

ADAPTATION TO CLIMATE CHANGE IN THE NKHOTA-KOTA DISTRICT OF MALAWI

By

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I hereby declare that the abovementioned treatise/dissertation/thesis is my own work and that it has not previously been submitted for assessment to another University or for Another Qualification.

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ABSTRACT

Climate change is the noticed change in climate patterns in the world, drawing from various weather patterns taken across the world. This study set out to look at how rural farming communities are adapting to climate change by drawing from their own locally available knowledge (LKFs).

For this study, adaptation to climate change using LKFs also meant to look at the presence of scientific knowledge and the combination of the two types of knowledge forms. This was done by researching in the village of Mwala o' Tongole in Nkhotakota district of Malawi.

A qualitative research was conducted guided by the following research themes; people's perceptions of climate change and the causes of climate change; local people's application of local and scientific knowledge as they adapt to climate changes; the effects that adaptation to climate change has had on other aspects of communities lives, in particular the religious, social and political domains, and finally, how people's adaptation knowledge can be incorporated into policy and inform policy-makers in dealing with mitigation and adaptation of climate change.

The study came to show that, the people of Mwala o' Tongole did know that there was climate change occurring in their community and beyond. They cited factors such as delayed onset of rains, higher temperatures, increased floods and cyclones amongst others as signs of climate change. The change in climate was attributed to human actions and supernatural factors beyond human control.

The temperatures and rainfall trends of Malawi as shown from the records of the Malawi Meteorological department showed that temperatures were significantly increasing while the mean for rainfall was drastically decreasing.

The study also found local and scientific knowledge to be at play in this village. Local knowledge (LK) was the knowledge which was developed within the community through the years, from their own interaction with the environment and their lived experiences. This is the knowledge they mostly use to adapt to climate change. Conversely, scientific knowledge was brought in by the Agriculture Extension Officers and the schools, and it is also being used in adapting to climate change.

The effects of adaptation to climate change on specific cultural domains show that they have both been negative and positive.

The study recommends that policy making should provide for intervention research, utilisation of LKFs, capacity building and women involvement in adaptation strategies. These strategies should allow coordinated information sharing, credit provision and weather risk insurance. Likewise, continuous education and training for agriculture extension officers and the local farmers on emerging issues in climate change adaptation should be prioritised.

Keywords:

Climate change, local knowledge forms (LKFs), scientific knowledge forms (SKFs), agricultural extension officers, cultural domains, climate variability

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CHAPTER 1: INTRODUCTION

1.1. Introduction

Climate change is a major global concern in the various parts of the world. According to the Intergovernmental Panel on Climate Change (IPCC) (2007), one of the leading global organisations which draws scientists and academics from different parts of the world, there is no doubt that human activities have been contributing towards climate change. The IPCC adds that climate change is one of the most challenging problems facing humanity today. It is believed that this will have significant consequences for human development and security in the coming years. Ironically, the poor who are mostly affected by climate change are always forgotten when it comes to policy development and implementation plans regarding this phenomenon. The issue of climate change has been one of the most contentious issues at international forums. It is thus, recognised as one of the biggest challenges of the human times that calls for serious efforts from all nations to come up with ways that will help deal with this challenge once and for all.

Since 1827, when the first account on global warming was published, a lot of research have been conducted globally (Alsfen & Skodvin, 1998; Dougil, Twyman, Thomas & Sporton 2002; Payton, Barr, Martin, Sillitoe, Deckers, Gowing, Hatibu, Naseem, Tenywa & Zuberi, 2003; Adger, Huq, Brown, Dellan & Hulmer 2007; Challinor, Wheeler, Garforth, Craufurd, Kassam, 2007; Kandiji, Verchot & Mackensen, 2006; Mertz, Mbow Cheikh & Diouf, 2009). The claims of climate change as being the fruits of human activities started coming out around 1896 when a Swedish chemist, Svante Arrhenius observed that the First Industrial Revolution (1IR) and its manufacturing companies had begun to generate a lot of carbon dioxide into the atmosphere (Alsfen & Skodvin, 1998). Svante projected that carbon dioxide concentrations would continue as long as the world's consumption of fossil fuels was increasing at that rapid rate. His understanding of the role of carbon dioxide led him to predict that if the atmospheric carbon dioxide doubled, the Earth would become severely warmer. Other than this, some studies on climate change have encompassed insights from the social and natural sciences as well as policy analyses both within and without the IPCC (Adger, 2003: 396). Studies of this kind have since resulted into making climate change become one of the very important areas worth investigating given the challenges it poses to humankind. Human development, especially industrialisation has led to an increase in greenhouse gases (GHGs) into the atmosphere, and this has as a

result increased weather changes (Bloom, 2010: 3). On this, many studies from elsewhere around the globe do indicate that indeed the problems we are facing today are as a result of human activities (Brosius, 1997; Dougil, et.al. 2002; Payton, et.al. 2003; Adger, et.al. 2007; Challinor, et.al. 2007; Kandiji, et.al. 2006, & Mertz, et.al. 2009).

According to these scholars, the challenges emanating from climate changes include the following: Firstly, there are increased droughts which lead to famine and hunger for the population. For example, due to changes in climate, there have been widespread, prolonged dry spells in countries such as Kenya, Tanzania, Zambia and Zimbabwe. In other years, there have been excessive rains and floods in countries such as Lesotho and Mozambique which have led to fierce cyclones such as IDAI and heavy floods (Kandiji, et.al., 2006; Shemsanga, Nyatichi & Yansheng, 2010). Other effects of climate change include the melting of the North Pole ice bergs which led to an increase in sea levels and resulted into heavy floods.

It should be noted that rural dwellers are more vulnerable to the effects of climate change than urban dwellers (Chikaire & Nnadi, 2011). This is largely due to the limited resources for their everyday livelihoods, and their direct dependence on natural resources. Studies have also shown that climate change will cause more and more casualties in developing countries than developed countries on account that developing countries have very limited coping mechanisms and resources (IPCC, 2001 & 2007). In particular, African countries are mostly vulnerable to climate change because of their dependence on rain-fed agriculture. Besides, inadequate land distribution policies, and widespread poverty are all factors that make Africa become vulnerable to climate changes. Given Africa's reliance on natural resources, there has been increased depletion of natural resources including sand and trees which has in turn contributed to devastating climate changes (Kandiji, et. al. 2006).

As noted earlier on, climate change has indeed drawn considerable debates and attention from different quarters of society at both national and international levels because it concerns life and means of survival. These debates have been predominant in the social sciences as researchers continue to investigate the phenomenon, its impact and solutions. For example, some researchers have focussed on how human activities have caused climate change and how it can be dealt with while others have focused on how people deal

with this problem, the perceptions that this might be something beyond human understanding (Morton, 2007; Payton, et al. 2003 & Rowlands, 1998).

1.2. Problem statement

Contrary to earlier held beliefs that people in different countries are passive victims of climate change, history and research have shown how people have adapted to conditions such as droughts, floods and other catastrophes (Nyong, Adesina, Osman Elasha, 2007). In western Sahel, for example, pastoralist farmers have been able to adapt to climate change by adjusting their movements in search for pasture whilst letting other land areas regenerate (Adger, 2003). Likewise, in the Canadian arctic, indigenous hunters have been able to adapt to climate change by adjusting their hunting seasons so that animals or fish can regenerate (Duerden, 2004). In Morocco, farmers have adopted strategic use of fallow and late planting of legumes through storage of farm produce and recycling the food leftovers. In some cases, the fallow is used as manure and protection against the heat during dry spells (Morton, 2007:1). Furthermore, in Bangladesh, Vietnam and Kenya, farmers have also shown continued resilience to climate change despite their being domiciled in the developing countries where the effects are said to be unbearable and repulsive (Mortimore & Adams 1998; Huq, Karim, Asaduzzaman & Mahtab 1999; Berkes & Jolly, 2002). In Kenya again, pastoralists have practised rotational grazing by moving from one land to another to allow the grazed land has its pasture fully recovered. It should be said that in Kenya, animal accumulation is regarded as an insurance against drought, and keeping multispecies is considered as an advantage to changing climatic conditions as these animals can be sold in times of need (Nyong, et.al.794: 2007).

Looking at these examples, it is clear that these communities have some indigenous knowledge forms (I/LKFs) which are used for adapting to climate changes. However, since communities are not static in nature as they potentially interact with outsiders whose knowledge is not the same as theirs, they may have their LKFs influenced, altered, assimilated or resisted. Accordingly, it is therefore important to investigate how adaptation to climate change is done at community level especially when scientific knowledge (SKFs) and LKFs converge. It is also important to understand how this knowledge forms convergence reflects on the communities social, political, cultural, religious and economic activities. Such knowledge will provide a more holistic understanding of how rural people adapt to climate change given the intersection of the LKFs and SKFs.

For the purpose of this study, LKFs refers to knowledge that is usually applied in rural communities and in semi-urban environments. Since it is practiced at the local level, it is envisaged that if such knowledge is properly nurtured and scaled up in its application, it can help add value to the communities. Besides, available literature on LKFs in Malawi shows that this form of knowledge is minimally applied by the locals when responding to climate changes (Stringer, Dyer, Reed, Dougil, Twyman & Mkwambisi, 2009 & Brysecon, 2006). Conversely, in Morocco and Kenya, studies have shown that LKFS are extensively applied in adapting to climate change (Cross & Barker, 2002; Morton, 2007 & Nyong, et.al. 2007). In Malawi, Non-Governmental Organisations (NGOs), government departments, and donors have shown significant interests in the promotion of LKFs and practices that are believed to minimise the effects of climate change (Kalanda, Ngondgondo, Chipeta & Mpembeka, 2011). The assumption is that existing social and cultural constructs create varying perceptions and needs within the different communities. In turn, these helps shape human interaction with the changing environment. It is therefore imperative to understand how these communities learn and transmit knowledge about their environment and its sustainability. This means an appropriate analysis of LKFs in terms of their applicability, and how farming systems and livelihoods adjustments ought to be done to suit climate changes becomes critical at this moment. The complex adaptation practices to be examined will be under social organisation, political organisation and religious organisation for us to have a wider perspective of the issues. These have been selected as they are subsumed to provide the basis for understanding the community in which this study was conducted.

The study on climate change in Nkhotakota in Malawi is important since this problem is affecting Malawians especially the rural poor. Since Malawi has been said to have abundant LKFs but has not been extensively explored, this study joins the limited few scholars who tried to examine this knowledge, and its role in mitigating climate change. Besides, the focus of the previous studies has been mostly on the effects of climate change on communities due to their dependence on the natural resources but did try to combine LKFs and SKFs as tools for mitigating climate change. In essence, the focus of those studies remained on agriculture hence examining how farmers adapt to climate change but not necessarily how different knowledge forms (KFs) can effectively be utilised to mitigate climate change (Malawi NAPA, 2003 & Stringer, et.al., 2009).

Accordingly, this study will focus on the local practices and KFs farmers of *Mwala o' Tongole* village in Nkhotakota district of Malawi utilise when transacting their everyday farming businesses, and how these activities impact on climate change. It is envisaged that such practices may contribute towards cost-effective farming practices, which when fully acknowledged by the national policy framework on agriculture can become the basis for their adoption. By considering the LKFs of the local people, I will be able to understand and interpret the reasons behind these practices, views and perceptions on the environment. Since these forms the basis for decision-making at the local level where climate change effects are mostly felt, LKFs must be incorporated into the policies that seek to mitigate the effects of climate change. Thus, any framework for understanding rural politics must be based on criteria that are more inclusive than just for economic maximisation.

Since LKFs are particular to distinct locals of a distinct place, this study will consider the LKFs inherent in the peoples of *Mwala o' Tongole* in Nkhotakota in Malawi for understanding their practices in climate change mitigation. It will also consider these LKFs alongside the scientific knowledge forms (SKFs) in order to understand how the latter knowledge forms have supplemented the former in dealing with the problem at hand. It is also envisaged that understanding the application of the LKFs in the adaptation to climate change will essentially enhance community-based collaboration processes (Zilindile and Pooly, 2014; Leibowitz, 2017). The projected climate change trends will also call for innovative livelihood options and adaptation strategies that will allow for coping with climate changes.

It is believed that the findings from this study will form a strong case for constructing logical, networked and contextualised climate change interventions by all stakeholders. It is also expected that this study will assist in promoting significant community practices that can be shared at national and international levels. The study will also help build case study for achieving the collaboration of LKFs and SKFs in dealing with change adaptation.

1.3. Aims and objectives

The main aim of this study is to understand the way rural farming communities adapt to climate change by applying LKFs and SKFs. Therefore, the following will be the objectives:

- To determine people's perception of climate change and its causes.

- To assess rural communities' application of local knowledge forms and scientific knowledge forms in farming practices and climate change adaptation.
- To assess how people's 'adaptation knowledge' can be incorporated into policy and also inform policy makers in dealing with climate change issues effectively.

1.4 Structure of this study

Chapter one provides a brief introduction to climate change and a brief historical background to worldwide climate changes. It then presents the problem statement alongside the aims and objectives of the study. Chapter two provides a literature reviews on climate change as a field of study; the different fields of thought that encompass it and commonly used key words. It has also provided the conceptual and theoretical frameworks for this study focusing on LKFs and climate change adaptation as employed in this area.

Chapter three provides an overview of the methodology used in this study. It outlines the step by step progression of the study from the data collection to data analysis. It also explains the different methods developed to address the research objectives, and the selection of the study site in Nkhotakota district. It describes the triangulation technique as applied in data collection and analysis.

Chapter four presents the findings focusing on the LKFs in climate change management. It starts by examining the community's understanding of climate change as obtained from the interviews with the communities in Nkhota-kota. It later explores the different types of local strategies local communities use when adapting to climate change as drawn from the study findings. It also examines the locally available strategies alongside the SKFs that are used for adapting to climate change. It last but not least re-examines the scientific strategies which are being used to adapt to climate change. It then concludes by giving a summary on the various strategies.

Chapter five looks at the community's perception of the effects of climate change. It does this by looking at the perceptions from the results collected from the study research. It also re-examines people's perceptions on the social and political spheres from within the society. Social, political and religious views and beliefs are examined to interpret and relate their positions and roles towards climate changes.

Chapter six concludes the study by highlighting the key findings of the study. It also presents policy implications and the areas for further studies. It then gives a summary of all the five chapters in the dissertation.

CHAPTER 2: LITERATURE REVIEW

2.0. INTRODUCTION

This chapter discusses the main concepts on climate change. It begins with a discussion on the different conceptions of climate change. It also explores what climate variability is in contrast to climate change. It also explains anthropogenic climate change, and then compares and contrasts climate variability and anthropogenic climate change. It further examines the different knowledge forms and their roles.

It further provides the theoretical framework and empirical background that informs this study. The literature covers the actual and projected environmental changes in general; climate change; variability at global level and regional and micro-scales. It also covers aspects of rural livelihood vulnerability and coping mechanisms, or adaptation to climate variability under different socio-economic contexts.

2.1 What is Climate?

“Climate is defined in purely physical terms, constructed from meteorological observations, predicted inside the software of Earth sciences models and governed (or not) by multi-lateral agreements and institutions” (Hulme, 2007, 6). This is normally arrived at after observing the weather for a period of time, ranging from twenty to thirty (20-35) years. No wonder then that one cannot refer to the weather condition for a particular day as the climate. “Climate change is also defined as a detectable change in climate over a long period of time, with the range of variability also being affected” (Reisinger, 2009: 11). The temperatures taken are inclusive of both land and sea measurements from ships. This is because the ocean surface makes up 70% of the planet earth’s surface. Climate consists of the statistics of temperature, rainfall, wind, humidity, atmospheric pressure, and other meteorological elemental measurements in a given region over long periods. This is unlike weather, which is the present condition of these elements, and their variations over shorter periods of time. Climate can also be classified according to the average and the typical ranges of different variables, most commonly precipitation and temperature (Trenberth, 2000).

2.2. What is climate change?

Climate Change' denotes long-term changes in the statistical distribution of weather patterns over decades of years. Climate has ever been changing even long before human activity played a role in its transformation. Climate Change is now one of the most commonly used word in environmental debates. Climate change is in modern terms understood as the changes in weather brought about by manmade actions. Human actions through industrialisation and burning of fossil fuels, deforestation and use of chemical fertilizers are some of such activities. Climate change is not just about the average temperatures, as has come to be understood, but rather average temperatures showing the changes over a long period of time may be spanning through 20-35 years. It also looks at sectors' relevant conditions such as the frequency of droughts or rains, changes in average diurnal temperatures, and the intensity of twenty-four-hour precipitation (Smit & Skinner, 2000: 89). It therefore includes an examination of the different weather conditions occurrences at different times. These weather events when studied historically will point at climate change, as they show changes in their intensity and occurrence. Briefly, climate change constitutes a shift in metrological conditions that last for a long period of time, at times centuries." (Gbetibouo, 2011: xiv). Climate change, using the metrological definition, is any change in global temperatures and precipitation over time due to natural variability or to human activity (IPCC, 1996). While there are claims that climate change has historically undergone through natural changes also known as climate variability or naturally occurring climate changes; many studies on variability have shown that the changes happening now are not due to natural variability, but rather human actions (Fraser, 2007, 496). These human activities are mostly through releasing of fossil gases into the atmosphere, deforestation and poor farming practices. Climate change is also a complex phenomenon given that it concerns complex interactions between the climate, environment, economy, politicians, institutions, society and technology (Garlan, et.al, 2003). Climate change therefore, affects all facets of human life and existence today.

We need to distinguish between the "natural" and the possible "enhanced" greenhouse effect for us to ably grapple with this complex subject. The *natural* greenhouse effect causes the mean temperature of the Earth's surface to be about 33°C warmer than it would be if natural greenhouse gases were not present. Fortunately, natural greenhouse effect creates a climate in which life can survive under relatively gentle conditions. Otherwise, the Earth would have been a very harsh and difficult place to live in without this mediation. Conversely, an enhanced greenhouse effect refers to the raised mean

temperature of the Earth's surface beyond the required level, and this happens due to the increase in the concentrations of greenhouse gases from human activities. Such ultra-global warming would probably bring deleterious changes to the climate such as precipitation, storm patterns, and oceans water level variations. Sometime, the word "enhanced" is usually omitted in some studies, but it should not be the case in the discussions of greenhouse effect. Nearly 100 years after the Arrhenius prediction, we are now just aware that carbon dioxide is increasing in the atmosphere, with the possibility of it doubling in the next century more than Arrhenius had presumed.

A distinction needs to be made between natural occurring temperature rise and that caused by the increase in the emission of greenhouse gases. The natural greenhouse effect causes the mean temperature of the Earth's surface to be about 33°C warmer than it would have been if natural greenhouse gases were not present. Conversely, an enhanced greenhouse effect refers to the possible raising of the mean temperature of the Earth's surface above that occurring due to the natural greenhouse effect because of an increase in the concentrations of greenhouse gases and human activities. This is thus referred to as global warming. With the increased occurrence of global warming, it has come to be known as climate change as it brings changes in climate. For example, changes in precipitation, storm patterns, and the level of the oceans are some of the changes. For the last 15 to 20 years, we have been seeing a fairly steady rise in temperatures, giving us some signs that we are now in the global warming phase. The human induced climate change has now come to be termed as anthropogenic climate change.

2.3. Climate variability

Climate variability refers to the deviations in the mean state of climate and inconsistencies (for example the occurrence of wind and precipitation extremes), on all temporal and spatial scales beyond those of individual weather events, including short-term fluctuations that happen from year to year. Variability in this case is an integral part of climate change, in which a change in mean climatic conditions is experienced through changes in the nature and frequency of particular yearly conditions, including extreme temperatures. Just as weather varies naturally, so too does climate. This is where there is distinction between climate change and climate variability. Climate varies over seasons and years instead of day-to-day like weather. Some summers are colder and mild while others are hotter and dry yet some years' experience more precipitation than others. Climatic conditions are

inherently variable from year to year, decade to decade, century to century, and beyond. Variability, in other words, is an integral part of climate change. Furthermore, a change in mean climatic conditions is actually experienced through changes in the nature and frequency of that particular year conditions including extremes, and it is to this variability that adaptations are made (Smit, Burton, Klein & Wandel, 2000: 226-227). Throughout history, and in agrarian settlements, climate has varied. Both natural climate change and variability have occurred, in which, past and current agricultural and forestry systems have adapted to (Salinger, 2005: 32). Just as the weather varies, so does climate, and this is where there is the distinction between climate change and climate variability. For example, the average annual rainfall of Nkhota-kota in the central eastern Malawi can be said to be 200 mm, but there is no guarantee that this amount will remain so in the subsequent weeks, months, years or decades.

The effects of global climate change have meant a shifting of climate zones, a rise in sea levels and lastly more severe weather-related events (Rowlands, 1998: 52). This is evidenced by higher temperature changes world-wide. Global climate change is observed through increased surface temperatures of between 0.3 degrees Celsius and 0.6 degrees Celsius (Leichenko & O' Brien, 2002: 7). Researchers observe that much of the global greenhouse emissions are from the developed countries; while countries in the developing world emit a nominal amount of greenhouse gases. The enhanced greenhouse effect is thus considered as the result of human activities. These activities have increased atmospheric concentrations of greenhouse gases and aerosols since the pre-industrial era. Unfortunately, despite emitting a limited amount of greenhouse gases, developing countries are gravely subjected to the effects of climate change and this objectifies them to the practices of the elite. Events like these are not only disastrous to life but also concern social injustices. This is the reason climate change issues are now a global concern, are complex to deal with, and do require concerted and collaborative efforts between demographic, climatic, environmental, economic, health, political, social and cultural institutions (Fisher, Shah, Tubiello & van Velhuizen, 2005: 2081).

It needs to be understood here that historic emissions commit the earth to some degree of future warming regardless of mitigation progress, and will probably surpass the 2 degrees Celsius threshold held by many as indicative of 'dangerous' interference (Berrang-Ford, Ford, & Paterson, 2010: 1) Given that the failure of the Kyoto Protocol Framework for

stabilising emissions by 4 degrees Celsius of global warming by the year 2021, it looks increasingly likely (Parry et al. 2009; Adger & Barnett, 2009) that climate change will continue haunting the world. It is this assumption that resilient adaptation measures to climate change cannot be ignored. Ironically, the challenge of adaptation is not necessarily new, as humans have lived with climatic variability for a long time and developed adaptation systems that were aimed at coping with climate variability. Such adaptations include adjustments in human systems in response to actual or expected climatic stimuli or their effects, which would moderate harm or exploit beneficial opportunities (Berrang-Ford, et.al. 2010: 2). Adaptation mechanisms will in this case most likely include community-level mobilisation rather than institutional, governmental or policy tools.

Studies from elsewhere have shown that climate change has had a lot of negative effects on people in developing countries particularly because most of them depends on agriculture for their livelihoods. Even with a moderate temperature increase such as 1-2 degrees Celsius, it is said that such an increase can impact negatively on the farm produce such as maize, rice and wheat which are the staple food crops worldwide (Morton, 2007, 19683). In most cases, the increase in temperatures has resulted in lowering farm yield by damaging crops at particular developmental stages, and making the timing of agricultural operations more difficult. Dry spells in Malawi, for example, have resulted in the wilting of maize crops before maturity leading to severe hunger and poverty. The most important elements of climate change for Africa are carbon dioxide enrichment, changes in precipitation and changes in extreme events (Collier, Conway, & Venables, 2008: 4-5).

Therefore, adaptation to climate change must include adaptation to variability (Smit, Burton, Klein & Wandel, 2000: 226-227). It should be said that climate is never defined by any particular timeframe although scientists typically use average weather conditions of over 20-30-year time-frames to track it. These averages are called climatological normal, and are used to determine, monitor or represent the climate – or a specific slice of climate – at a particular location. Thirty years of data is long enough to calculate an average that is not influenced by year-to-year variability. The variety around the average — the range of weather — is the other half. When an average is calculated, the variety of the data within it is “smoothed. Climate change is thus a long-term continuous change (increase or decrease) to average weather conditions (for example average temperature) or the range

of weather though both may happen simultaneously. Since climate change may be in some years slow and gradual, unlike yearly variability, it becomes very difficult to perceive it without any scientific records. In climate change, there is a look for long-term trends in climatological averages and the variety around these averages.

Precisely, climate change occurs because of changes to Earth's environment. These changes can be changes in the orbit around the sun or human modification of the atmosphere. There is nothing inherently wrong with climate change as long as that change does not pose a threat to life. After all, climate change has happened in the past and will continue to happen. Nevertheless, the main issue here stems from the rate and severity these changes are happening. Relative to this, scientists have found out that the current rate of temperature increase is higher than any previously seen in the last 800,000 years. They suggest that the major culprit to these changes is human-driven activities that are contributing to the unprecedented rate of temperature increases. A good way to gain appreciation of global warming conception is to compare it to natural year-to-year variability of temperature.

From time in memorial, and within agrarian settlements, climate has always varied as I had already alluded to in the previous sections. Both natural climate change and variability has occurred, in which past and current agricultural and forestry systems have adapted to (Salinger, 2005: 15). For example, natural variability of the El Niño Southern Oscillation (ENSO) has been a factor in the analyses of climate variability and change throughout history (Guloba, 2014: 50). However, the magnitude and severity of the changes projected for the 21st century fall outside that range which is shown in the variability of the El Niño Southern Oscillation. There is in fact a 90 percent confidence range of global warming to be in the range of 2 to 5 Degrees Celsius (Wigley & Raper, 2001: 451) and if that comes to pass, it may be catastrophic to life.

2.4 Climate change re Africa

The IPCC (2007) third assessment report warned the world of the unavoidable impact of climate change in the near term and raised awareness of the need to cope with the impact of climate change through "adaptation". In particular, the report hinted that poor countries would be the most affected and would need assistance to adapt to climate changes since they are more dependent on resources such as rainfall; natural resources and agriculture, and have a lower adaptive capacity at present. In other regions of the world, the key issue

is how to reduce carbon emissions while in Africa the main concern is the adaptation of production methods to changing and deteriorating opportunities (Toulmin, 2009). This is already evident in those countries where consequences of climate change such as floods and dry spells are being felt. Concerted action is therefore required in the areas of mitigation, monitoring, and preparedness to respond effectively to emerging climate related crises (Schipper, 2007). Whether these issues are being properly addressed in Africa or not is yet to be determined. This is the very same reason this current study is being conducted.

Sub-Saharan Africa is predicted to be particularly hard hit by global warming because it already experiences high temperatures and low precipitation, and that the economies are highly dependent on agriculture, and not technology (Kurukulasuriya, et.al. 2006) In the Sahelian region of Africa, warmer and dry conditions have led to a reduced length of growing season with detrimental effects on crop production levels (Berrang-Ford, Ford, Paterson, 2010). In southern Africa, longer dry seasons and more uncertain rainfall are prompting adaptation measures too. The Sub-Saharan Africa is indeed one of the regions that continue to face chronic food insecurity and persistent threats of famine and cyclones. In 2002/2003, for example, over 13 million people faced food shortages as a result of severe drought in southern Africa alone (Oxfam, 2002). Similarly, in 2002, the UN issued an appeal for US\$611 million to address the food crisis in Lesotho, Malawi, Swaziland, Zambia, Zimbabwe and Mozambique (Vogel & O'Brien, 2006).

Furthermore, while solar radiation passes through the earth's atmosphere, and warms the earth system, greenhouse gases such as Carbon dioxide and methane emitted by human activity re-radiate lower-wavelength radiation that would otherwise be reflected back into space, causing additional warming. The results in higher temperatures at both sea and land surfaces, change patterns of atmospheric circulation, and rainfall distribution, snow caps and glaciers, storm intensity, and water levels (Lamboll, Stathers & Morton, 2017).

2.5. Climate change as a product of anthropogenic factors

Climate change is not just about the change in average temperatures as it has come to be understood. It also looks at sector relevant conditions such as the frequency of droughts or wet years, changes in diurnal temperature differences and the intensity of twenty-four-hour precipitation (Smit, et. al. 2000). The changes in diurnal temperatures relate to the variation in temperature that occurs from the highs of the days to the lows of the nights.

When studied historically, these weather events point towards climate change, as they show a change in their intensity and occurrence. Gbetibouo, (2011) points out that 'climate change constitutes a shift in meteorological conditions that last for a long period of time, at times centuries. Briefly, climate change using a meteorological definition is linked to any change in global temperature and precipitation over time due to natural variability or to human activity (IPCC, 1996).

It is known fact that climate has historically gone through natural changes which are characterised by warming and cooling. However, current studies on climate variability have shown that the changes in climate currently occurring are not due to natural variability, but rather human actions. As already seen in the previous sections, it involves complex interactions between climatic, environmental, economic, political, institutional, social and technological processes (Tompkins & Adger, 2003). Therefore, climate change affects all facets of human life existence as it affects things which are intricately linked to human wellbeing.

As already noted, human development, with an increase in industrialisation, has heavily contributed to this condition over the past 200 years. Some of the activities that have contributed towards this phenomenon have also been presented in the above section but these are the ones as identified by (Hansen, Johnson, Lacis, Lebedeff, Lee, Rind & Russel, 1981). For example, the current rate of deforestation across the world including South America, Africa and Asia are contributing to more than 20% of the greenhouse gas emissions. Hence, deforestation is contributing significantly to climate change (UNFCCC, 2009). As a result of these activities, carbon dioxide concentrations have increased by more than one quarter, and methane concentrations have more than doubled since the industrial revolution (1IR) while nitrous oxide concentrations have increased by more than 15% since 1950 (Lanchberry & Victor 1995). All of these different gases combined contribute towards global warming, even though carbon dioxide is the culprit. Therefore, according to the Greenhouse Theory, it is only plausible that the atmosphere will trap more of the sun's heat, causing the warming up of the earth. Let it be known that the greenhouse emissions are mostly from the industrialised world not the developing world which only contributes an insignificant proportion.

The IPCC concluded that it was convinced that human activities are substantially increasing the atmospheric concentration of the greenhouse gasses by particular

reference to carbon dioxide, methane, chlorofluorocarbons and nitrous oxide (IPCC, 1990). Hence, it confirmed that these increases were enhancing the natural occurring greenhouse effect, causing an additional warming of the earth's surface.

2.5.1. Historical development of climate change

Historical research investigating the trends in temperature from the time when reliable temperature records were first kept in the 1880s show an increase in temperatures throughout the world. The Greenhouse Theories (GHT) go back to just over a hundred years ago, and it is based on the discoveries of studies spanning that period. As early as 1827, Baron Jean-Baptiste Fourier suggested that human activities could modify the surface climate (Alfsen & Skodvin, 1998). He was probably the first person to link human anthropogenic action to changes in climate. In 1890, an examination of the GHT of climate change was taken up in earnest by a Swedish scientist, Svante Arrhenius, who concluded that the burning of fossils and the release of carbon dioxide could end up affecting the escape of the heat from the earth (Alfsen & Skodvin, 1998). Arrhenius took note of the 1IR then getting underway and realised that the amount of carbon dioxide that was being released into the atmosphere was ever-increasing. Moreover, he believed that carbon dioxide concentrations would continue to increase as the world's consumption of fossil fuels, increased ever more and more rapidly. His understanding of the role of carbon dioxide in heating the earth even at that early date, led him to predict that if atmospheric carbon dioxide doubled, the earth would become several degrees warmer.

Hereafter (1898-1964) examined historical trends in global average temperatures. He grouped temperatures from the most reliable weather stations in given regions of the world. His calculations, with the grouping of averages, suggested that world temperatures had increased by more than 0.2 degrees Celsius between 1890 and 1935 (Bloom, 2010). The cause of this increase in temperature was attributed to rising carbon dioxide in the atmosphere. Unfortunately, his discovery was disregarded at the time by climatologists on the basis that temperatures being fluid can statistically be manipulated to support nearly any conclusion (Bloom, 2010). Almost two decades passed before any further examination of these proposed changes to the atmosphere were explored.

In the 1950's, Revelle and Suess at the Scripps Institute of Oceanography indicated that the oceans were not absorbing half of the manmade carbon dioxide emissions. Thus, it was concluded that the carbon dioxide concentration in our atmosphere was increasing.

Their discovery led to the establishment of a monitoring system under the guidance of Charles Keeling, a member of the same institute. A further investigation into the presence of carbon dioxide in the atmosphere showed an upward trend in its levels. This was unlike the existing levels during pre-industrial times. This increment in carbon dioxide has reliably been attributed to the human mobile industrial world (Urry, 2011: 24). This means that the presence of carbon dioxide and other greenhouse gases started to increase with the industrial revolution historically and has continued to do so with the advancement in the post-industrial world.

In 1958 geophysical year, monitoring of atmospheric carbon-dioxide concentration levels began in Antarctica and Mauna Loa, Hawaii (Alsfen & 1998). The study established that there was a significant change in the atmosphere. Duplicate measurements of about 749 discrete samples collected at the South and North Pole showed that there was a seasonally adjusted concentration of atmospheric carbon dioxide in the polar southern hemisphere, which had increased by 3.7% between the years 1957 and 1971. However, despite a slight decrease in the carbon dioxide concentration during these years, caused by a cooling of the surface ocean, there has not been any downward trend. The statistics indicated an increasing acceleration of the carbon dioxide concentration in the atmosphere (Sundquist & Keeling, 2009). Historical research has thus shown increased levels of green-house gas emissions, emanating from the outset of the industrial world since 1750s.

Despite these findings, there was not enough attention which was given by the world in relation to climate change. Following this, a conference was held in 1963, at a NGO meeting organised by the Conservation Foundation. It was concluded that a doubling of carbon dioxide in the atmosphere would lead to a temperature rise of 3.8 degrees Celsius (Alsfen & Skodvin, 1998). Unfortunately, as in the case of previous assessments, this was not given any official recognition by governments and scientists at that time.

In 1965, Lyndon B. Johnson, former president of the United States, gave official recognition to a report submitted by the President's Science Advisory Committee (PSAC). This committee was commissioned to examine the effect of high-carbon synthetic oils. The committee's findings on the effects of high- carbon synthetic oils were shown to be detrimental to the environment, toxic to the soils, acid rains, an increased presence of carbon dioxide in the air amongst others all of which pointed to climate change (Alsfen & Skodvin, 1998). It then concluded that climate change could be caused by human activities

causing serious consequences for humankind (Lanchbery & Victor, 1995; & Bloom, 2010). With this official acknowledgement by the United States government, growing interest and concern on climate change was now evident. Henceforth, a rise in conferences, forums and workshops with themes based on climate change characterised the world scene.

Thus, from the 1970's scientific research on human and societal impacts on climate change were stimulated through conferences, loose research networks and assessments (Agrawal, 1998). By the early 1980's, scientific research on climate change was steadily increasing. Scientists predominantly focused on the warming trends in the mean climate which were said to stem from greenhouse gas concentrations. At the first World Climate Conference, which was held in 1979 in Geneva, Switzerland, scientists and policy makers recommended that there was need to be an active collaboration to explore the effectiveness of the development of policies and adjustments in relation to climate change (WMO, 1985). The second World Climate Conference in 1985 revealed that there was enough scientific knowledge on climate change, and that there was need for proactive implementation. As will be explained later, these developments helped in the establishment of major bodies which would later play key roles in climate change agendas and policies.

Another major conference was also held in Villach, Austria in 1985, where an international grouping of scientists who supposedly participated in their own capacity came to the conclusion that a rise in global mean temperature would occur in the first half of the 21st century. It would be greater than in any other time in human history, and would have detrimental effects (Alsfer & Skodvin, 1998: 607). It is important to note that these scientists were doing this research in their personal capacity without any governmental support which, sadly, did not elicit as much action from the governments as would have been expected.

In 1999, Michael Mann of Pennsylvania University, USA, and his colleagues examined a reconstruction of average temperatures in the northern hemisphere over a period of 900 years, from A.D. 1000-1900 and the temperatures from the last century. The results of this period were relatively straight, while the ones representing the last century showed a sharp incline (Bloom, 2010). The representative graph of temperature averages came to be termed as the 'hockey stick' (Urry, 2011: 24). The 'hockey stick' showed a clear upward stream of temperature for the past century. Mann and his colleagues further concluded

that the unusual shape of the graph representing the past century, was due to the emissions of carbon dioxide and other greenhouse gases from the burning of fossils (Bloom, 2010). It was only after eight years later that the National Academy of Sciences in the USA, upheld the Mann report. The stated global temperatures had warmed more than 0.6 degrees Celsius during the last century and such changes were without precedent during the preceding centuries and probably much longer. They were these findings that future researchers began benchmarking their studies and did assent that the temperatures were really rising at a swift rate.

2.5.2. Establishment of the Intergovernmental Panel on Climate Change (IPCC)

In 1988, the IPCC was established by the United Nation's Agencies, The World Meteorological Organization (WMO) and the United Nations Environmental Program (UNEP), which drew experts worldwide (Agrawal, 1998). As both these agencies were under the UN, the IPCC naturally became a UN Organisation. In the process, governments worldwide became engaged in the goals and activities of the IPCC, ensuring a worldwide consensus on the assessments that would be provided by the IPCC. The IPCC grouping is the largest scientific review of an international environmental threat ever undertaken; and it encompasses the work of several thousands of scientists (Downing, et.al., 1997). Despite such a composition of scientists, the IPCC does not conduct any scientific research for its assessments but rather conducts assessments on the basis of published research within different relevant disciplines and fields (Alfsen & Skodvin, 1998).

The IPCC was mandated by the United General Assembly (UNGA) in 1988 to urgently initiate action leading to a comprehensive review and recommendations with respect to the science of climate change as well as social and economic impacts. These would result into possible policy responses by governments in a bid to delay, limit or mitigate the impacts of adverse climate change. It would also result into the signing of relevant treaties and other legal instruments dealing with climate change and elements for possible inclusion in future international conventions on climate change (UNGA, 1988). Hence, the IPCC assesses the scientific, technical, social and economic understanding of the risk of climate change and the impact of climate change and policy responses necessary to address it. The information produced is supposed to be relevant to the understanding of the risk of human-induced climate change.

In order to achieve this mandate, the IPCC is divided into three working groups which focus on different aspects of climate change (Agrawal, 1998). Working group, one is composed of scientists that gather information and make considerable judgments on the likelihood and extent of any change in climate resulting from anthropogenic emissions of green-house gases. Working group two is multi-disciplinary as it assesses the impacts of climate change; and the third group is multi-disciplinary but responsible for formulating response strategies and policies in order to cope with climate change, based on the reports coming from the two working groups (Fankhauser, Smith & Jol, 1997).

The first report of the IPCC came out in 1990, and focused on the physical science of climate change. It reported the presence of climate change as confirmed by various studies through simulation models. These climatic models look at the earth through which increasing greenhouse gases generated have resulted in temperature increases.

The second report of the IPCC which came out in 1995, captured the focus of the research on climate change that had taken place during the preceding decades, and dealt intensively with issues of modelling the potential impacts of anthropogenic climate change, greenhouse gas mitigation, and issues of the cost effectiveness of mitigation policies (Banuri, et.al. 2001). While as the first report of the IPCC dealt extensively with the scientific aspect of climate change by drawing from the findings of the natural sciences, the second report dealt with both the scientific aspect and the anthropogenic aspect of climate change.

2.6. Mitigation policy under the UN Framework for Climate Change (UNFCC)

The UNFCC was established in 1992, as a response to the growing political concerns that human activities were substantially increasing the concentrations of the greenhouse gases in the atmosphere. The treaty was developed at the UN conference in Rio de Janeiro in June, 1992. Its objective was to stabilise greenhouse gas concentrations in the said atmospheric levels to a level that would help prevent anthropogenic interference. The treaty itself though, set no binding limits on greenhouse emissions for individual countries and had no enforcement measures in it for the control of emissions. It was then agreed that one of the ways that climate change could be dealt with was mitigation. Mitigation was in this context defined as an anthropogenic intervention to reduce the sources of greenhouse gases (Maarland, et.al. 2003). As such, mitigation can also be referred to as a

form of adaptation as there is an altering of activities in relation to greenhouse gases (Smit, et.al. 2000).

The UNFCCC then set out to find ways through which it could bring about mitigation to the world. These endeavours led to the adoption of a major protocol, known as the Kyoto Protocol, in 1997. It was resolved that emissions of greenhouse gases should be reduced through a coordinated effort by the main industrialised nations. It required countries to develop greenhouse gas inventories and plans to respond to climate change as the crisis facing humankind. The UNFCCC's objective was directed towards the prevention of climate change now and in the future and accepting that this was really a problem. The UNFCCC itself was signed by 175 countries which entailed all member states of the UN (Ramakrishna, 2000).

The negotiating process on climate change revolves around the sessions of the Conference of the Parties to the UNFCCC (COP), which meets every year to review the implementation of the resolutions of the Convention (UNFCCC, 2009). The parties meet to monitor progress in the prevention of climate change by focusing on the different activities taking place in the realm of climate change, and also whether there are any new discoveries and assessments which will be of benefit in the prevention of climate change.

The Congress of Parties (COP) considers resolutions published in the reports of the UNFCCC and other relevant publications coming from research in the field of climate change. Successive resolutions considered by the COP provide a detailed set of rules for practical and effective implementation by the Convention. At the first meeting of the COP, it was agreed that much of the greenhouse emissions were caused by the developed world and that the rate at which these greenhouse gases were being emitted, had to be slowed. The background was hence set for the Kyoto Protocol which claims its commitment is to reduce greenhouse gases and remove sinks resulting from direct human-induced land use and forestry activities limited to afforestation, reforestation and deforestation (Babiker, et.al. 2002).

2.6.1. The Kyoto Protocol

The Kyoto protocol recognised that developed countries are principally responsible for the current high levels of greenhouse gas emissions in the atmosphere as a result of more than 150 years of industrial activities (Linacre, et.al. 2011). It was premised that mitigation

addresses the root causes of climate change as identified above. Even if a reduction of emissions takes place, scientists have indicated that climate change will still continue to occur. Developed countries are thus required to stabilise greenhouse gases by developing ways to reduce their emission rates into the atmosphere by at least 5% by the year 2012 (Klein, et.al., 2003). The mass emission of the greenhouse gases was found to be caused by the industrial increase in developed countries. Industrialised countries committed themselves to embark on the reduction of the gases by being signatories to the UNFCCC and Kyoto Protocols. This strategy was propagated for, as it was believed it would help stop or rather slow down the effects of global warming. However, a lot of the countries did not ratify the said protocol.

On February 16, 2005, the Kyoto Protocol of the UNFCCC came into force. At the time, only 37 countries of the industrialised countries had ratified it, committing themselves to reduce their greenhouse emissions (Santili, et.al. 2005). Developed countries would have to achieve this by investing in alternative energy sources. The commitment was to be observed from 2005 to 2012 as a first period and a review was to be done in 2012. The baseline for the greenhouse carbon emission levels was pegged at 350 parts per million (PPM) as determined as far back as 1990 (UNFCCC, 2009). However, for the contents in the protocol to be effectively implemented, it required 55 countries to ratify it. It should be noted then that at the time that the protocol was introduced, only 37 countries had committed themselves to ratifying it, hence impeding its implementation (Santili, et.al. 2005).

The Kyoto protocol stipulates what commitments are expected from various countries but it does not provide suggestions on how these changes can be economically viable. The reduction of emissions requires institutional and economic adaptations. However, it also implies technological advancements (Metz, et.al. 2007).

The ultimate objective of the Kyoto protocol is the reduction of carbon emissions, which in climate change circles has to be achieved through mitigation. Major changes in behaviour and production methods will be required in order to achieve greenhouse mitigation at the lowest possible cost. It is expected that this can be achieved by reducing the carbon intensity of energy used in respect of the Gross Domestic Product (GDP). One of the ways through which mitigation is to take place is through reforestation which will help in the creation of sinks. Sinks in this context refer to forests or soils that help in the re-absorption

of carbon dioxide (UNFCCC, 2009). A lot of forests in the world are cut down for various reasons, hence the importance of reforestation in mitigating climate change. However, the developed nations argue that it would not be viable as it would require too drastic changes to their economies (Bloom, 2010).

A commitment by the developed countries to reduce greenhouse gases would mean supporting an action that would be detrimental to their countries' economies. Most of these countries have a lot of industries, commercial farming and automobiles on which their economies thrive; a case in point, the USA. If it were to reduce industrial carbon emissions by 7% below 1990 levels in 2010, it would require a reduction of 550 million tons from its current emissions (Manne & Richels, 1998). This would aggravate unemployment together with a big reduction in its GDP. However, this can happen only if the industries are replaced with green industries.

Further challenges within the Kyoto plan began to emerge when the USA made their ratification of the plan conditional, saying that there was need for meaningful participation on the mitigation of greenhouse gases (Baer, et.al. 2000). By imposing this requirement before the long-term equity concerns of developing countries are addressed, the USA may effectively block the implementation of the protocol. Developing countries cannot reasonably be expected to restrict their future emissions without being assured of a fair allocation scheme that will not impair their ability to develop. However, the emerging developing nations such as China and Brazil, felt this would be detrimental to their countries' development. Eventually the USA did not ratify it despite being one of the main nations emitting a lot of gases.

2.7. Strategies for dealing with climate change

Different stakeholders have proposed strategies which when applied effectively will assist in combating climate change. These strategies are grouped under two main categories, namely mitigation and adaptation. The upcoming sub-sections will discuss the types of strategies which are being encouraged in dealing with this.

The success of mitigation may depend on technological solutions, changes in economic structure, societal organisation, and or individual behaviour. Through these strategies governments and stakeholders attempt to contribute towards the reduction of greenhouse gases in their countries.

However, regardless of how much mitigation will be achieved, climate is already changing, and significant changes are expected in the coming decades due to past emissions. Therefore, adaptation has become a contentious issue in recent years among nations and peoples. Contra-wise, the fact that human society can adapt to climatic changes has implications for understanding the true impact of climate change and for designing optimal climate change strategies given its uncertainty. And since climate change is already inevitable, it is necessary to think about it and act on adaptation now.

Adaptation methods are those strategies that enable society cope with the impact of climate change in the local areas. Such strategies include the adoption of efficient environmental resources, management practices such as the planting of early maturing crops, hardy varieties of crops and selective keeping of livestock in areas where rainfall has declined. They also include the adoption and use of technology that enable the individual to function in the “new” condition (Nyong, et.al. 2007). Adaptation also refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices and structures to moderate potential changes or to benefit from opportunities associated with climate change (Smit & Pilifosova, 2001, 879). We use adaptation only in the meaning of a process, and – more specifically – with regard to socio-cognitive-behavioural processes. Hence, we see adaptation not only as adaptive behaviour, but also as changes in cognition which are socially constructed and negotiated. Adaptation should enable agricultural systems to be more resilient to the consequences of climate change. Adaptation should encompass actions to reduce vulnerability and build resilience of ecological and social systems and economic sectors for the present and future adverse effects of climate change on life and settlements.

The World Bank’s guidance note on adaptation identifies adjustment in human systems in response to actual or expected climatic stimuli or their effects. Adaptation can thus be carried out in response to (ex-post) or in anticipation of changes in climatic conditions. It entails a process by which measures to prevent, moderate, cope with and take advantage of the consequences of climate events are planned, enhanced, developed and implemented (UNDP, 2005, UKCIP, 2003 & IPCC, 2001). This way, an action is considered an adaptation response when it is only “planned” and “an explicit response to climate risk considerations”

“A process by which strategies to moderate, cope with and take advantage of the consequences of climatic events is enhanced, developed and implemented” (UNDP, 2005). So, to say, adaptation can also be looked at as the process through which people reduce the adverse effects of climate on their health, and take advantage of the opportunities that their climatic environment provides (Burton, 1992, as cited in Smit, Burton, et.al. 2000). According to Smit (1993) adaptation involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events and longer-term climate changes. Adaptation then looks at how best the community or people make the most of the change in climate to enhance their livelihood activities.

2.7.1. The development of National Plans of Action

After the realisation that mitigation alone cannot help in dealing with climate change the UNFCCC came up with adaptation as a response strategy in 2004. It committed its member parties to formulate and implement national plans of actions (NAPA) and, where necessary, regional plans too (Smit, et.al. 2000). Countries who were signatories of the UNFCCC had to submit the NAPAs. Less developed countries received funding, provided by the Least Developed Country Fund which was established by the UNFCCC. This funding helped them in identifying problem areas to climate change, as they came up with their NAPA (Blok, et.al., 2005). Article 4.1(c) of the UNFCCC (1992) says: ‘Promote and cooperate in the development, application and diffusion, including transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors’. This cooperation is to be done by the different member countries which are parties to the convention and have ratified it.

Countries are committed to cooperate in preparing for adaptation to the impacts of climate change, develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture and for the protection and rehabilitation of areas. This applies particularly to Africa which has been affected by floods, droughts and desertification (UNFCCC article, 1994). As such, less developed countries had to develop NAPAs. In particular, reference was made to Africa due to its vulnerability to changes in climate while being mostly dependent on agriculture for its economic growth.

The issue being advanced here by the protocol was that Africa must be ready to adapt to climate changes. It follows therefore that adaptability refers to the degree to which adjustments were to be made to practices or structures of systems with regard to projected or actual changes of climate. Adaptation can thus be spontaneous or planned and can be carried out in response to or in anticipation of changes in conditions (Watson, Zinyowera & Moss, 1996). The adjustments to the system are done in response to this change. The acceptance of the world to undertake adaptation to climate change is symptomatic of the reality of climate change and the realisation of its detrimental consequences.

Even though climate change is seen as a relatively recent phenomenon, individuals and societies are already used to adapting to a range of environmental and socio-economic changes (Gregory, et.al. 2005). However, the stress brought by climate change presents a different situation altogether causing them to deal with something that never reached such a magnitude before. Adaptation is therefore undertaken as a response to this threat. Decisions are thus taken to deal with climate change but are done at an individual level, and encapsulate far more hidden agendas. This is reflected in that the adaptation decisions maybe undertaken at an individual level, but its implementation requires the input of the majority. Since it can sometimes be independent based, people often take advantage of the new conditions, or will adjust completely to the disadvantages brought about by it.

Overall, the response to climate change by means of NAPAs is characterised by decision-making under uncertainty because much of the projected effects of climate change are based on scientific simulations and whatever decision is taken at that level has cumulative effects on the nations. For example, the Kyoto Protocol was a result of more than two years of preparatory discussions and eleven days of which were at utmost times filled with intense negotiations (Breidenich, et.al. 1998) but its effects, implementation and achievements have been murky and debatable.

2.8. Climate change as a local phenomenon

Despite the general consensus that climate change is a reality caused by greenhouse gas emissions, there is still a group of advocates who believe that the climate had always experienced changes. One of these critics is Montford (2010) who criticised Mann's (1996) 'hockey stick' graph, and made a sweeping statement against the IPCC. He argued that

Mann 'cherry –picked' samples which fitted into his graph, so as to compile the stated graph. Further, he believes that, since there is evidence of a warming medieval period, the increase in temperatures is not something unique. Other sceptics claim that any change in temperature is as a result of natural processes (Urry, 2011). Therefore, they argue that the change in the world's climate is not human induced but something which has occurred naturally. Evidence reveals that there have been some ten ice ages over the past million years on a global scale, each of them lasting about 100,000 years; with warmer interglacial periods of about 10,000 years (Etkin & Ho, 2007). Hence, it is natural for the climate system to vary over time, on scales ranging from local to global. Temperatures had also risen at the turn of the previous century, but eventually declined in the 1940's and 1950's. In Zimbabwe, for example, there is evidence of a ten-year drought which occurs after a span of time (Waal & Whiteside, 2003). It is therefore natural for certain countries, such as Zimbabwe, to experience a sequence of normal rains and drought periods.

Obviously, in most communities, adaptation strategies are expected to be many, and their combinations in various ways will be required in any given location. This will in turn significantly reduce vulnerability. However, adaptation to climate change by farmers is based on decisions on farming practices and not only on changes in general conditions. In taking these decisions, climatic factors observed through personal experience by the local farmers such as rainfall frequency, timing and intensity of the rain, heat and duration of the rains are seriously taken into account (Bryan, et.al. 2009). This kind of knowledge is best termed as local knowledge forms (LKFs), particular to a place and helps the farmers adapt to climate change.

2.9. Knowledge

Knowledge forms (KFs) have been in existence since time in memorial. KFs are the means through which various things are stored and come to be known, be it discoveries, innovations or ways of doing something. Therefore, it is not surprising that, KFs have come to play a pivotal role in dealing with climate change adaptation. There are three known KFs, which are: instrumental as those in labour or technical workers, then practical as the one in natural sciences and emancipatory as the one in critical conscientization. For this study, we look at local and practical/scientific knowledge. Knowledge is understood as something that carries the attributes of incontrovertibility (although at times probabilistic rather than absolute), objectivity, rationality, testability, and finally, the bedrock of positivist

legitimacy, replicability or verifiability. Knowledge, much like development, is not a fixed concept since what we know and how we know is constantly changing. Knowledge is also a driving force in social change, for better or worse, as history has proven. In the knowledge discourse, two categories of knowledge are often specified; there is formal, (instrumental/experimental/technical, practical/scientific and emancipatory knowledge) and then there is knowledge that could be called informal, local, traditional or indigenous knowledge. The following two sections will discuss the two types of knowledge, including the roles they play in dealing with climate change.

2.9.1. Scientific knowledge

Scientific knowledge explanation will look at a person complaining of a headache. In terms of being demonstrable outside of any unique symbolic structure; it must have universality under specified empirical methodological conditions independent of the practitioner's beliefs. It is the understanding of knowledge that must be demonstrable outside of any unique symbolic structure, and it must have universality under specified empirical methodological conditions. Scientific knowledge is generated by experts using recognised and rigorous approaches to observation and experimentation (Roncoli & Ingram, 1998: 410). Scientific knowledge is centralised and orderly, objective and viewed as a system that follows the scientific method to explain the world around us. The phenomenon is observed, a hypothesis is made which is then either proven or disproven. It is at the core of the idea of development and that strategies are undertaken using a framework of western knowledge. Scientific knowledge is open, systematic, objective and analytical, advancing by building rigorously on prior achievements. (Agrawal, 2004). Thus, it is knowledge, which is developed within a set framework, in search of universal validity. The scientific knowledge system is generated through the global network of universities and research institutes. Scientific knowledge is generated quite separately from the daily lives of people, aiming at explanations which are analytical but abstract representations of the world (Agrawal, 1995: 421). It aims to give explanations and solutions to issues despite being generated afar from realities.

Scientific knowledge is a consequence of successful conjecture that requires an adequate theoretical perspective (Carey & Smith: 1998). This comes out through both observation and experimentation. This knowledge is thus accumulated through the systematic study that comes about thereof; it being organised by general principles. The organisation into

general principles alludes to how, it is particularised, validated and achieved, before it is circulated to be used more widely (Zegeye & Vambe, 2006). In due process, as this happens, it renews itself basing on new discoveries thus coming out.

2.9.2. Local knowledge

Place-based knowledge that is rooted in local cultures and generally associated with long-settled communities which have strong ties to their natural environments has come to be termed as Local Knowledge (LKFs). Alternative terms for the name indigenous knowledge are found in the literature and these include rural people's knowledge, indigenous technical knowledge, local knowledge and indigenous agricultural knowledge. However, for the purposes of this study local knowledge forms will be used. Local knowledge is a flexible entity which, by virtue of its diverse and empirical nature, can easily integrate skills and insights from other knowledge systems as well as from experimental practice. Many populations around the world are close observers of the natural world. Such knowledge tends to be the result of cumulative experience and observation, tested in the context of everyday life, and devolved by oral communication and repetitive engagements rather than through formal instruction. Indigenous knowledge is a flexible entity which, by virtue of its diverse and empirical nature, can easily integrate skills and insights from other knowledge systems as well as from experimental practice (Speranza, Kiteme, Ambenje, Wiseman, Makali, 2010).

Local knowledge stresses the site specificity of farmers' environmental knowledge and the place-based dimension of cultural and social meanings associated with such knowledge. Farmers' knowledge is intimately interwoven with local and regional processes of ecological and historical change that impinge on local landscapes and lifeways.

The study of indigenous knowledge has received considerable attention from scholars and more specifically from anthropologists. Initially, the term indigenous knowledge was used to imply that it was static. However, over time the definitions have changed for better suited ones. This is so because it has been observed that indigenous knowledge is not static but adaptable as local farmers have supplemented their indigenous knowledge; thanks to their contact with the outside world knowledge. Hence, indigenous knowledge has acquired various definitions. One definition explains indigenous knowledge as a cumulative body of knowledge and beliefs about the relationship of living beings, with one

another and with their environment as handed down through generations by cultural transmission (Gadgil, Berkes & Folke: 1993). It has also been defined as ‘the unique, local knowledge existing within and developed around specific conditions of humans indigenous to a particular area’ (Grenier, 1998: 10). Brosius (1997:52) argues that, “discussions on indigenous understandings of the natural world, systems of classification, and how various societies understand or interpret natural processes and what such groups know about the resources they exploit, all form part of local knowledge”. Local knowledge is largely based on “subjective” historical and cultural experiences, uncontrolled and undocumented observations.

The study of local knowledge has become not just a body of facts, but something which is more in accordance with ‘how’ and ‘what’ things are known. It could be argued that local knowledge is an understanding of peoples’ social surroundings and local natural environments. As such, it is only proper to say that studying local knowledge can only be done within the contexts in which it happens. In this regard, Nyong, et.al. (2007) state that ‘a key element of indigenous knowledge is that it tends to be deeply embedded within the society in which it has been developed, and it must therefore be seen in its economic, political and cultural contexts’. Indigenous peoples with a historical continuity of resource-use practices often possess a broad knowledge base of the behaviour of complex ecological systems in their own localities. This knowledge has been accumulated through series of observations transmitted from generation to generation. The knowledge set is influenced by the previous generations, observations and experiments and provides an inherent connection to one’s surroundings and environment. The local knowledge of a given society is created through a dynamic process driven by the local environment and its relation to productive activities of indigenous people. Local knowledge is unique to a given society. It is the basis for agriculture, health care, food preparation, education, environmental conservation and a host of other activities. Hence, local knowledge provides relationships that connect people directly to their environments and the changes that occur within it, including climate change (Nyong, et al. 2007).

Local knowledge is not static but is developed by locals through a continuous process of adaptation to their environment. The adaptation is done by means of self-creativity, reworking and reshaping their knowledge in the process or when local people have had exposure to outside knowledge. Local knowledge should thus be viewed as a combination

of diverse knowledge systems (Pottier, 2003). Local knowledge is, therefore, not exclusively local but rather a result of complex negotiations. The complex negotiations which take place in its generation show that it is also socially and culturally embedded. It is therefore only proper to look at it as a social construction (Pottier, 2003). The social construction is as a result of encounters and discontinuities in the social realm of local communities in different localities. Local knowledge is therefore the outcome of everyday struggles and problems that occur in people's lives.

Local knowledge is also experiential, rooted in place, transmitted orally or by practice, empirical, functional, reinforced by trial and error, dynamic, shared in a fragmentary fashion between individuals within a population and usually distributed unevenly between them, and it is embedded in the local socio-cultural milieu (Grenier, 1998). However, no single cultural bearer is the carrier of the total body of local knowledge prevalent in their community, irrespective of how underdeveloped it may be. There tends to be a differentiation and distribution of local knowledge which is determined by factors such as age, experience, wealth, production priorities, household circumstances, political power and gender (Pottier, 2003). These different factors have an effect on the transmission of local knowledge. It is therefore essential to pay special attention to the local elites, but also not to forget the other people within the community as they are also the bearers of local knowledge.

For centuries, traditional farmers have developed diverse and locally adapted agricultural systems, managing them in accordance with local practices that often result in both community food security and conservation of agro biodiversity (Altereii, 2004). Local knowledge is tested in the context of survival and is either more or less effective in providing the means of survival, a conclusion more meaningful in the context of everyday existence. Farmers worldwide hold a huge body of information about their farming systems. Farmers have observed phenomena and adapted their farming systems to better suit changing needs. Such practices are particularly seen in the array of crop varieties and livestock breeds developed solely for local use (Borron, 2006: 16). Farmers therefore with a traditional knowledge base stand at an advantage in further developing ecological processes to respond to the effects of climate change. As farmers observe conditions and develop responses to current challenges, they hone skills necessary to adapt to climate change as well (Tompkins & Adger, 2004: 4). Communities as a whole increase their

resilience when they develop information and support networks to handle new challenges (Tompkins & Adger, 2004). Traditional knowledge extends beyond crop and livestock varieties to apply to every aspect of the farming system. Most traditional practices seek to avoid risk and attempt to maximize the use of local resources (Altieri & Nicholls, 2006; Tengo & Belfrage, 2004).

Local knowledge in development contexts may relate to any knowledge held collectively by a population, informing interpretation of the world. It may encompass any domain in development, particularly that pertaining to natural resource management. It is conditioned by socio-cultural tradition, being culturally relative understanding inculcated into individuals from birth; structuring how they interface with their environments. According to this definition, it is difficult to see where local knowledge differs from anthropology as studied for the greater part of this century (Brookfield, 1996). Local knowledge is not just a system for the present, but a source of institutional memory about what practices have worked best over time. Such knowledge has been described as a “reservoir of adaptations,” a whole set of practices that may be used again if the need arises (Tengo & Belfrage, 2004). Local knowledge thus represents a process of learning as much as a single body of information.

In its Fourth Assessment Report, the IPCC (2007a: 435) states that “Africa is one of the most vulnerable continents to climate change and climate vulnerability.” Climate change is already having profound impacts in developing countries, especially in sub-Saharan Africa, with the increasing frequency and intensity of climate-related disasters, notably recurrent droughts, floods and erratic rainfall. Africa’s vulnerability is also exacerbated by the multiple other stresses it faces such as natural resources degradation, high dependence on rain-fed agriculture and inadequate infrastructure, low levels of technology, widespread poverty, weak governance.

A study conducted in the Sahel region of Africa shows how farmers were able to come up with mitigation strategies to cope with climate change through the usage and improvisation of their own local knowledge taking into account that this region is fraught by frequent droughts. Despite these unfavourable conditions, the countries in this region are said to have an increase in population, and are able to produce something from their subsistence agriculture practices. It has been reported that even before the advent of chemical fertilisers, some farmers used organic fertilisers and some are still doing so. Organic

fertilisers are known for cooling the soil and for reducing the amount of greenhouse gas emissions (Nyong, et.al. 2007). This practice has by itself demonstrated the abilities of local knowledge to help in combating climate change.

In Northern Nigeria, local farmers have come up with a number of ways of adapting to climate change. These include allocating farm labour throughout the season in ways that follow unpredictable intra-seasonal rainfall variations which could be referred to as negotiating the rains, biodiversity in cultivated crops, eating edible wild plants as well as increasing the integration of livestock into farming systems (Mortimore & Adams, 2005).

A study conducted in rain-fed areas in Morocco reveals how farmers have responded to drought by coming up with methods on farm-storage of food and feed, strategic use of fallow, and late planting of legume crops when cereals fail (Morton, 2007).

Climatic changes have also been noted in the Canadian Arctic community of Sachs Harbour, a coastal community on the Beaufort Sea, which has noted changes in the sea ice around the area. These changes have taken into account increased timing and rate of break-up of ice in the spring, intensified east winds in the fall that push ice flows away from the community and result in an absence of multi-year ice around which new ice can form. These aside, scientists have not been able to tell these kinds of changes as they occur because such changes are better explainable from the local inhabitants' viewpoint through lengthy observations over the years. While local people observe and experience weather effects, scientists only record actual changes (Tam, 2012).

In conclusion, from the studies examined in this literature review, a lot of issues have emerged. But of particular importance is the topic on knowledge forms and their applications. It has been examined that LKFs help local people solve their problems in relation to climate change, and hence help produce more and better food (Mauro & Hardison, 2000: 1264). LKFs, as a resource, also help build resilience among communities which are at risk of climate change, especially in developing countries. This shows that a further exploration of LKFs will provide insights on its usage, and how it should be understood in dealing with climate change.

2.10 The role of social scientists in climate change

Since the advent of climate change as a field of study, much interest spanning decades by researchers came from the natural sciences, while social scientists have only become involved most recently. This has been characterised by 34 studies conducted thus far (Adger, 2003), looking at the human side of climate change, more particularly how people perceive, understand and react towards climate change. Nevertheless, these studies tended to focus on the economic activities as a means of adaptation. Such a focus means that limited attention has been given to the social aspects of adaptation which underplay the complex relationships between people and their environments relative to climate change.

When the IPCC was formed, the representation of social scientists was lamentable, as many researchers came from the natural sciences (Agrawal, 1998). This led to the general lack of assessment of the findings from the fields of the social sciences in the first three assessment reports although different trends have since arisen in this field.

Climate change is an incredibly complex issue as studies from the natural scientists have revealed, and approaching it from different perspectives would be beneficial. People are at the centre of climate change since they contribute to it and can find solutions. Therefore, the increase in social scientists in the IPCC and an upsurge of their general concerns and interest in climate change is an important development. Prior to the third assessment report, most analyses of human responses to climate change were limited to estimations of specific climate change impacts on people's economic activities. The assumption was that human sciences could be used to fill the knowledge gaps that plagued studies of climate change, and that policy-makers could simply rationalise this knowledge to the development and implementation of effective response strategies (Irwin, 1995; Irwin & Wynne, 1996; Jasanoff & Wynne, 1998).

A recognition of the limits of this approach led to an attempt by the IPCC, in the third and fourth assessment reports, to significantly pay more attention to the need for consideration of human issues, such as the social, cultural, political and institutional constraints on responses to climate change. This realisation drew more social scientists into the IPCC and into the study of climate change. As such, social sciences such as cultural anthropology, sociology and psychology have contributed to the understanding of the

processes through which societies perceive, understand, recognise and deal with new threats to their security. Studies in the social sciences have also found out that possible options for dealing with climate conditions are embedded within the socio-economic and value systems of peoples (Trumbo & Shanahan, 2000).

While climate change has not traditionally been a subject of major theoretical concerns in the social sciences, developments in recent years, which have been driven by political ambitions, have opened up new research and theoretical directions into the social sciences discourse. Hence, social sciences research focuses on the macro level of national and international policy choices. Social sciences research also helps people understand social activities that affect climate change; their consequences that directly and indirectly affect people; human responses to anticipated and experienced climate change, and ways to help them respond effectively (Petheram, Zander, Campbell, High, Stacey, 2010; Swim, Stern, Doherty, Clayton, Reser, Leber, Gifford & Howard, 2011).

The nature of research that has been conducted within the indicated social sciences will accordingly be discussed in the following sections.

2.10.1. Economics

From the discussions so far, it appears that climate change is to a large extent the result of human actions which are still taking place and are exacerbating the situation and at the same time causing human responses. In particular, these responses affect the economic activities of people. The central role that economics has come to play in climate change research is reflected in the Stern Economic review, published in 2007, which focused on assessing and managing the risks of climate change, and the presentation of an individualistic and utility maximising model of human behaviour (Urry, 2011). Economics research into climate change is following along the trend of there being a change in consumerism behaviour by humans as this behaviour. The change in behaviour will help in slowing down climate change. Despite some of the economists calling for a change in consumerism behaviour, other quarters are against this, arguing that a complete change in consumerism behaviour will prove to be detrimental to the growth of people's economies (Weitzman, 2007). Economics research on climate change hence provides an analytical exploration of consumerism behaviour, how it has contributed to climate change, and the development of appropriate changes to it through necessary theories and actions (Goulder

& Pizer, 2006). Economics of climate change thus brings in the ability to look at the long-term changes that can happen, in dealing with climate change in the aspects of the long term in relation to the economy. This it does by providing improved understanding of costs in the presence of various market distortions that may exist (Rennings, 2000). The main debate coming forth from the discourses of economics on climate change is that, for there to be significant change, there need to be global cooperation. Global cooperation in terms of providing an understanding of the various costs that will be incurred, when there is a change in consumerism behaviour. One of the main ways through which this is to be done is by coming up with improved technological innovations, which will help cut back the environmental economic impact, whilst also cutting costs (Davison, 2003).

2.10.2. Sociology

Sociology is understood as a science of order which studies the development and functioning of those fragments that make up society, in this case, it includes human social relations and the institutions that are in existence within the society (Beck, 2010; Inkelas, 1964 and Giddens, Dunier & Appelbaum, 2002). In essence, sociology is a science that involves a critical examination of the nature of modern societies. Hence, sociologists have focused mostly on social constructionism and the actor-network theory in researching environmental issues (Shove, 2010 & Fox, 2000).

Sociologists began to study climate change after earlier involvement in the sociology of the environment. Hence, sociological research has focused on the social factors that drive excessive production, the socio-dynamics of climate change and the varied interactions humans have with their physical environments. Inevitably, it explores the public understanding of climate change, and any solutions perceived by it. It also explores the role of social networks in policy formation and implementation as well as the social and political dynamics that are involved in this arena (Shove, 2010 & Lee & Brown, 1994). Sociological approaches in dealing with human adaptation to the changing environment have looked at the future and comparative history of past societies and they have drawn examples from past societies to present societies (Orlove, 2005). The discussions and debates about community action and engagement in sociology are looking at ways of linking climate change adaptation to ways of thinking about social and cultural change. It is deemed fit that, linking these things will greatly help in understanding the underpinnings of

human behaviour in their social and cultural settings whilst dealing with climate change adaptation (Mulligan, 2010).

The social network theory has examined the spread of different ideas and actions through populations, which in this scenario explores the notion of climate change and innovations in dealing with it. The theory has helped to reveal different attitudes and challenges and how best to deal with them (Beck, 2010). Therefore, sociological studies in climate change can be expected to continue exploring the adaptations required in social systems in order to adapt to climate change. This includes making of policy which acknowledges the significance of local knowledge in adapting to climate change (Urry, 2011).

2.10.3. Psychology

Psychology offers knowledge and concepts that can help explain the human understanding, causes and consequences of climate change and inform effective responses to it (Swim, et.al. 2011). It explores the much personal social, economic and institutional behaviour of humans in relation to their contributions towards climate change and adaptation. Psychologists conduct fundamental research on individuals and climate change while assessing the acceptability of proposed policy and structural changes and the impact of these changes on the behaviour, well-being, stress and quality of life (Gilford, 2008). Psychology in climate change research thus studies the driving force of human behaviours in causing climate change as well as the adaptation options. Psychological processes in climate change are helping in making conflicting predictions about the choices that society is likely to make, whilst weighing the weight of the predictions against undertaking precautions to reduce the threat posed by global climate change (Rachlinski, 2000). There is a polarisation in attitudes about climate change in the field of psychology.

2.10.4. Anthropology

The adaptation of humans to their environment has always been the main focus of Anthropology. Anthropology's core theoretical tenet is that culture frames the way people perceive, understand, experience, and respond to key elements of the world they live in (Roncoli, et.al. 1998). Hence, it is only logic consequence that climate change, its effects on humans, and the ways they respond and adapt to it, would draw the attention of anthropologists. Some examples of work that has been done in respect of human

adaptation to the natural environment include (Smit and Wandel, 2006) who discussed practical adaptation to climate change, focusing on ways that contribute to practical implementation of adaptation measures at the community level. Such a study is relevant to the scope of this study as it helps divulge information on how adaptation is applicable at a community level, drawing from an anthropological scope. There are two main trends that are found within the field of Anthropology in relation to climate change and these are; people's perception towards climate change through their different cultural lenses and the transformative power climate change is having on people's cultural and social meanings (Purcell, 1998).

Social science research into climate change is thus bringing in the societal factors, as it redefines the purely physical events that have been researched by natural scientists. As has been discussed, by looking at the three main social sciences branches, social scientists are studying climate change on a purely human level, analysing its impacts on humans and how they adapt to it (Urry, 2011 & Agrawal, 1998). In the process, they identify alternative courses of policy action which will in the future be compatible with the goals of alleviating further negative impacts of climate change (Torry, 1983). Social scientists are determining the social and economic costs and benefits of these changes. Economics of climate change brings out the need to have global cooperation in changing consumerism. Sociology explores the adaptations required in social systems in order to adapt to climate change. Psychology studies the force behind human behaviour in effecting climate change, and what changes will help in adapting to climate change. Lastly Anthropology gives a cultural perspective on the understanding of climate change and the resulting change when adaptation occurs. Studies in the social sciences show an increasing attention to adaptation options and the resulting effect on humans. Some analyses involve social structural and situational factors that affect the acceptance and implementation of adaptation. Hence, the anthropogenic driving forces of climate change have become a central research topic in the social sciences (Jorgenson, 2006).

CHAPTER 3: METHODOLOGY

3.0 Introduction

This chapter gives an examination of the type of research methods which were used in this study. It begins with a discussion on the study area of Mwala o' Tongole in Nkhota-kota district. This is done by firstly examining qualitative research. Then we move to ethnographic research. It is then followed by exploratory studies which were done prior to the commencement of the actual research. This is followed by the types of research tools, which were used and data analysis tools. A triangulation technique was employed throughout the research process in order to address the research questions. Primarily, data collection involved questionnaire surveys, personal interviews, participatory observations, and documentary review. All questionnaires and interview questions had to be pre-tested and edited before used in the field.

3.1 Qualitative Research

The study was based on ethnographic research which falls under qualitative research. Qualitative research is defined as, "a multi-perspective approach (utilising different qualitative techniques and data collection methods) to social interaction, aimed at describing, making sense of, interpreting or reconstructing this interaction in terms of the meanings that the subjects attach to it" (Schurink, 1988: 241). "An ethnographic research examines social units, on a broad spectrum such as an entire culture, or single social units (Locke, et.al. 2010: 189-200). Qualitative research helps in researching human behaviours, feelings and attitudes. On the other hand, ethnography is an eclectic methodological choice which privileges an engaged, contextually rich and nuanced type of qualitative social research, in which fine grained daily interactions constitute the lifeblood of the data produced. Ethnographies encompass some element of observation by the researcher. Ethnographies therefore involve observing subjects in different settings. The duration of the observation differs depending on the nature of the research. For the purpose of this study, the observation period was for four months. The type of ethnography that was undertaken for this study was observational and participatory observation

The qualitative approach has myriad benefits as broadly discussed in the literature. Griffins mention that such qualitative approaches increase the degree of flexibility in research design. They allow for the ability to avoid dependence on the researcher's pre-determined

assumptions and focus on the meaning of important issues for participants, especially any illogicality or discrepancies in their perspectives. Qualitative approaches can enable the researcher to solve sensitive issues and appreciate the broader social context of a certain community's experience, and later make connections across various localities of participants' lives (Griffin, 2004: 3). In addition, qualitative approaches allow the researcher to observe behaviour and conditions in a natural setting. It usually treats the researcher as the primary tool for gathering data, and on descriptions since the phenomenon is captured through words, pictures and other media. It is concerned with meaning (that is the way people make sense of their daily living, and experiences) and is inductive in nature (i.e. researcher usually builds abstractions, concepts, hypotheses and theories from facts observed (Creswell, 1994).

The ethnographic study was conducted in four phases, namely: the document study, the monitoring/observation study, reconnaissance/exploratory and interviews. The document study is to be understood as reading and understanding documents that pertain to the subject being researched on in this case climate change. The monitoring or observation phase is when the researcher embarks on observing the people's everyday activities, either as a passive observer or as an active participant (Creswell, 1998). The reconnaissance/exploratory phase is when an effective method for providing in-depth understanding of different interest groups' perspectives and experiences is done quickly to provide an overview of the study group (Bryman, 1984, 84). The interview phase seeks to describe and underscore the meanings of central themes in the real-life world of the subjects. The main aim for interviewing is to understand the meaning of what the interviewees say covering both a factual and at meaning level, for an attainment of real facts (Kvale, 1996: 95).

The research adopted a qualitative research approach in order to establish an understanding of the importance of local and scientific knowledge in adapting to climate change. The study was undertaken in the natural habitat of the respondents. Consequently, the researcher was able to understand the meanings and intentions that underlie their everyday human actions regarding their interaction with the environment and livelihoods. Hence, we do agree with (De Vos, Strydom, Fouche and Delport, 1998) that qualitative research involves understanding, naturalistic observation and a subjective exploration of reality from the perspective of an insider.

Interviewees were able to discuss different issues, such as different on-going changes they had experienced in the last 30 years, as well as long-term adaptation practices used to deal with these changes. Furthermore, documentary review, participant observation, expert interviews, resource mapping, transect walks, and history timelines were used to obtain empirical data. This approach provided me an understanding and description of the local community's experiences regarding their changing environment.

3.1.1. Qualitative data assurance

A triangulation technique was employed throughout the research process in order to address the research questions. Primarily, data collection involved questionnaires surveys, personal interviews, participatory observations, and documentary reviews. All questionnaires and interview questions had to be pre-tested and edited before used in the field. The sampling approach was based on theoretical sampling which according to Mason (1996) is defined as, "selecting groups or categories to study on the basis of their relevance to your research questions, your theoretical position and most importantly the explanation or account which you are developing. Theoretical sampling is concerned with constructing a sample which is meaningful theoretically, because it builds in certain characteristics or criteria which help develop and test your theory and explanation." The ensuing sub-sections are a discussion of the different methods which were employed. They are discussed based on how the research was undertaken following each other chronologically. This started with exploratory/pilot survey, document study, participant observation, interviews and finally focus group discussions. While the three types of methods were interview-based, focus group discussions and participant observation were undertaken simultaneously.

3.2. Exploratory/pilot survey

An exploratory study was carried out in the Nkhotakota district prior to the development of the proposal. This was conducted from January 2011 to February 2011. It aimed at establishing the reality and awareness of climate change as far as the people were concerned and their application and adaptation of knowledge in dealing with climate change. This was done by taking the qualitative approach of gaining meaning, perception and experiences amongst others. To do so, the researcher identified a few key informants by making use of the district commissioners and extension workers as intermediaries. A few themed based interviews were conducted to ascertain the actual situation with regard

to people's awareness of climate change and their realisation to adapt to it. A prior preliminary survey of the study area was undertaken to establish the methods for data collection that would be suitable to answer the research questions (Lado, 2004). This was also done to help in the development of the research proposal.

The researcher carried out sensitisation meetings before commencement of FGDs and Key informant interviews. During these meetings, the researcher sought consent from participating farmers who were informed that responses given during Key Informant Interviews and FGDs were for academic purposes only, in addition to assuring their anonymity and confidentiality. They were also informed that the results might be published in academic journals. And, the chosen study period ensured that most of the farming activities from land preparation to harvesting of perennial and annual crops were involved in the observation.

3.3. Document study/Literature review

The initial stages of the research were characterised by the consultation of literature on climate change, adaptation and its impact on rural livelihoods. Data sources in this case were journal articles, books, magazines, newspapers, and the various policy papers on climate for Malawi. The reports produced by the Intergovernmental Panel on Climate Change and UN publications on climate change were also in use. Documentary review involved a detailed literature review of both published and unpublished works in order to have a broader understanding of the research topic. Mikkelsen (1995:74) emphasised that "no matter what your research topic is, there is almost always a wealth of information hidden in a variety of sources". In this study, published and unpublished works related to history of the Haya people, climate related issues, and LKFs on climate change adaptation were reviewed. Additionally, a detailed review of relevant government documents on Climate Change Strategy was done. Information obtained from documentary review was used to build the conceptual and theoretical underpinning of this study. Official demographic statistics were obtained from the National Statistics Office (NSO) in Zomba. Information regarding the different agricultural programs in the study area was collected from the DC's Office and NGOs.

Extensive reviews of the literature were conducted on climate change and variability, crop production, agricultural practices, food security and livelihood options. Secondary data included research stations reports, crop production reports, climate change reports,

agricultural policy papers, gender policy reports, education policy papers; local community projects reports and any other relevant documents. The data were kept manually with no computerised systems, coupled with high rate of turnover of the civil servants. Climatic data such as temperature and rainfall data were collected from the meteorological department. The data were collected on historical basis covering more than 30 years.

This initial stage also considered the use of primary as well as secondary data sources which formed the basis of a continuous desk literature research in the preparation of this dissertation. This assisted me in making a comparative analysis of what other scholars have written on adaptation and its application towards climate change and rural livelihoods. Data sources in this case were journal articles, books, magazines, newspapers, and Malawi National Climate Change policy papers; Malawi's National Adaptation Programs of Action, Intergovernmental Panel on Climate Change and United Nations publications on climate change. The document study permitted going beyond the perspectives of members in the field.

3.4 Participant observations

Participant observation involves the studying of the natural and everyday set-up in a particular community or situation (Glesne & Peshkin, 1992: 25). Participant observation is the data collection method that allows a researcher to learn about different activities of a certain community under investigation by observing and participating in those activities (Kawulich, 2005). Participant observation provides researchers with a means to check for nonverbal expressions of feelings, to see how different people interact and communicate, as well as to see how much time is spent on different activities (Schmuck, 1997: 50). This method allows researchers to investigate local terms and phrases that respondents use in interviews or observe events that respondents may be unwilling or unable to share. Respondents in interviews may also give a researcher what they think they want to hear, rather than the truth (Peters, 2002 & Tembo, 2003). Since participant observation allows a researcher to observe the practices in person, the problems of deliberate and unintended distortion from respondents can be avoided.

Participant observation is essential for qualitative research as it helps one's attainment of entry into the people's lives, without one having to ask them any questions and with no play acting by the people. The researcher moved into the community where the study was being undertaken, and was there during the duration of the study. This helped the

researcher to always be within the same context of the community members to help gain an understanding of the community in its everyday dealings as it deals with climate change.

Participant observation in this research was also intended to observe the farmers in relation to their day to day agricultural activities. The participant observations were carried out during the entire data collection period. It has to be understood that, the participant observation was not done as an individual research collection tool in its entirety. In particular, the researcher targeted the time when the communities were clearing their lands in preparation for the next growing season. For accurate information capturing, the researcher resided in the village for the whole growing season starting from the farm land preparations to harvesting time. This created an opportunity to participate in early morning farming activities when the people went to till their lands, and in the late afternoon hours when the sun's heat had declined. The researcher interacted with the community members using the local language which is used in the area. The language was not a problem for the researcher as Chichewa is the native language which is spoken by the researcher as well. The researcher resided in the community from 1st November 2012 to March 31st 2013.

The participant observation involved actual recording of farm activities on a daily basis. The researcher would go with farmers to their fields and observe them as they went about their activities. This would even involve getting up early in the morning at 4am, as they set out for their fields. The researcher would also sit and observe as the farmers set about doing their activities at the farm. The researcher also took part in some of the farming activities, to help in understanding and getting a hands-on experience with the different practices at hand. This started from the time when they were busy with land preparation.

As part of the participant observation, the researcher embarked on transects walks. These transect walks were done at the beginning of the study, the exploratory study, during the actual research. Transect walks are community tours undertaken by researchers using community guides who best understand their village and represents various group within the community (Mahiri, 1998). During this walk, important social and physical features of the region were recorded. In this study, transect walks involved diagonal walks across the study villages, and I was able to observe, discuss, and ask open-ended questions, to the villagers. This approach was useful as it helped me gain the trust of the local community. It

was also helpful to identify conditions under which climate change may have significant impacts in the village. Transect walks were combined with field observations in assessing the magnitude of crop damage, crop pests and diseases within farms. Permission from individual farmers to visit their farms was sought in advance. This authorisation came after I had explained to them the purpose of the transect walks. The visits were conducted when farmers were on their farms. However, transect walks also helped me observe other livelihood activities, which were established as alternative sources of income after the decrease of banana and coffee production. Some of the activities observed were fish farming, brick-laying, local beer brewing, stonemasonry, and small businesses. Local farmers were asked to show me the boundaries of their farms before starting a transect walk. Local communities were then asked questions regarding the findings of the transect walks to give information on farm management practices.

The accompaniment of the farm owners during transect walks was helpful since it allowed for discussion and further probing on issues related to field observations, which contributed to the positive attitudes on the respondents (Lado, 2004). Generally, transect walks covered distances of about six kilometres per day. The walks were conducted during the planting period and were thus, used to confirm the specific planting dates of various seasonal crops. After the initial rains fell in December, I had to visit the farms to record the planting dates of crops, especially seasonal crops such as maize, beans, groundnuts, Cassava.

3.5. Key informant interviews

Key informant interviews are interviews that involve the main people who are knowledgeable in the subject area, and whose activities in the field comprise their day to day work plan. Key informants are said to provide researchers with a deeper understanding of the setting under study (De Vos, et. al. 1998).

During the exploratory study, particular individuals were identified as key informants, namely community leaders, principal agents of knowledge: village elders, farmers and women. These had first-hand information regarding LKFs and how they are applied in their lives. These informants were selected and interviewed by virtue of their knowledge during the pilot study. The criteria which was used for the selection of these key informants included, age; position in the community such as those who worked in the agricultural sector, natural resource management; community elders and NGO workers. I conducted

ten interviews in total. The interviews were recorded on a digital voice recorder. The interviews duration was for thirty minutes to an hour. Other informants who were identified were the DC, Agriculture officers and the officers in charge of the Management for Adaptation to Climate Change (MACC) project being run by Total Land Care (TLC). These key informants were essential because of their responsibility in disseminating and introducing mitigation and adaptation strategies which were adopted by government. Interviews with government officials and other stakeholders gave information on the role they were playing in climate change. Government policy and strategies, with respect to mitigation of climate change, were crucial to this study as they were some of the most important channels in which people of *Mwala o' Tongole* village were exposed to scientific knowledge.

I was able to understand different extension services provided within the community and their modes of delivery. Two retired extension workers were interviewed and provided information about their past experience with LKFs and the current status of its application in farming and climate change. This was imperative to help gain an understanding on the impacts different programs were making, and how LKFs and SKFs were impacting on climate change.

I also abided by the social science code of conduct by seeking written consent of the community leaders and also from all participants in the research before embarking on the actual data collection. This was done to ensure that participants had given me informed consent for their participation. In this case, informed consent involved as much information as possible about the research for them to be able to make informed choices. Their participation was voluntary and that the, information sought was purely for academics. The participants were informed of that their identities will not be disclosed (Silverman, 2010). Also, the information gathered was also kept with utmost confidentiality and that names will be fictitious ones.

3.6. Focus groups (FGDs)

Krueger quoted in De Vos, et. al. (1998: 306) defines FGDs as “a carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment”. According to Rabiee (2004, 656) FGDs is a technique which involves the use of in-depth group interviews in which participants are selected because they are to serve a purpose, although not necessarily representative sampling of

a specific population. This therefore allows the researcher to investigate a multitude of perceptions in a defined area of interest. Four FGDs were conducted with the aim of soliciting information from the people, which was normally harnessed when it was discussed. Free discussions were made possible by making sure that the setting was as relaxingly as possible in a social conversing way (De Vos, et. al. 1998). The first FGD was composed of females only, to accord them the opportunity to express themselves freely. The second one was composed of males only for the same reasons. The third one combined the two groups and consisted of equal numbers of participation to level the field. The fourth one was done with the elders from this community as the gate-keepers of LKFs. The selection of participants was based on the criteria that they would have something to say on the given topic. This means particular age group with similar socio-characteristics were grouped to make sure that they freely exchanged their views. This way, age became one of the factors used for the selection of the participants as it would help me collect information on climate change based on their rich histories. Although I had a set guideline of questions, it was never my intention to make the interviewees read and answer the questions given literacy issues. Throughout the interviews, I adopted an in-depth semi-structured or “conversational” interviewing style. The general aim was to encourage the subjects to speak freely and explain the issues on climate change in detail. Therefore, I took an interventionist approach to make sure that the balance between what was interesting to me and what was interesting to them was maintained.

FGDs also helped in corresponding to the way people’s opinions were expressed and exchanged in everyday life. It was seen that the participants acted as guiders in terms of statements and views whilst validating them. Some of the questions and answers revealed common processes and practices the community do to solve climate change issues. The FGDs also showed how opinions were created, exchanged, and asserted in the social context within the community. In the process, it unearthed deeper meanings people attached to the topic at hand, and how they do negotiate those meanings thereby generating diversity within and between groups. The FGDs also helped examine how knowledge was generated and applied in relation to climate change. The FGDs also provided information about a range of ideas and feelings that individuals have about certain issues, and did mirror the differences in perspective between the groups (Rabiee, 2004, 656).

Note also that the FGDs were conducted among men, women and the youth (working age group) and these people were segmented using a pre-prepared FGD questionnaire to guide the discussions (Annex 2). I assumed that FGDs could potentially produce useful information that would be less accessible if other tools alone were used (Landlof & Taylor, 2002). This approach also showed the diversities in the opinions and experiences of the subjects unlike the conclusions that would be obtained from *post adhoc* analyses of statements (Morgan, 1997: 292). FGDs were also used to confirm or refute research findings that were generated using other approaches as obtained from the literature reviews.

Before each discussion, I would inform the respondents about the topics to be discussed. For example, their daily experiences and perceptions of different on-going climate changes; causes of those changes; different adaptation strategies to reduce climate change; knowledge transfer systems within the groups in the community, and challenges of applying LKFs in climate change management. Here, I simply acted as a facilitator and a secretary by taking minutes of the discussions. This was not easy hence had to use a voice recorder to capture the data and as backup. I would ask permission in advance from the subjects before any notes were written down or voice recorded.

Some of the challenges I faced with FGDs included difficulties to get minimum number of respondents in good time and at once for a session. As emphasised by Bernard (1988) FGDs should ideally have between six and thirty respondents. Most of the local communities were busy planting crops. This meant I had to organise the meetings during lunch time and before they returned to the fields.

During interviews, it was difficult for some respondents to understand my questions. Sometimes, they often started discussing off point issues. With this, I had to make more clarifications to make them understand the questions. In some instances, it could be seen that some people were telling lies. Given this, I had to challenge the responses by giving a follow-up and related question but put differently in order to spot the contradictions. At the end, I would ask the subjects to ask or comment on the session. This helped me revisit the issues that required clarifications. Moreover, some old subjects could not speak fluently in Chichewa but rather Yao and that needed me to hire a translator at a fee.

At the end of the interviews, I re-organised my notes and later expanded them to make sure that they were reflective of the sessions. I also kept a journal for all problems arising from the sessions.

3.7. Data analysis

Data analysis began right from the field and was facilitated by the respondents themselves. Different emerging themes were discussed and evaluated with the respondents. After the evaluation, new themes could be identified and reinvestigated. The work was edited at different stages while in the field. The decision to edit each interview helped me get back to the respondents and get clarification on any gaps or contradictions.

The analysis went through a pain-stacking process of sorting and classifying the collected information. Analyses started alongside the interviewing process as it was ongoing. This helped me keep track of the information and store it safely.

Observation of community activities and processes helped me determine what was being done, how, and by whom. The constant comparative method (Glaser & Strauss, 1967) guided me through the data analysis, which was based on an inductive approach geared at identifying patterns and discovering theoretical properties in the data. In a back--and--forth interplay with the data, I constantly checked and rechecked the elemental codes and concepts. I scrutinised and compared data against with codes in order to organise the ideas and pinpoint concepts that seemed to cluster together. Codes were clustered into substantive categories, and these categories were compared across interview transcripts, observational data, respondent feedback, and data from documents. I compared coded segments by asking, 'How is this text similar to, or different from, the preceding text?' and 'What kinds of ideas are mentioned in both interview statements and documents?' Hence, I identified similarities, differences, and general patterns as recommended by (Bowen, 2008). When new categories were suggested by the new data, the previous transcripts of interviews, data from field observations and documents, were re-analysed to determine the presence of those categories. By doing so, I managed to fill up the gaps in the categories and narrowed excess ones. The coding framework was thus based on recurring texts, within the data which was drawn from the research questions. The coding therefore helped me understand how the various elements were linked to each other.

The process of data analysis also involved examining the information collected, and transforming it into a coherent account of what was found, using the coding framework. I also used the narrative analysis as suggested by (Cook-Gumperz & Green, 1984: 201 & Green, 1982). This involved me getting immersed into the data, coding, creating categories and finally identifying the themes which were underlying the study.

CHAPTER 4: DISCUSSION OF THE FINDINGS: FIRST PART

4.0 Introduction

This chapter presents the discussion of the findings. It then gives an examination of how local people view or perceive climate change. This discussion is drawn mostly from the interviews held in the Mwala o' Tongole. It will also present the communities understanding of climate change by looking at the how they forecast their weather and climate change. Later the discussion of community ways of adapting to climate changes using LKFs is presented followed by a brief conclusion which sums up the chapter.

4.1. Community understanding of climate change

This section examines the community members understanding of climate change in this area. It begins by examining the way they understand climate change. This will be done by examining views on weather forecasting using LKFs and instruments. This is then followed by a discussion.

4.1.1. Local knowledge and weather forecasting

In late seventies and to somewhere around the early 1980s, local farmers indicated that they were able to use their LKFs of weather systems in order to prepare their farming calendar. Such knowledge was garnered through the years of experiential learning through observing the patterns of clouds and rainfall, wind, temperature, floods, harvest, storms, plants and animal behaviour changes.

4.1.2. Clouds and rainfall changes

One of the discussions held with the elders within the community revealed that in the past the people were able to know when the rains were coming by simply interpreting the types of clouds appearing in the sky and their movement. This was done by observing the clouds in the sky from time to time. They indicated that certain clouds when observed could guide them or help them know that the rain will soon come or will not and even the direction where it would come from and the reasons. A sixty-year-old farmer said:

Way back in time when we were young, we used to have heavy rains. The elders taught us how to observe the skies and our natural environment, and that could help us interpret the signs and symbols of the imminent rains. These skills would also tell us when the first rains would come, and even if there would be bad rains or good

rains that year, we could still tell... For example, when the clouds were too black and dark and the weather was so hot so much so that we could sleep outside because it was too hot to sleep inside. We knew that the rains were nearing and such rains would be violent sometimes accompanied by thunders. In some cases, there were certain birds and animals which when appear flying or chirping, we knew that it would soon rain. Such birds included 'Nanzeze'. Sometimes, plants and trees could shed-off leaves or some could begin growing leaves such plants would tell you that the rains are near. When 'magobola therere' first appears or 'ngumbi' or 'agonthamkutu' begin coming out, we knew that the rains coming were not 'chizimalupsa' but rather the ones we should plant our crops. There was a time when we could tell that it will rain heavily when certain big frogs croaked but now, the frogs do not croak as much and or if they do so, they have seen a snake meaning that they no longer take their messenger role. For your information, the first rains were known as 'chizimalupsya' (fire extinguishers) and would usually last for a couple of days, and that must not make you go planting since they simply came to cool the earth and dissolve the ashes from the burning bushes. (Interviews, 13th, December, 2011).

Chizimalupsya would simply moisten and cool down the soil, hence the name. After these rains, it was possible for people to plant their crops, according to this man. However, these days no matter how much time people spend looking up at the clouds to be able to predict about rain falling, it is proving to be difficult as the clouds are not as easy to decipher as they did in the past. These days, the clouds can start showing as if it will soon rain however, within a few minutes they disappear. There is no explanation one can assign to these changes other than the effect of climate change and global warming which brings about climate variability and unpredictability of weather and rainfalls. For those villagers, especially hard determinists, this is a sign of the end-times. They cannot believe and see the logic why rains do not come the time they usually anticipated it or why after it comes for some time and they have planted their crops, it suddenly disappears. This is more of a miracle and the end of the world. Others believed that in those days, when such weather changes and droughts came, people could offer sacrifice to their local gods and families would separate. But today, people do not fear god or gods and no longer offer sacrifices and fasting. They instead keep on sinning and this could be one of the causes of these weather changes as they think them to be 'milili'. While the aim of this paper is to not to question myths or claims that are self-evident; based on our literature reviews these events

are as a result of natural changes on climate changes which are as a result of human actions such as deforestation, siltation, mining and fossils fuels gas emissions.

4.1.3. Winds

In the past, local people were able to tell weather variability. At the beginning of the rainy season, they were able to know that the rains are coming, through the winds that would be coming in from the lake side, called *Mwera* and these winds were mostly warm and moisty and could smell moist with some kind of humid dust. They indicated that these days winds are coming from every direction, and these winds can either bring rains or not. One of the respondents said: "Today, the winds are very unpredictable, sometimes too windy, sometimes too dusty, sometimes too cold, sometimes too dry, sometimes violent and sometimes too friendly". The winds that once were considered to be the messengers of rainfall are today even coming without any drop; sometimes they come when the crops have germinated, resulting in destruction of the homes and crops. They also reported that the other problem is the onset of heavy winds that comes soon after rain clouds have formed in the sky. These winds chase away the rain clouds which bring rains. According to one of the farmers, these winds are increasingly occurring these days. These views were coming especially from the people who have resided in the area for more than twenty years. He explained that these winds are also a sign of omens apart from the effects of the environmental degradation and climate changes. Those who were superstitious also believed that some magic men and lazy people who are making bricks while it is time to rain are the ones that tie the rain. Most of the times, these would be old who just want to practice witchcraft on nature or are young men but are making bricks so that they cannot afford to lose them. This is a mythological approach to the concept of rainfall and natural disasters; which in principle, are as a result of human actions and climate change.

4.1.4. Temperature changes

Increasing temperatures in the area was also mentioned by the locals. Nkhotakota has always been a hot area, due to its proximity to the lake however for the past couple years; the temperatures have been too high becoming unfriendly. This is having a spill over effect onto their growing season, as the temperatures are having a detrimental effect on their crops. Farmers agreed that it is always essential for crops to have a break from continuous rainfall, to assist in the healthy growing. Unfortunately, the increased temperatures, were negatively affecting the crops instead of helping them. Eventually, most of the crops do

not growing healthily, as they dry up before maturity and this leads to perpetual famine and hunger. It is said that even when the rains come in the right amounts after this dry spell, the damage is mostly already done. This leaves the farmers having to cope with their lives with the little that comes out of their farms.

4.1.5. Animal behaviour change

In addition, local farmers were also able to predict the coming of the rains by looking at behaviour of certain animals and birds. For instance, birds would migrate from one area to another. However, nowadays birds are not migrating anymore and very few are left in the area, hence making it difficult to predict rain patterns. The locals feel that they are now at the mercy of the climate, unlike in the past when they were equal partners with nature and were able to plan by mere observation and interpretation of their natural environment, based on their LKFs.

Although sufficient rains fell in certain parts of the country during the farming seasons of 2004/ 2005 and 2005/2006; food deficits still occurred in many other parts of the country due to inadequate rainfalls. Food deficits have become a general phenomenon due to weather inconstancy which causes droughts, dry spells and floods as observed by (Cooper, et.al. 2008). Erratic rainfalls are also contributing to crop failure and hunger. Like Richards (2003) observed, the changes in climate are exposing the vulnerability of various social groups to the weather inconsistencies. This condition poses particular threats to the local community's livelihood systems which are very sensitive to even modest climate change.

4.1.6. Deforestation

According to some of the elders, the changes in climate can also be seen in their local surroundings. Villagers are not able to find some of the wild fruits and vegetables which they used to gather and eat from the local environment. Similarly, the animals that used to live in the near bushes have their habitat destroyed due to deforestation, poaching and poor farming practices all of which propels climate changes (Nkhotakota Economic Profile, 2009). This occurrence makes it even harder for people to predict the coming in of the rains as they used to do since this was done by interpreting animal behaviour. This implies that their knowledge base for predicting the coming in of the rains or even an impending drought is getting eroded and unreliable.

Most of the locals have linked the changes in climate mainly to deforestation, poor farming practices, and over population. Deforestation leads to soil erosion; poor farming methods such as rotational farming and burning down of vegetation lead to deforestation and damage of the terrain which in turn silts the water bodies. Siltation of water bodies leads to low evaporation and low rainfall as well impeding on the lives of marine life. On the other hand, population increase leads to people having to clear more land, and over cultivating the same piece of land. Scientific evidence suggests that large scale deforestation results in changes in local and regional climate (particularly relative humidity and temperature) affecting the rates of evaporation, the extent of cloud formation and hence, the occurrence of rainfall (Ziervogel, et.al. 2008). This is further aggravated by the declining trend of rainfall noticed in the rainfall pattern, shown in the graphs generated from the rainfall data of Nkhotakota metrological station (see Figures 1&2). Consequently, this has resulted in food insecurity across recent generations.

Agriculture in Malawi is highly dependent on rainfall for successful output. The understanding of the changing rainfall patterns in this area is therefore very critical as they affect planting dates and crop growth cycle. Malawi in general and Nkhotakota in particular have been experiencing increases in the length of dry spells and a reduction in the frequency of rainy days as observed in the literature review. Planting dates have therefore been changing due to the increased occurrence of false starts of rains (Tadross, et.al. 2003). These observations are consistent with local accounts which indicated an increased length of the dry season with rains starting later with each passing season, resulting in people changing their planting times each season.

In communities that do rely on natural resources, people are keenly watchful of the landscape and quickly discern climatic anomalies and their effects as observed by (Roncoli, et.al. 2009). This is also reflected by the *Mwala o' Tongole* community as they were able to tell that the climate in their area has radically changed by drawing from their LKFs they have used from time immemorial to tell the weather patterns, and adjust their farming calendars. Many livelihoods are supported by drawing from the natural environment and the associated ecosystems. These include firewood, forest products, and wild plants used for medicine; food, and religious purposes. Climate change is impacting on the functioning of the ecosystem thereby diminishing the benefits humans obtain from it. The change in climate is resulting in the felling of trees which leaves fewer wild plants

for medicinal use and food. As the landscape is changing, natural resources from which locals derive their livelihoods are also diminishing; consequently, the community is faced with more and more challenges. The droughts are affecting human spheres of activity resulting in the escalation of social problems. For example, there are food shortages which result in malnutrition of children, and financial problems in the households, as the people search for money to buy food and sustain their families.

Climate change is indeed taking place in *Mwala o' Tongole*, and this fact is not only backed by scientific facts but also personal and local accounts. The Malawi metrological department's data of both rainfall and temperature indicate a significant change in the climate. The rainfall data shows a decreasing trend from the mean of zero and an increase of maximum temperature between the periods of 1960-2011 (see figure one and two). Agricultural officers, local community leaders, community members and various stakeholders, who are on the ground, all provided accounts of how the climate of the area has significantly changed for the worst. Furthermore, statements by the farmers in *Mwala o' Tongole* village who talked of an increase in dry spells and floods were supported by the NAPA document of Malawi (2006), which indicated that droughts and floods have increased in frequency and magnitude in this country. These observations alongside the scientific knowledge are all indicators that there is indeed a change in the climate which gives the farmers less room to plan their farming activities as was normally the case.

4.2. Application of local knowledge in adapting to climate change

The local knowledge that has been applied by the local community of *Mwala o' Tonogle* has helped them, through the years, adapt to climate variability. With the advent of climate change, this local knowledge is being used to adapt to climate changes. Local knowledge skills have been seen to stand the test of the times and are reaffirming themselves as good practices hence becoming part of the processes of adaptation to climate change. In the subsequent sections, I will discuss some of the practices that are being used in adapting to climate change. They are discussed by looking at the type of tillage in which they are used, crop varieties being planted, conservation practices and finally storage practices. The discussion is following the set structure as it is based on the practices which are followed from the planting stage to harvesting.

4.2.1. Pit planting (*Dzenje Lokumba*)

The type of conventional tillage that is done in Malawi involves soils being inverted to an angle of degrees (Williams, 2008). Pit planting is a type of cultivation method where the land is tilled without creating ridges. In place of the ridges, pits are dug and they call them 'mapando' in Chichewa:

Timakumba dzenje limene timadzalamo mbewu. Dzenjelo silimakhala lalikulu kwambili mulingo wake..koma loti litha kusunga madzi kukakhala ng'amaba“ In English: We dig pits which are not too deep, but can just store an element of moisture when there is a dry spell (Interview, January, 2012).

The pits are now dug to a quarter of the original depth to allow for just enough depth to plant the maize seeds and for moisture conservation. Digging is done to control the splash over by rainwater. Wherever possible, the pits are covered with dry grass or left-over stalks from the previous season. This is done to help in the retention of water in the pit whilst also controlling the amount of rainwater that may be lost through free flows.

4.2.2. Cultivation of traditional varieties

According to some local farmers in this area, due to the unpredictability of the rains today, they started looking at varieties which can help them deal with these changes. They are reverting to planting more traditional crop varieties like the ones that were being grown some decades ago before maize was introduced. The three main crops being grown since 2005 include finger millet (*eleusine coracana*), Sorghum (*sorghum bicolor*) and Cassava (*Manihot esculenta*) because of their ability to withstand weather shocks. Finger millet is more resilient to droughts; while sorghum is an indigenous crop that grows well in heat, requiring little rain, and Cassava is able to thrive in high temperatures. They also indicated that cassava requires enough water during planting but afterwards can survive in little water. These crops are also easily processed into flour, which can then be cooked into pulp. According to the FGDs, Cassava was being grown widely in the past before maize came in. Cassava was in those days preferred because of its versatility in uses. For example, it can be used as a vegetable; the root can be eaten while raw or boiled; tubers can be pounded and be made into pulp or porridge. Raw tubers are preferred by men to boost their sexual libido that way it becomes medicinal plant. Cassava tubers can also be

stored in the ground for as long as 4 months. The local farmers are reverting to cassava as it is seen to be more resilient towards weather changes.

Discussions with the communities revealed that, most of the times there are dry spells which make other weaker crops fail to survive. Although cassava requires optimal conditions to achieve high growth rates, it performs well in drought-prone areas and on poor soils and is thus considered one of the best options (Zhang, et.al. 2008). In seasonally dry and semi-arid environments, those with less than 700 mm of annual rain, improved cultivars of cassava can give dry root yields of over 3 tonnes per hectare (El-Sharkawy, 2006). Therefore, cassava is often considered as an insurance and hence major food security crop for resource-poor smallholder farmers in marginal lands (Kamukondiwa, 1996). This was supported by the local farmers who added that their soils were barren before they started planting cassava such that other crops could only do if chemical fertilizers were applied. But because they were poor, and chemical fertilizers were too prohibitive, cassava became the saviour. This way, the cultivation of cassava is in this context based on their ability to tap from their pool of LKFs inherent in them.

4.2.3. Mulching

Mulching is the protection of the soil partially or fully by using grass or any other locally available material such as left-over stubs from previous harvest (Truax & Gagnon, 1993, 22). Before the advent of chemical fertilizers, local farmers largely depended on the use of home-made manure. According to the people of Nkhotakota, this practice was encouraged by the elders and was applied when the temperatures were very high because mulching helps keep the soil cool, moist and fertile. Community members also agreed that chemical fertilizers were too expensive for them. For example, in maize farming, two types of fertilizers have to be applied which are CAN and 23-23-0 and each of one these now costs almost MK24, 000.00 utmost per 50kg bag, and MK48, 000.00 or more for two bags.

Farmers are therefore resorting to mulching as it works best for them economically, ecologically and agriculturally (Nyong, et.al. 2007). Nyong also observed mulching have been known to moderate extreme soil temperature, suppress diseases and harmful pests, and conserve soil moisture. Furthermore, the crop residues undergo a decomposing process which contributes to the soil nutrients, and that they can enable the community to mitigate and adapt to climate change. During my transect walks, I came to notice that

mulching was really being applied by the farmers. It was observed that mulching was done from the crop residues such as, maize stalks and even dead grass to conserve soil moisture. Farmer here compared mulching with chemical fertilizers and said:

Chemical fertilizers are really too expensive for poor farmers like us. They are also addictive in that if you don't apply them the next season, you will never harvest anything. Once you begin applying them, you need to do so every year on that same land. This is not the case with local manure. Chemical fertilizers can also damage the soils permanently as well the environment and aquatic life if the field is washed by gushes.

Arguments and observations like these were also observed by (Hinsinger, 2001).

4.2.4. Traditional storage practices

Owing to the change in climate and having to revert more and more to cassava as a staple food, farmers have had to go back to their original ways of storing food. In as much as cassava can stay in the field for a long period of time before harvesting even after maturity, with them staying in the ground for over 18 months. There are times when they do harvest more than necessary. Such cassava is kept in the dugout, which is covered with some ash and it can be kept there for up to 4 months provided there is no moisture (interview).

In addition, to help supplement their diets, local people are going back to eating the vegetables and fruits found in their forests. They have also reverted to the traditional means of preserving fruits and vegies by drying them. These fruits and vegies are usually in abundance during the rainy season. Vegetables and fruits which farmers keep include pigeon peas (*caganus cajun*) eaten as legumes and or vegetables; *nyika* (*nyamphae petersiana klotzsch*) a wild root plant whose roots and leaves are eaten; pumpkins, beans, sweet potato and cassava. The leaves are plucked, cleaned, chopped and boiled for a period of time. After this, they are dried in the sun for a number of days and are later stored in locally made storage bags known as '*chikwatu*.' The storage bags are made of leaves and strings. The entire process is known as '*kufutsa*'.

Traditional storage of these vegetables is now being used more commonly due to increased length of lean months. Storage of this kind is cheap and convenient for local people of this community. See the excerpt from the interview:

Kale timatha kukhala osafutsa mfutso wa ndiwo za msamaba chifukwa mvula imagwa mokwawnila ndiye kumadimba kwathu kumapezeka ndiwo zamsamba zambiri chaka chonse ngakhale mvula ikatha. Koma pano chifukwa cha njomba ndikusowa kwa mvula, masammba akumasowa kudimbanso madzi kulibe, adawuma. Ndiye tayambapo kumafutsa masamba wochulukirako kulekana ndimene timapangira kale.

This again is a sign that the people are going back to their traditional ways of coping with the effects of environmental change hence a symbol that LKFs are still significant in this society.

CHAPTER 5: DISCUSSIONS OF THE FINDINGS: SECOND PART

5.0 Introduction

This chapter discusses the findings on at the perceptions of the community on climate change. When asked whether they perceive any change in climate or not, most of them reported that climate variability has increased. They added that rains have decreased and became erratic and inconsistent. This is resulting in the farmers not being able to plan their farming activities. Climate variability has likewise weakened the farmers' confidence in local forecasts of weather patterns. It begins by examining the role of religion which falls under the social domain, followed by a breakdown of the types of religion practiced in this area and the way the faithful perceive climate change. The discussion will then go into the political domain.

5.1. Religion

Religion exists in one form or another among all the communities of the world (Bloom, 2007). Hence, it also implies that the people of *Mwala o' Tongole* village are in a certain form religious animal. According to Posas (2007, 39), religion can be defined as 'a system of beliefs concerning the supernatural, sacred or divine and the moral codes, practices, values and institutions associated with such beliefs. Religion brings a sense of unification for the believers. In Malawi 75% are Christians, 15% are Muslims and the remaining 10 % belong to African Traditional religions (NSO, 2008). Amongst the Christians, there are three main religious denominations, which are the Church for Central African Presbyterian (CCAP), Roman Catholic (RC), Anglican Churches and many other mushrooming Pentecostal churches. The African Traditional Religions which makes up about 10% has pockets of adherents scattered throughout the country (Rankin, et.al. 2005).

These various types of religions all entail different practices by their members. However, despite the different denominations, religion provides a basis for common purposes and values that help maintain social order, oneness and group norms and morals (Posas, 2007). Such practices are performed through going to church, fasting, applying sermons and performing certain rituals such sacrifices and demon casting. The coming sections begin by examining Christianity followed by Islam then ATR.

5.1.1. Christianity

Christianity believes in church service attendance, fasting, tithing, charity, docility and empathy. The poor, the widow, the pastors have to be supported by the church through cash and kind. During my FGDs with community members and their pastors, it came out clear that the people here are God fearing, faithful to their God and ethical.

They also claimed that, the changes in climate are also hugely affecting people's attendance of the church. Many members are now turning towards religion due to fears of climate change. I did allude that some old people were superstitious and determinists suggested that these calamities were as a result of human sins. The believers here argued that the changes in climate were not just something ordinary but rather coming from a God because people have sinned. Because of these views, people are now scared and have resorted to going to churches where salvation is assured. Interviews with the pastors revealed that when things were better, the attendance proportionally decreased. However now, with the change in climate, there has been a steady increase in church attendance.

For those believers who fulfil their obligations by attending church services, the priest claimed that if the people turn to God and be born again, God will forgive them and will restore the good climate. Hence, people now take pastors by their word in anticipation of climatic reverse. Since some churches require donations, Interviews here revealed that many people cannot manage to raise money or food though they still go to the church. Some members also indicated that climate change adaptation gave them room for positive results by harvesting more which was later given back to the church.

However, there were some people who were simply using climate change as an escape goat for not meeting their church obligations. Others were of the view that since God had abandoned them, the only way out was to use reason by applying LKFs and SKFs in unison. The other reason why these people no longer attend the church was that due to climate change, harvests were poor not even enough to be shared between their homes and the church. This excuse is still being used despite the success stories of the adaptive strategies on their economic well-being. However, their non-fulfilment of church obligations does not mean they are barred from attending the church. Ironically some of the church members were of the view that their attendance of the church was not right as they were not really abiding by the church dictates. Another requirement is the 'Paper Sunday',

where only paper monetary contributions are accepted. Some people reported that they do not go to this event because they are poor given the poor harvests.

Interviews with local church pastors revealed that there was a gradual increase in church attendance in recent years. "These days, a good number of people are attending the church (Interview, 14th January, 2012). They however felt that the change in climate has somehow pushed people towards God as they hoped God will solve their problems. They also explained that people were now more willing to be godly. As for those few who have rejected God, the priests indicated that these were due to personal problems. It was interesting to note that the church leadership did not feel that the decrease in attendance was due to their own failure to provide the poor with food as it was expected of them by the Bible. The church also revealed that women's roles within the church remained the same despite climate change issues. Otherwise, they only participate in the activities meant for women only committees which deal with strengthening of faith in their families.

5.1.2. Islam

Islam is based on the five pillars. The first pillar is *Shahada* Testimony, the praying and declaration of faith and trust in one God who is Allah and that Mohammed is God's messenger. This is obligatory in daily prayer. The second pillar is *Salat* (Prayer) which is the Islamic prayer and is done five times a day while facing Mecca. *Zakat* (alms giving) is the practice of charitable giving which is based on accumulated wealth and it is obligatory for all who can manage. *Sawn* (fasting) is the abstaining from food which is required from all Muslims, apart from those physically constrained to do so. They fast for a month, not eating from dawn till dusk. The fifth and final pillar is the *Haji* which is the pilgrimage to Mecca, which every devout Muslim, if means allow, is supposed to take once in their life time as an affirmation of their faith (Nkrumah, 1991). These five pillars are adhered to by Muslims worldwide including those in Mwala o' Tongole. It should be noted that, the role of women in the Muslim faith is limited to the background as men play it all.

Discussions with the Muslims here revealed that there is an underlying theme of the importance of the people to co-exist in harmony with the environment as it has been presented to them by Allah. Islam is rich in specific information about the environment and how it should be protected and kept. It is even stated multiple times in Islamic holy texts that when you do good things such as planting a tree, you will benefit from it on earth, and even when you die; you continue to get rewarded for that. Hence, practitioners of the

Islamic faith do their utmost best to look after the environment. The make-up of the Muslim community is such that most of them are considered to be faithful adherents of the requirements of Islam.

According to the Muslims interviewed, the changes that climate has brought upon them have not affected their faith. However, there is a general acceptance that they apply both local and scientific knowledge for the adaptation of climate change. They also believe that their holy teachings on the importance of the responsible utilisation of the environment are in fact becoming more relevant since they are convinced that the change in climate is because of human lack of proper interaction with the environment. According to one Muslim informant, Mohammed commanded his followers to be neat and keep the environment clean thus making cleanliness the central pillar. Cleanliness, in this case, is not only at personal level, but also at environmental level (Interview, 16th January, 2012). Thus, Muslims in this community are at the forefront advising people on the importance of managing the environment and also practicing adaptation strategies. The results from climate change are that their belief systems have been reaffirmed. This is so because their teachings encourage positive interaction with the environment. Additionally, the change in climate has not affected the role women play in the Mosque.

5.1.3. African Traditional Religion

ATR is based upon the Supreme Being who is known as '*Chauta*', as is believed at *Mwala o' Tongole*, and other ethnic groups. They believe that '*Chauta*' is through whom the world was established. '*Chauta*' put in place necessary gods, and priests through whom they pray, depending on the types of requests. ATR in *Mwala o' Tongole* mostly focuses on praying towards the rain god *Make wana*, through the priest *Chauwa*. *Make wana* is a female rain god, and the priest *Chauwa* is male.

ATRs were in the past widely practiced by members of the communities. When rainy season comes, the people through *Chauwa* would offer rain sacrifices to *Make wana* who is believed to be the one who brings the rain from the *Chauta*. These sacrifices would be done with assistance of a representative medium within the village, known as *Chauwa*. Hence, *Chauwa* would be requested to make the necessary rain sacrifices to the gods and request for rains. The people would give him the needed items for the sacrifice, namely maize, groundnuts, beers and chickens. The agricultural products were sacrificed as indicative of the need for rains. *Chauwa* would go to the forest to sacrifice these products

and to pray to the gods for the rains. Upon seeing the Python, it was indicative to him that the rains would come and that the gods have accepted his sacrifice. In some cases, the snake would follow *Chauwa* to his hut, and stay within the vicinity till the first rains have fallen for a couple of times before slithering back to the forest. Till the present day, people do not kill this snake for fear of the gods' wrath upon them or their families. The snakes are perceived not to be vicious and as such are not killed even if one comes across it (Kalinga, 1999). Many people in *Mwala o' Tongole* still believe in this practice as it is still performed by *Chauwa* who resides within the village.

The felling of trees means that the traditional religious stronghold is slowly falling away as the sacrifices to the gods are performed in the forest. The results are that the snakes which are indicative of the sacrifices being accepted and proof of the coming rains are disappearing. Hence, the traditional medium (priest) *Chauwa* and his practitioners have to go even further away in search of a forest where they can offer sacrifices. Members of the village who still believe in this practice also felt that people nowadays do not have respect for this snake. Hence, the snakes prove to be elusive to the mediums (priests) as they offer the sacrifices. However, they still hold on to their ideals that continuing to do so will convince the gods to save the environment. They are also actively involved in the replanting of trees initiative in the community, as they believe if there are more trees, sacrifices will be offered and the snakes will come back. They are also receptive of the adaptive strategies that are being introduced to the community in adapting to climate change. That is, even though they still turn to their gods in these matters, they are also helping restore the green culture.

ATR leaders who were interviewed said that the change in climate has caused a reduction in the number of adherents to their faith. According to these leaders, people have stopped worshipping because they feel that the gods are cowards and have fled them (Interview, 15th January, 2012). People claim that there are more visible positive impacts being experienced from applying the adaptation knowledge coming in from the agricultural extension officers, and other SKFs than ATR.

The adaptation to climate change has brought about a change in people's attitudes towards ATR. What was gathered from those who have stopped participating in ATR is that most of them felt that they have been let down by their gods and these must be dismantled.

5.2. Social domain

The area where the study was conducted is a matrilineal society. A matrilineal society is where the husband moves to his wife's home (Davison, 1993). When the husband moves to the wife's village, he is given land upon which to farm, but this land is not his. The children that he bears are not his but rather for the wife's brothers known as an uncle to the kids. The brother refers to his sister as his *mbumba*. If the marriage ends in divorce, the husband moves away from the wife's village and does not have any say over his children. If the children grow and the marriage is still there, when they are getting married, the uncles handle that. Relations of production at the household level in this kind of society are gendered, from the socially determined networks of beliefs, attitudes, customs, behaviours and activities that differentiate females and males in a particular society rather than biological factors (Davison, 1993). This is especially so as was revealed during the course of the study in the matrilineal society of *Mwala o' Tongole*. The running of the household in a matrilineal society lies upon the husband and wife, with the woman holding primary rights in land management through her *mbumba* lineage (Hirschmann & Vaughan, 1983). The woman has strong rights over land allocation and use. Despite the woman having exclusive rights over the land, tillage of the land until harvesting is done jointly with the husband doing much. When asked as to what happens when there are surplus harvests, it was revealed that the decisions on the harvest are done jointly. This agrees with what (Davison, 1993) said, that despite the practice of matrilineal system, socio-economic decisions mostly lie upon their husbands. In the event of a divorce or separation, they women retain ownership over the same garden.

It has to be noted that despite men coming to women's villages upon marriage, they still played a prominent role in their wives' villages, in the running of the community in *Mwala o' Tongole*. The study also revealed that, in certain cases, despite their being the practice of matrilineal as a family system in the area, some women upon permission from their families, which their husbands had sought, had moved to their husbands' villages and stay there. The main reason for this, in most cases was non-availability of farming land. They said that as much as there was land for them to farm in their wives' villages, it was not possible to harvest enough food and sustain their families. This means there was land pressure in their wives' villages. However, the number of women who had moved to their husbands' villages was not so significant.

At the social level, the community has shown a change in its social value constitution. Things that were previously held to be of great value have either been replaced with other values or adapted in coherence with the original social system. The social system of the community was based on a hierarchical reverence towards those in power, elders and holders of community values and knowledge with males playing a more prominent and role in the affairs of the community and their own households. However, due to the adaptation to climate change, the social structure of the community has been affected by the newly acquired status of women. These impacts reveal themselves in the family structures as well as kinship and friendship networks. The implication of this was that men in this kind of society would not really be free to initiate practices that would help sustain the environment as they do not own land. Besides, where the village has too many women, there is a likelihood of facing over-population and land pressure hence environmental degradation.

5.2.1. Status of women

Women in the community which is predominantly composed of the *Chewa* and *Yao*, were traditionally ascribed the roles of being mothers and wives. Although a married woman was regarded as an adult, she remained a perpetual minor in the indigenous law. She remained subject to her husband and his family's authority which meant that she could not enter into any agreement without permission. Traditionally, women were responsible for clearing the land, tilling, planting, harvesting, fetching firewood, looking for food, water and cooking for the family. Hence, they were just required to follow already set conditions and decisions (Phiri, 1983).

Discussions with women in the community readily revealed that this is how they had been traditionally raised to fit into the community structures. Where matrilineal family system is practiced, women's role within the community was that of being under the headship of their husbands, even though their eldest brother is the one with sole control over them. The women within this community do not have much say in the daily running of their community or their lives. According to Kishindo (2002), all matters pertaining to their livelihoods are handled by their husbands whenever there are matters to deal with, for example, illness, marriages, deaths and disputes among members of the family. However, women have an upper hand since their husbands are in most cases in their villages, where they are treated as visitors. As was earlier mentioned, women have ownership over the

land, as it is allocated to them by their eldest brother. Women are looked upon as important part of the village as they build the village (Kishindo, 2002). Nowadays, women are acquiring traditionally male responsibilities without having equal or direct access to all resources that are in existence. Responsibilities which were carried out by the men in their households, pertain to issues on the socio-economic milieu like selling of extra harvest, when to start tilling their land and even what crops to plant on their land, in minimal cases the acquisition of temporary labour to help in the fields. In certain cases, women have taken it upon themselves to seek out temporary work *ganyu*, so as to supplement their family income. Prior to climate change issues, taking up *ganyu* was something that was done by men only. Climate change has now forced men to leave their homes in search for employment in the nearby towns or abroad; hence women now take the lead in the family affairs.

A female respondent said:

'With our husbands away in the city, our voices are now being heard at community meetings. Considering that we are the ones who do much of the tilling of the land, going in search of firewood, water and food; it is only proper that we now have this added responsibility in our community. We know much more about the land and climate than what we are given credit for' (10th December, 2011).

Climate change is therefore forcing women to redefine the traditional socially ascribed roles in the community. Furthermore, women in the village organise themselves into groups in order to create ideas, based on their LKFs, on how to adapt to climate change. These further compounds the fact that women have the necessary skills to network and organise groups composed of social actors (Lambrou & Piana, 2006).

These new roles appear to create friction when husbands return home from work due to a role conflict. Women who have become used to making decisions suddenly have to change to be submissive. Hence, it is reported that cases of separation are arising because men feel that women do not fulfil their roles. However, there are also exceptions with some women who said that their husbands have been receptive of their new roles and encourage them to continue. Other women indicated that it has taken an extra effort to match and reconcile the two conflict roles even without anybody straining them.

Women in the community now have access to money, giving them a certain measure of independence and financial freedom. This means that they do not have to rely solely on their husbands for money to buy food, farming inputs and other necessary accessories. This, according to the women, has resulted in peace and calmness of their minds, as they are able to tend to their families need.

Local knowledge systems are in some instances gender specific, implying that within a community, different groups such as women, men, youth and elders, possess expert knowledge that pertains to that particular group. Hence, the expert knowledge possessed by each group relates to each of their access to and utilisation of natural resources, agricultural products and practices (Lambrou & Piana, 2006). With the emancipation of women in *Mwala o' Tongole*, fields of expertise formerly dominated by men are now also dominated by women. This has also increased their experiences and knowledge of climate change management and adaptation.

5.2.2. Social networks

The traditional social network system in the village operated on gaining access to land labour, and capital for agricultural production through exchange, membership and status within various existing social structures. Domestic relations played a vital role in determining one's access to labour in relation to one being able to farm and tend to his/her piece of land (Berry, 1989). Domestic relations, in most cases, would spill out to extended family, and these would include aunts, uncles, cousins, nieces and nephews. Traditional social networks thus helped people exchange 'use' rights in return for assistance on one's piece of land in the form of labour.

Effective adaptation will look at the social networks, cultural traditions, gender relations, religion, political systems and economic activities that provide food and income for the community (Schipper, 2007). These characteristics which make up the community are what hold it together in the social system of the society. As such, it is very important to consider how the adaptation efforts are affecting the community's social networks. Climate change adaptation practices are transcending onto the resource dependent communities, affecting not only their natural environment but also their social systems (Regmi, 1997). Through this study, it has been observed that social systems changes are affecting climate change adaptation efforts. For example, women are now having a more visible role in decision making in communities (Interview, 15 February, 2012). The creation of new

opportunities for women means that the social capital that is created is benefitting them as they take on the new roles.

Even though climate change is affecting all members of society, there are disparities in the way some groups are being affected. This is because of the different social roles and inequalities in the access and control of resources, and participation in decision-making at household and community levels (Quintero & Vargas, 2008). In *Mwala o' Tongole*, women are always out looking for food, firewood and water as their traditionally ascribed roles. These roles put them out as providers within their families but do not give them the mandate to make decisions. Unfortunately, women are the ones who have to deal with the realities of changing climate on daily bases as they are the ones who fend for the house. Because of the need to adapt to climate change, the women of *Mwala o' Tongole* are also engaging in community consensual decisions and ensure that there is enough crop harvest through enforcement of climate adaptation options. These functions are being acknowledged as they are now seen as sources of knowledge and abilities in the process of adaptation. According to FGDs that combined men and women, it came out clear that women's roles are expanding the already existing social networks and are being utilised by the community. Adaptation has been shown to have two effects on the social networks. Before the advent of climate change adaptation strategies, the community did not use any socio-information networks as most of them just minded their own businesses including using their own individualistic knowledge. However, now there has been a growing tendency to be more reliant on the socio-informational networks that exist in this village. This has come about due to the knowledge farmers are getting from their fellow farmers and from other interest groups. It is not uncommon today to see farmers sitting down, sharing knowledge obtained through other climate adaptation platforms. They even visit fellow farmers to demonstrate agricultural practices they are following in order to mitigate climate change.

Unfortunately, though, kinship networks are also being diluted and eroded. Kinship networks are defined broadly as extended family, including biological relationships, cognates by marriage, and other self-ascribed associations beyond the family nucleus of parents and dependent children (Urry, 2011). Kinship networks are conceptualised as having a fixed meaning of natural or genealogical relationship but as a socially and culturally constructed and maintained network of individuals in constant flux (Adger, 2003).

Prior to climate change, the kinship networks in the community played a significant role in looking after one another and creating a sense of interdependence on one another. However, this sense of kinship interdependence is becoming obsolete as social and economic needs are now being secured through participation in social networks and associations within the community. As a result, people are gaining an element of independence from the strong hold that comes with kinship networks. This is coming about as they see the many advantages of applying adaptation strategies onto their farms which are of course a product of increased social networks. The expansion of these networks in terms of access to power on various forums within the community is providing the local people an opportunity to engage in network developments such as adaptation strategies.

The expansion of social networks also manifests itself in the way local people now create spaces for engagement with community members and the peripheral. The main players in these social networks are the farmers and extension workers. The nature of the relationships that exist between these two players is very good. This is clear from the success that is experienced from the implementation of the adaptation strategies. At the heart of these successes, remains the usage of both local and scientific knowledge forms. In the process, a wider social network which is based on mutual trust and respect has been created wherein local farmers are looking to these officers for more and more information on climate change. In a nutshell, the expansion of networks in terms of power and representation provides local people an opportunity to engage and support each other in the fight against climate changes.

The farmers are also learning new innovations from their own experimentation. Information is readily flowing through social networks hence bringing the people closer. Geographical distance is not limiting the spreading of adaptation knowledge as noted by (Maddison, 2007). Some farmers' land is not in close proximity to those of their fellow farmers who are applying a particular adaptation strategy on their lands. However, they simply learn about these strategies by visiting their friends and watch them as they apply them.

The creation of a committee, which oversees the application and practice of different adaptation strategies and techniques, is helping the community collaborate more effectively. The village meetings which enable people to raise their views on the changing climate and how adaptation is affecting them on their farm lands create bonding and social cohesion in the community. "Social cohesion is defined as the ability of a group of people

or community working together towards a common goal which results in a general feeling of satisfaction” (Green, et. al., 2009). In *Mwala o’ Tongole* social cohesion is in particular experienced through people’s collaboration in committee’s contexts in implementing adaptation strategies (see chapter four) especially in afforestation, and other ways of arresting natural disasters. Some of the adaptation strategies have included construction of gullies to take away excess water from around their homes into their fields and or away from their fields to reduce water lodging. It can therefore be said that social networks and social cohesion are helping the community in implementing climate change adaptation strategies effectively which have in turn improved their livelihoods.

5.2.3 Breakdown in social values

The area is experiencing increased food insecurity due to weather variability caused by the change in climate. Traditionally held practices entailed that children look after their elders and relatives by sharing their harvest with them and by appointing a younger member of the family to cook for them and clean their house (Caldwell, et.al., 1992). However, people are increasingly breaking away from these cultural norms due to modernity and climate change challenges. In this study, the elderly revealed that they sometimes do not receive any assistance from their children unlike in the past when society was agglutinated and sharing was normative. One respondent said

The decreasing amount of food available in this community is due to the weather not behaving as it used to do. People can now not afford to share the little they have with their family and the extended relations which sometimes may include the whole village if properly tracked down to the ancestry genealogy. In the past, nobody would go hungry, even if it is your neighbour, you would share because that was then, and the norms were as a matter of principle meant to be dog followed’. (Interview, 5th December, 2011).

Adaptation to climate change means that at times the farmers have to cultivate on small pieces of land to make the most of their limited farming inputs and to gain as much as possible. As a result, the harvest is only at times enough for the household which means that the extended relations cannot just be served. Adapting to climate change is resulting in the dissolution of long held traditions of communism and extended relations. Recently, there has been an inclination towards the development of nuclear family as the self-supporting unit which is composed of only the parents and children.

5.3 Political structures

In the context of this study, political structures refer to powerful structures and the execution of power within the community, spreading to the means to make or participate in decision-making, planning, implementing of plans and strategies. Due to climate change, there have been structural changes within the institutions. The traditional structures that have been in existence within the community were based on the central role that men played. Males held all main roles in the community starting from the chief to his elders and all such committees in existence (1980). This meant that only men and those who were considered to be old and well versed with the community's values amongst the males had a say in the functioning of the community. However, recently, the community has come to accept that not only elders can play advisory roles in the community but also the young and the middle-aged. In the community-based organisations, there is now representation from women, men and even the youth. This has had an effect on the composition of other organisations which are not related to farming and climate change adaptation. There is now general appreciation from the whole community that even women and the young have the capabilities to take part in essential decisions which affect the community. It is now considered that the scientific knowledge which the young people have gained from schools is of use for their communities. The resulting factor has meant that there are young men and women, who have an amount of schooling, being included in their communities' committees. This is a clear escape from what used to happen in the community where political realms were held by men and the elderly only. The women in the community, despite it being a matrilineal society, prior to climate change were subject to the authority of their elder brothers but today, women are considered the main agriculturalists, bread winners and climate change champions.

CHAPTER 6: POLICY AND CONCLUSION

6.1. Introduction

This chapter gives a summary of the five chapters given therein. It will also look at how the various findings can contribute towards policy development for the country. The chapter begins with an examination of what a policy is, and what it entails to have policy developed. It then gives an examination of policy making in Malawi with a discussion of the policies which are relevant to climate change. It then discusses the implications for policy making in relation to climate change adaptation. This will further be developed by looking at how the different findings from this research can feed into the policy development for the country. Then there is a concluding summarising discussion on the findings of the research. It will finally look at the implications of the study in relation to future research.

6.2. Meaning of policy

A Policy is a principle or guiding statement that sets out to give direction on decisions and achieve rational outcomes (Chinsinga, 2007 & Torjman, 2005). Policy making processes undergo a complex mesh of interactions and ramifications, between interested stakeholders, who are constrained and driven within the contexts of which they operate. Thus, policy formulation involves setting goals and outcomes. When a problem requiring policy solutions is identified, research will be the next step that is involved in the policy making process. Research is undertaken to determine what aspects to put into the new policy. This involves having outreach programs with the people in the communities, consultative meetings as they are called. From the research, it brings out the kind of strategies that are to be used in the new policy. This knowledge is gained from the interaction that is done during research. Strategy is thus the second step in policy formulation. Strategy comes with the set goals of the policy and expected outcomes. A strategy refers to the plan according to which a policy will be implemented. For example, if a policy is to be developed regarding access to improved strategies to adapting to climate change, consultative meetings will be held to look at what people at the grassroots are deeming to be successful as they apply it in their lives. After these stages, the proposed actions are drafted and debated into language for policy.

6.3. State of policy making in Malawi on climate change

Malawi as a country is very good at policy making but not implementation. However, if one is to look at the current policies in existence in relation to climate change, there is only one which is the National Plan of Action (NAPA) which is also ineffective. Recently, there have been other policies which have been produced such as The National Charcoal Strategy (NCS).

The NAPA indicates that mitigation and adaptation are the best ways for combating climate change. For example, the NAPA refers to adaptation to climate change as one of its main running themes (Malawi Government, 2006). It provides a basis for understanding the required competencies in terms of human resources, goals and actions to be taken for the management of the environment. However, not much is taking place on the ground including at local level. Some initiatives are being made by local farmers in adapting to climate change as has been examined already. Discussions with the extension officers revealed that they have no guidelines from government, but have attended workshops and trainings on climate change organised by the Ministry of Agriculture (MoA) and NGOs.

The National Agriculture Policy (2010) briefly looked at climate change as an issue that is affecting agriculture in the country by exploring climate change in relation to the NAPA. It did this by identifying the goals of the NAPA on agriculture and those goals that would be necessary for specific departments. This being the case, it remains a vague policy that does not specify how climate change would be handled. In this respect, if we allude to chapters one and two of this dissertation, which delves on the effects of climate change, we come to realise that the Agriculture sector is the one that is mostly affected.

6.4. Implications for policy making on climate change

Despite adaptation being considered as one way of combating climate change, not much has been done by the government to get things done. While the NAPA (2006) talks of adaptation as its hub, there is nothing being done on the ground especially in rural areas. Adaptation is mostly being done by farmers using their own initiatives and networks and with some minimal assistance from government and NGOs. However, what emerges from this study is that there is need for more action from government. This must stem from government by way of operationalising the policy statements as outlined in the NPA. In other words, adaptation to climate change should be integrated within the general

development policies encompassing or sister departments. Climate change is expected to seriously impact the agricultural sector hence increasing rural poverty and general economic meltdown. The most effective disaster adaptation and risk reduction plans are those that offer development benefits in the relatively short-term, as well as minimise vulnerability in the long terms. It is difficult to predict what changes will occur given the unpredictability of the weather in the modern age. Nevertheless, adaptive capacity is needed to detect new problems and ably respond to them as soon as possible. For example, Malawi lacks effective surveillance of crop pests and diseases, early detection and rapid response systems for new or changing pest problems and natural disasters. Interventions by public extension agencies are often inflexible and do not enable smallholders to cope with unpredictable changes and emerging challenges.

If Malawi is to continue with its quest for national development, there is an essential need to include policies of adaptation in its development agendas. As an agro-based economy, policies on adaptation should be aligned with climate adaptation and mitigation. But for these to be real, there is need to incorporate various members of the knowledge systems from within and without the communities. Climate change is increasing the already existing cycles of poverty and famine among the poor farmers. Therefore, it is essential that policy development should look at how this cycle can be broken.

Indigenous knowledge of farmers is an important factor in climate change management. Societies through the ages have been able to adapt to changing circumstances, hence continuing to flourish in their own environments. Unfortunately, the NAPA (2006) has fallen short of recognising the existence and roles of local knowledge in climate mitigation and adaptation. The study has already revealed that use of local knowledge alongside scientific knowledge in *Mwala o'Tongole* village, has registered successful stories in climate change management. The study has also established that some of the histories, practices and local knowledge systems are crucial for adapting and mitigating climate changes. Moreover, the literature reviews and the interviews have all indicated that climate change bears hard on the rural poor and semi urban dwellers, especially women and children as they are the ones who keep the homes. Since 80% of the people in Malawi are poor peasants, framing watertight policy on climate change is a must, and the process must involve the poor.

6.5. Considerations for policy making

Climate change seriously impacts on agriculture by deepening rural poverty, and as a result affects the people's livelihoods. The urgency of incorporating climate change adaptation policies into development agendas in agriculture need not be over emphasised. The most effective adaptation policies are those that offer development benefits in the relatively short and long terms. It is nevertheless not easy to tell when and what changes will occur in this era given the notoriety of the climate change phenomena. It is obvious that adaptive capacity is needed to detect new problems quickly and respond to them effectively. That aside, utilising various research study findings, it is possible to some degree to predict what kind of disaster will strike in the immediate or near future.

As an agro-based economy, policies on adaptation should be aligned with the needs of the agricultural systems. It is vital that the various knowledge forms and its custodians be engaged whenever coming up with strategies and policies regarding climate change.

Climate change adaptation policies should not only focus on agricultural practices but should also be contextualised in response to the existing socio-political conditions caused by climate change. For instance, in the case of *Mwala o' Tongole* village, the socio-political conditions of the community reveal that there is a need for adaptation policies which take into account the prevalence of single-headed families. Now that women are heading the families in isolation or as a couple, hence leading in decision making processes, they need to be incorporated in climate change key positions. This is in line with what (Scheyvens, 2000, 235-236) observed when he said that there is overly dependence on the natural environment by women, and these must form the backbone of the mitigation processes. This was also observed in *Mwala o'Tongole* village, where women were responsible for the collection of food, water, fodder and firewood and other IGAs. Therefore, policymakers must bring on board women to make sure that they are not left out in the fight against climate change management.

Since the issue of local knowledge has been captured in the previous chapters and has been shown to be effective in climate change management, policymakers must also consider bringing onboard the custodians of both scientific and local knowledge systems to the drawing board when these policies are being framed. After all, it has been said that the most vulnerable people are the ones that feels the impact of climate change hence they must be part and parcel of the policy formulation process.

The next section will discuss the elements that can be included into the policy on climate change adaptation. These elements have been drawn from the findings of the research. The following section dwells on local knowledge followed by intervention research which needs to be done on the sustainability of the various adaptation strategies discussed in preceding sub-section. The subsections are developed in a logical manner building upon one another.

6.5.1. Local knowledge

As already discussed to some degree, indigenous knowledge of farmers is an important factor in climate change management. We noted that human societies through the ages have been able to adapt to changing circumstances, hence continuing to flourish in their environments. Unfortunately, despite identifying areas requiring urgent adaptation effort, (NAPA, 2006), fails to bring out the relevance of local knowledge adaptation strategies even though this has played a huge role. From this study, we have already seen how the people of the study area have benefited from local knowledge forms in managing the environment and adapting to the effects of climate change and hence the need for its inclusion.

The incorporation of local knowledge in the policy is important for two reasons. Firstly, in development circles, it is well known that for development to occur there is need to take a bottom up approach (Arce & Long, 1993). This means that problem identification and solutions must be as a result of a combined effort from both the government and the farmers who are also both the custodians of local knowledge and the consumers. This also forms the basis for technological and socio- economic development of the society (Posas, 2007).

Secondly, use of local knowledge will ensure that locally available materials which can be used in adaptation are utilised. This will ensure that it is effectively outplayed as it builds on the local coping and adaptive mechanisms (Allen, 2006). This will also remove the need for purchasing farm inputs such as chemical fertilizers and hybrid weed chemicals. Since farmers need to break away from the poverty strings; use of chemical and organic chemicals is one way of ripping them of their money. The local farmers are moreover the ones who feel the pinch of climate change on a daily basis. Therefore, their involvement at policy development and implementation levels becomes justifiable and meaningful.

We have also seen from this study that the farmers have worked in unison with extension workers and that allowed for an effective combination of local and scientific knowledge in the fight against climate change and perhaps this must be crafted into the policy frameworks (Ouedrago & Bertelsen, 2008). Local farmers have stored and passed on their experiences through storytelling, folk-role and riddles all of which have aimed at dealing with the climate and its problems and this has been orally done. Therefore, there is need to formally document this innovative knowledge by way of having this view reflected in the policy.

6.5.2. Intervention research

With the need to incorporate local knowledge in the policy as indicated above, it follows that local knowledge and scientific knowledge must be further investigated to establish the one or ones that best serve the communities. An iterative process of monitoring, evaluating, learning, and innovating can reduce disaster risks and promote adaptive management in the context of climate extremes (Field, et.al. 2012). Adaptation efforts benefit from repetitive risk management strategies because of the complexity, uncertainties and long-time frameworks associated with climate change. Addressing knowledge gaps through enhanced observation and research can reduce uncertainty and help design effective adaptation and risk management policies. Therefore, a coherent, inclusive and solid policy on intervention research is an important step in climate change management in Malawi. Having observed the farmers, community leaders, government and other stakeholders, a number of issues came out that need to be addressed through intervention research. This requires increased financial support to sustain research and development for agriculture and climate change adaptation.

Such research needs to be directed towards developing sustainable adaptation strategies which will incorporate both local and scientific knowledge. In addition, the research should also look at developing agricultural practices that are context based. The development of adaptive policies stemming from the research findings for the smallholder farmers will make farmers resilient in their current crop production systems (Twomlow, et.al. 2008). At present, the current crop production systems are not coping with the changes in climate. By supporting the current agricultural practices with the necessary policies on Intervention Research to develop relevant agricultural practices, it will make the farmers less

susceptible to climate change. Considering that the effects of climate change will persevere for the decades to come, a policy framework is thus essential.

A lot of research also need to be done on adaptation strategies among the local farmers given that the situation on the ground is still bad despite the fact that various stakeholders continue to put together their knowledge systems. This is particularly true when we consider that today, over 80% of Malawians who live on agriculture are still poor and sometimes food insecure. In addition, Malawi's road networks and manufacturing industries are very poor and in other cases non-existent. This is why there is a need for longitudinal research on development and implementation of adaptation strategies in agriculture. Given efficient adaptation strategies in agriculture coupled with the right knowledge body and technologies obtained through research, the impact of climate change may be averted (Kurukulasuriya, et.al. 2006). This research should also extend to areas such as proper land use practices and management practices and their effectiveness. Such studies may further explore management strategies that could lead to improved crop production and natural resource conservation.

6.5.3. Coordination of information sharing

There is a need to develop and strengthen the coordination, networking and information flows between government departments, NGOs and communities who deal with matters of climate change and the environment in general as observed by (Bauer & Scholz, 2010). This will help in policy development that will see to it that adaptation issues are not dealt with in isolation. This coordinated approach will assist in easing cases of duplication. Timely communication is critical for effective aversion of disasters caused by the change in climate as suggested by (Majule, 2011). The complexity of climate change strengthens the need for effective risk communication. Because in most cases information about climate change does not trickle down as needed and the end result is that when disaster strikes, the impact becomes unbearable.

Effective risk communication must be built on exchanging, sharing, and integrating knowledge about climate-related risks among all stakeholders. Among individual groups, perceptions of risks are driven by social, psychological, and cultural factors, and values and beliefs (Efa, 2011). For example, the community of *Mwala o' Tongole*, regards communication as very essential to their livelihoods. To this community given the diversity of the population, disaster is as a result of natural phenomena, spiritually driven when the

gods or God are angry, or are human made as shown in the previous discussions. This diversity must be carefully considered when designing policies to make sure that such diversion is craftily merged into a body of knowledge that effectively addressed the problems. In addition, communication on weather through weather stations must be presented in local language to be easily understood if it is to be effective.

6.5.4 Capacity building

The new interventions that will be generated through interventional research shall need to be disseminated through capacity building workshops and seminars. Capacity building is an ongoing process through which individuals, groups, and organisations enhance their ability to identify and meet development challenges (Harrow, 2001). This is done to facilitate learning by providing the necessary resources and training to the people. Capacity building is seen as an important part of any organisation as it works towards fulfilling set policies and strategies for particular purposes.

The majority of agricultural extension workers who were interviewed during this study revealed that they had limited knowledge about climate change due to limited trainings. This in turn affects their responses to climate change issues in the district. Lack of adequate adaptation knowledge by NGOs also makes it difficult for them to effectively mesh with the farmers and deliver the right stuff that would mitigate climate changes. This means the government must provide the necessary resources to assist in the training of the extension officers and NGOs so that they can acquire enough knowledge for climate change adaptation. Given these, capacity building should target the communities through training, mentoring, technical support, and practical courses as observed by (Conde, et.al. 2005). Trainings should also be an ongoing process which does not end abruptly after the session. It must go with the development of new theories which can inform climate change, mitigation and adaptation practices. This will help the workshop participants keep pace with the new developments in the discourses of climate change and mitigation.

6.5.5. Civic education

Civic education is important for the communities in order to create awareness among them regarding climate change. The study revealed that, many of the farmers had local knowledge about climate change, and this was based on countenance and experiences. Civic education is the provision of education to the masses on matters that are of

relevance to them by helping them understand certain important issues that are to happen or are already happening in their society (Galston, 2001).

Research amongst the farmers of *Mwala o' Tongole* revealed that they have knowledge of climate change. This is as a result of their own observations of the weather and some pieces of information from agricultural officers and social networks. This aside, there is no evidence to suggest that the information they have is adequate to address the issues of climate change fully, and this is due to lack civic education. If we quickly think about the contradictions and tensions in the knowledge, they have about the causes of climate change and disasters, we would easily agree that this community hold diverse views on this matter.

To this end, policies should focus on increasing public awareness on climate change through civic education so that alternative views and ideas are brought together, examined in their historical and social context and then compared with the available information sources before reaching at concrete ideas and solutions that would best inform the farmers. This process is more of an academic endeavour as it uses Critical Theory and Ideology Critique, however, it does demystify false claims or the seemingly self-evident claims, and the only way to achieve this is through formal civic education. This then will help in bringing about improved understanding of what climate change is all about, how it is caused and how it can be mitigated. There should be a deliberate policy which emphasises the need for public awareness on matters of climate change and how it does affect lives and its ever-changing nature. An increased availability of information that is correctly pitched will help the farmers deal with climate change effectively.

The provision of information on climate change adaptation to farmers will also increase their awareness of the available technological adaptation options to climate change for them to choose and adopt (Maddison, 2007). Improved farmer education on adaptation will quicken the acceptability and application of the adaptation practices. Farmers ought to be made aware that there are new technological adaptation techniques in terms of practices and tools that can be adopted and be used to deal with climate change. It is therefore important to implement an effective two-way communication process among all the stakeholders to strengthen their capacities. Civic education, as a policy on climate change, shall thus require appropriate co-ordination of information sharing.

6.5.6. Weather forecasts

The study revealed that weather broadcasts help the farmers in planning their farming activities. General attitudes among these farmers also indicated that they have an overarching anxiety when it comes to the onset and cessation of the rains. Thus, the provision of extended-range of weather forecasting options for periods longer than five days will assist them in planning their farming calendars as was the case in Nigeria (Adejuwon, et.al. 2007). Farmers showed that there is need to time their operations to correspond with specific weather patterns. The dry season is used to prepare the land for cultivation; usually before the first rains. Now, there may be instances where the rains come too early. Thus, preparations tend to be adversely affected. It is therefore even more necessary to know when the rains are likely to begin. This of course shall be done through the provision of information weather forecasts. Advance information helps in the preparation of farming operations and labour. It is therefore essential for forecasts to be transmitted in local languages. These forecasts should include information that will help in making decisions based on timing of the farm operational schedules if the need to alter or not arises (Adejuwon, et al., 2007). Studies have also shown that for these weather broadcasts to be utilised, their timing must be well planned so as to catch the locals at home and not when they are likely to be in the fields. It is also important that there should be close cooperation between forecasters and extension personnel in communicating the forecasts. A policy should thus be created drawing on the premise of the study conducted by (Adejuwon, et.al. 2011) in Nigeria, where extended weather forecasts proved to be of great benefits to the farmers. It is hoped that in Malawi, a policy on weather forecasts will be formulated, and that this policy will be comprehensive and in local languages for the people to understand its contents.

6.6. Conclusion

The following sub-sections will conclude the discussions based on different findings.

The literature review presented in this study examined various debates on climate change. It revealed that climate change has come to be understood as a result of anthropogenic activities by humans through the decades. These anthropogenic activities stem from industrial activities, deforestation, automobile and factory emissions and agrichemicals. These activities have led to the releasing of greenhouse gases which are ushering in

climate changes leading to floods, droughts, cyclones, extreme heat and water bodies' reduction.

Previously, when climate change developed as a field of study, it was dominated by the natural scientists. Natural scientists came and showed that due to the increasing industrialisation, there had been increased emissions of greenhouse gases such as carbon dioxide and methane amongst others into the atmosphere. These greenhouse gases were thus causing climate change. Later, with passage of time, debates on climate change have revealed the role of the social scientists to be critical. Then, various ways of dealing with climate change were explored, and these included mitigation and adaptation. Mitigation's aims were to help prevent and or minimise the impact of climate change. This was done through putting across the need to control the amount of greenhouse gases put out into the atmosphere. This method was advocated for through the Kyoto protocol. As time went, mitigation as an effort would not work alone in dealing with climate change, hence the coming in of adaptation. Research within the social sciences brings in the aspect of human understanding, as they study the intricacies of human actions on an everyday basis. By bringing in social scientists to help with the process of adaptation to climate change, they also brought in a new perspective for understanding things such as what drives humans to do what they do; their consumerism behaviours; economic motivations and the other socially related drivers. As with climate change depletion, social sciences have identified economic interests as the main issue that drive man into acting the way he does against the environment. Social sciences have also revealed that there is an implicit need for behaviour change among humans, not only in consumerism behaviour but also in climate change adaptation advocacy. Drawing from these views, the development of adaptation strategies commenced. This is the reason my study drew from the social scientists' perspectives on climate change adaptation, by looking at it from the anthropological lenses to mirror how people perceive climate change.

We noted that natural sciences are divorced from reality in their research on climate change. This is so, because they confine their studies into laboratories and in the process miss out on the social and cultural realities that envelop issues like climate change. Natural scientists have also only managed to come up with estimates of climate change figures, impacts of climate change by drawing insinuated scenarios of the environment due to the change but these failed to explain the actual causes and motivations and interests of

humans. On the other hand, social scientists work with the people on the ground, bringing in societal factors, and redefine the abstractions that were once presented by natural scientists. This way, social scientists bring in an element of humanity into this whole phenomenon and try to position humans on their roles and responsibilities within the phenomena.

An effective way to address the impacts of climate change is by integrating adaptation measures into sustainable development strategies so, as to reduce the pressure on natural resources; improve environmental risks and improve lives of the poor. To minimise the climate change problems in Malawi, we need great collaboration among communities, government, NGOs and other stakeholders as proved in this study (Gemeda & Sima, 2015) observed.

This study has also shown that experiments with a mix of traditional aspects of sustainable agriculture do provide successful results in climate change adaptation. Furthermore, combining local and scientific knowledge has been significantly effective. There is need to make policies, objectives and action plans inclusive and realistic to effectively deliver on climate change mitigation and adaptation. Integrating indigenous knowledge into climate change policies can also lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable. Knowledge of climatic perceptions and adaptations are vital entry points for policy makers to learn how and where to enhance the adaptive capacity. Traditional knowledge should also be considered to develop, expand and mainstream indigenous adaptation measures into global adaptation strategies. There should be further research on how this knowledge can best be integrated into the scientific knowledge as there might be contradictions leading to conflicts and tensions.

The study therefore recommends the need to incorporate local knowledge into climate change policies that will lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable.

In general, the community seemed to have adapted best when working as a collective entity rather than as individuals and this ought to be encouraged.

Finally, the general perception by the local farmers in this area was that climate change is really a problem, and has really affected their families, livelihoods, relations and social cohesions in a number of ways as already proved. Therefore, there is need for real

adaptation and mitigation strategies which must be encompassing, democratic, inspiring and inclusive.

REFERENCES

- Addejuwon, J.O., Odekunle, T.O. & Omotayo, M.O. 2007. Extended range weather forecasting in sub-Saharan West Africa. Assessing a potential tool for adapting food production to climate variability and climate change. *AIACC working paper, number 46*. Nairobi.
- Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. & Wreford, A. 2009. Are there social limits to adaptation to climate change? *Climatic Change*, 93, 335–354.
- Adger, W. N., Huq, S. Brown, K., Dellan, C., & Hulme, M. 2007. Adaptation to climate change in the developing world. *Progress in Development Studies* 3(3), 179-195.
- Adger, W.N., Arnell, N.W. & Tompkins, E. L. 2005. Successful adaptation to climate change across scales. *Global environmental change*, 15,77-86.
- Adger, W.N. 2003. Social capital, collective action and adaptation to climate change. *Economic Geography*, 79 (4),387-404.
- Adger, N. 2001. Social capital and climate change. Tyndall centre for climate research. *Working paper number 8*. Norwich.
- Agrawal, A. 2008. *The role of local institutions in adapting to climate change. Paper prepared for the social dimensions of climate change, social development department*, World Bank. Washington DC.
- Agrawal, A. and Perrin, N. 2008. *Climate adaptation, local institutions and rural livelihoods*. Working paper, University of Michigan. Michigan.
- Agrawal, A. 2004. Indigenous and scientific knowledge: some critical comment. *Indigenous knowledge monitor*, 3(3),1-9.
- Agrawal, A. 1998. Contexts and early origins of the International panel on climate change. *Climate change*,39. Amsterdam: Kluwer academic publishers. pp.605-620.
- Agrawal, A. 1995. Dismantling the divide between indigenous and scientific knowledge. *Development and climate change*, 26, 431-431.

- Aisabokhae, R. A., McCarl, B. A., & Zhang, Y. W. 2011. 14 Agricultural adaptation: needs, findings and effects. *Handbook on Climate Change and Agriculture*, 327.
- Alfsen, K.H. and Skodvin, T. 1998. The IPCC and scientific consensus, how scientists come to say what they about climate change. *CICERO, Policy note number 3*. Norway. Oslo.
- Allison, E.H., Perry, A.L., Badjeck, M.C., Adger, W.N., Brown, K., Conway, D., Pilling, G.M., Reynolds, J.D., Andrew, N.L., & Dulvy, N.K. 2009. Vulnerability of national economies to the impacts of climate change on fisheries. 2009. *Fish and fisheries*. Oxford: Blackwell Publishing Limited,1-19.
- Alpers, E. A. 1969. Trade, state, and society among the Yao in the nineteenth century. *Journal of African History*,10(3). Cambridge: Cambridge university press, 405-420.
- Al-Roubaie, A. 2010. Building indigenous knowledge capacity for development. *World Journal of science, technology and sustainable development*, 7 (2), 113-129.
- Altieri, M. A. 2004. Linking ecologists and traditional farmers in the search for sustainable agriculture. *Frontiers in ecology and the environment*, 2 (1). Stable Publishers.pp.35-42.
- Andersen-pinstrup, P. 2009. Food security: definition and measurement. *Food security*, 1,5-7.
- Arce, A. & Long, N. 1993. Bridging two worlds: an ethnography of bureaucrat peasant relations in western Mexico. In Hobart, M. (ed.). *An anthropological critique of development. The growth of ignorance*, 179-208.
- Ayers, J. & Forsyth, T. 2009. Community-based adaptation to climate change. USA, Taylor and Francis publishers. *Environment Magazin*, 52 (4),22-31.
- Babu, S.H., & Mthindi, G.B. 1994. Household food security and nutrition monitoring The Malawi approach to development planning and policy interventions. *Food Policy* 19 (3),272-284.

- Baer, P., Harte, J., Haya, B., Herzog, A.V., Holdren, J., Hultman, N.E., Kammen, D.M., Norgaard, R.B. & Raymond, L. 2000. Equity and greenhouse responsibility. *Science*, 1289. American association for the advancement of science. pp.2287-2292.
- Banuri, T., Weyant, J., Akumu, G., Najam, A., Roas, L.P., Rayner, S., Sachs, W., Sharma, R. & Yohe, G., 2001. Setting the stage: climate change and sustainable development. *In: Proceedings of the Third Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, Mitigation*. Cambridge: Cambridge, 73–114.
- Bauer, S. & Scholz, I.(2010). Adaptation to climate change in southern Africa: New boundaries for sustainable development. *Climate and development*, 2,83-93.
- Beck, U. 2010. Climate for change on how to create a green modernity? *Theory, culture and society*, 26 (2-3),254-266.
- Beck, U. 2010. Remapping social inequalities in an age of climate change: for a cosmopolitan renewal of sociology. *Global networks*, 10 (2),165-181.
- Berkes, F. & Jolly, D. 2002. Adapting to climate change-Socio-ecological resilience in a Canadian western Arctic community. *Conservation ecology*, 5 (2).
- Berrang-Ford, I., Ford, D.J., Paterson, J. 2010. Are we adapting to climate change? *Global Environmental change*, 1-9.
- Blanco, A. V. R. 2006) Local initiatives and adaptation to climate change. *Disasters*, 30 (1),140-147
- Blok, K., Hohne, N., Torvanger, A. & Janzic, R. 2002. Towards a post 2012 climate change regime. Unpublished.
- Bloom, P. 2007. Religion is natural. *Developmental science*, 10 (1),147-151.
- Bloom, A. J. 2010. Global climate change. *Convergence of disciplines*. *Sinauer*.
- Bollig, M. & Schulte, A. (1999). Environmental changes and pastoral perceptions: Degradation and Indigenous knowledge in two pastoral communities. *Human Ecology*, 27 (3), 493-514.

- Bradley, R. 2009. Green and mean: can the U.S. economy be both climate friendly and competitive? Testimony before the world resources institute.. Unpublished *Paper presented at a Hearing before the commission on security and cooperation in Europe*.
- Breidenich, C., Magraw, D, Rowley, A. & Rubin, J.W. 1998. Current developments: The Kyoto Protocol to the UNFCCC. *The American Journal of International law*, 92 (2),315-331.
- Briton, H. 1982. Using critical personal narratives: A poststructural perspective on practice. *VL Chapman - New directions for adult and continuing*. Harvester Press.
- Briggs, J. 2005. The use of indigenous knowledge in development: problems and challenges. *Progress in development studies*, 58 (4), 99-114.
- Brosius, J.P. 1997. Endangered forest, endangered people: Environmentalist Representations of indigenous knowledge. *Human Ecology*, 25 (1),47-69.
- Bryan, E., Desersa, T.T., Gbetibouo, G.A., & Ringler, C. 2009. Adaptation to climate change in Ethiopia and South Africa: Options and constraints. *Environmental Science and Policy* 12, 413-426.
- Bryman, A. 1984. The debate about quantitative and qualitative research: a question of method or epistemology? *British Journal of Sociology*, 35 (1),75-92.
- Building on gender, Agro biodiversity and local knowledge. 2005. *Food and Agriculture Organization*. Rome.
- Burton, I. 1997. Vulnerability and adaptive response in the context of climate and climate change. *Climatic Change*, 36(1-2),185-196.
- Carey, S. & Smith, C. 1993. On understanding the nature of scientific knowledge. *Educational Psychologist*, 28 (3), 235-251.
- Challinor, A. Wheeler, T., Garforth, C., Craufurd, P., & Kassam, A. 2007. Assessing the vulnerability of food crops systems in Africa to climate change. *Climate Change*, 83,381-399.

- Chen, R.S., Boulding, E. & Schneider, S.H., (eds.). 1983. *Social science research and climate change an interdisciplinary appraisal*. Amsterdam, D. Reidel Publishing company.
- Chibwana, C. and Fisher, M. 2011. The impacts of agricultural inputs subsidies in Malawi. *International Policy Food research*, policy note, number 5. Rome.
- Chinsinga, B. 2007. Social Protection Policy in Malawi: Processes, Politics and Challenges. *Future Agricultures*.
- Chirwa, E.W. 2005. Adoption of fertilizer and hybrid seeds by smallholder maize farmers in southern Malawi. *Development Southern Africa*, 22 (1),1-12.
- Climate change and food security: a framework document. 2008. *Food and agriculture organization of the united nations*. Rome.
- Cochrane, K., Young, A.C., Soto, D., and Batri, T. (Ed.).2009. Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. *Food and Agriculture organization*. Rome.
- Collier, P., Conway, G. & Venables, T. 2008. Climate change and Africa. unpublished.
- Cooper, P.J.M., Dimes, J., Rao, K.P.C., Shapiro, B., Shiferawa, & B., Twomlow, S. 2008. Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, Ecosystems and Environment*, 126. Elsevier publishers. pp.24-35.
- Cresswell, J.W. 1998. *Qualitative inquiry and research design: choosing among five traditions*. New York: Sage Publishers.
- Dansa, D.A. 2010. *Dissemination of climatic information to smallholder farmers: A case study for Musika area, Zambia*. University of the Free State. PhD thesis, unpublished.
- Davenport, T. H., & Pruzak, L. 2000. *Working knowledge: How organizations manage what they know*. Harvard Business Press.
- Davison, P. 2003. *Deconstructing the four pillars of the climate change debate: A critical review of the Scientific, Economic, Political and ethical dimensions*. FES outstanding

graduate student paper series, 8 (8). Faculty of environmental studies, York University. York.

Denton, F. 2002. Climate change vulnerability, impacts, and adaptation: why does gender matter? *Gender and development*, 10 (2), 10-20.

Denzin, N. K. and Lincoln, Y. S. (eds.). 2000. *Handbook of qualitative research*. London: Sage Publications Inc.

Deressa, T.T., Hasan, R.M., Ringler, C. Alemu, T. & Yesuf, M. 2009. Determiners of farmers' choice of adaptation methods to climate change in the Nile basin of Ethiopia. *Global Environmental change*, 19,248-255.

De Voss, (ed.). 2000. *Research at grass roots; a primer for the caring professions*. Pretoria: Van Schaik Publishers.

De Waal, A., & Whiteside, A. 2003. New variant famine: AIDS and food crisis in southern Africa. *The Lancet*, 362(9391), 1234-1237.

Dinar, A., Hassan, R., Mendelsohn, B., & Benhin, J. 2008. *Climate change and agriculture in Africa. Impact assessment and adaptation strategies*. London: Earth scan publishers.

Dorward, A., Chirwa, E., Kelly, V., Jayne, T., Boughton, D., Slater, R., 2008. *Evaluation of the 2006/7 agricultural input subsidy program, Malawi*. School of Oriental and African Studies. London.

Downing, T.E., Ringius, L., Hulme, M. & Waughray, D. 1997. Adapting to climate change in Africa. *Mitigation and adaptation strategies for global change*, 2,19-44.

Dougil, A. J., Twyman, C., Thomas, D.S.G. & Sporton, D. 2002. Soil degradation assessment in mixed farming systems of southern Africa: use of nutrient balance studies for participatory degradation monitoring. *The Geographical Journal*, 168 (3),195-210.

Drimie, S. & Gillespie, S. 2010. Adaptation to climate change in southern Africa: Factoring in AIDS. *Environmental Science and Policy*, 13,778-784.

- Duerden, F. 2004. Translating climate change impacts at the community level. *Artic*, 57 (2),204-212.
- Dumaru, P. 2010. Community-based adaptation: enhancing community adaptive capacity in Druadrua Island, Fiji. *Climate Change*, 1,741-763.
- East African Community. (2011). *East African Community Climate change policy*. East African community secretariat, Arusha, Tanzania. Arusha.
- Edame, G.E., Ekpenyong, A.B., Fonta, W.M. & Duru, E.J.C. 2011. Climate change, food security and Agricultural productivity in Africa: Issues and policy directions. *International journal of humanities and social sciences*, 1, (21),205-223.
- Elasha-Osman, B., Goutbi, N., Siegfried-Spanger, E., Dougherty, B., Hanafi, A., Zakieldeen, S., Sanjak, A., Atti, H.A. & Ekassan, H.M. (2006). *Adaptation strategies to increase human resilience against climate variability and change: Lessons from the arid regions of Sudan*. AICC working papers, number, 42. Nairobi.
- Enete, A.A., Madu, I.I., Mojekwu, J.C., Onyekuru, A.N., Onwubuya, E.A. & Eze, F. 2011. *Indigenous agricultural adaptation to climate change: study of south east Nigeria*. *African Technology policy studies, working paper number 6*. Kenya, African technology network policy studies network. Nairobi.
- Etkin, D. & Ho, E. 2007. Climate change: perceptions and discourses. *Journal of risk*, 10 (5),623-641.
- Fankhauser, S., Smith, J.B. & Jol, R.S.J. 1999. Weathering climate change: some simple rules to guide adaptation decisions. *Ecological Economics*, 30, 67-78.
- Fankhauser, S. & Tol, R.S.J. 1997. The social costs of climate change: The IPCC second assessment report and beyond. *Mitigation and adaptation strategies for global climate change*, 1,385-403.
- Fisher, M., Chaudhury, M., Mccusky, B. 2010. Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World development*, 38 (9),1241-1250.

- Fisher, M. & Shively, G. 2005). Can Income Programs Reduce Tropical Forest Pressure? Income Shocks and Forest Use in Malawi. *World Development*, 33(7),1115–1128.
- Food and Agriculture Organization. 2005. *Building on gender, Agro biodiversity and local knowledge*. Rome.
- Fox, S. 2000. Communities of practice, Foucault and Actor-Network theory. *Journal of Management studies*, 37 (6),853-868.
- Franklin, D. F. W., & Sherman, S. 1998. *Agroforestry Principles*. London.
- Fraser, E.D.G. 2007. Traveling in antique lands, using past famines to develop an adaptability/resilience framework to identify food systems vulnerable to climate change. *Climate change*, 83,495-514.
- Gadgil, M. Berkes, F. & Folke, C. 1993. Indigenous knowledge for biodiversity conservation. *Ambio*, 22 (2/3), 151-156.
- Gbetibouo, G.A. 2011. *Vulnerability and adaptation of farming to climate change in South Africa*. Environmental economics, University of Pretoria, PHD thesis. Pretoria.
- Giddens, A., Dunier, M. & Appelbaum, R. P. 2012. *Introduction to Sociology*. W.W. Norton and company.
- Gifford, R. 2008. Psychology's essential role in alleviating the impacts of climate change. *Canadian Psychology*, 49 (4),273-280.
- Gilbert-Ricker, J., Jayne, T. S., & Chirwa, E. 2011. Subsidies and crowding out: A double-hurdle model of fertilizer demand in Malawi. *American Journal of Agricultural Economics*, 93(1), 26-42.
- Glesne, C. & Peshkins, A. 1992. *Becoming qualitative researchers: An introduction*. White plains, New York: Longman.
- Gordon, C., Jallow, A.M., Lawson, E.T., Ayivor, J.S., & Mensah, A.M. 2010. Food security and Natural Resources management: overview on climate change implications for Africa. *Nature and faunae*, 24(1),10-16. Food and Agricultural Organization, Africa.

- Goulder, L.H. & Pizer, W.A. 2006. *The economics of climate change*. Discussion paper, Resources for the future. Washington DC.
- Green, A., Janmaat, J. G., & Han, C. 2009. *Regimes of social cohesion. Leading Education and social research*. Institute of education, University of London. London.
- Green, Solomon & Osteweis, N. 1984. Introduction to the special section: Use of bereavement narratives to predict well-being in gay men whose partner died of AIDS—Four theoretical perspectives. *Journal of personality and social psychology*, psycnet.apa.org
- Gregory, P.J., Ingram, J.S.I., & Brklacich, M. 2005. Climate change and food security. *Philosophical Transactions of the Royal Society Biological Sciences*, 360, 2139-2148.
- Grenier, L. 1998. *Working with indigenous knowledge. A guide for researchers*. International development Research centre, Ottawa.
- Grothmann, T., & Patt, A. 2005. Adaptive capacity and Human cognition: The process of individual adaptation to climate change. *Global Environmental change*, 15,199-213.
- Hansen, J., Johnson, D., Lacis, A., Lebedeff, S., Lee, P., Rind, D. & Russel, G. 1981. Climate impact of increasing carbon dioxide. *Science*, 218, (4511),957-966.
- Hassan, R. & Nhemachena, C. 2008. Determinants of African farmers' strategies for adapting to climate change: multinomial choice analysis. *The African Journal of Agricultural and Resource Economics*, 2(1),83-102.
- Hasselmann, K., Latir, M., Hoos, G., Azar, C., Edenholfer, O., Jaagur, C.C., Johannessen, O.M., Kemfert, C., Welf, M. & Wokaun, A. 2003. The challenge of long-term climate change. *Science*, 302. American Association for the Advancement of Science.pp.1923-1925.
- Heltberg, R., Siegel, P.P. & Jorgensen, S.L. 2009. Addressing human vulnerability to climate change: towards a 'no-regrets' approach. *Global environmental change*, 19. Elsevier Limited. pp. 89-99.

- Hertel, T.W. & Rosch, S.D. 2010. Climate change, Agriculture and Poverty. *Applied Economics Perspectives and Policy*, 32, (3),355-385.
- Hughes, M.K. & Diaz, H.F. 1994. Was there a 'medieval warm period' and if so, where and when? *Climate change*, 26. Amsterdam: Kluwer Academic publishers.
- Hulme, P.E. 2005. Adapting to climate change: is there scope for ecological management in the face of a global threat? *Journal of Applied Ecology*. 42, 784-794.
- Human Development Report, 2007/2008. *Fighting climate change: Fighting human solidarity in a divided world*. United Nations development program. Unpublished.
- Hunziker, M. 1995. The spontaneous reforestation in abandoned agricultural lands: perception and aesthetic assessment of locals and tourists. *Landscape and urban planning*, 31,399-410.
- Huq, S., Rahman, A., Konate, M., Sokana, Y. & Reid, H. 2004. Mainstreaming Adaptation to climate change in least developed countries. *Climate policy*, 4 (1),25-43.
- Huq, S., Karim, Z., Asaduzzaman, M. & Mahtab, F. 1999. *Vulnerability and adaptation to climate change for Bangladesh*. Kluwer academic publishers, Netherlands.
- Inkels, A. 1964. *What is Sociology?: an introduction to the discipline and profession*. Englewood cliffs, New Jersey: Prentice Hall.
- Intergovernmental Panel on climate change. 2007. *Climate Change: Impacts, Adaptation and Vulnerability*. Working Group two contributions to the Intergovernmental Panel on Climate Change, fourth assessment report.
- IPCC-AR4, Climate Change 2007. *The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (New York: Cambridge University Press, 2007). Available online at <http://www.ipcc.ch>
- Intergovernmental Panel on Climate Change. 2001. *Climate change: The scientific Basis*. Cambridge University Press.
- Jasanoff, S. & Wynne, B. 1998. 'Scientific Knowledge and Decision Making', in S. Rayner and E. Malone (eds). *Human Choice & Climate Change*, 4,1-112.

- Joshua-Kalanda, M., Ngongondo, C., Chipeta, L., Mpembeka, F. 2011. Integrating Indigenous knowledge with conventional science: Enhancing localised climate and weather forecasts in Nessa, Mulanje, Malawi. *Physics and Chemistry of the Earth*,36, 996-1003.
- Jury, M.R. & Mwafulirwa, N.D. 2002. Climate variability in Malawi; part one: Dry summers, statistical associations and predictability. *International Journal of climatology*, 22, 1289-1302.
- Kalinga, O. J. 1998. The Production of History in Malawi in the 1960s: The Legacy of Sir Harry Johnston, the Influence of the Society of Malawi and the Role of Dr Kamuzu Banda and his Malawi Congress Party. *African Affairs*, 97(389), 523-549.
- Kandiji, S. T., Verchot, L., & Mackensen, J. 2006. *Climate change and variability in southern Africa: Impacts and adaptation in the agricultural sector*. World agroforestry centre and United Nations environment programme. Nairobi.
- Kates, R.W. 2000. Cautionary tales: Adaptation and the global poor. *Climate change*, 45. Amsterdam: Kluwer academic publishers,5-17.
- Kay, M. & Brabben, T. 2010. *Treadle Pumps for Irrigation in Africa*. *IPTRID-Knowledge Synthesis Report no. 1*, October 2010. International Programme for Technology and Research in Irrigation and Drainage (IPTRID)/ FAO Rome, Italy.
- Kelley, E.W., Aridi, A., Bakhtairi, L. (1996). Muslims in the United States: An exploratory study of universal and mental health values. *Counseling and values*, 40, 206-218.
- Klein, R.J.T., Schipper, E.L. & Dessai, S. 2003. *Integrating mitigation and adaptation into climate and development policy, three research questions*. Tyndall centre for climate change research, working paper number 40. Norwich.
- Kotir, J.H. 2011. Climate change and variability in sub-Saharan Africa: a review of current and future trends and impacts on agriculture and food security. *Environmental development sustainability*, 13, 587-605.
- Krueger, R.A. 1988. *Focus groups: a practical guide for applied research*. Los Angles: Sage Publishers.

- Kurukulasuriya, P., Mendelsohn, R., Hassan, R., Behin, J., Deressa, T., Diop, M., Mohammed Eid, H., Fosu Verfi, K., Gbetibouo, Jain, S., Mahamadou, A., Mano, R., Mariara-Kabubo, J., Marsafawy, S.E., Molua, E., Ouda, S., Ouedrago, M., Sene, I., Maddison, D., Niggolsseo, S. & Dinar, A. (2006). Will African Agriculture survive Climate Change? *The World Bank Economic Review*, 20, (3), 367-388.
- Kvale, S. 1996. *Interviews. An introduction to qualitative research interviewing*. Los Angeles: Sage.
- Kyoto protocol to the United Nations framework convention on climate change*. 1998. United nations. Unpublished.
- Lambrou, Y. & Piana, G. (2006). *Gender, the missing component of the response to climate change*. Food and Agriculture organization. Rome.
- Lambrou, Y. & Laub, R. 2004. Gender perspectives on the conventions of biodiversity, climate change and desertification. *Gender and population division*. Food and Agriculture Organization of United Nations. Rome.
- Lanchberry, J. & Victor, D. 1995. 'The role of Science in the Global Climate Negotiations', in Helge Ole Bergesen, Georg Parmann, and Øystein B. Thommessen (eds.), *Green Globe Yearbook of International Co-operation on Environment and Development*. Oxford: Oxford University Press, 29–39.
- Leibowitz, B. 2017. Cognitive justice and the higher education curriculum. *Journal of Education*. Issue 68, 11/1/2017. Accessed [www.http://joe.ukzn.ac.za](http://joe.ukzn.ac.za) on 12/05/2019.
- Leichenko, R.M. & O'Brien, K.L. 2002. The dynamics of rural vulnerability to global change: the case of Southern Africa. *Mitigation and adaptation strategies for global change*, 7(1), 1-18.
- Linacre, N., Kossoy, A., & Ambrosi, P. 2011. *State and trends of the carbon market 2011* (No. 13400). The World Bank.
- Locke, L.F. Silverman, & S.J. Spirduso, W.W. 2009. *Reading and understanding research*. Sage publications. Inc.

- Macedo, D. 1999. Decolonizing Indigenous knowledge. In *What is indigenous knowledge? Voices from the academy*. Semali, L.M. and Kincheloe, J.L. (eds.) New York: Falmer press group, Taylor and Francis group, I-X.
- Macgrath, R. 1993. *What are seasonal forecasts?* Londo.
- Maddison, D. 2007. *The perception of and adaptation to climate change in Africa. Policy Research working paper, 4308*. The World Bank development research group, Washington.
- Magombo, T.M., Kanthiti, G., Phiri, G., Kachulu, M. & Kabuli, H. 2010. *Incidence of indigenous, emerging and innovative climate change adaptation practices for smallholder farmers' livelihood security in Chikhwawa district, Southern Malawi*. Working paper, Zomba.
- Majule, A.E. 2011. Implications of ecological and social characteristics to community livelihoods in the coastal areas of Tanzania. *African journal of environmental science and technology*, 6 (1), 72-79.
- Maarland, G., Pielke, R.A., Apps, M., Avissar, R., Betts, R.A., Davis, K.J., Frumhoff, P.C., Jackson, S.T., Joyce, L.A., Kauppi, P., Katzenberger, J., Macdicken, K.G., Nielson, R.P., Niels, J.O., Niyogi, D.D., Norby, R.J., Pena, N., Sampson, N. & Xue, Y. 2003. The climatic impacts of land surface change and carbon management, and the implications for climate change mitigation policy. *Climate Policy*, 3, 149-157.
- Maley, J. 1996. The African rain forest-main characteristics of changes in vegetation and climate from the Upper Cretaceous to the Quaternary. *PROCEEDINGS-ROYAL SOCIETY OF EDINBURGH B*, 104, 31-74
- Manne, A. and Richels, R. 1998. *The Kyoto protocol a cost-effective strategy for meeting environmental objectives*. Unpublished.
- Mannke, F. 2011. Key themes of local adaptation to climate change: results from mapping community-based initiatives in Africa. *Climate change management*. 17-32.
- Mannke, F. 2010. *Community-based adaptation to climate change in Africa*. London Metropolitan University, London.

- Mauro, F & Hardison, P.D. 2000. Technical knowledge of indigenous and local communities: International debate and policy initiatives. *Ecological applications*, 10 (5),1263-1269.
- Mearns, R. & Norton, A. eds. 2010. *Equity and vulnerability in a warming world. Social dimensions of climate change*. World Bank, Washington DC.
- Mendeloshn,R. 2000. Efficient adaptation to climate change. *Climate change*, 45,583-600.
- Mertz, O., Mbow Cheikh. E. & Diouf, A. 2009. Farmers' Perceptions of Climate Change and Agricultural Adaptation strategies in rural Sahel. *Environmental Management*, 43,804-816.
- Metz, B., Davidson, O., Bosch, P., Dave, R., & Meyer, L. (2001). *Climate Change Mitigation*. Cambridge University, Cambridge.
- Mikkelsen, B. 2005. *Methods for Development Work and Research*. New Delhi, India: Sage Publications Ltd.
- Mloza-Banda, H. R., & Nanthambwe, S. J. 2010. Conservation agriculture programmes and projects in Malawi: impacts and lessons. *National Conservation Agriculture Task Force Secretariat, Land Resources Conservation Department, Lilongwe, Malawi*.
- Montford, A. W. 2010. *The hockey stick illusion: Climate gate and the corruption of science*. Stacey International.
- Mortimore, M.J., & Adams, W.M. 1998. Farmer adaptation, change and crisis in the Sahel. *Global environmental change*, 11, 49-57.
- Morton, J.F. 2007. The Impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Science*, 104 (50),19680-19685.
- Mulligan, M. J. 2010. *Towards a more grounded and dynamic sociology of climate change adaptation*. Globalism research Centre, The Royal Melbourne Institute of Technology, Melbourne, Australia.
- Mundy. P. & Compton, L.J. 1996. Indigenous Communication and Indigenous knowledge. *Development Communication Report 74*, 1991/3. Clearinghouse on Development Communication.

- Najam, A., Saleemul, H. & Sokona, Y. 2003. Climate negotiations beyond Kyoto: developing countries concerns and interests. *Climate policy*, 3 (3), 221-231.
- National Adaptation Plan of Action*, 2006. Government of Malawi. Unpublished.
- National Statistics Office of Malawi, 2008. *Malawi Census Main Report*. Zomba, NSO.
- Nelson, G. C., Rosegrant, M. W., Koo, J., Robertson, R., Sulser, T., Zhu, T. & Lee, D. 2010. The Costs of Agricultural Adaptation to Climate Change. *World Bank*.
- Nelson, G.C., Koo, J., Rosegrant, M.W., Robertson, R., Sulser, T., Zhu, C. , Ringler, C. , Msangi, S., Palazzo, A., Batka, M., Magalhaes, R., Santos-Valmonte, R., Ewina, M. & Lee, D. 2009. *Climate change impact on agriculture and costs of adaptation*. International food policy research institute.
- Nelson, V., Meadows, K., Cannon, T., Morton, J. & Martin, A. 2002. Uncertain predictions, Invisible Impacts and the need to mainstream gender in climate change adaptation. *Gender and development*, 10, (2),51-59.
- Ngongondo, S.C. 2006. An analysis of long-term variability, trends and groundwater availability in the Mulunguzi river catchment area, Zomba mountain, Southern Malawi. *Quaternary international*, 148 (1), 45-50.
- Nhemachena, L. & Hassan, R. M. 2008. *How can African Agriculture adapt to climate change? Insights from Ethiopia and South Africa; Micro level analysis of Farmers' adaptation to climate change in southern Africa*. Centre for Environmental Economics and Policy in Africa. University of Pretoria, South Africa.
- Nhemachena, S. & Hassan, R. 2010. Measuring the economic impact of climate change on African agricultural production systems. *Climate change Economics*, 1, (1), 33-55.
- Nkhota-kota district of Malawi, *District development program*. 2010. Nkhota-kota.
- Nkhota-kota Department of forestry Government of Malawi 2010: *Tree planting report*. Nkhota-kota.
- Nkhota-kota district of Malawi, *Socio-economic profile*. 2009. Nkhota-kota

- Nkrumah, G. G. (1991). Islam in Southern Africa. *Review of African political economy*, 52. Taylor and Francis Limited. pp.94-97.
- Nyong, A. Adesina, F. & Osman-Elasha, B. 2007. The value of indigenous knowledge in climate change mitigation an adaptation strategy in the African Sahel. *Mitigation Adaptation Strategies Global Change*, 12, 787-797.
- Nyirenda, S. 2011. *Financing of climate change: An analysis of projects to be funded under the least developed countries fund*. MA thesis, University of Leeds. Leeds.
- O'Brien, K., Eriksen, S. Schjolden & Nygaard, L. 2004. Why different interpretations of vulnerability matter in climate change discourses. *Climate policy*, 7 (1), 73-88.
- Orlove, B. 2005. Human adaptation to climate change: a review of three historical cases and some general perspectives. *Environmental Science & Policy*, 8(6), 589-600.
- Ouédraogo, S. & Bertelsen, M.K. 1997. The Value of Research on Indigenous Knowledge: Preliminary Evidence from the Case of Zaï in Burkina Faso. *Journal of Sustainable Agriculture*, 10 (1),33-42.
- Page, M.E. 1980. The Great War and Chewa Society in Malawi. *Journal of Southern African Studies*, 6(2), 171-182.
- Patt, A.G. & Schroter, D. 2008. Perceptions of climate risk in Mozambique: Implications for the success of adaptation strategies. *Global environmental change*, 18,458-467.
- Paavola, J. 2008. Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Environmental Science and policy*, 11, 642-654.
- Payton, R. W., Barr, J.J.F., Martin, A., Sillitoe, J.F. ,Deckers, J., Gowing, W., Hatibu, N., Naseem, S.B., Tenywa, M. & Zuberi, M.I. 2003. Contrasting approaches to integrating indigenous knowledge about soils and scientific soil survey in East Africa and Bangladesh. *Geoderma*, 111 (3-4),355-381.
- Pelling, M. 2011, *Adaptation to climate change from resilience to transformation*. London: Routledge.
- Pendegraft, C.A. 1998. Human dimensions of climate change: cultural theory and collective action. *Climate change*, 39, 643-666.

- Petheram, L.; Zander, K. K., Campbell, B. M., High, C. & Stacey, N. 2010. 'Strange changes': Indigenous perspectives of climate change and adaptation in NE Arnhem Land (Australia). *Global Environmental Change*, 20(4), 681–692.
- Phiri, K.M. 1983. Some changes in the matrilineal family system in the Chewa of Malawi since the Nineteenth century. *The Journal of African History*, 24(2). London: Cambridge University Press, 257-274.
- Pielke, R.A. 2005. Misdefining “climate change”: Consequences for science and action. *Environmental Science and Policy*, 8, 548-561.
- Pinstrup-Andersen, P. 2009. Food security: definition and measurement. *Food Security*, 1(1), 5-7.
- Posas, P.J. 2007. Roles of religion and ethics in addressing climate change. *Ethics in science and environmental politics*, 4, 31-49.
- Potter, M.E. 1996. *What is Strategy?* Harvard Business review. New York, Harvard University press.
- Pottier, J. 2003. Negotiating local knowledge: an introduction. In Pottier, J. and Sillitoe, P. and Bicker, A. (eds). *Negotiating Local knowledge: Identity and power in development*, 1-29, London, Routledge publishers.
- Prakash, M.S. 1999. Indigenous knowledge systems - ecological literacy through initiation into people's science, in Semali, L. M. and Kincheloe, J.L. (eds.) *What is Indigenous knowledge? Voices from the academy*. New York: Falmer Press, Taylor and Francis group, pp. 157-189.
- Purcell, T. W. 1998. Indigenous knowledge and applied anthropology: Questions of definition and direction. *Human Organization*, 57(3), 258-272.
- Quintero-Angel, M. & Garcis-Vargas, M. 2008. Women's role in adapting to climate change and variability. *Advanced Geo-science*, 14. London: Corpenicus ,277-280.
- Rachlinski, J. J. 2000. Psychology of Global Climate Change. *The U. Ill. L. Rev.*, 299.

- Ramakrishna, K. 2000. *The UNFCCC-History and evolution of the climate change negotiations. Climate change and development.* Yale school of forestry and environmental studies, New Haven, CT, UNDP, New York, 47-62.
- Ranger, N. & Garbett-Shiels, S-L. 2011. How can decision-makers in developing countries incorporate uncertainty about future climate risks into existing planning and policy-making processes? *Centre for Climate change economies and policy.* Policy paper, unpublished.
- Regmi. B.R. 2012. *Revisiting community-based adaptation.* Unpublished.
- Reisinger, A. 2009. *Climate change 101 an educational resource: science- impacts- adaptation-mitigation- decision-making challenges.* Wellington institute of Policy studies New Zealand climate change research institute.
- Rennings, K. 2000. Redefining innovation—eco-innovation research and the contribution from ecological economics. *Ecological economics*, 32(2), 319-332.
- Riberio, N. & Chaque, A. 2010. *Gender and climate change, Mozambique case study.* Heinrich Boll stiftung Southern Africa. Unpublished.
- Richards, M. 2003. *Poverty reduction. Equity and climate change: global governance synergies or contradictions?* Overseas development Institute, globalization and poverty programme. London.
- Robey, D., & Markus, M. L. 1984. Rituals in information system design. *MIS quarterly*, 5-15.
- Roncoli, C., Jost, C., Kirshen, P., Sanon, M., Ingram, K.T. , Woodin, M., Some, L., Ouattara, F., Sanfo, B.J., Ciriague, S., Yaka, P., & Hoogenboom, G. 2009. From accessing to assessing forecasts: an end-to-end study of participatory climate forecast dissemination in Burkina Faso (West Africa). *Climatic Change*, 92,433-460.
- Roncoli, C., Crane, T. & Orlove, B. 1998. Fielding climate change in cultural anthropology. *Climate and culture.* 87-115.
- Rowlands, I.H. (ed.) 1998. *Climate Change cooperation in Southern Africa.* London: Earthscan.

- Saka, A.R., Bunderson, W.T., Itimu, O.A., Phombeya, H.S.K., & Mbekeani, Y. 1994. The effects of *Acacia albida* on soils and maize grain yields under smallholder farm conditions in Malawi. *Forest ecology and management*, 64, 217-230.
- Santili, M., Moutinho, P., Schwartzman, S., Nepstad, D., Currans, L. & Nobre, C. 2005. Tropical deforestation and the Kyoto protocol. *Climate Change*, 71. Springer sciences. pp.261-276.
- Schipper, E.L. F. (2007). *Climate change adaptation and development; exploring the linkages*. Tyndall Centre for Climate change research, working paper. Norwich.
- Schurink, W. 1988 *Introduction to qualitative research methods*. Pretoria: HSRC.
- Semali, L. M., & Kincheloe, J. L. (eds.). 1999. *What is indigenous knowledge?: Voices from the academy*, 2. London: Taylor & Francis Limited.
- Shemsanga, C., Nyatichi, A., & Yansheng, G. (2010). The cost of climate change in Tanzania: Impacts and adaptations. *Journal of American Science*, 6(3). American journal of science.182-196.
- Shove, E. 2010. Beyond the ABC: climate change policy and theories of social change. *Environment and planning. A*, 42(6), 1273.
- Shove, E. 2010. Sociology in a changing climate. *Sociological Research Online*, 15(3), 12.
- Sillitoe, P. 1998. The development of indigenous knowledge: A new applied anthropology. *Current Anthropology*, 39 (2) ,223-252.
- Smith, J.B. & Lenhart, S.S. 1996. Climate Change adaptation policies. *Climate Research*, 6. Inter-research science centre, 193-201.
- Smit, B. & Wandel, J. 2006. Adaptation and adaptive capacity and vulnerability. *Global Environment change*,16,282-292.
- Smit, B. & Skinner, M.W. 2002. Adaptation options in Agriculture to climate change: A typology. *Mitigation and Adaptation strategies for global change*, 7, 85-114.

- Smit, B., Burton, I., Klein, R.J.T. & Wandel, J. 2000. An Anatomy of adaptation to climate change and variability. *Climatic change*, 45. Amsterdam: Kluwer academic publishers. 223-251
- Smit, B. (ed.) 1993. *Adaptation to Climatic Variability and Change*. Guelph: Environment Canada.
- Speranza, C.I., Kiteme, B., Ambenje, P., Wiseman, U. & Makali, S. 2010. Indigenous knowledge related to climate variability and change; insights from droughts in semi-arid areas of former Makueni district, Kenya. *Climate change*, 100, 295-315.
- Stakhiv, E. 1993. *Evaluation of IPCC Adaptation Strategies*. Fort Belvoir, VA: Institute for Water Resources, U.S. Army Corps of Engineers, draft report. Virginia.
- Stern, P.C. 2011. Contributions of psychology to limiting climate change. *American Psychologist*, 66(4), 303-314.
- Stern, N. 2006. Review on the Economics of climate change. London HM Treasury. London.
- Stigter, C.J., Dawei, Z., Onyewotu, L.O.Z., & Xurong, M. (2005). Using traditional methods and Indigenous technologies for coping with climate variability. *Climatic change*, 70, 255-271.
- Stringer, LC., Dyer, J. C., Reed, M. S., Dougill, A. J., Twyman, C., & Mkwambisi, D. (2009). Adaptations to Climate change, drought and desertification: local insights to enhance policy in southern Africa. *Environmental science and policy*, 12, 748-765.
- Sundquist, E. T., & Keeling, R. F. (2009). The Mauna Loa Carbon Dioxide Record: Lessons for Long-Term Earth Observations. *Carbon Sequestration and Its Role in the Global Carbon Cycle*. pp 27-35.
- Swart, R., Robinson, J., Cohen, D., & Stewart, C. (2003). Climate change and sustainable development: expanding the options. *Climate policy*, 3(1). Elsevier Limited. Elsevier publishers. 19-40.

- Swim, J.K., Stern, P.C., Doherty, T.J., Clayton, S., Reser, J.P., Weber, E.U., Gifford, R., & Howard, G.S. 2011. Psychology's contribution to understanding and addressing global climate change. *American psychologist*, 66(4),241-250.
- Tadross, M., Suarez, P., Lotsch, A., Hachingota, S., Mdoka, M., Unganai, L., Lucio, F., Kamdonyo, D. & Muchinda, M.2007. *Changes in growing-season rainfall characteristics and downscaled scenarios of change over southern Africa: implications for growing maize*. Meeting report papers, regional expert meeting. Unpublished.193-204.
- Tam, B. 2012. *The effects of weather and climate variability on the well-being of a rural and urban aboriginal group in Ontario, Canada*. Doctoral dissertation, University of Toronto. Toronto.
- Tambulasi, R. I. 2011. Local government without governance: A new institutional perspective of local governance policy paralysis in Malawi. *Public Policy and Administration*, 26(3). Sanford: Duke University Press. 333-352.
- Tarhule, A. 2005. Damaging rainfall and flooding: the other Sahel hazards. *Climatic change*, 72(3), 355-377.
- Tembo, D. 2011. *Climate change adaptation best practices: Towards enhancing smallholder farmers' livelihood*. CEPA. Blantyre.
- Terry, G. (ed.). 2009. *Introduction: Climate change and gender justice*. London: Practical Actions Limited.1-10.
- Thomas, D.S.G. & Twyman, C. 2005. Equity and justice in climate change adaptation amongst natural resource dependent societies. *Global environment change*, 15. Elsevier limited. 115-124.
- Thomas, D.S.G., Twyman, C., Osbahr, H. & Hewitson, B. 2007. Adaptation to climate change and variability: Farmer responses intra-seasonal precipitation trends in South Africa. *Climate Change*, 83. Springer Science. 301-322.
- Tompkins, E. L., & Adger, W. 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and society*, 9(2), 10.

- Tompkins, E.L. & Adger, W.N. 2003. *Building resilience to climate change through adaptive management of natural resources*. Tyndall centre for climate change research. Working paper number 27. Norwich.
- Toulmin, C. 2009. *Climate change in Arica*. Zed books, United Kingdom.
- Truax, B., & Gagnon, D. 1993. Effects of straw and black plastic mulching on the initial growth and nutrition of butternut, white ash and bur oak. *Forest Ecology and Management*, 57(1).17-27.
- Trumbo, C. W., & Shanahan, J. (2000). Social research on climate change: where we have been, where we are, and where we might go. *Public Understanding of Science*, 9(3), 199-204.
- Tschakert, P. and Dietrich, K.A. 2010. Anticipatory learning for climate change adaptation and resilience. *Ecology and Society*, 15(2). Lund: Resilience and Alliance publishers. 11-28
- Turnbull, D. 1997. Reframing science and other local knowledge traditions. *Futures*, 29(6). Elsevier Science limited. 551-562.
- Twomlow, S. Mugabe, F.T., Mwale, M., Delve, R., Nanja, D., Carberry, & Howden, M. 2008. *Building adaptive capacity to cope with increasing vulnerability due to climatic change in Africa- A new approach*. Physics and chemistry of the earth, 33. Elsevier publishers. 780-787.
- Urry, J. 2011. *Climate change and society*. Oxford: Polity press.
- Verchot, L.V., Noordwijk, M.V., Kandji, S., Tomich, T., Ong, C., Albrecht, A., Mackensen, J., Bantilan, C., Anupana, K.V. & Palm, C. 2007. *Climate change: linking adaptation and mitigation through agroforestry*. Mitigation Adaptation strategy global change. Springer science.1-18.
- Vos, A.S. Strydom, H. Fouche, C.B. & Delpont, C.S.L. 2003. *Research at grassroots: for the social sciences and human service professions*. Pretoria: Van Schaik Publishers.
- Warren, D. M. 1991 'Using Indigenous Knowledge in Agricultural Development', *World Bank Discussion Paper 127*. Washington, DC World Bank.

- Washington, R., Harrison, M., Conway, D., Black, E., Challinor, A., Grimes, D., Jones, R., Morse, A., Kay, G., & Todd, M. 2006. African climate change: Taking the shorter route. *American Metrological Society*. 1355-1365.
- Watson, R. T., Zinyowera, M. C., & Moss, R. H. (Eds.). 1996. *Climate change 1995: impacts, adaptations and mitigation of climate change: scientific-technical analyses* Cambridge: Cambridge University Press.
- Weingart, P., Engels, A. and Pansegrau, P. 2000. Risks of communication: discourses on climate change in science, politics, and the mass media. *Science*, 9. London: IOP publishing limited. 261-283.
- Weitzman, M.L. 2007. A review of "The Stern Review on the economics of climate change." *Economic Literature*, 45 (3), American Economic Association. 703-724.
- Whiteside, M. 2000. Ganyu labour in Malawi and its implications for livelihood security interventions-An analysis of recent literature and implications for poverty alleviation. *Agricultural Research and Extension Network*. Network Paper, 99. 1-10.
- Williams, L. & Rota, A. 2011. *Impact of climate change on fisheries and aquaculture in the developing world and opportunities for adaptation*. IFAD. Rome.
- Winklerprins, A. M. 1999. Insights and applications local soil knowledge: A tool for sustainable land management. *Society & Natural Resources*, 12(2), 151-161.
- World Metrological Organization. 1985. *Atmospheric Ozone*, WMO Rep No.16., Geneva.
- Zegeye, A., & Vambe, M. 2006. African Indigenous Knowledge Systems. *Review (Fernand Braudel Center)*, 329-358.
- Ziervogel, G., Bharwani & Downing, T.E. 2006. Adapting to climate variability: pumpkins, people and policy. *Natural resources forum*, 30. Oxford: Blackwell Publishing Limited. 294-305.
- Ziervogel, G., Taylor, A., Hachingota, S. & Hoffmaister, J. 2008. *Climate Adaptation in Southern Africa: Addressing the needs of vulnerable communities*. Stockholm environment institute. Unpublished.

Zilindile, M. & Pooly, L. 2014. Problematizing the concept epistemological access with regard to foundation phase education towards quality schooling. *South African Journal of Childhood Education* 4(1): 187-201.

http://ec.europa.eu/europeaid/documents/case-studies/malawi1994_nice_en.pdf.

accessed on 16th May, 2013.

<http://www.worldbank.org/humandev/developmentreport1997/1998> accessed on 20th February, 2012.

<http://www.ask-force.org/web/Bioprospecting/Agraval-J-Int-Soc-1468-2451.00382.pdf.04042011>. Accessed on 16th May, 2011.

https://www.wmo.int/pages/themes/climate/international_background.php. Accessed on 14th May, 2011.

APPENDICES

APPENDIX 1: Informed Consent Form for Key Informants

Informed Consent Form for Key Informants

Name of researcher:

Title of research project:

By filling out this questionnaire / answering the questions put to me:

- I agree to participate in this research project.
- I have read this consent form and the information it contains and had the opportunity to ask questions about them.
- I agree to my responses being used for education and research on condition my privacy is respected, subject to the following: - *(tick as appropriate)*

	Yes	No
My name may be used in the published research		
My personal details (e.g. age, occupation, position) may be included in the published research		
My responses can only be used in a way that I cannot be personally identifiable		

- I understand that I am under no obligation to take part in this project.
- I understand I have the right to withdraw from this project at any stage.
- I understand that this research might be published in a research journal or book. In the case of dissertation research, the document will be available to readers in a university library in printed form, and possibly in electronic form as well.

Name of Participant

(or Guardian if participant is under 18)

: _____

Signature of Participant

(or Guardian if participant is under 18)

: _____

Date

: _____

The researcher must supply you with an **Information sheet** which provides his / her contact details, outlines the nature of the research and how the information will be used and explains what your participation in the research involves (e.g. how long it will take, participants' roles and rights (including the right to skip questions or withdraw without

penalty at any time), any anticipated risks/benefits which may arise as a result of participating, any costs or payment involved (even if none, these should be stated))			
Has this been provided?	Yes	No	
Have you received verbal confirmation/explanations where needed?	Yes	No	

APPENDIX 2: Focus Group Discussion (FDG) Consent Form

[If selected person is not the same person you first met, repeat introduction]

Good day. My name is Chifwiri Nyirongo. I am from the Department of Anthropology and Archaeology at the University of Pretoria in South Africa. I am doing this research for my Masters studies project titled Adaptation to climate change in *Mwala o'Tongole* village in Nkhota-kota village of Malawi. The

I am studying the views of _member's in your community in order to learn more about climate change adaptation_____.

I would like to discuss these issues with a member of your household in an interview which will be made up of eight to 15 people in a form of a discussion. All information will be kept confidential. Your household has been chosen by chance. I would like to choose an adult from your household.

This interview will take about 60 minutes. There is no penalty for refusing to take part. And if they do choose to take part, they may stop at any time, or skip any questions they do not wish to answer without penalty.

Please remember there is no penalty for not participating, and your answer will be kept confidential. If you choose to take part you may stop at any time, or skip any questions that you do not wish to answer without any penalty. Do you wish to proceed?