenous communities is an important consideration. There are several models of how the customary sector, that includes fishing, hunting, bush foods and natural resources for arts and crafts production, contributes to the economy of indigenous. Investigating the impacts of climate change on indigenous communities is important to understand the customary sector and its role in indigenous economics. This is particularly relevant where local resources are sources of fresh food for the households or are used to supplement family income (Turpie, 2002).

The African continent is endowed with diverse and important ecosystems such as tropical savannahs, tropical forests, coral reef, marine and fresh water habitats, wetlands and mountain ecosystems adversely affected by climate change as a result, the livelihoods of a large numbers of the rural poor will be put at risk and their vulnerability to food insecurity increased. Putting into consideration the heavy dependence on natural resources for livelihood in Africa, biodiversity loss is a possibility (UNFCCC, 2013). Ecosystems change yields a variety of land-based resources including soils, vegetation, wood products, and fauna, and constitute the basic capital to meet Africa's food, fuel, water and shelter requirements (FAO, 2007). Climate change effects on ecosystems resources, as they relate to food security in Africa, will impact significantly on biophysical processes like plant and animal growth, biodiversity and nutrient cycling, and the way these processes are managed for food production in a sustainable manner (FAO, 2007). In Ethiopia, a huge impact is felt in the arid, semi-arid, and dry sub-humid lowlands which are more vulnerable to the adverse effects of climate change than those living in the highlands. Lowland households with fewer and less diversified assets than highland households are less able to invest in adaptation measures and to meet their basic needs when faced with the adverse consequences of climate change. In addition, the lowlands have

become increasingly depleted and, as a result, many pastoralists from the lowlands have migrated to highland areas, leading to social conflicts over land (IPCC, 2013).

Approximately 30 million people live in the forests of Central Africa, and they eat approximately 1.1 million metric tons of wildlife each year – the equivalent of almost 4 million cattle. The estimated annual value of the bush meat trade in West and Central Africa could exceed 1 billion US dollars (IPCC, 2007). As a result, the IPCC projects that by 2020, between 75 and 250 million people in Africa would be exposed to increased water stress. Decreasing water levels is also expected to negatively affect water quality. If this decrease in water is coupled with an increase in demand of water for different uses (agriculture, industry, energy, etc.), will adversely affect livelihoods and exacerbate water-related problems, such as conflicts resulting from competing demands and the management of shared water resources (IPCC, 2007).

Sustainable environmental development is more jeopardized by climate change in recent years. The environment is suffering from excessive de-vegetation that is presently instigating fuel scarcity and loss in forest resources. The change in climate patterns and the destruction of the natural resource base leads to the unpredictable and erratic rainfall patterns, warmer temperature, increased evapotranspiration, increased deforestation and ecosystem fragmentation, diminishing pasture and water availability, frequency of drought, changes in the livelihood patterns of communities, increased social conflicts between communities, loosening of social cohesions, increased incidence of diseases and epidemics, increased rural urban migration and increased community displacement from fragile environment (IPCC, 2013).

South African Studies Programme identified the health sector, maize production, plant and animal biodiversity, water resources, and rangelands as areas of highest vulnerability to climate change and these are the areas that need to be targeted for adaptation measures. Research about the local perceptions on climate change in the Limpopo Province provides that, climatic and ecological changes caused by global warming have caused negative consequences for people's health, the economy, and livelihoods (Kruger & Shongwe, 2004; Seager, 2008). These studies show that somehow the indigenous people see themselves as 'climate change victims', with

little agency to effect positive change. The indigenous people are depicted as 'empowered' to manage environmental change by developing culturally appropriate responses. Elderly community members' perceptions showed concerns about increasing unusual weather, rainfall, water resources depletion effects of climate change in the community (Kruger & Sekele, 2012).

South Africa's industrial, domestic and agricultural users are highly dependent on a consistent supply of water. A reduction in rainfall amount or variability, or an increase in evaporation (due to higher temperatures) is further straining the already limited amount of water resources. An increase in rainfall or a reduction in plant water use (due to a higher atmospheric concentration of carbon dioxide) would ease the problem slightly. Bulk water supplies are largely provided via a system of large storage dams and basin water transfer schemes and such infrastructure takes years to develop. Thus a reduction in the amount or reliability of rainfall, or an increase in evaporation is exacerbating the already serious lack of surface and ground water resources. Furthermore, changes in river flow may have immense consequences on human health by increasing suitable habitat for water-borne diseases, as well as affecting water supply and the maintenance of ecosystem functioning. There are incidences of strokes, skin rashes, dehydration and the incidence of non-melanoma skin cancers. However, increased inundations during rain events do not produce useful water since they will not necessarily recharge groundwater. Meanwhile longer dry spells between rainfall events lead to an overall drying trend in some areas, even if it appears that more rain is falling over a season during inundation events (Stern, 2006).

About 70% of total grain production in South Africa consists of maize. Crop yield modelling predicts that, under a hotter drier climate, maize production will decrease by up to 20%, mostly in the drier western regions. Further, specialty crops grown in specific environmentally favourable areas have also be at risk, since both rainfall and temperature effects are causing significant changes in areas uniquely suitable for such specialized production. Climate change can seem remote, compared with such immediate problems as disease, poverty and economic stagnation yet it can directly affect the efficiency of resource investments and the eventual achievement of many development objectives. How development occurs also has implications for the

vulnerability of societies to its impacts. Clearly the community's constructive capability is far more needed than its individual members' knowledge of climate change (Kruger & Sekele, 2012).

### **2.3 Adaptation to changing climatic conditions**

Adaptation to climate change implies responding to the adverse effects of its effects. However, an effective South African climate change response is focused on economic, social and environmental interventions that integrate mitigation and adaptation elements within a developmental framework. Furthermore, an effective South African climate change response also requires the management of any response measures generated by action as well as being able to respond to the response practices of other countries to effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity (South African Climate Change White Paper, 2004).

Indigenous knowledge systems and practices can be tapped to provide solution to many mitigation and adaptation measures to climate change. Many indigenous peoples are taking their own initiatives in coping with climate change in the form of identifying the changes that are occurring in climatic patterns and the ensuing challenges (MoE, 2012). Despite the lack of support, indigenous peoples are demonstrating varieties of adaptation and mitigation strategies across Asia. These successful cases are often based on the use of their traditional knowledge, innovations and practices with minimal support from outside. The success in their adaptation and mitigation strategies is contributing to the survival of their cultural identities, sustainable use and management of natural resources and ecosystem restoration (MoE, 2012). Indigenous communities, especially those in remote rural areas of Nepal, have been using indigenous knowledge practices to adapt to both climatic and non-climatic changes (FAO, 2014) for centuries. Indeed, marginalized communities in the most remote parts of the country depend on these practices to survive the harsh climate and poverty they face.

Community-level climate change adaptation efforts acknowledge the wider context of sustainable local development as an agreeable view according to which society has to evolve (IPCC, 2007) and recognize the key importance of local participation. Local communities aim to regain control of land, natural resources and cultural practices in order to restore the balance of the universe and reverse impacts from climate change. In facing the global challenges of climate change local people believe that asserting traditional and spiritual land management practices is a significant step to restoring environmental degradation and facing the global challenges of climate change. A great deal of research on climate change, its effects on cultural systems and social organization as well as adaptation measures, has been carried out in archaeology, historical ecology and cultural ecology (IPCC, 2007).

Rural communities are presently responding to climate change in the same way that they have dealt with climate variability throughout history (Brooks & Adger, 2005). African context of climate exposes a rich knowledge of weather predictions among local community members and practitioners in different socio-economic sectors. This community knowledge has for centuries enabled people to deal with changes in the weather patterns such as storms, wind patterns and to design their disaster management strategies and mechanisms long in advance by constructing types of shelter, wind break structures, walls and homestead fences appropriately. The Batswana of Southern Africa knew that floods could be predicted from the height of birds' nests near rivers. Other insightful weather indicators used by the Batswana included moth numbers to predict the coming of drought conditions; the position of the sun; and the cry of specific birds on trees near rivers assisted people to predict the onset of the rainy season (Brown, 2004).

The capacity to respond to changes in environmental conditions exists within communities to different degrees. Not all responses are sustainable, and there is recent historical evidence that large-scale, systematic changes in global climate have had profoundly negative consequences for many societies in the past (Puri, 2007; Cullen et al., 2000,). Climate change social responses are focused exclusively on managing the consequences of change. Limits are traditionally analysed as a set of immutable thresholds in biological, economic or technological parameters. The indigenous peoples' extraordinary knowledge of their natural resource base has



been extensively documented by scientific research worldwide which shows that traditional knowledge provides the foundation for intricate resource management systems that have sustained indigenous societies for millennia (Hansen et al., 2009; Paolisso, 2003; Smith et al., 2001).

Developing countries lack the financial, institutional, physical and technological capacity to deal with climate change (World Bank, 2012). This implies that more development is required for developing countries to have the capacity to deal with climate change. However, climate change is evidence that traditional development pursued by less developed countries is also impacting on the environment (IPCC, 2007). The scientific knowledge about the impacts of climate change is increasing all the time, as are practical experiences in responding to climate change. Climate change decisions are critical, as are access to and participation in the wider decision-making processes to adapt to change (Adger, 2003b). Irrigation, insurance and weather forecasting are just three of the many human institutions which have been prompted and shaped by the interactions between our physical and imaginative encounters with climate. They are examples of how we have adapted our social practices in the face of variable climates. Research revealed that traditional ways of using and managing biodiversity are grounded in progressive principles of sustainability. In short, indigenous knowledge and management systems represent critical yet frequently untapped resources in global conservation efforts (Smith et al., 2001; Paolisso, 2003; Hansen et al., 2009).

Adaptation to the impacts of climate variability therefore needs to be brought into the mainstream of economic policies, development projects, and international aid efforts (Klein, 2002; Agrawala, 2005). The case of African agriculture and water resources illustrates that stakeholders and potential adapters range from vulnerable consumers to international organizations charged with relief and research (Eele, 1996; Magadza, 1996; Downing et al., 1997). Poor and landless households have limited resources, yet failure to adapt may lead to significant deprivation, displacement, morbidity, and mortality. Subsistence farmers do not have the same adaptation options as commercial producers. Water supply adaptations may involve landowners, private traders, local authorities, water-dependent businesses, national governments, and international organizations. Each stakeholder has distinct

interests, information, risks, and resources and hence would consider distinct types of adaptive responses (Downing et al., 1997).

There are examples of community conventional wisdom which suggest that climate change is caused by the high reliance on the natural veld for harvesting of resources such as fuel-wood and medicinal plants, as well as for subsistence livestock production in most African rural communities. This is only partially true. Adaptation to environmental change is a fundamental human capability and is not a new concept. The how, when, and why of adaptation is necessary to make informed judgments on the vulnerabilities of sectors, regions, and communities ( Burton, 1997; Smithers & Smit, 1997; Tol et al., 1998; Klein et al., 1999). Throughout history, human societies have shown a strong capacity for adapting to different climatic conditions and environmental changes. The resilience and flexibility exhibited in the patterns of human settlements show an inherent desire and some measure of capacity to adapt (Easterling et al., 2004). Perceptions, local knowledge, and adaptive strategies at the household and community levels, as well as lessons learned, can provide the basis for concepts and methods of assessing climate change impacts, vulnerability and adaptation on livelihood of rural communities. The detection of anomalous patterns of wind, rain, hail, snow, frost, and temperature hinges on local understandings of time. By revealing the ways that people organize cyclical and linear time into meaningful segments, linguistic anthropology elucidates the kinds of variations people are able to discern and adapt to (Puri, 2007).

The awareness of household vulnerability of climate hazards measures a community's knowledge of susceptibility to climate hazards and its ability to cope with, recover from, or adapt to those hazards. Climate hazards are climate-related events that have the potential to cause harm (Tol et al., 1998). Rural communities may be at risk for different types. Some may be transient—characterized by rapid onset and identifiable termination (such as a storm, flood, or drought). Others may be susceptible to longer-term change in climatic variables (such as temperature or precipitation), be gradual, or result in related events such as sea level rise, mass coral bleaching, or ocean acidification. Vulnerability to climate hazards can be put into three main functions which factor as: exposure, sensitivity, and adaptive capacity (Alexander et al., 2006).

Community members receive support in climate adaptation and hazard mitigation as they possess their history and length of time of supporting preparation for climate hazards and their effectiveness. Indigenous communities have ownership in formulating adaptation and mitigation strategies that are relevant to them if they are going to work. The United Nations University has produced video clips for YouTube illustrating the impacts of climate change on indigenous people. Researchers and practitioners should not equate vulnerability to poverty, though, and they should not consider adaptation and adaptive capacity in isolation. Brooks and Adger (2005) conclude that efforts to promote adaptive capacity should incorporate aspects of education, health and governance and thereby extend the context beyond a particular stress to include factors that are critical in a broader development context.

Thinking about adaptation, limitations are endogenous and emerge from inside society. What is or is not a limit to adaptation becomes a contingent question. It all depends on goals, values, risk and social choice. These limits to adaptation are mutable, subjective and socially constructed (Inglehart, 1997; O'Brien, 2009). They are widely recognized steps in developing climate change adaptation strategies on a community level. Climate modeling is usually presented on too large a scale to show direct relationship on impacts to a particular place, the first step is to identify specific impacts to a particular region. The second step is consultation with the specific community related to the selected place to determine how those identified potential changes will impact the economic and cultural practices of that specific area. The priority of resources will be dependent on how valuable individual communities perceive that resource, it is important that the community has ownership of identifying and prioritizing resources. Finally, adaptive strategies can be formulated at a local level once there is an understanding of specific impacts to resources and how much those resources are valued by a community (Smit, 2001).

Greater access to, and use of climate related information should increase adaptive capacity by better preparing community members to cope with climate change. Access to and use of climate-related knowledge measures household access to different sources of information related to climate change, climate variability, and its impacts, and how this information is used. It also includes access to any type of early

warning system and can include past experience, traditional or local knowledge of climate patterns and events, as well as other sources of education, media, and communications (IPCC, 2007).

Informal networks are often formed through social connections in a group that shares common values, interests, engagement or purpose. They could be large families, clans, church groups, women's groups, or occupational groups. In some communities, such networks may have been in place for a long time, but only recently begun to address climate hazards. In other communities, such networks may have already dealt with climate related hazards that regularly impact the community. In South Africa the village headmen are very important people when it comes to land affairs. In the Pacific, such as on Namdrik Atoll in the Marshall Islands, traditional leadership institutions are being reinforced as they are used to reconnect to ancestral practices that help the community deal with climate hazards (Ishoda, 2011).

Sustainability of livelihood and income sources is a critical issue when a household faces growing impacts and challenges to that livelihood activity. A livelihood is considered sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Carney, 2008). Increase in temperature and decrease in rainfall also leads to soil moisture loss. This instigates increase in the use of soil water conservation techniques. Mulching and land sheltering techniques are also extremely important ways of dealing with changes in temperature and soil moisture loss (Huber & Pedersen, 1997).

Local communities have managed forest and grasslands very well which is the good indication of coping with the impacts of climate changes. The reason maybe that there were no big vast land spaces to manage. Majority of these local farmers practice vegetable farming instead of cereal crops as crop diversification as well as to earn more income than cereal crops. Optimum utilization of marginal lands by planting fodder trees, fruit trees, and other grasses are practiced (Smith et al., 2001).

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

The chapter presents information about the research methodology adopted for the study and the area from which the study was conducted. The chapter is therefore, divided into two sections. The first section presents an overview of the research setting. It presents information about the study site, topography and the community's livelihood patterns. The second section discusses the research methodology adopted to conduct the study. It provides information about the study sample and the research techniques adopted for selection of the study sample, collection and analysis of data.

#### **3.2 Study Area**

##### **3.2.1 Location**

The study area chosen for this research is Dikgale community which falls under the Capricorn District Municipality. The area is located in Limpopo Province of South Africa approximately 40 km from Polokwane City, the capital of the Limpopo Province and 15km from the University of the Limpopo. The main cultural group in the area is the *Pedi Kone* of Dikgale. Other Northern Sotho groups in the area include the *Kgaga-Kone*, *Batlokwa*, *Kolobe*, *Hananwa*, *Babirwa*, *Nareng*, *Tlou*, *Pai*, *Phalaborwa* and *Hlaloga*.

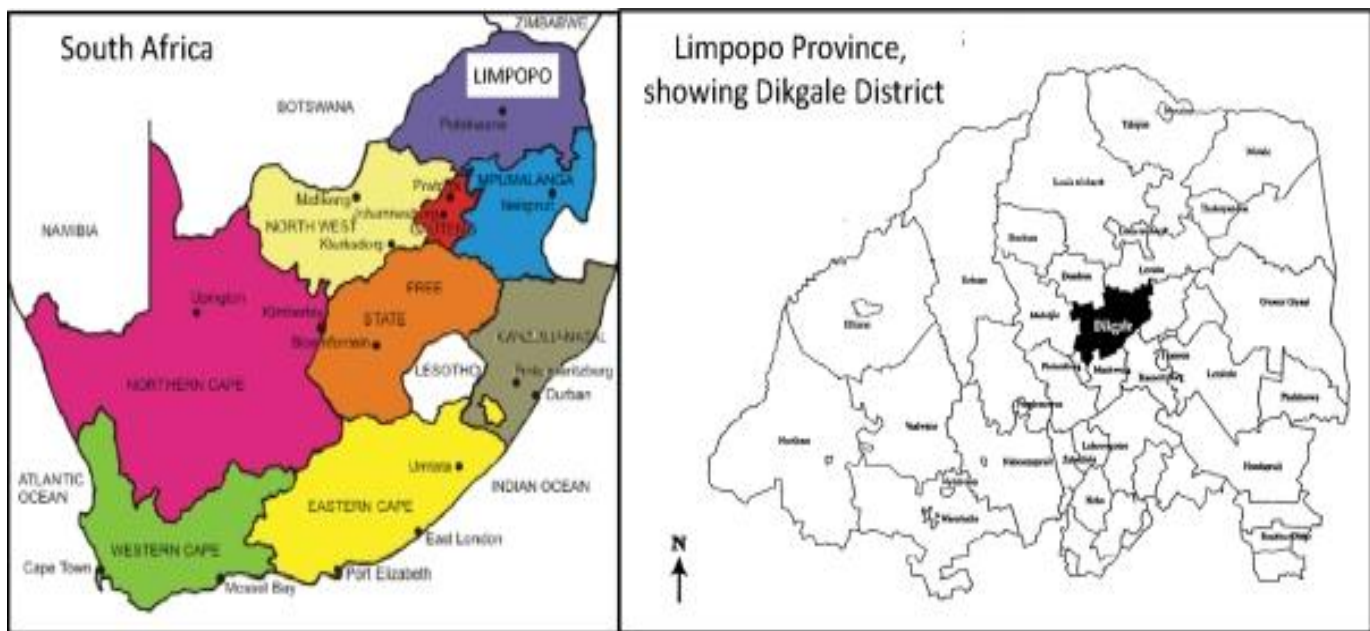


Figure 1. Source: Global Health Action Report 2012

The primary language in the area is *Sepedi*. Primary education is now bilingual, and most children are learning to speak English, but *Sepedi* is spoken in the home. The community inhabited the area they stay many years back, which is an indication of long history of cultural interaction with the local natural environment spanning many generations. They are perched on the edge between retaining traditional practices and maintaining their district linguistic heritage and succumb to their cultural affinities (Limpopo Employment, Growth and Development Plan [LEGDP], 2009-2014).

The area is on the Highveld Plateau, which is bounded in the south and south-east by the Strydpoort Mountains and in the east and north-east by the Wolkberge. Soils found in this area are more related to the parent material, which is granite. Gritty sandy loam to sandy texture is found on summit, back and shoulder slopes of the

landscape. The soils are poor in nutrients. Only areas at the bottom landscape positions have high natural fertility. Dikgale area lies in a semi-arid to arid climatic type with an annual rainfall of approximately 505 mm. It has a daily average summer temperature of between 16, 9°C and 27, 8°C, and a winter average temperature of between 4.3°C and 19.8°C. Summer rainfall occurs between October and April, followed by a dry winter season.

### **3.2.2 Topography**

Topography of the area is characterized by irregular undulating lowlands with hills and low-lying mountains. It also has some moderately undulating plains. The bushveld is made up of a combination of dense shrubby thickets and small trees of both *Acacia* and broad-leaved species. Tall *Mountain Aloes*, *Aloe marlothii* are conspicuous and are characteristics of granite boulders and *koppies*, which give this habitat its uniqueness. These outcrops support a great variety of plant life including *Euphorbia cooperi*, and various *Ficus*, *Combretum* and *Acacia* species. The thickets consist mainly of *Acacia gerrardii*, *Dombeya rotundifolia*, *Cussonia natalensis*, *Pappea capensis* and several *Euclea* species. Unfortunately, much of this habitat types have been lost due to deforestation and rural densification and it may be considered threatened. (Limpopo Department of Finance and Economic Development [DFED], 2004.)

### **3.2.3 Demography**

Dikgale is a community of about 90,000 people. There are 23 villages within Dikgale community. According to the South Africa Community Survey (2011), Limpopo Province is accounted for approximately 5.2 million of the 48.5 million national populations. The site is peri-urban and the main ethnic group is Pedi. Most of the inhabitants belong to the Moria Zionist Church which has a combination of Christian and traditional beliefs, while others belong to the Lutheran or Anglican churches. A large proportion of adults are migrant workers, some in the nearby mushrooming shopping complex's while others work as farm labourers on neighbouring farms, or as domestic workers in nearby towns. Unemployment rate in the area is very high (Stats SA, 2013).

### **3.2.4 Livelihood patterns**

The community is an impoverished rural settlement scattered into the periphery of the municipal boundary with improved services and infrastructure. Dwelling units consist of a mixture of shacks, traditional mud huts and conventional brick houses. Settlements patterns are conducive for development. There are many examples of human ingenuity and creativity, which have created the conditions for survival and enrichment (Alberts, 2008).

There are four primary schools and three secondary schools in study the area. In all schools, the classrooms are overcrowded and few educational amenities are available. Most children attend primary school and the adult literacy rate is 79.8% and 73.6% in males and females respectively. The community is made up of mixed formal and informal settlements. A few households have water taps in their yards, but most must fetch water from the taps situated at strategic points in the villages. There are households that have pit latrines in their yards but there is no organized waste disposal (Stats SA, 2013).

Electricity is sometimes a luxury to some of the residents and the immigrants who cannot afford to pay for this service. The villages are connected by a network of untarred roads. The main road to the west of the area provides public transport to nearby Mankweng Township, where there is a government hospital and other urban facilities (Alberts, 2008).

Provision of household services has increased between 2001 and 2011. The municipality has 46 health facilities in the form of hospitals and clinics, excluding private hospitals (Stats SA, 2011). One of the key social problems facing the Dikgale is poverty. Unemployment estimates in the Municipality vary between 45% and 70% of the economically active population (people between the ages of 15 and 64 years). The establishing, improving and maintaining rural infrastructure in the form of water and power supplies as well as modes of transport will alleviate the burden on women and children who bear the brunt of inadequate infrastructure in the rural areas (Stats SA, 2011).

Fewer subsistence crops grown around houses in the home gardens and ploughing fields. Agriculture has been identified as the main land use (more than 80%) in the



area. The agriculture sector contributes only 1.9% to the local economy and accounted for 9, 4% of employment opportunities in 2004. Privately owned farms account for the bulk of production in the local Agriculture sector. Other forms of farming in the community include urban agriculture and subsistence farming (Department of Rural Development and Land Reform [DRDLR], 2009). The most common subsistence crops are maize, beans, melons and sweet reed. Cattle and sheep are raised by fewer households.

### **3.3 Research Methodology**

This section presents the research methodology adopted for this study. The section presents the research design, the study sample and size, sampling procedure, data collection and analysis methods. Ethical considerations are discussed in the last part of the section.

#### **3.3.1 Research design**

The researcher adopted a qualitative research design for this study. A qualitative research design was proper to undertake an explorative study. The study was designed to understand the perceptions of climate change, its impact and the indigenous adaptation measures for sustainable livelihood. The researcher employed a multi-method approach to collect and analyse data.

#### **3.3.2 Population and sample**

The study population was community members aged between 50 and above in Dikgale community. This population has knowledge about the community's indigenous knowledge systems and the types of natural resources that should be exploited for livelihood (Rankoana, 2012). It must be noted that time observations of community occurrences would have been an important reason to choose people above 60 years.

#### **3.2.3 Sampling procedure**

In this ethnographic research approach, the study informants were selected on the basis of their knowledge of the phenomenon being studied. For example, according to Cotton the informants should have good, relevant knowledge of the domain of the study and should be able to interpret the meaning of their own cultural phenomena (Cotton, 1996). Purposive sampling technique was used to select

community members above 50 years. The informants were also selected on the basis of their period of resident in the community. This type of sampling technique ensures exploration of phenomena across genders to obtain experiences of climate change from male and female members of the community. However, equal gender representative was ensured by having 25 males and 25 females. The informants were all indigenous inhabitants of the community identified for the study.

### **3.3.4 Data Collection**

Data presented in the dissertation are the results of a study conducted for a period of 10 months between January 2015 and January 2016. The study was conducted during the winter and summer months. This was done in order to observe different seasonal change in climate of the area. Data were collected through interviews and field observations. The interviews were conducted in the local dialect, as a result the principal research was unable to engage in full discussions and request for clarity and follow-up questions were limited. This was resolved by asking the research assistant to put the questions in the local dialect and brief the principal researcher about the responses to the question to enable him make follow-ups and clarity.

#### **3.3.4.1 In-depth interviews**

The interview is a face-to-face interaction between an interviewer and the respondent, which seeks to build the kind of intimacy that is common for mutual self-disclosure. The advantage of in-depth interviews is to help the researcher to achieve the same level of knowledge and understanding as the study respondent (Rankoana, 2012). The technique is generally used when detailed information is needed from individuals in the study population (Walter, 2006). In-depth interviewing was the first methodological procedure applied to collect data. The aim of the interviews was to explore the perspectives on climate change, its impact and the indigenous adaptation measures for sustainable livelihood. The informants showed great interest in the research. They frequently provided additional information regarding their knowledge of climate change. Interviews were conducted concurrently with observations. The interviews were tape-recorded.

#### ***Interview schedule***

The list of climate associated questions (Appendix B) was developed to ask the same questions to all the informants. Open-ended questions were put to the informants, but they were also given the opportunity to discuss issues which they deemed relevant. Throughout the research process the informants were asked for further explanations as new issues arise. The interview schedule commenced with biographical information of the informants such as age, gender, educational level and marital status. These were followed by open-ended questions, which focused mainly on informants' perceptions of climate change and its impact on the livelihood of the community, and the indigenous adaptation measures the community has developed for sustainable livelihood.

The time allocated for each interview was an average of one hour and thirty minutes. Interviews were conducted in the households of the informants where they were most comfortable. Interviews were conducted in the local language (*Sepedi*) to encourage free disclosure. The conversations were held with the assistance of the research assistant. It must be noted that some of the informants spoke *Sepedi* and English. Rapport was established between the researcher, research assistant and the informants to facilitate open discussions and interactions.

The informants were not difficult to interview because many of the males were very socially committed to the interviews. They were not suspicious that the information may be used by other people to make money from their own knowledge. The researcher selected the study informants two months in advance of data collection process and this made it fairly easy to locate their households during data collection process. Unstructured conversations were carried out before structured questions could be initiated.

#### **3.3.4.2 Observations**

Transect walks were taken to the nearby wild to view indicators of climate change as explained by the informants. Direct observations were planned to develop a scientific, holistic sense of aspects of knowledge of climate change and its implications as well as the adaptation measures used to adapt to climatic conditions.

### **3.3.5 Appointment of the research assistant**

The research assistant was a University of Limpopo graduate student who had grown in the study community. The assistant helped in the clarification of certain cultural practices and behaviors expressed during the interviews. The assistant was also important in winning the trust of informants and establishing rapport. The assistant was subjected to brief training sessions to develop knowledge of the nature of study and expectations. Upon arrival in the field, the research assistant was deployed in the community for assistance in data collection. Before data collection process ensued, the researcher with the assistance of the research assistant explained the purpose of the study, ethical rights and what was expected from the informants. Consent form was then distributed to be signed by each respondent (Appendix B). None of the informants withdrew from participating in the study. The informants were requested to answer the questions as honestly as possible.

### **3.3.6 Data analysis**

The researcher analyze data by organizing it into categories on the basis of themes, concepts or similar features. The researcher developed new concepts, formulates conceptual definitions and examines the relationship among concepts. Eventually he/she links concepts to each other in terms of sequence (Neuman, 2005). Data from the field were consisted of infinite number of possible answers, and was carefully managed, read, compared, categorized and recorded. Furthermore, data were organized into different themes according to the study objectives and research questions on climate change. A content analysis method was employed. Content analysis is a method used to determine the presence of certain words or concepts within a text or sets of texts. This method of analysis was helpful as it quantifies and analyses the presence, meaning and relation of such words and concepts, then make inferences. This means that data are explored under common themes. In this case information relating to perceptions of climate change, its impact and indigenous adaptive practices was sorted into meaningful units or codes. Later the codes became the basis for further analysis (Barbie & Mouton, 2006). A final analysis was done to produce themes such as indicators of change in climate conditions, cultural activities affected by change in climate

condition and the indigenous adaptive measures available and used by the community to adapt to the changing climate conditions.

### **3.3.7 Quality criteria**

Trustworthiness was ensured by means of credibility, transferability, confirmability and dependability. Credibility was confirmed through prolonged engagement with the informants through interviews and transect walks. Data gaps, inconsistencies and contradictions were addressed with the informants. Transferability was ensured through purposive sampling of community members aged 50 years and above. Dependability was achieved through quick reviews of data with the informants to confirm that data represents the views of the informants other than the researchers'. Confirmability was obtained through interpretations, conclusions and recommendations based on the study findings in the form of field notes derived from interactions with the informants and ecological observations.

### **3.3.8 Ethical considerations**

The ethical considerations were observed during this study. Code of ethics was observed by the researcher and the research assistant. The researcher obtained ethical clearance to conduct the study in Dikgale community (Appendix C). The researcher and research assistant presented documentation about the project before data collection in the field. These documents (letters) spelled out the researcher's affiliation, the funding agency and how long the research would be conducted (De Vos et al, 2005). The ethical considerations had to be explained and shown in writing to the local authorities in the study community and permission to conduct research was granted. They were letters spelled out the researcher's affiliation, the funding agency and how long the research would be conducted (De Vos et al., 2005).

#### **3.3.8.1 Entry into the research sites**

The researcher is coming from a foreign country so his mother tongue was not the same as the one spoken in the study area. This made interaction with the informants a bit hard although the researcher has knowledge about the culture acquired through years of anthropological research and staying in the same community for the past four years. During the study the researcher used a research assistant chosen from

the community for assistance in data collection and interaction with the informants and interpretation of the research questions and the responses.

#### **3.3.8.2 Informed consent**

The informants were asked for their consent. The researcher briefed the informants upfront about the aims of the study, their rights and roles in the study. The informants were made aware that participation in the study was voluntary, and that they were free to withdraw from the project at any time. The informants agreed to take part in the study was asked to sign the consent form if they agreed to take part in the study (Appendix B). Despite the fact that 5% of the informants were not literate; and could not read or write English properly, all the interviewee signed a letter of consent. Those who could not write put a cross in the space provided.

#### **3.3.8.3 Freedom from harm**

The researcher did not take advantage of the informants as they were free to participate in the study. No harm was inflicted on or exposed the informants to unnecessary risk. Cases of outright refusal to be interviewed and to participate in the study were not encountered. All the informants were cooperative throughout the study period. Moreover, the informants were all mature, responsible members of the community and were willing to share their experiences on the subject.

#### **3.3.8.4 Right to self-determination**

The informants were treated as autonomous agents who have the freedom to conduct their lives as they chose to participate in the study without external control (Burns & Grove, 1999). During the study; the informants were well informed that their participation was purely on voluntary basis and that they could pull out at any time from the study. However, none of the informants withdrew from participation in the study.

#### **3.3.8.5 Right to full disclosure**

Human dignity principle encompasses the informants' right to make informed choices, voluntary decisions about study participation, which require full disclosure

(Neuman, 2005). Subsequent to data collection, the informants were provided with full information about the study and the value of their participation in the study.

#### **3.3.8.6 Right to fair treatment**

In the study the informants have the right to fair and equitable treatment before, during and after their participation in the study (Martin, 1995). The informants were justly treated to participate freely in the study and their cultural preferences were taken into consideration.

#### **3.3.8.7 Right to privacy**

Privacy is the freedom that people have to determine the time, extent and general circumstances under which personal information will be shared with or withheld from others (Burns & Grove, 2005). The identities of the informants were protected and not revealed in the study findings. The informants' privacy was protected by acquiring the informants' informed consent and assuring them that there would be no invasion of their privacy. The researcher assured the respondent that the information collected would only be used for the research purposes.

#### **3.3.8.8 Anonymity and confidentiality**

The informants' anonymity was ensured by not asking them to provide their real names during data collection process. As an alternative, the researcher numbered the notebooks and tape recordings in terms of the first and last respondent interviewed. The researcher ensured that all information gathered during the study was treated as strictly confidential and only available to the researcher and those directly involved with the study. In the research report, statistics was used without the informants' names mentioned.

## CHAPTER 4

### PRESENTATION OF RESULTS

#### 4.1 Biographical information

This section presents the biographical information of the study sample.

##### 4.1.1 Gender

Collection of information about gender statistics was to determine the males' and females' knowledge of climate change and whether their cultural activities are affected by changing climatic conditions. Figure 1 below presents the statistics about gender of the informants.

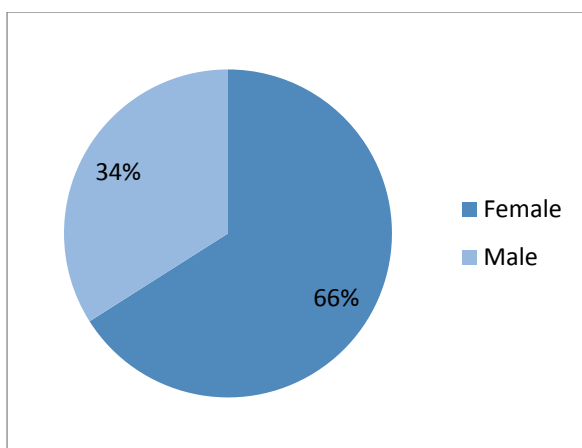


Figure 1: Gender of the informants



From Figure 1 above, 66% of the informants were females and only 34% were males. The study sample was made up of more female informants than their male counterparts.

#### 4.1.2 Age

The rationale for capturing data about the age of the informants was to find out which age group in the study area was more likely to have knowledge about climate change and the adaptation measures to cope with the impact of climate change on their livelihoods.

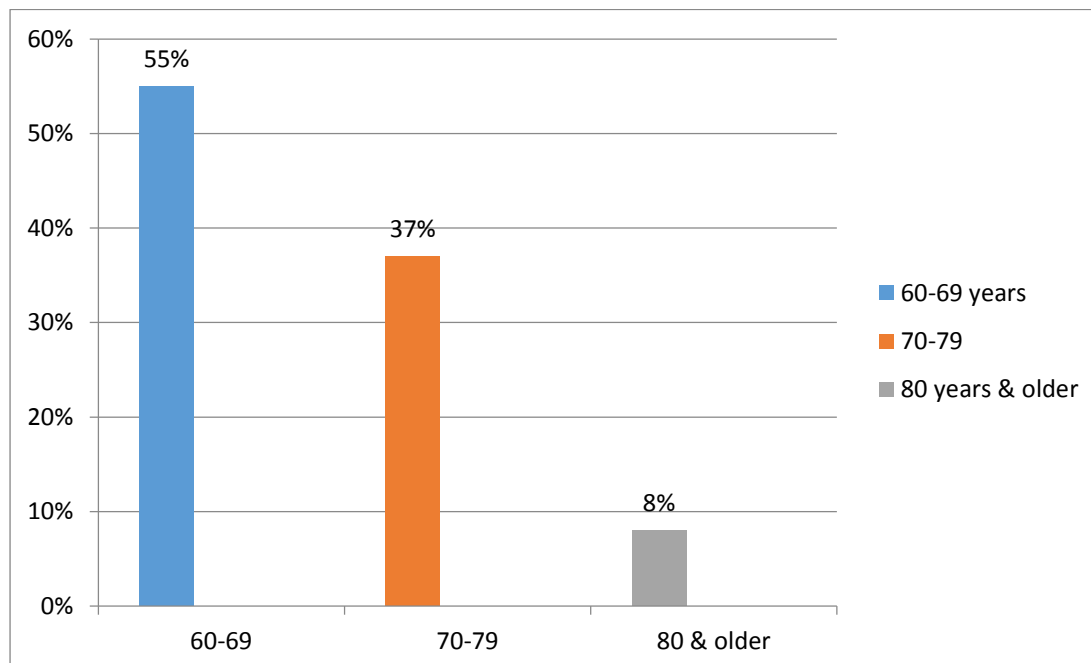


Figure 2: Age of the informants

A larger percentage of the informants (55%) falls between the age group of 60-69 years. Only 8% of the informants were older than 80 years. This shows that a large number of community members who participated in this study stayed in the community for more than fifty years.

#### 4.1.3 Employment status

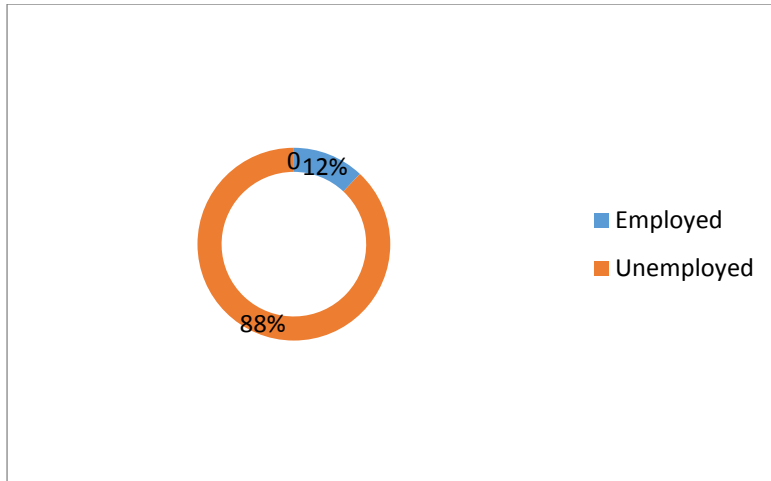


Figure 3: Employment status of informants

Figure 3 above indicates that out of a total of 33 community members who took part in the study, 29 of them were unemployed, which constitutes 88% of the study sample, that is, 12%. Eighty-eight percent of the unemployed community members were likely to benefit from old age grant and not involved in agricultural or having their own livelihood sustaining businesses that could be affected by changing temperature, seasonal and rainfall patterns. The remaining 12% self-employed make a living by taking advantage of the vegetable market business and complained of price increase from the farmers they get their produce from.

#### 4.1.4 Educational qualifications

The reason for probing the educational qualifications of the informants was to check whether community members were able to read information given on the media about the impact of change in temperature, seasonal and rainfall patterns on the socio-economic and health conditions, and the adaptation measures developed to sustain a livelihood change and whether they were capable of participating in debates about climatic related issues in the community.

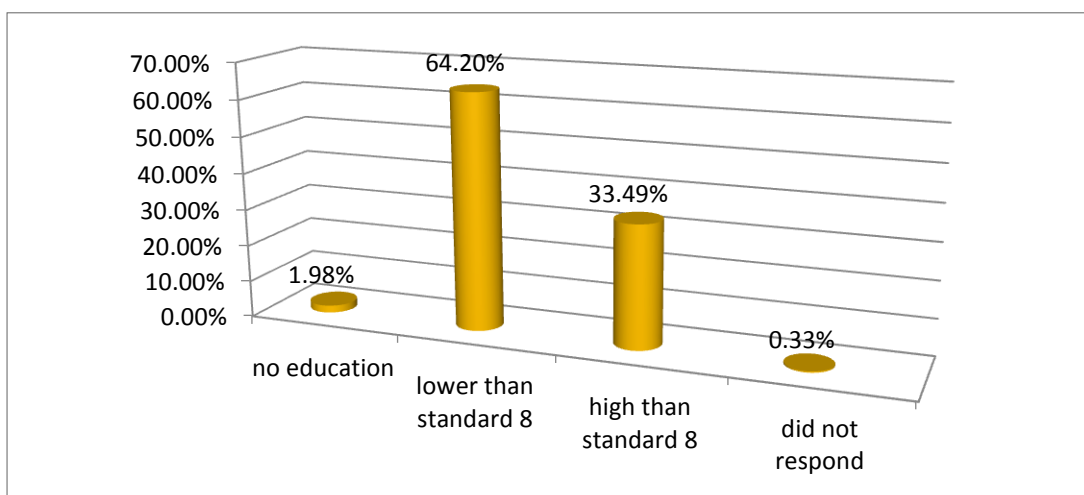


Figure 4: Academic qualifications of informants

According to Figure 4 above, a large proportion of the informants (64, 2%) have education lower than Standard 8. Forty-nine percent constitutes informants with qualification higher than Standard 8. This indicates that the majority of the informants were not able to read well and could not make sense of any information that was given about climate change and weather reports. One respondent did not answer the question and this constitutes 0.33% of the 33 members of the informants. The fact that the majority of the informants do not have education did not disadvantage them in participating in the study.

#### **4.1.5 Period residing in the community**

All the informants have been staying in the community for more than fifty years. The aim of including the informants who stayed in the community for more than fifty years was to obtain the informants knowledge of any change in the environmental conditions and the indigenous measures taken to sustain their livelihoods. Majority of the informants' households has an average household size of six people.

#### **4.2 Knowledge of climate change**

The informants were asked questions about their knowledge of any change in their environment with the objective of examining their understanding of changing climatic conditions. The responses were provided by all the informants.

##### **4.2.1 Changes in temperature patterns**

The informants responded that they experienced change in climate with increasing change in temperature patterns such as hotter summer and warmer winters, drastic changes between heat and cold in the same season. The informants reported lack of rain, withering of plant materials, death of livestock, and cessation of subsistence crop productions as the consequences of excessive heat.

##### **4.2.2 Erratic rainfall patterns**

There was a general perception of decrease in rainfall trends among informants. They observed that the last time they had good rain was about thirty five years ago.

Since that time rain has become unpredictable. Recent winter rainfall is attributed to change in cooler winter and warmer summer. It was reported that the community used to receive the first rainfall in September, but in the recent years the first rain falls between October and November marked by thunderstorm. Erratic rainfall patterns resulted in drought with debilitating effects such as decreased subsistence economy, depletion of biodiversity and water resources.

The informants reported that the incident of drought has been increasing and is linked with the untimely and unusual rainfall patterns over the past few years. One woman explained that previously rivers flowed all year round but today when the rains stop, most of the rivers in the area dry up. It is reported that recently summer rainfall is becoming unpredictable. It is also reported that in old times, there would not be rain during the dry season, and in the rainy seasons they had rain. "Those things have changed." These changes have disrupted growth cycles.

Elderly informants considered rainfall as a supernatural gift and there were popular cultural rituals performed to request for rain from ancestral spirits. Recently this practice has gradually disappeared as people have lost faith in such rituals and they understand rain scarcity as a problem caused by the changes in climatic change. There were no significant differences between males and females' responses in terms of their perceptions regarding climate variability. It must also be noted that most responses did not face any contending views, they were either supported or left unchallenged. This shows that there was a clear discernible pattern of knowledge and experiences being shared thus reflecting shared knowledge and information in the community.

#### **4.2.3 Seasonal change**

There were observations of change in the seasons. Summer is hotter than it was ten years ago. Winter is warmer with rainfall. This change makes the summer longer with short winter. Climate change intemperate the livelihood patterns of the community with its winter temperatures that constrain developments and hinder growth of biodiversity upon which the community derives a livelihood.

#### **4.2.4 Depletion of biodiversity**

The area is rocky with patches of infertile sandy soil. Cattle in the area are leading to bush encroachment by reducing grass cover and subsequently leaving the area exposed to bush fire occurrences. This processes lead to reduced biodiversity in the area that most villagers complain about. The informants are of the view that the indigenous trees together with wild animals are perceived as nuisances by farmers and are usually removed. The informants observe that there has been a rapid loss of vegetation due to drought. The species under grow and wither. Matured species dry off and do not regrow. The informants showed that the most indigenous species under threat are the sources of medicine, fuel and fodder which are overharvested with little chances of regrow as a result of excessive heat and rainfall scarcity. Other observations were that in the home gardens the apple and orange trees production decreased because of increased heat and lack of rainfall. Subsistence farming was directly blamed for contributing to the animal species decline. Farmers use organo-chloride insecticides to prevent birds and other wild animals from destroying the crops.

#### **4.2.5 Decline in subsistence crop production**

A decline in the subsistence economy is a major observable change reported by the informants. Unpredictable rainfall patterns led to a decline in crop and livestock production. About 10 years ago, the community depended on rain-fed crops. Recently, the community produces crops from home gardens which last for one season. In view of these variations in precipitation patterns and changes in crop production, community members use kraal and poultry manure to fertilize the soil to improve production.

Evidence of decline in subsistence economy is also reflected in the fallow fields, cessation of cultural rituals and festivals, brewing of traditional beer and communal labour. Cattle, goats and sheep are produced by fewer households and production is dependent upon stock feed bought from local white farms. For example, community members have opted to switching from raising cattle to sheep and goats during as a result of drought. The latter have lower fodder demands and thus do not require lush pastures that would only be available with abundant rainfall. A clear decline in sources of livestock fodder in the form of grass, leaves, fruits and pods is attributed

to a decrease in grazing land due to new settlement patterns, erratic rainfall patterns, drought, and changing weather conditions.

#### **4.2.6 Change in water quality**

Most of the informants noticed that stream flows have dramatically changed in recent years, making it more challenging for livestock rearing. Drinking water supply is maintained through water storage tanks and the municipal water supply system. Although there is a clear consensus among the informants there is water shortages due to inconsistent running water, water conservation practices are not clear. For example community members with storage tanks for water storage, open the tanks to drain off the water and pour fresh water into the tank. The water supply system faces major challenges in terms of operations of reservoirs and maintenance of facilities like pumps and pipes. This has caused a situation in which water resources are less dependable, with significant social and economic ramifications. In addition to the runoff and spilt water that create water-logged conditions around the communal taps, the drainage problem worsens due to the lack of proper washing areas near the communal taps that have adequate drainage. It is evident that some community members have to travel to communal water pump not within the rural development plan standards distance to fetch water.

#### **4.2.7 Cessation of cultural activities**

There were observations that cultural activities such as traditional beer-brewing, communal labour, division of labour and cultural dances have ceased to exist as a result of unpredictable rainfall. These are dependable upon subsistence crop production which has since 2006 characterised by low production as a result of unpredictable rainfall. Eighty percent of the informants indicated that there are changes in the livelihood patterns such as gathering and making crafts for festivals, rituals, household use and income generation. In the off-season, diversified activities provide a way to use labour and other resources to earn income. Fewer informants showed that payment of *lobola* used to be in the form of cattle, but recently cattle are replaced by cash payment. Collection of roofing grass, firewood, timber and river reed have ceased to exist. Huts are retained by fewer households. Maintenance of the huts is a challenge as the beams; walls and floor have to be maintained by using

cow-dung and fresh timber. Cessation of these livelihood patterns is a major challenge to sustainability of cultural values and of Dikgale community.

### **4.3 The impact of climate change**

The informants were asked questions relating to their knowledge of the impact of climate change on their livelihoods. The responses showed that changes in temperature and rainfall patterns have negative implications on the livelihood patterns of the community.

#### **4.3.1 Subsistence economy**

Poor production of crops and livestock in subsistence economy was a major observable change reported by the informants. Erratic rainfall patterns led to a decline in subsistence crop and livestock production. It was reported that about 20 years ago, the community depended on rain-fed quality crops such as sorghum, millet, beans and nuts which could last for more than two seasons. Recently, community members produce crops in the home-gardens which could last for one season. There are problems of new diseases destroying large chunks of crops every year, like sorghum plant turning black, small red ant-like insects destroying cash crops like tomatoes.

The informants showed that the decline in subsistence economy is evidenced by fallow fields and cessation of brewing traditional beer. The fields are lying fallow because they could not be ploughed when rain is scarce and unpredictable. Traditional beer, which is made from sorghum and millet crops was the main source of entertainment for men and women. Beer was served as the major source of thirst quencher and a gift to the ancestors during weddings, festivals, ritual healing and ancestor.

Cattle, goats and sheep are produced by fewer households and production is dependent upon stock feed bought from local white farms. A noticeable decline in sources of livestock fodder in the form of grass, leaves, fruits and pods is attributed to a decrease in grazing land due to new settlement patterns, erratic rainfall patterns, drought, and changing weather conditions. Fewer community members depend on

cattle and goat farming and some smaller animals such as chickens for a livelihood. The informants mentioned that cattle are breeding slower because of decreased availability of fodder and drinking water in the community.

#### **4.3.2 Biodiversity**

The informants mentioned that the indigenous plant and animal species on which they depend for food, fuel, stock-feed and medicine are near extinction because of changing temperature patterns and unpredictable rainfall. Decline of the indigenous plant and animal species are ascribed to human causes such as overgrazing, increase of settlement area and overharvesting of scarce plant and animal resources coupled with drought in the community due to drought.

Depletion of indigenous edible plant and animal species contributes to poor less dependency on the species for food and medicine. Construction of huts has ceased as it required timber, cow-dung, thatch grass and reed. Depletion of plant diversities resulted in excessive dust, soil erosion and increased exposure to wind. The informants noticed the decline of bird species like Northern Black Korhaan and Short-clawed Lark which is triggered by changing environmental conditions in its habitat. In general, Larks breed during the wet season or after irregular rains in arid areas when primary production of invertebrates is abundant.

The informants noted that rainfall patterns are affected by deforestation of large areas. The informants noticed that there is less availability of medicinal plants. Due to climatic stress such drought and change in weather patterns the local vegetation is near extinction. The sources of fodder are scarce. Livestock owners and herders drive cattle, sheep and goats to far locations in order to get fodder. Some owners have leased grazing land from the nearby white farms to sustain their livestock. Traditional health practitioners and community members with knowledge of healing indigenous plants walk long distances to get the healing plants.

#### **4.3.3 Health**



Observable change in environmental conditions negatively affected the living conditions of informants. Poor supply of food and water, temperature variations, persistent wind and dust as well as depletion of biodiversity negatively implicate the health conditions of community members. A decline in dependency on traditional crops negatively implicated the health conditions of community members as well. The informants are conscious that traditional rain-fed crops were nutritious and affordable. The nutritional value of crops is supported by statements that when people were dependent on subsistence economies, there were lesser incidences of health conditions associated with food supply such as marasmus, diabetes and kwashiorkor.

There were observations that community members are susceptible to diseases because of exposure to dust and wind resulting from long periods of lack of rain. The informants maintained that excessive heat during summer is a health risk factor. They identified reoccurring fever, cough, cold, dysentery; headaches, diarrhea, skin diseases, burning sensation, conjunctivitis, jaundice, blisters, asthma, pox, weight loss and pneumonia as health challenges the most frequently reported ascribed to extreme and irregular patterns of heat, cold and rainfall. Diseases associated with heat such as stroke, high blood pressure, fatigue, swollen feet and headache were mentioned. It was observed that exposure to wind is responsible for diseases such as asthma, tuberculosis, persistent colds, flu and cough. Poor water supply is regarded as a possible health hazard to the community. Inconsistent water supply by the municipality and polluted water from ponds are the main factors that may predispose the community to malaria, dysentery, diarrhea and cholera.

#### **4.4 Adaptation measures**

The informants were asked about the indigenous knowledge systems they have developed and use to limit the impact of climate change on their livelihood patterns. There were reports about the indigenous practices of coping with erratic rainfall patterns.

##### **4.4.1 Adaptation to drought and rain scarcity**

### *Cosmology*

The responses to the question about the indigenous adaptive measures developed and used to cope with drought and rainfall scarcity reflected cosmology as an adaptive practices. The responses showed that community members are able to predict rain availability and scarcity through observance of the behaviour of the animal and plant species and the position and appearance of the sun. It is observed that at the beginning of September month, the *Senegali* plant species produce yellow flowers which denote the beginning of a good season with forthcoming rainfall if the flowers are deep-yellow whereas pale flowers signify limited rainfall. The appearance of *tsie* (edible insects) in greater numbers in spring signifies shortage of rain in the next season. In summer the sun is situated in the south and in the north in winter. Change in these positions envisages bad omen in the form of infrequent rain. Community members strictly observe these changes to plan the planting process as this method has proved successful and has been passed down through generations. When limited rain is predicted, cultivation of crops is restricted to short-season crops such as maize, nuts, beans and melons.

Furthermore, it is observed that a good season with plenty rain is marked by wind blowing from south to north direction in August. Higher temperatures at the beginning of spring also symbolize a good season with plenty rain. Knowledge of seasonal change is the additional adaptive method. There were observations that winter starts at the end of March and ends in July and August is dusty. Rain begins to fall in September. The months of November and December have plenty rain and planting starts any time before the end of December. Simple indicators like the appearance of a rainbow towards the end of the month of November indicates the start of the dry season, acting as an early warning system, thus preparing communities to stockpile grains. Erratic rainfall and increased temperature patterns have led to the recent shifting seasons. Lately the planting season is shifted to late December to early January due to late onset of rainfall.

### *Crop production*

Smaller amounts of subsistence crops are grown in the home gardens. The fields are lying fallow and have not been ploughed for the past ten years. The most

common crops produced are short-season crops such as maize, melons, pumpkin, sweet-reed, nuts and beans. Traditional sources of staple food in the community; millet and sorghum are no longer grown because their production requires plenty rain and are susceptible to damage by granivorous animals. The farmers plant early-maturing and drought-tolerant crop varieties to reduce crop failure.

The traditional method of multi-cropping is practiced. The seeds of maize, melons, pumpkin, sweet-reed, nuts and beans are mixed and sown simultaneously on the same field to maximize the chances of concurrent growth of the crops. Kraal manure is applied to fertilize the soil and improve its moisture content to maximize crop productivity. Additionally, subsequent to harvesting, the soil is tilled with the crop residues to improve the soil texture and fertility and sustain crop production. The traditional method of crop planting along the river banks for the ease of irrigation caused competition for water between the fields and the livestock.

#### *Preservation of food*

Heads of maize are hung from the roof of a house to preserve them as sources of seed for the next ploughing season. The most common storage practice reported by the informants was sun-drying of the beans, nuts and the seeds to preserve the materials for future use. The tender leaves of the *Vigna sinensis*, *Citrullus species* and *Cucurbita pepo* are sun-dried for proper storage of the leaves for future use. Sometimes the cooked leaves are spread on the steel-sheets and put in the sun to dry-up. The dried materials are stored in plastic bags and buckets. There were no storage practices mentioned for watermelon, squash and sweet-reed. The sun-dried maize, beans and nuts are mixed with the ash of *Aloe ferrox* to prevent the seeds from attack by weevils. The seeds could be stored for up to three years.

## **CHAPTER 5**

### **DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Discussion of the study results**

##### **5.1.1 Research methodology**

The study was motivated by observations from the literature that climate change is threatening the livelihoods of rural communities in South Africa. The researcher conducted a qualitative study to explore a rural community's perceptions of change in climatic conditions, the impact of change and the measures developed and used by community members to adapt to change. The study employed a sample composed of community members who lived in the community for a period of more than fifty years. The sample was mostly made up of more females than males, which may be attributed to the fact that males are employed in nearby towns and cities. The informants have lived in the community, tendered livestock and cultivated the fields relying on rain for their production.

An Afrocentric paradigm informed the methodology adopted for the study. Qualitative data were collected with 50 informants by means of in-depth interviews. The inclusion of both males and females added a new dimension to the existing literature as there is less information regarding gender in relation to climate change; especially in Limpopo Province. An interview schedule was developed with open-ended

questions to allow the informants to express their own perceptions, experiences, and responses to changing climatic changes. Collected data covered biographical information of the informants, their perception of climate change and its impacts as well as the mechanisms developed to adapt to the impacts of climate change. The researcher abided by code of ethics governing research such as informed consent, freedom from harm, right to self-determination, right to full information, right to fair treatment, right to privacy, anonymity and confidentiality.

Adoption of the Afrocentric approach necessitated the use of a purposive sample to explore African experiences of climate change in their own locality (Mazama, 2003). In the study, only community members aged 50 years and above were sampled to share their experiences of climate change. The approach also allowed for face-to-face interactions with the informants to obtain experiences of climate change in a permissive and non-threatening environment. Another important tenet of the Afrocentric approach is analysis of data in terms of the informants' own experiences of climate change and how it impacts on the livelihood of the community (Asante, 2007). The study was centred on the community's experiences on climate change.

### **5.1.2 Knowledge of climate change**

Climate change in the study is understood as change in temperature and rainfall patterns. The informants observe that the summer is extremely hot while the winter is warm with little unusual precipitation. It is however important to mention that climate change in the study is explained as change in temperature and rainfall patterns. There are observations of drastic increase in temperature patterns traced back about ten years which are responsible for excessively hot and dry summer and warm winter. The last period of good rain in the community is the past ten years ago and since that time rain is unpredictable. These observations are corroborated by the IPCC (2007) that remarkable changes in temperature patterns were reported between the years 1960 and 2009 where the mean annual temperature increased by at least 1.5 times the observed global average of 0.5°C over the past five decades.

The present study is among the first to examine community level perceptions of climate change. Some of informants' perceptions of climate change are indicators like production losses, poor growth of crops, increased sickness as well as the

shared experiences of other members of the community. Community members become sick, lose their crops and suffer other losses, which they then attribute to extreme heat or cold events or unprecedented floods or storms. The informants reported observations of climate change similar to those in the literature.

It is reported that rural communities' explanations of climate change are centered on variations in temperature and rainfall patterns manifest as rising temperature trends and scarce rainfall (IPCC, 2013). Rural communities are aware that devastating changes in their living conditions such as malnutrition, poverty, water and air contamination, increased risks of disease, floods, soil erosion and depletion of biodiversity are as a result of climate and environmental variability (Gandure et al., 2012).

Rankoana (2016) attests that climate change is explained in terms of cessation of cultural activities and important livelihood patterns. These include consumption of traditional fruits and vegetables, brewing of traditional beer, production of traditional crops and livestock, celebration of the first-fruit rituals, communal labor, hunting and fishing. It was mentioned that rain-induced diseases such as cholera, bilharzia and dysentery are becoming common in the community as a result of use of contaminated water, drought and excessive heat.

Further explanations of climate change are supported by evidence of persistent rainfall hazards such as drought which resulted in loss of livestock, fallow fields dust and depletion of biodiversity. Additionally, climate change is explained in terms of cessation of cultural activities and important livelihood patterns. These include brewing of traditional beer, production of subsistence crops and livestock. The health conditions of community members are affected by changing weather and rainfall patterns. It was mentioned that rain-induced diseases such as cholera, bilharzia and dysentery are becoming common in the community as a result of use of contaminated water, drought and excessive heat.

The informants' knowledge of climate change is consistent with the farmers' knowledge of changing climatic conditions in the Sahelian region of West Africa where they point to shrinking water bodies, disappearing plants and crops, and

changing settlement patterns as evidence of reduced rainfall over the last three decades of the twentieth century (Tschakert, 2010; Roncoli et al., 2002). These observations are further supported by Rankoana (2016) that in the past fifty years, the first rainfall was received in September, but recently the first rain falls between October and December with the ploughing season coming later in the year to the beginning of the next year. Further explanations of climate change are persistent rainfall hazards such as drought which resulted in loss of livestock, fallow fields and deteriorating water levels in the rivers and boreholes; soil erosion, dust and depletion of biodiversity. The IPCC (2007) adds that rural communities are aware that devastating changes in their living conditions such as malnutrition, poverty, water and air contamination, increased risks of disease, floods, soil erosion and depletion of biodiversity are as a result of climate and environmental variability.

Further observations from the literature supporting the informants' understanding of climate change are that local communities are aware of devastating changes in their living conditions such as malnutrition, poverty, water and air contamination, increased risks of disease, floods, soil erosion and depletion of biodiversity as a result of climate and environmental variability (FAO 2007; IPCC, 2007a; Seager, 2008; Bhursal, 2009; IPCC, 2013). In South Africa the average temperature patterns are likely to increase by 1-3°C; rainfall may become erratic; droughts and floods may become more frequent and devastating (Kruger & Sekele, 2012).

The informants' experiences of climate change and associated phenomena affirm the need to adopt the Afrocentric framework in any study on climate change among Africans. The community's perceptions of climate change affirm its ideals, values and dependency on the natural environment for livelihood. This proves the benefit of a community centeredness, holism and intuition (Mazama, 2001).

### **5.1.3 The impacts of climate change**

The informants are aware of the direct effects of climate change on their livelihoods. They observe that drought, depletion of biodiversity, decreased subsistence economies and cessation of cultural activities impact negatively on the community's livelihoods. The increase in temperature patterns and scarcity of rain negatively impacted on the community's subsistence economy. A major observation is the

decline in the plant species which are major sources of stock-feed which has led to a decline in livestock production. This is compounded by the fact that there has been a break in water cycle, decline in rainfall, lowering of groundwater, drying up streams and wells. This, together with the poor water retention capacity of the soils, causes large inter-year variations in the plant growth. This finding is supported by Food and Agriculture Organization [FAO] (2007) that about 70% of people in developing countries living in the rural areas depend on subsistence crop production which is recently characterized by low productivity and instability as a result of marginal and erratic rainfall, low soil and ambient temperatures below the minimum temperature of 10 °C.

Subsistence farmers are vulnerable to the impacts of increased temperature and drought which are among the recent pervasive stressors rural communities have to cope with (IPCC, 2007; Rankoana, 2016). The IPCC (2007) further attests that climate change impacts on food security are influencing susceptibility to diseases. Incidences of food insecurity in the era of climate change are high so that most indigent families become susceptible to disease (IPCC, 2007; Rankoana & Mothiba, 2015). This is further reinforced by community knowledge of climate change, which remains characteristically interwoven with other environmental and societal problems including outbreak of diseases and frequent deaths in the local and neighboring communities (Bhursal, 2009)

### **5.2.3 The indigenous adaptation measures**

Indigenous peoples have consistently participated in the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC). As part of their international advocacy efforts, indigenous peoples have been consolidating themselves through networking and alliance building. For instance, the International Indigenous Peoples Forum on Climate Change (IIPFCCC) has become an effective channel for consolidating their position and for providing recommendations to influence the outcomes of the COP. An example of positive outcome that is favorable to indigenous peoples in relation to climate change adaptation under the UNFCCC is paragraph 8 of Article 4. This paragraph recognizes the urgency that faces those different social groups living in the marginal,



threatened areas and areas prone to sea level rise, drought and desertification. It also includes fragile and mountainous ecosystems (FAO, 2014).

The Convention on Biological Diversity (CBD) is another International mechanism where indigenous peoples have been actively participating in promoting their issues and concerns relating to climate change adaptation, mitigation and biodiversity. Indigenous Peoples have been participating under the banner of International Indigenous Forum on Biodiversity (IIFB) in the CBD processes and have made significant impact in influencing the outcome of the negotiations. The IIFB has an advisory status to the CBD and the processes relating to this has been more open to the participation of indigenous peoples as compared to the UNFCCC.

In the study, the informants have developed culture-based mechanisms of adaptation to the impacts of climate change. Increased frequency and intensity of unpredictable rainfall have challenged the abilities, skills, knowledge and practices of the informants to cope with and adapt to the changing climate. For example, the informants use their knowledge of observable changes in their surroundings to decide their agricultural activities. Crop production is sustained by adapting the indigenous cropping mechanisms in which short-season crops are planted to minimize food insecurity. The little harvest the informants receive from the fields is preserved to ensure food availability throughout the season. These indigenous adaptive practices are reported in Rankoana (2016) where community members use their knowledge of subsistence farming to adapt to the negative impacts of climate change on crop production.

The IPCC (2013) attests that adaptation mechanisms used by rural communities to cope with changing climatic conditions are complex, developed and used within cultures and imply greater dependability on the use of indigenous knowledge to carry on production of subsistence crops. Production of subsistence crops in the era of climate change is planned in terms of the people's knowledge of the seasons, soil fertility and texture, and seed variations which enhance sustainable production of crops (Ziervogel et al., 2014). Small-scale farmers sustain the production of crops through knowledge of environmental conditions and seasonal change without access

to modern scientific knowledge. These community-based adaptation methods are grounded on the communities' priorities, needs, knowledge and capacities which empower people to plan and cope with the impacts of climate change (IPCC, 2013).

Gyampoh et al. (2014) show that in the rural communities affected by the negative impacts of climate change, adaptation to drought, scarcity of rain, decreased production of crops is accomplished through community-based measures to sustain human livelihoods. For Ziervogel et al (2014) these mechanisms are complex, developed and used within cultures and imply greater dependability on the use of indigenous knowledge to adapt to change. These community-based adaptation methods are grounded in the communities' priorities, needs, knowledge and capacities which empower people to plan and cope with the impacts of climate change (Ziervogel et al., 2014).

There is some degree of awareness, knowledge and capacity at local level to understand climate change scenarios, address issues, and conduct long-term planning. Smith et al. (2001) shows that adaptive strategies can be formulated at a local level once there is understanding of specific impacts to resources and how much those resources are valued by the community. Rankoana (2016) reports that adaptation to the impacts of climate change is informed by the community's worldview in which knowledge of the seasons, rain forecast, crop diversification and improvement of soil structure is used to plan the planting season to sustain the crop yields. This type of adaptation is resilient to climate variations and sustains human livelihoods and may be helpful in the development of sustainable adaptation policies to assist rural communities vulnerable to climate change hazards (IPCC, 2013). Climate change forces community members to think innovatively and to develop practical solutions to the challenges of climate and development (Huq et al., 2015).

Community level adaptive practices are within the province of elderly community members whose assumptions about seasonal rainfall are informed by natural phenomena, while cultural and ritual specialists draw predictions through divination, visions or dreams (Roncoli et al., 2001). Indicators such as timing, intensity and duration of cold temperatures during the early part of the dry season were useful to predict weather. Other forecasting indicators used include the timing of fruiting by

certain local trees, the water level in streams and ponds, the nesting behavior of small birds, and insect behavior in rubbish heaps outside yards also substantiated by Roncoli et al. (2001).

### **5.3 Conclusion**

Climate change in the study is designated as increased temperatures and erratic rainfall patterns. These changes have negatively impacted on the livelihood patterns of Dikgale community. Important cultural practices which are dependable on subsistence economy, kinship relations have ceased to exist. The health, social and economic aspects of the community are negatively impacted. Decline in subsistence economy, poor water supply, exposure to dust and wind as a result of drought are the major health hazards community members are susceptible to. Despite these negative impacts of changing temperature and rainfall patterns, community members have the potential to adapt to rainfall scarcity through their indigenous knowledge systems. These systems are informed by the community's worldview in which indigenous knowledge of the seasons, and crop diversification and improvement of soil structure are used to respond to drought for improved crop productivity. This type of adaptation is resilient to climate variations and sustains human livelihoods and may be helpful in the development of sustainable adaptation policies to assist rural communities vulnerable to climate change hazards. There was no mention of adaptation measures to limit the impact of changing temperature patterns on the livelihood of community members. However, in future studies it is essential to examine the effectiveness of the adaptive strategies, particularly in relation to biophysical conditions and to human livelihoods, above all the welfare of the most vulnerable groups – pregnant and nursing women and children, towards restoration of ecological integrity and reduction of human misery through appropriate environmental recovery and livelihoods support programs. The improvement of knowledge sharing between community elders and the youths must be prioritized so that the community retains the rich indigenous knowledge they have already accumulated with time.

### **5.4 Recommendations**

Most rural communities continue to depend on exploitation of natural resources to fulfill basic needs. Remarkable increase in temperature patterns and rainfall

scarcity is negatively impacting on their livelihood resources. Adaptation to this change is only through the indigenous knowledge systems with little interventions from outside the community. As a result government and its parastatals offer little or no assistance to rural communities affected by climate change because of minute knowledge about its impacts on rural livelihoods. Therefore, the present study recommends further studies on rural communities' explanations of climate change and their potential for adaptation to climate change hazards. These studies will provide evidence of communities which are mostly affected by changing climatic conditions and the type of interventions government should provide.

Climate change impacts rural communities differently to urban communities because they live in diverse natural environments and experience it differently. This necessitates cross-cultural communication in the search of sustainable solutions to the challenges of climate change through shared experiences. The causes and impacts of climate change had different cultural meanings and interpretations in diverse rural culture. These diverse cultural experiences and knowledge systems on climate change need to be documented and protected for sustainability through the use of information and communication technologies throughout the communities.

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## APPENDIX A

### DATA COLLECTION INSTRUMENT

#### A. Interviewees' biographical information

##### a. Gender

Male	1
Female	2

##### b. How long have you live in Dikgale

1-10	11-20	21-30	31-40	41-50	OTHER
1	2	3	4	5	6



c. Marital status

Singled	Married	Divorced	Separated	Other, specify
1	2	3	4	5

d. Educational standard

No education	Primary	Secondary	Tertiary	Graduate
1	2	3	4	5

e. Occupation

Unemployed	Pensioner	Professional	Self-employed	Other, specify
1	2	3	4	5

F. Income

Non	Pensioner	State pension	remittance	Other benefits
1	2	3	4	5

G. Land ownership

Landlord (renting out land)	Owner – cultivator	Tenant (renting in land)	Communal ownership (usufruct)	Other
1	2	3	4	5

H. Livestock

Cows	Sheep	Poultry	Goats	Other
1	2	3	4	5

i. Main occupations in area

field crop farm worker	labourer in factory	sales person in grocery retail trade	education teacher	Other
1	2	3	4	5

**B. Climate change and its implications on the socio-economic and health conditions of the Dikgale community, and the indigenous adaptation measures the community has developed for sustainable livelihood**

1. What is your understanding and knowledge about temperature, seasons and rainfall?
2.
  - 2.1 Are temperatures, seasons and rainfall patterns in your area the same as the time when you/parents/grandparents were born?
  - 2.2 Are you noticing any change?
3. What are the indicators of change in temperature, seasons and rainfall patterns?
4.
  - 4.1 Are you noticing any change in the cultural activities as a result of change in temperature, seasons and rainfall patterns?
  - 4.2 Which cultural activities are mostly affected?
  - 4.3 Are there seasonal rituals and celebrations affected by this change?
  - 4.4 Which health conditions are associated with change in temperature, seasons and rainfall patterns?
  - 4.5 Which conditions of your life are affected by change in climate conditions?
5. Which conditions are mostly affected?

6. How are you coping with the changing temperature, seasons and rainfall patterns?
7. What indigenous adaptive measures are available and used by you/the community to adapt to the changes in temperature, seasons and rainfall patterns?
8. How can normative, culturally bound positions be beneficially expressed with analyses of climate change?  
Are worried about climate change? Will it affect you personally?
9. Why do cultural changes matter in climate resilience and adaptation?  
What are some of the impacts we can expect from climate change?
10. What role does human activity play in the climate trend?
11. What can be done to slow climate change and make a difference?

## **APPENDIX B**

### **CONSENT FORM**

I \_\_\_\_\_ hereby voluntarily consent to participate in the following project: **The Impact of climate change: Its implications and the indigenous adaptation measures for sustainable livelihood in Dikgale community in the Limpopo Province.** I have been fully informed of the project where the procedures to be followed for taking part in the project have been explained to me. I understand that there are conditions to be met for me to participate in the study. I will be required to answer questions relating to indigenous knowledge of adaptation to the changing climatic conditions. I am aware

that I do not have to take part in the project and may voluntarily withdraw at any stage. Under these conditions I am willing to participate in the project.

Signature of Participant ..... Date .....

Signature of Witness..... Date .....

Signature of Project Leader ..... Date  
.....