TRADITIONAL ENVIRONMENTAL KNOWLEDGE AMONG LOZI PEOPLE IN MITIGATING CLIMATE CHANGE EFFECTS IN THE BAROTSE PLAINS OF WESTERN ZAMBIA

BY

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A thesis submitted to the University of Zambia in fulfilment of the requirements for the award of Doctor of Philosophy in Adult Education

The University of Zambia

Lusaka

2016

AUTHOR'S DECLARATION

I, Stephen Banda, do hereby solemnly declare that this thesis represents my own original work. Where reference has been made to other people's views and analyses, full acknowledgements are given. This work has not previously been submitted in whole or in part for award of any degree at the University of Zambia or any other educational institution.

Signed: ……

Date: ……

CERTIFICATE OF APPROVAL

This thesis for Stephen Banda is approved as fulfilling the requirements for the award of Doctor of Philosophy in Adult Education by the University of Zambia.

Signature of Examiner	Date of approval
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DEDICATION

To my late father, Wedson Zulu, and mother, Faidesi Zulu; my sisters Joyce and Margaret; my brothers Raphael, Chipanje and beloved sons, Wezi, Dalitso and Chimwemwe Banda, whose support and love in my education and work will forever inspire me.

ACKNOWLEDGEMENTS

Many thanks to the Barotse Royal Establishment (BRE) for the opportunity they accorded me to conduct the study in their territory. I would like to express my sincere thanks to all people, organizations and institutions that in one way or the other helped make this study possible.

My greatest gratitude goes to my supervisor Professor Charles Mwendabai Namafe.

Many thanks go to management of the University of Zambia for giving me a Special Research Fellow award to enable me successfully pursue the doctorate studies. I also thank the staff in the Department of Adult Education and Extension Studies, School of Education at the University of Zambia for their support and encouragement throughout my study. Thanks to library staff at the University of Zambia main library and British Council library in Lusaka for their endless effort in providing literature for the study.

Last, but not least, my appreciation goes to all respondents who participated in this study.

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Abstract

The genesis of this study comes from the realization that little was known about the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Mongu District, Western Zambia. Climate change has indeed emerged as the most prominent global environmental problem (IPCC, 2007). At the time of conducting this study in the year 2015, negative effects of climate change were a source of great concern in Zambia. Climate change endangers not only our ecosystems, communities and cultures, but the future of humanity itself. Western Zambia and particularly south-western and southern Zambia lie in a zone of very high risk from the negative impacts of climate change, being at the southern extremity of the migratory track of the Inter-Tropical Convergence Zone. The Barotse plains are found in the rural part of Western Zambia experiencing high impacts of climate change coupled with high illiteracy rates. Few rural residents in Zambia have access to seasonal climate forecasts from the meteorological department. As observed by Salick and Byg (2010) in many such rural areas, indigenous people tend to use indigenous knowledge systems to solve their environmental problems.

Although studies conducted elsewhere in Africa have shown that people in rural communities use indigenous knowledge systems to solve environmental problems (see Salick and Byg, 2010; Gyampoh, *et al*., 2007; Atteh, 1992), little was known about how Lozi adults in the Barotse plains of Western Zambia mitigated negative effects of climate change. This study was an attempt to fill in this knowledge gap.

The study was guided by the following objectives: i) to find out how Lozi adults around Lealui Ward area of the Barotse plains had been affected by climate change; ii) to assess the role of traditional environmental knowledge among Lozi adults of Lealui Ward area in mitigating climate change; and iii) to establish what could be done to enhance traditional environmental knowledge among Lozi adults around Lealui Ward area in mitigating climate change. In order to achieve these objectives, the following specific research questions were formulated: i) how have Lozi adults around Lealui Ward area of the Barotse plains been affected by climate change; ii) what is the role of traditional environmental knowledge among Lozi adults of Lealui Ward area of the Barotse plains in mitigating climate change; and iii) how can traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains be enhanced to mitigate climate change?

This research was a case study, which employed more qualitative than quantitative approach to collect and analyse data. The pilot study was conducted in Kalabo while the main research was in Lealui Ward area in the Barotse plains of Mongu District, Western Zambia. According to statistics captured in the 2010 national census, Mongu had a population of 179,585 people. Interestingly only about a quarter of this population live in Mongu town, while the majority live in the Barotse plains (http://www.zamstats.gov.zm). The sample consisted of one hundred and thirty (130) subjects drawn from the target population: one hundred (100) indigenous Lozi adult respondents who utilize the Barotse plains resources in Lealui Ward area, twenty-five (25) local leaders like village headmen and senior traditional leaders known as area *indunas*, as well as five (5) institutions that provide education in environmental sustainability to mitigate climate change in Mongu District.

According to the findings of the study, it is evident that the indigenous Lozi people of the Barotse plains community in Western Zambia had already started being affected by the effects of the climate change. The main negative effects included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected

changes in seasons and their durations; reduction in food production, food security, water supply, energy and income; increase in diseases like malaria and diarrhoea among humans, heat stress among livestock; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people. The study also revealed that traditional environmental knowledge among the Lozi adults was important in mitigating climate change. Indigenous Lozi people and local communities in Mongu District were actively involved in innovative solutions based on their traditional knowledge, such as reducing emissions through use of non-polluting modes of transport and fire management techniques, adopting renewable energies in their territories, and engaging in resource management culture and projects that reduce pressure on natural resources and enhance local adaptive capacity. The study findings further showed that climate change mitigation and adaptation strategies using indigenous knowledge could be enhanced through cross-pollination of knowledge, co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders.

In conclusion, this study, therefore, may add value to the role of indigenous knowledge systems, cardinal in adult education. The study revealed that climate change was already a reality and posed threats and dangers to the survival of the Barotse plains' Lozi communities, culture and livelihoods. The study also found out that traditional environmental knowledge among Lozi adults around Lealui Ward of the Barotse plains was very important in mitigating climate change and needed to be enhanced. The study further revealed that local traditional environmental knowledge found among Lozi adults could be enhanced through collaborative strategies of integration with Western science. It is also hoped that the study may help to provide and enhance both literature in theoretical terms as well as evidence on the actual role of traditional environmental knowledge in mitigating climate change among Lozi adults in the Barotse plains of Western Zambia.

In light of the findings, the study recommends that there is need for the Government of Zambia and other policy-makers to always consult and involve people in communities including indigenous people in rural areas during policy and project planning, policy-making, project implementation, monitoring and evaluation stages to achieve sustainable development by all and for all people. There is also great need for the country to undertake intensified energy switching initiatives mainly from fossil fuels like diesel to solar, wind, mini-hydropower and sustainable forest management. These projects can greatly contribute to the global reduction in greenhouse gases emissions and promote sustainable development in Zambia. The study also recommends intensifying promotion of conservation and organic agriculture to enhance mitigation of climate change. The Government and other stakeholders should promote and facilitate irrigation schemes in communities throughout the country to reduce hunger, rural poverty and enhance food security and sustainable development.
The study further suggests that future research could be undertaken to investigate perceived extinction of some plant and animal species related to effects of climate change, not only in the Barotse plains, but in other parts of Zambia highly effected by the global warming.

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.0 Background to the Study

This chapter gives a synopsis of the background to the present study, major theories guiding the study as well as concepts that are used in the study for the purpose of making them clear to the reader.

This study intended to investigate the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District in Western Zambia. Climate change in Zambia is becoming more variable, with frequent droughts, seasonal and flash floods, extreme temperatures and prolonged dry spells as a result of global climate change (MTENR, 2007). In the future we expect temperatures to increase further and rainfall to decline or increase more. In some vulnerable areas like the Barotse plains, and for the poorest and most vulnerable rural households, this might result in people finding it increasingly difficult to support sustainable production, have secure livelihoods and bring about sustainable development.

The study had its genesis from the realization that little was known about the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Mongu District in Western Zambia. Climate change has emerged as a major challenge of our time, threatening human survival and development globally. Scientific evidence stresses that climate change will increasingly affect human and natural systems with potentially disastrous effects on local, regional and global economies (IPCC, 2007). Climate-induced changes to physical and biological systems are already being felt and exerting considerable stress on Zambia's vulnerable sectors, such as agriculture and food security, especially among the rural poor (Zambia National Adaptation Programme Action, 2007). The climate induced changes are exerting considerable stress on the Zambia's already vulnerable sectors mostly the agriculture and food security others being the human health, water, energy, wildlife, and forestry. It is significantly affecting the economic, social and environmental dimensions of national development. Adapting and mitigating the impacts of climate change will depend on how effectively countries respond to the challenge. But the greatest challenge under the United Nations Framework Convention on Climate Change

(UNFCCC) is finding solutions to combat the threat from the impacts of climate change. Similarly, national governments are pre-occupied with finding solutions to existing and unprecedented impacts at national and local levels. Adult education is cardinal in this task to find solutions to curb negative impacts of climate change.

Adult education deals with cross-cutting issues or fields of study that help people operate effectively and efficiently. All the multitude of ways in which adult people are helped to learn to improve themselves is often collectively known as adult education (Banda, 2014). These specific fields greatly contribute to individual, community and national development. Moreover, it should be mentioned that the most pragmatic way of meeting a country's developmental needs is to educate interested adults who are already in positions of influence, since adult education is supposed to provide a change of attitudes, knowledge, values and skills in the shortest possible time (Nyerere, 1970; Luchembe, 2012).

Eduard Lindeman, a man mostly considered 'Father of American Adult Education', had a holistic vision of adult education. Lindeman (1925)'s vision for adult education was not bound by classrooms and formal curricula. It involved a concern for the educational possibilities of everyday life; non-vocational ideals; situations not subjects; and people's experience. He noted that 'experience is the adult learner's living textbook' (Lindeman, 1925: 8). He viewed education as life. The whole of life is learning, therefore, education can have no ending until one dies. It can also safely be stated that education is a process that helps in the development of the human mind, increases one's knowledge, skills, changes attitudes, values and understanding of the total environment. It increases powers of observations, analysis, integration, understanding, decision-making, and adjustment to new situations throughout life. Learning transforms who we are as people, not just because it gives us knowledge or skills we otherwise would not have had, but also because it gives us confidence in our ability and transforms our attitudes as a result. With the power of learning we have the ability to do whatever it is we want in life.

Although scholars have defined an adult differently, a simple definition adopted in this work is 'a person (man or woman) who has achieved full physical development and expects to have the right to participate as a responsible homemaker, worker and member of society' (Houle, 1972: 229).

The goals of adult education are individual development and, through this, improvement of community and society. Adult education achieves its goals through continuously helping adults learn how to learn to achieve self-actualization. The ultimate purpose of learning is change, particularly relatively permanent change in behaviour or knowledge. It includes observable activity and internal processes such as thinking, attitudes and emotions (RHEF, 2007). Indeed adult education focuses specifically on the lifelong education of adults. Thus, it can safely be stated that the whole point of adult education is to help people, particularly adults to contribute to, promote, and participate in community and national development. It is not a fringe activity: adult educators and adult learners, using lifelong learning, have to take account of national goals, national needs and the system of planning (Freire, 1972; Oakley, *et al*., 1991).

A new way of looking at adult education is what is contained in UNESCO (1997, par.2) which emphasizes that adult education should become the key to the twenty-first century. It is both a consequence of active citizenship and a condition for full participation in society. It is a powerful concept for fostering sustainable development; promoting democracy, justice, gender equity, scientific, social and economic development; and building a world in which conflict is replaced by dialogue and a culture of peace. It is the education of the adults whose responsibilities is to make important political, cultural and other social decisions; and it is the education which tries to change the attitudes of adults whose old values are incompatible with contemporary social, economic and technological development. Adult education, therefore, could be remedial, innovative and in a sense, a warehouse of cultural values. Mtonga (2012) further argues that adult education is the most significant educational aspect of the social adjustment taking place throughout the world today.

Every society has had an education system responsible for enabling its members master their environment. A healthy natural environment is a fundamental prerequisite for sustainable human development and human survival (www.unesco.org). Traditional environmental knowledge is among cardinal issues that need serious attention in adult education in Zambia to enable people and communities positively contribute to national development and effectively deal with climate change and other environmental problems.

Traditional environmental knowledge which is a critical component of indigenous knowledge systems can refer to the collection of botanical, zoological, hydrological, cultural, and geographical know-how rooted in the spirit, culture and language of a given people's community that has developed over time, and that continues to develop from generation to generation (Salick and Byg, 2010). This is often learned by members of a community mostly through informal and non-formal education methods such as dialogue education, common in adult education and indigenous knowledge systems in particular. In this work, indigenous knowledge systems and traditional knowledge systems are used interchangeably.

Non-formal education is any organized educational activity outside the established formal system that is intended to serve identified learning clienteles and learning objectives. Informal education is the lifelong process whereby every individual acquires attitudes, values, skills, and knowledge from daily experience and the educative influences and resources in each one's environment. For the greater part, individuals acquire most of their knowledge, skills, attitudes and values through informal education, in homes, from other members of communities, from the media, and even the street (Youngman, 2001; Houle, 1972). Indigenous knowledge is the local knowledge that is unique to a culture or society. Indigenous people have a broad knowledge of how to live sustainably. However, formal education systems have disrupted the practical everyday life aspects of indigenous knowledge and ways of learning, replacing them with abstract knowledge and academic ways of learning. Today, there is a grave risk that much indigenous knowledge is being lost and, along with it, valuable knowledge about ways of living sustainably (Nakashima, *et al*., 2000).

Indigenous knowledge systems are cardinal in Africa's adult education. As earlier alluded to, major goals of adult education are individual development and, through this, improvement of family, community and society. Adult education has a symbiotic relationship with the environment in which it occurs. It tends to respond to social change and further social change (Banda, 2011). Indeed adult education can and should play an integral role in improving not only individuals' lives but also improving society; adult education can promote change as well as respond to it.

Given today's pressing environmental issues, environmental adult education can help us learn to live more sustainably (Banda, 2014). Climate change is one of the most pressing problems currently facing humanity (Woodley, 1991). Climate is naturally variable. It is never the

same from one period to another. However, evidence of earlier climates suggests that 'global temperatures have warmed more during the twentieth century than in any other century during the past 1,000 years' (Canadian Council of Ministers of the Environment, 2003: 5). Moreover, overwhelming scientific evidence concludes that there is need to drastically reduce greenhouse gas emissions by up to 13 billion tonnes by 2020 in order to avoid the most devastating impacts of climate change (IPCC, 2007).

Climate change is indeed considered to be a critical global challenge and recent events have demonstrated the world's growing vulnerability to climate change. Climate change can affect human sustenance and livelihoods. Climate change is a complex issue. The global climate change system is enormously complex, mainly because of the many linkages and feedback mechanisms in the atmospheric system. Furthermore, the associated socio-economic system is complex and continuously changing. The impacts of climate change range from affecting agriculture to further endangering food security, to rising sea-levels and the accelerated erosion of coastal zones, increasing intensity of natural disasters, species extinction and the spread of vector-borne diseases. The United Nation's Intergovernmental Panel on Climate Change has unequivocally affirmed the warming of our climate system, and linked it directly to human activity.

Climate change is about the growth of greenhouse gas emissions mostly due to the burning of fossil fuels, resulting mainly from industrial activities and motor transportation (Garvey, 2008); hence, there is a build-up of the carbon dioxide levels in the atmosphere. The carbon dioxide build up is made worse by the increasing loss of forests, which act as 'carbon sinks' that absorb the carbon dioxide gas and prevent its release into the atmosphere. Further, the increase of carbon dioxide and other gases in the atmosphere also enhances the 'Greenhouse Effect' (in which more heat is generated), thus leading to temperatures rising. Based on data from the United Nation's Intergovernmental Panel on Climate Change, it is estimated that the mean global surface temperature has increased by about 0.3 to 0.6 degree Celsius since the late nineteenth century to the present (IPCC, 2007).

It is not possible to talk about climate without talking about community because available research shows that the community has as much effect on the environment as the environment can affect the community (see Adams, 2003; and Namafe, 2006). Over the past few decades, natural and social scientists' understanding of the complexities of the Earth

system has evolved to the point where they now recognize that the components of the system – the atmosphere, oceans, land, and associated living beings including humans – are inextricably intertwined. A change in one part of the Earth system has repercussions for other parts – often in ways that are neither obvious nor immediately apparent (Namafe, 2006). The environment means a lot to human life and humanity, hence the need for it to be preserved and improved for future generations. One effective way to do this is through adult education. In many African countries including Zambia, the community has played a major role in providing adult education programmes (Nafukho, *et al*., 2005). Adult education can, therefore, be an effective means to use to address the impacts of climate change in Africa.

It is estimated that Africa experienced warming through the twentieth century at a rate of between 0.26^{o} C and 0.50^{o} C. Some parts of the continent warmed by 0.7^{o} C during the twentieth century (IPCC, 2007). This trend is expected to continue and even see a significant increase in the rate of warming with its attendant negative effects on livelihoods. According to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, a medium-high emission scenario would see annual mean surface air temperatures expected to increase between 3^{o} C and 4^{o} C by 2080 (IPCC, 2014; 2007). This implies difficult times ahead for the local people who depend directly on the natural resources for their livelihoods and their main or only weapon to cope with the changes that are yet to come is their traditional knowledge and practices.

Natural resources are cardinal to the economic viability and the quality of life among indigenous people. One of the models for more sustainable ways of life is through traditional environmental knowledge, based on a knowledge system that works with nature, not against it (Banda, 2009). In rural subsistence communities in particular, traditional environmental knowledge is a central concern for the regulation and balance of exploitative pressures that permit an ecosystem to maintain stability and regenerative capacity.

The generation of Zambians who lived before independence did not experience very high levels and effects of climate change. However, the generations of late twentieth and the twenty-first century have experienced high levels and effects of climate change (Sikanwe, 2014). The 2006 World Bank Report indicates that Zambia's increasing temperature at the rate of 0.6° C per decade is unprecedented, ten times higher than the global or Southern

Africa rate in 2006 (World Bank, 2006). The frequency of occurrence of extreme events (drought, seasonal floods and flush floods, extreme temperatures and dry spells) along with their intensity and magnitude has also increased, and future scenarios for the period 2010-2070 indicate that temperature will increase further by 2˚ C and rainfall is projected to decrease by 8-10 per cent (Bwalya, 2010). If this trend continues, the implication of higher temperatures for rainfall will be even more difficult to predict. It is already emerging as a major challenge of the time, threatening human survival and development in Zambia. Drought and floods have increased in frequency, intensity and magnitude over the last two decades. Frequent floods and late rains have resulted in serious damage to crops and infrastructure. Meanwhile, on the other hand, drought periods have often been accompanied by reduced precipitation; high temperatures and evapotranspiration with adverse consequences for staple food production (Zambia National Adaptation Programme Action, 2007).

This situation is expected to alter food security sources for more than 60 per cent of Zambians living in rural areas who depend on rain-fed agriculture for their livelihoods, with maize, sorghum, millet and cassava as predominant staple crops, as indicated in the 2007 Zambia National Adaptation Programme Action on Climate Change report. Cash crops include wheat, cotton, rice, oilseeds, coffee and horticultural produce. Zambia's food security situation remains precarious despite occasional surpluses during good seasons. The current agricultural practices in use will no longer be sustainable in the face of the limitations imposed by climate change, a situation calling for an urgent need for adaptation to avoid food insecurity and malnutrition diseases. The impacts of climate change in Zambia are generally manifested in human health and the agricultural sector, worsening the existing levels of poverty and undermining all development efforts at the community and national level (Zambia National Adaptation Programme Action, 2007).

High levels and effects of climate change can change the way of life and values of sections of society. However, little is known about the effects of climate change and how climate change has effected change in way of life among Lozi adults in the Barotse plains of Mongu District, Western Zambia. The Barotse plains are found in a rural part of Western Province with high illiteracy rates. According to Zambia's Census of population and housing of 2010 (www.zamstats.gov.zm), the literacy rate in Western Province was 61.6 per cent compared to the national literacy rate which was 70.2 per cent. The other two provinces with low literacy

rate were also rural provinces namely Northern and Eastern at 61.0 and 54.4 per cent respectively compared to urban Copperbelt and Lusaka with the highest (83.1 per cent and 83 per cent, respectively). The census findings show that Western Province still had high illiteracy levels which stood at 38.4 per cent, and the figures are much higher in the remote areas and among the aged and women (www.zamstats.gov.zm).

Elsewhere studies have shown that among rural communities with high illiteracy levels, indigenous knowledge systems like traditional environmental knowledge play a pivotal role in mitigating climate change (Gyampoh, *et al*., 2007; Salick and Byg, 2010). Many communities in the Barotse plains are found in the hard to reach remote areas. Many people in the plains are illiterate and probably rely on indigenous knowledge systems to survive.

Although research is gradually recognizing the importance of indigenous knowledge systems in many developmental studies including adult education (Woodley, 1991), the role of indigenous knowledge in mitigating climate change in Third World countries like Zambia has received very little attention. Similarly, although a lot has been researched and recorded on climate change (IPCC, 2014; 2007), little was known about how the Lozi adults in the Barotse plains of Western Zambia mitigate effects of the climate change - thus, a knowledge gap and an aspect of concern. This study, therefore, was an attempt to fill the gap.

Traditional environmental knowledge is a potentially powerful medium through which to facilitate environmental adult education and has the potential for influencing transformative learning. Although many educators agree that one of the focuses of environmental education is adult transformation, it appears this has not been extensively explored in the context of Zambian traditional environmental knowledge. This study intended to analyze the possibility of transformative learning in this context. In order to bridge this knowledge gap, the study particularly intended to investigate the effects of climate change, how communities in the Barotse plains value traditional environmental knowledge among Lozi adults in mitigating climate change and how the local knowledge is utilized. So far, to the knowledge of the researcher, it appeared there was no study that had been conducted to establish the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Mongu District to ensure sustainable development. This study was an attempt to fill in this knowledge gap.

1.1 Statement of the Problem

At the time of conducting this study in the year 2015, negative effects of climate change were a source of great concern in Zambia. Climate change was a looming global threat. It endangers not only all of our ecosystems, communities, and cultures, but the future of humanity itself. Climate change had indeed emerged as the most prominent global environmental problem (IPCC, 2007). The grave impacts of global warming were differentiated across countries and hemispheres. The hardest hit were the geographically and economically vulnerable communities, which had little resources and the least access to support, technology, basic social services and financial resources to respond to impacts of climate change.

Zambia, and the western region where the Barotse plains are found in particular, had not been spared by the negative impacts of climate change. Western Zambia and particularly south-western and southern Zambia lie in a zone of very high risk from the negative impacts of climate change being at the southern extremity of the migratory track of the Inter-Tropical Convergence Zone (ITCZ) and have already experienced the negative impacts of intensified climate change in the last two decades of the twentieth century and first decade of the twenty-first century (Sikanwe, 2014).

The Barotse plains are found in the rural part of Western Zambia experiencing high impacts of climate change coupled with high illiteracy rates. According to Zambia's census of population and housing of 2010 (www.zamstats.gov.zm), the literacy rate in rural Western Province stood at only 61.6 per cent compared to the national literacy rate which was 70.2 per cent. Few rural residents in Zambia had access to seasonal climate forecasts from the meteorological department. As observed by Salick and Byg (2010) in many such rural areas with high illiterate levels, indigenous people tended to use indigenous knowledge systems to solve their environmental problems.

Little was known about how Lozi adults in remote rural communities in the Barotse plains of Western Zambia mitigated negative effects of climate change. Since climate change may negatively affect people's livelihoods and life in general, it was cardinal to know how such people mitigated effects experienced to ensure sustainable development. Elsewhere, it had been reported that illiterate and semi-literate people in rural areas mostly use traditional

knowledge systems like traditional environmental knowledge to solve various problems, for their survival and personal development (Salick and Byg, 2010). However, many people of Western Province in Zambia and elsewhere did not precisely know the role and type of traditional environmental knowledge used among Lozi adults in mitigating effects of climate change in the Barotse plains. In view of such knowledge gap, it was felt important to investigate how Lozi adults used traditional environmental knowledge to address climate change. Little or lack of knowledge about how local people in a community mitigated and adapted to effects of climate change through their traditional environmental knowledge was a problem and source of concern, which this study tried to address.

1.2.1 Dimensions of the Problem

Several sub-problems emerge where we know little of how Lozi adults through their traditional environmental knowledge mitigate and adapt to climate change. First, climate change is currently causing increased hardship for many rural communities in many parts of the world. Concerns over negative impact of climate change have strengthened fears that environmental degradation and demographic pressures may displace many people in the Third World and create social upheaval (Adams, 2003). However, little was known about the effects of climate change and how climate change has effected change in way of life among Lozi adults in the Barotse plains.

Second, Western scientists and traditional environmental knowledge practitioners all agree that we are only just beginning to feel its effects, and that we can expect more dramatic changes. As Bwalya (2010) argues, currently many Zambians are clearing forests and destroying wetlands at a tremendous rate, which may leave future generations without access to the gifts of the forests and wetlands including adequate rainfall, energy, animal habitats, traditional medicines, and many more. The consequences of destroying our environment such as forests and wetlands are many: more erosion of topsoil and more flooding; more droughts and drying of rivers; fish and animal populations declining; difficulties in growing crops and raising livestock; increase in various diseases, to mention but a few. Although studies conducted elsewhere in Africa have shown that people in rural communities tend to use indigenous knowledge systems to solve environmental problems (see Salick and Byg, 2010; Gyampoh, *et al*., 2007; Atteh, 1992), little was known about how Lozi adults in the Barotse plains of Western Zambia mitigated and adapted to negative effects of climate change.

Third, strategies for mitigation and adaptation need to focus on the needs of the people most affected by climate change impacts and aim to reduce the most significant hazards they face. In recent times, people have lost respect and regard even for good traditions that used to preserve natural resources (Kajoba, 2008; Namafe, 2006). Many places that had abundant natural resources which are cardinal in mitigation of climate change do not have them anymore. There are times, however, when responsible human intervention in nature such as traditional environmental knowledge is called for. However, little was known about how traditional environmental knowledge among the Lozi adults in the Barotse plains could be enhanced to mitigate climate change.

In this regard, it was deemed important to investigate how such Lozi adults mitigated climate change and, hence, the present study.

1.2 Purpose of the Study

In research, purpose refers to a general statement which reflects the intentions of one's research (Chilisa and Preece, 2005). This study sought to investigate the role of traditional environmental knowledge among Lozi adults of Lealui Ward area in mitigating climate change in the Barotse plains of Mongu District, Western Zambia.

1.3 Specific Objectives of the Study

The above purpose was addressed through the following specific objectives:

i) to explore how Lozi adults around Lealui Ward area of the Barotse plains had been affected by climate change.

ii) to investigate the role of traditional environmental knowledge among Lozi adults of Lealui Ward area in mitigating climate change.

iii) to establish what could be done to enhance traditional environmental knowledge among Lozi adults around Lealui Ward area in mitigating climate change.

1.4 General Research Question

According to Kombo and Tromp (2006: 36), 'a quality study needs to have research questions that help in responding to the study objectives.' Apart from this, Kasonde-Ng'andu (2013: 17) defines a research question as 'a statement that identifies the phenomenon to be studied.' The general research question of this study read as follows: What is the role of traditional environmental knowledge among Lozi adults of Lealui ward area in mitigating climate change?

1.5 Specific Research Questions

The general research question was addressed through the following specific research questions:

i) how have Lozi adults around Lealui Ward area of the Barotse plains been affected by climate change?

ii) what is the role of traditional environmental knowledge among Lozi adults of Lealui Ward area of the Barotse plains in mitigating climate change?

iii) how can traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains be enhanced to mitigate climate change?

1.6 Significance of the Study

Through this study, communities in the country might become aware of the contribution of traditional environmental knowledge among adults in mitigating negative effects of climate change in rural Zambia. The study may also show the significance of traditional environmental knowledge and its potentials to enhance environmental sustainability and sustainable development in the Barotse plains and surrounding areas of Mongu District, Western Zambia.

The findings of this study may also benefit community members of the Barotse plains by providing them with useful literature that may enable them to fully participate in devising strategies to meet challenges of climate change affecting their communities.

The findings may also contribute information to the existing body of knowledge on the significance of traditional environmental knowledge in environmental adult education.

Furthermore, the findings of the study may stimulate more research in the role of indigenous knowledge systems in solving other problems in the field of adult education.

1.7 Limitations of the Study

As it is expected in any research, there were limitations in this study. The purposive snowball sampling procedure used among Lozi traditional leaders may decrease the generalizability of findings. A lot of data collected from residents and traditional leaders in the Barotse plains was in Silozi language. This was translated into English by the research assistants. It is possible that some data might have been distorted during the translation process, thereby affecting the findings of the study. Another limitation was the inadequacy of funds by the researcher to pay the hired research assistants to cover a larger area of the vast Barotse plains over a longer period of time than thirteen weeks to make more observations during fieldwork as participant-observers. Moreover, since the study was more qualitative than quantitative in nature, its findings could be subjected to other interpretations.

1.8 Delimitations

The study confined itself to Lealui Ward area in the Barotse plains east of Zambezi River in Mongu District. The scope of this study was limited to an assessment of traditional environmental knowledge among Lozi adults in the Barotse plains of Mongu District. Hence, it would not consider other floodplains for data collection and analysis. The findings, therefore, would only be a reflection of the Barotse plains in the study area not the whole vast plains.

1.9 Theoretical Framework

Theory and practice are intricately intertwined. A theoretical framework locates a study in a certain theory or theories. Such theories are used to guide the study and make sense of the findings (Kombo and Tromp, 2006). Besides andragogy, this study was particularly guided by transformative learning and iceberg cultural theories. This framework provided the analytical and interpretive lens for the analysis of the findings.

1.9.1 Andragogy

Just as there is no one theory that explains how humans learn, no single theory of adult learning has emerged to unify the field of adult education. The general theory of adult

learning is Malcolm Knowles' andragogy, characterized by autonomous learner-centredness which encourages participatory approach in all areas concerning adult learning. In the early 1970s an American Malcolm Knowles popularized the use of 'andragogy,' the term which describes differences between children and adult learners (Knowles, 1980). Specifically, andragogy places value on the *process* of learning. It uses approaches to learning that are problem-based and collaborative rather than didactic or rooted in lecture, and also emphasizes more equality between the instructor or facilitator and the learner.

Since the 1970s, andragogy as an adult learning theory has offered a framework for educators and trainers whose job it is to help educate or train adults. Malcolm S. Knowles (1973) was among the first proponents of this approach. In his book, *The Adult Learner: A Neglected Species*, he resurrected the word 'andragogy' a term popular in German education circles in the early 1800s, and used it to label his attempt to create a unified theory of adult learning. Initially, Knowles' contentions were based on four assumptions:

(1). As they mature, adults tend to prefer self-direction. The role of the adult educator or instructor is to facilitate learning - engage in a process of inquiry, analysis, and decision-making with adult learners, rather than to transmit knowledge.

(2). Adults' experiences are a rich resource for learning. Active participation in planned experiences - such as discussions or problem solving exercises, an analysis of those experiences, and their application to work or life situations - should be the core methodology for training adults or helping adults learn. Adults learn and retain information more easily if they can relate it to their reservoir of past experiences. Adults learn by comparing past experience with new experience. Every adult learner has a lifetime collection of previous knowledge and experience. When learning something new, most adults need to see how it fits in with (or is different from) what they already know.

(3). Adults are aware of specific learning needs generated by real-life situations and events such as marriage, divorce, parenting, taking a new job, losing a job, and so on. Adult learners' needs and interests are the starting points and serve as guideposts for training activities. Adults learn most effectively when they have an inner motivation to develop a new skill or gain new knowledge. They resist learning material if it is forced on them, or if the only reason given is that the material will, in some vague way, be "good for them to know".

Adults need to know why they are being asked to learn something; they want to know what the benefits will be before they begin learning. In the work world or any other real life situation, adults are expected to evaluate the relative importance of information, to exercise personal judgment in setting priorities and allocating their time. This basic orientation of personal responsibility of also how adults approach the world of learning. Adults must feel the material they are learning is relevant, and that it will have an immediate effect. They want to see how the objectives of the learning relate to authentic situations and real solutions to problems.

(4). Adults are competency-based learners, meaning that they want to learn a skill or acquire knowledge that they can apply pragmatically to their immediate circumstances. Life or work-related situations present a more appropriate framework for adult learning than academic or theoretical approaches. At a later stage, Knowles (1980) added two more assumptions concerning adult learning.

The identified six cardinal assumptions about adult learning are: (1) need to know, (2) self-concept, (3) prior experience, (4) readiness to learn, (5) learning orientation, and (6) motivation to learn.

The Need to Know: Adults need to know why they need to learn something before undertaking learning (Knowles *et al.,* 2005). Facilitators of adult education programmes must help adults become aware of their 'need to know' and make a case for the value of learning to improve quality of life as individuals, in communities and society – hence, contribute to national development.

The Learner's Self-concept: Adults believe they are responsible for their lives (Knowles *et al.*, 2005). Adults have a self-concept of being responsible for their own decisions, for their own lives. Once they have arrived at that self-concept they develop a deep psychological need to be seen by others and treated by others as being capable of self-direction. As a person matures, his or her self-concept moves from a dependent personality towards a self-directing human being (Knowles *et al.*, 2005). They need to be seen and treated with great respect as capable and self-directed. Facilitators of adult learning should create environments where adults develop their latent (hidden or suppressed) self-directed learning skills (Brookfield, 1986; Banda, 2014).

The Role of Adult Learner's Prior Experience: Adults come into an educational activity with different experiences than children do (Knowles *et al.*, 2005; Merriam and Caffarella, 1999). Adult learners have individual differences in background, learning style, motivation, needs, interests, and goals, creating a greater need for individualization of teaching and learning strategies (Brookfield, 1986). Amazingly, the richest resource for learning resides in adults themselves; therefore, tapping into their experiences through experiential techniques such as use of dialogue education, discussions, games and simulations, problem-solving activities, field work or case studies is beneficial (see Brookfield, 1986; Vella 2002; Vella 2004; Knowles *et. al.*, 2005; and Banda, 2014).

Readiness to Learn: Adults become ready to learn things they need to know and do in order to cope effectively with real-life situations (Knowles *et. al.*, 2005). Adults become ready to learn those things they need to know and be able to do in order to cope effectively with their real-life situations. The readiness of an adult to learn is closely related to the developmental tasks of his or her social roles. Adults want to learn what they can apply in the present, making training focused in the future or that does not relate to their current situations, less effective.

Orientation to Learning: Adults are life-centered (task-centered, problem-centered) in their orientation to learning (Knowles *et al.*, 2005). They want to learn what will help them perform tasks or deal with problems they confront in everyday situations and those presented in context of application to real-life (Merriam and Caffarella, 1999; Knowles *et al.*, 2005).

Motivation to Learn: Adults are responsive to some external motivators (e.g., increasing food security in their family, promotion at work place, getting better job, higher salaries), but the most potent motivators are internal (e.g., self-esteem, desire for increased job satisfaction, solving day-to-day challenges, improving quality of life and the like). Their motivation can be blocked by training and education that ignores adult learning principles (Knowles *et al.*, 2005).

In andragogy, the richest resource for learning resides in adults themselves. Adult learners are a valuable resource because they bring to a learning environment the richness and diversity of their lives with them. In this study, it was revealed that the Lozi adults around Lealui Ward area of the Barotse plains became interested to learn how to solve some problems brought about by the negative effects of climate change (see Section 4.3.1. in

Chapter 4). Using mostly informal learning, the Lozi adults learnt through interactive traditional dialogue education. This is in line with the assumptions of Malcom Knowles' theory of andragogy.

1.9.2 Transformative Learning Theory

Highly related to andragogy in adult education is transformative learning theory, very useful in this ever changing world. The transformative learning theory is an adult education based theory that suggests ways in which adults make meaning of their lives. The theory defines learning as a change in a person's frames of reference and behaviour that results from critical discourse and reflection (Mezirow, 1991). The theory was developed by Jack Mezirow, who stresses that making meaning is nothing else than making sense of an experience. Transformative learning involves a process of increasing an individual learner's capacity for change. Jack Mezirow's *Ten Phases of Transformational Learning* was first published in 1978 (Mezirow, 1991). Mezirow's transformative learning theory is based on extensive research in a 1975 American nationwide study of consciousness-raising in women education, a study that sought to explain the unprecedented 'presence of women in higher education' (Mezirow, 1991: 19). Mezirow identified phases most often encountered during the learning processes women experienced as part of their empowerment process. These experiences resulted in profound shifts in women's capacity to take action on the basis of their new beliefs.

Along with the women's movement in adult education, Jack Mezirow was influenced by Thomas Kuhn's (1962, cited in Mezirow, 1991) work on 'paradigms', Paulo Freire's concept of 'conscientization' (1972), and Jürgen Habermas' 'domains of emancipatory action learning' (1971, cited in Mezirow, 1991). Mezirow describes transformative learning as a process of 'becoming critically aware of one's own tacit assumptions and expectations and those of others and assessing their relevance for making an interpretation' (Mezirow, 1991:4). The theory posits that for learners to change their *meaning structures* - that is, beliefs, attitudes, and emotional reactions - they must engage in critical reflection on their experiences, which in turn leads to a transformation of perspective. Mezirow's (1991) phases of perspective transformation begin with a disorienting dilemma and then moves through stages which include emotional release, sharing with others, critical reflection, and, finally, action.

Transformative learning theory creates learning environments that promote self-directed learning in which learners or participants work in problem-solving groups and learn from one another by becoming aware and critical of their own and others' assumptions. This process is informed by a critical awareness of contextual, biographical, historical and cultural aspects of our collective beliefs and feelings in regard to the problems under examination. Transformative learning 'enables us to recognize, reassess, and modify the structures of assumptions and expectations that frame our tacit points of view and influence our thinking, beliefs, attitudes and actions' (Mezirow, 1991: 18). Through critical reflection we learn to 'act on our own purposes, values, feelings, and meanings rather than those we uncritically assimilated from others' (Mezirow, 1991: 8). Learners develop greater urgency for transformation to solve their problems as they become more emotionally capable of change. The results are evidenced in reflective discourse and ultimately, in action.

Transformative learning theory could successfully be used as a theoretical framework to analyze the cultural adaptation processes which form major part of this study. As earlier stated, Mezirow (1991) initiated the transformative learning study by focusing on re-entry women in community colleges. He found out that women experience fundamental changes in their understanding of social roles, personality and characteristics. According to Mezirow (1991), learning may be defined as the process of making a new and revised interpretation of the meaning of an experience, which guides subsequent understanding, appreciation, and action. Mezirow assumes that most of our meaning perspectives are acquired unconsciously through cultural assimilation from childhood till death. Only these meaning perspectives meet challenges during their huge life transition, people started to think of the assumptions of their meaning. Adults can achieve significant transformation to adapt to any problem they may encounter in life to help self-development and development of their community and society at large.

As discussed above, the main goal of transformative learning is perspective transformation. Educational researchers suggest that perspective transformation is often the result of a disorienting dilemma triggered by a life crisis or major life transition within learners themselves (Bates, *et al.*, 2009). Transformative learning aims to build the urgency among learners to put new critical generated knowledge into practice. Beyond the mere dissemination of information, transformative learning engages participants in dialogical and

experiential learning processes with the aim of creating deep learning. Due to the fact that problems with regards to sustainability are both complex and deeply entrenched into our culture, these transformative learning processes are essential for the learning process associated with sustainability and ecological literacy such as climate change mitigation in environmental adult education.

Transformative learning engages an ecological view of education that is relational, holistic, participatory and practical. Transformative learning involves becoming aware of one's assumptions in order to address issues from a critical perspective and take action on the basis of new knowledge. Transformational learning is complete when an individual is able to act according to beliefs he or she has validated through critical reflection.

As earlier stated, transformative learning is an important educational practice developed in consciousness-raising and women's education in the 1970s. This contributed to the massive shift in power relations for women in the twentieth century. The same strategies could now be used to confront contemporary challenges in regard to human relations with the natural world, such as the climate change issues which form part of this study.

As earlier mentioned, transformative learning involves a process of increasing an individual learner's capacity for change. Transformative learning theory creates learning environments that promote self-directed learning in which learners or participants work in problem-solving groups and learn from one another by becoming aware and critical of their own and others' assumptions. Transformative learning engages an ecological view of education that is relational, holistic, participatory and practical. In this study, transformative learning came out very much during focus group discussions. Discussions among Lozi adults of Lealui Ward area in the Barotse plains brought critical issues related to the objectives of the study, such as problems related to climate hange and possible solutions to solve the problems. The discussants identified problems which affected them mostly in their community. Possible solutions like how to curb deforestation at the edge of the Barotse plains, upholding of the Lozi culture which encourages conservation of natural resources, extending tree planting practices to cover some areas where their cattle were taken for grazing such as along canals to reduce heat stroke among the livestock, enhancement of conservation farming and use of

irrigation farming to improve on food security and increase household income (see Chapter four for details).

1.9.3 Iceberg Theory of Culture

In adult education it is difficult to talk about traditional environmental knowledge outside people's culture. Although there is no universal definition of culture, it may simply be said to be the total way of life of a given group of people – it tells group members how to behave and provides their identity. Culture can be seen as a system of behaviours and beliefs passed from one generation to the next. It is a powerful human tool for survival, but it is also a fragile phenomenon. It is constantly changing and can easily be lost because it mostly exists in our minds. Many scholars like Edward Hall have even argued that culture can be likened to an iceberg. Hall (1976) even came up with what has come to be called the iceberg theory of culture. The 'Iceberg Theory' has been applied to various things from writing and other arts to leadership and culture. The diagram in Figure 1 shows the iceberg theory of culture.

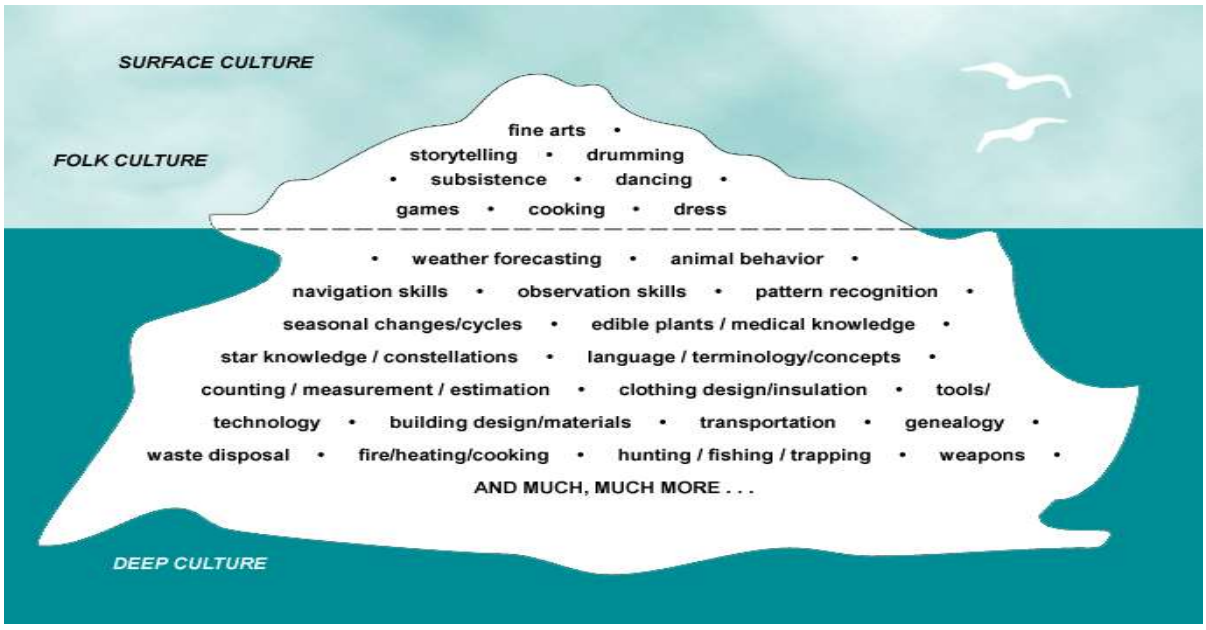

Figure 1: The Iceberg Theory of Culture
Source: http://www.ankn.uaf.edu/IKS/Iceberg.html.

The iceberg theory of culture is often used by scholars, trainers and managers of various projects in order to elucidate the concept of culture. The image of the iceberg with its small visible part on the surface of the water and the much bigger invisible part below the surface illuminates the different layers of culture. Elements of culture which can easily be noticed

such as clothing, language, gestures, food, music or rituals are represented by the upper portion of the iceberg. Rituals include descriptions of ways of greeting and paying respect. Clapping of hands among Lozi male and female adults is a good example of this. Males and females clap hands differently.

The portion below the surface of the water in the iceberg theory of culture stands for those elements which are not as obvious such as values, beliefs and attitudes. Traditional environmental knowledge which forms a large part of this study is one of the invisible underlying aspects of people's culture. It is difficult to make sense of the 'visible' aspects of a culture without understanding the 'invisible', underlying elements from which they originate. The Iceberg theory of culture asserts that some aspects of culture are observable while others are unobservable. Above the waterline aspects are observable or visible. They are easily identifiable, but are the most readily changed aspects, particularly when accommodating new knowledge. Below the waterline aspects of culture may not be obvious or observable. Below the waterline aspects of culture are implicitly learned, often unconsciously important and difficult to change.

Thus, this study was also guided by the iceberg theory of culture to help us understand the deep cultural issues in the study area. In 1976 Edward T. Hall theorized that culture was like an iceberg in that there were two parts: internal and external. If the culture of a society was the iceberg, Hall (1976) reasoned in his theory, then there are some aspects visible, above the water, but there is even a larger portion hidden beneath the surface.

The visible or external culture is the outward behaviours of a society while invisible or internal culture comprises the beliefs, values, and thought patterns underlying those behaviours (Hall, 1976). The idea of culture as an iceberg reminds us that only a smaller proportion of cultural aspects are more 'visible' and therefore more obvious than many other facets of culture which, while far less tangible and visible, are just as essential to our understanding of how cultures work. In fact, the sub-surface aspects shown above will directly influence those on the 'tip' of the iceberg.

A number of issues related to the iceberg theory of culture came out in this study. To illustrate, it was revealed that the invisible aspects off the *Kuomboka* ceremony shows how the Lozi migrate from the plains to release pressure on consumption of natural resources,

allow regrowth of the natural resource found in the Barotse plains, and potray their culture of use of less polluting nature by paddling the *Nalikwanda* barge and other canoes instead of using the polluting diesel engines to drive the barge or canoes (see Plates 14 and 15).

1.10 Definitions of Terms

The definition of terms clarifies how some terms are used in this study.

Adaptation: In this study, adaptation is an adjustment made to a human, ecological or physical system in response to a perceived vulnerability.

Adults: In this study, adults are basically perceived to be people of 18 years or older, having self-directing images of themselves, and able to relate stories, proverbs and legends from the collective memory of the community for the purpose of informing, educating and socializing the young in society.

Climate change: In this study, climate change refers to seasonal changes in patterns of temperature, precipitation, humidity, wind and seasons over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them.

Community: This refers to a group of interdependent people living in a particular local area. This group of people who live in a given territory have a common history and shared values, participate together in various activities, and have a high degree of solidarity.

Indigenous people: Indigenous people are composed of the existing descendants of the people who inhabited the present territory of a country wholly or partially at the time when persons of a different culture or ethnic origin arrived there from other parts of the world.

Learning: In this study, the learning has been defined as an active continuous process of change in behaviour which is demonstrated by people implementing knowledge, skills, attitudes, values or practices derived from education.

Mitigation: In this study, mitigation means to make something less harmful, unpleasant or serious.

Traditional environmental knowledge: In this study, traditional environmental knowledge refers to dynamic time-tested knowledge and wisdom, skills, attitudes and values of local

people in communities transmitted orally from one generation to another through generations of living in close contact with nature; it is a complex system regarding sustainability of local resources among indigenous people that has been evolving since time immemorial.

1.11 Organization of the Study

This thesis is organized into five chapters. The first chapter has an introduction which gives a synopsis of the background to the present study. Further, an attempt has been made to explain certain concepts that are used in the study in order to make them clear to the reader. The chapter also comprises the statement of the problem, purpose, objectives, questions, significance, theoretical framework, limitations and delimitations of the study.

The second chapter reviews related literature on the role of traditional environmental knowledge in mitigating climate change among indigenous people. It has attempted to analyze some of the existing literature on the subject of the role of traditional environmental knowledge among indigenous people at a global level and Africa. Chapter Three discusses the methods of data collection used in the study. The chapter is divided into sections subsumed under the following headings: the research design, study area, study population, the sample and sampling procedures, data collection procedures, research instruments and data analysis.

The research key findings are presented, analyzed and discussed in Chapter Four. Chapter Five consists of discussion and analysis of the findings of the study. Chapter Six deals with the summary, conclusion and recommendations. This chapter ends with suggestions for further research. The subsequent pages consist of the references and appendices.

CHAPTER TWO

REVIEW OF LITERATURE

2.0 Introduction

International, regional and local literature related to the objectives of the study was reviewed. Literature search was employed in this study because it offers the greatest opportunity to benefit from the experience of others who have conducted related studies. Literature review refers to the consultation, synthesis and critique of various works written by other scholars in order to understand and investigate a research problem. Hart (1998) defines literature review as the critical synthesis and evaluation of previous research which logically leads to research questions. 'The review of literature provides the background and context for the research problem. A comprehensive review of literature also justifies the need for research and signifies that the current researcher is knowledgeable about their study area' (Wiersma, 1995: 406). Not only does literature review demonstrate to the reader that the researcher has a comprehensive grasp of their study area but also shows that the researcher is knowledgeable about the methodological developments in their study area.

The review of studies related to the role of traditional environmental knowledge in mitigating climate change helped the researcher to formulate a research topic so as to fill in the research gap which was lack of knowledge on traditional environmental knowledge among Lozi adults of the Barotse plains in mitigating climate change. In addition to this, reviewing relevant literature did not only help the researcher to identify a research gap but also to avoid repetition of the same study (Kasonde-Ng'andu, 2013). Documents consulted in this study include books and journals, annual reports for various organizations, government policy documents, international and local publications, and conference, workshop and seminar presentations, and the Internet.

The literature was reviewed in detail with the help of the following subheadings which relate to four major issues related to the study objectives:

1. Effects of climate change on indigenous people;
2. Significance of traditional environmental knowledge in mitigating climate change;
3. Enhancing climate change mitigation and adaptation using indigenous knowledge; and

4. Traditional environmental knowledge among Lozi adults in relation to climate change

The literature review discusses what has been researched by others elsewhere and identify knowledge gaps which this study might fill. The reviewed literature can also help in forming a basis for analysing and interpreting the research data (Kombo and Tromp, 2006).

2.1 Adult Education and Traditional Environmental Knowledge

Perhaps before we go into detailed literature review, it is cardinal to understand the relationship between adult education and traditional environmental knowledge. There is no universally accepted definition of traditional environmental knowledge in the literature. However, many scholars agree that traditional environmental knowledge is part of the wide indigenous knowledge systems (see Sherry and Myers, 2002 and Bates, *et al*., 2009). Knowledge is not a static concept. It is created, discarded and improved upon all the time, through experience, interaction with our surroundings and through formal, non-formal and informal education. Indigenous knowledge includes an understanding of society-nature relationships that have been tested by time and proven to be sustainable and successful in limiting the effects of hazards. This knowledge has usually been internalized by communities and become part of their life styles, sometimes transparent to outsiders or even to themselves. With its unique culture characteristics, indigenous culture and local knowledge is mostly based on the oral and practical learning of daily activities, and often lacks written records. This fact may be part of the challenge faced by policy makers in many countries in the world, incorporating these indigenous knowledge and practices into mainstream sustainable development processes through participatory approaches. Studies have shown that adult education encourages use of participatory approaches as cardinal in education (Youngman, 2001; Omolewa, 1981). The indigenous knowledge systems world-over has adult education as its critical aspect.

Adult education can safely be said to be as old as the human beings themselves, its existence has been seen from the kind of activities that adult people engage themselves in since time immemorial. These activities would include; initiation ceremonies, marriage counselling, weather forecasting and many other community activities. Everyone should remember learning does not - and should not - stop when we reach adulthood. Adult education can

provide us with the knowledge, skills, attitudes, values and confidence we need to make life-changing decisions or take us further in our lives.

The term adult education denotes the entire body of organized educational process whatever the content, level and method used, whether they prolong or replace initial education in our communities, places of work, schools, colleges, universities, as well as in apprenticeship, whereby persons regarded as adults by society to which they belong develop their abilities and enrich their knowledge, improve their technical or professional qualifications, skills or turn them in a new direction and bring about changes in their attitudes or behaviour to achieve full personal development and participation in balanced and independent social, economic and cultural development which may enhance sustainable development (RHEF, 2007; Spencer, 2006).

In other words, adult education is a practice in which adults engage in systematic and sustained learning activities in order to gain new forms of knowledge, skills, attitudes, or values. It can mean any form of learning adults engage in beyond traditional schooling, encompassing basic literacy to personal fulfilment as a lifelong learner. In particular, adult education reflects a specific philosophy about learning and teaching based on the assumption that adults can and want to learn, that they are able and willing to take responsibility for that learning, and that the learning itself should respond to their needs. Driven by what one needs or wants to learn, the available opportunities, and the manner in which one learns, adult learning is affected by various changes in life such as demographics, globalization and technology. The learning happens in many ways and in many contexts just as all adults' lives differ. Adult learning can be in any of the three major contexts i.e.

(i) Formal - Structured learning that typically takes place in an education or training institution, usually with a set curriculum and carries credentials;
(ii) Non-formal - Learning that is organized by educational institutions but non credential. Non-formal learning opportunities may be provided in the workplace and through the activities of civil society organizations and groups; and
(iii) Informal education - Learning that goes on all the time, resulting from daily life activities related to work, family, community or leisure (e.g. community natural resource conservation strategies, fish drying preservation methods, conservation farming, and traditional environmental knowledge).

The goals and purposes of adult education in Africa have a critical historical relevance. In traditional African societies, education's purpose was to holistically enable the individual to play societal roles. Both the individual and society were at the centre of learning (Msimuko, 1987). With the coming of missionaries and colonialists, the goals and purposes of education changed. Missionaries provided education mostly for salvation purposes. Colonialists, on the other hand, provided education that would make African men and women better unquestioning labourers. All over the world, two general purposes of adult education, namely individual improvement and societal development, as identified by Lindeman (1925), should remain central to the field of adult education. This calls for the critical role of lifelong learning in adult education.

The concept of lifelong learning in grounded in the four pillars of education expounded by Delors, *et al*., (1998): learning to know; learning to do; learning to live together; and learning to be. In simple terms, lifelong education refers to holistic learning for life and work. The concept of lifelong learning is as old as Africa itself (Fafunwa, 1974). It goes back to the origin of human life on the continent of Africa. African traditions encouraged continued learning. For instance, children learnt from adults how to live and function in society and likewise adults learnt from children and fellow adults. Learning is taken as any change in behavior, information, knowledge, understanding, attitudes, values, skills, or capabilities which can be retained and which cannot be ascribed to physical growth or to the development of inherited behavior patterns (Youngman, 2001; Houle, 1972). Learning was an important part of life in Africa long before the arrival of missionaries and colonialists. Fafunwa has ably demonstrated the significance of lifelong learning in indigenous education in pre-colonial Africa before it encountered Western education. He has stated that 'African education emphasized social responsibility, job orientation for all, political participation, and spiritual and moral values' (Fafunwa, 1974: 9). Fafunwa provided one of the earliest attempts at conceptualizing what amounts to an African indigenous or traditional system of education. He summarized it as involving four cardinal strands. Firstly, great importance is attached to education in society, especially to its collective social nature, meaning that it is holistic or all-encompassing. Secondly, it is intimately tied to the social life roles of the people, both in material and spiritual sense. Thirdly, it is multivalent in character, both in terms of its goals and the means it employs. Finally, it is gradual and progressive in its

achievements and in conformity with the successive stages of the physical, emotional and mental development of the learner.

Admittedly, Africa has many cultural areas, but there are some similarities in cultural pursuits and objectives. Fafunwa (1974) points out that the aim of traditional African education was multilateral, playing many roles, and that its end objective was to produce a responsible individual who is all-rounded, honest or trustworthy, respectable, skilled, co-operative and who conforms to the societal order of the day. He argues that every society has its own system of educating and training its citizens. Traditional African education aimed at providing an immediate induction into society and a preparation for adulthood. It was here that 'children learnt by doing, that is to say, children and adolescents were engaged in participatory education through ceremonies, rituals, imitation, recitation, and demonstration' (Fafunwa, 1974: 9).

Similarly, Youngman (2001: 7) has stated that 'it is evident that the practice of people learning throughout their lives was characteristic of pre-colonial African societies'. Further, Omolewa (1981) in his study of Nigerian society made ample provision for facilitating adult development and provided a variety of informal and non-formal adult learning situations within a lifelong learning context. Youngman (2001) also observed that the elders in African societies, especially grandparents, parents, uncles and aunts played a major role in passing on to younger adults and children essential knowledge, skills and values. The African philosophy, knowledge, skills, values and morals were passed on through peer alliances, as well as through interaction with older people deeply familiar with various aspects of community laws, life experiences, values and morals. This could be during initiation, marriage, planting, hunting, fishing, recreation, harvesting, funeral and burial ceremonies. Therefore, like many other societies in the world, traditional African societies valued and promoted lifelong learning from one generation to the other. Lifelong learning empowers adults by giving them the knowledge, skills and confidence to better their lives, their families and their communities.

Traditionally, in Zambia and other parts of Africa, adults have a special place in society. They have power to influence decisions of their families, clans, communities, headmen and chiefs (Kenyatta, 1979; Msimuko, 1987). They offer help to the community with their advice, wisdom and experience. As earlier stated, experience is cardinal in adult education.

In attempting to help adults learn how to help themselves achieve self-actualization, adult education facilitates the learning process that improves the quality of life among individuals' experience, communities and society to enhance sustainable development. Adult education as a sub-section of education, is a very important process that helps the development of the human mind, increases one's knowledge, skills, changes the attitudes and understanding of the total environment. It increases powers of observations, analysis, integration, understanding, decision-making, and adjustment to new situations depending on one's experience. Connected to experience, Merriam (2001) explains that adults are more interested in learning things that have an immediate relevance on their job, day-to-day community life or personal life. This is mainly because adult learning is ideally meant to be problem-solving centred, meaning that adults will participate in learning if and when they have identified a gap in their day-to-day life. This entails that adults may only engage in a learning activity if they can use what they learn as soon as they learn it, as opposed to banking the acquired knowledge or skills for future use.

Mtonga (2012) argues that if a functional meaning of adult education was to be offered, adult education would be seen as a type of education concerned with the immediate solution to the problems of hunger, diseases and poverty; in short, the problems of underdevelopment. It is the type of education which increases adult's working skills, which in turn increase productivity. Adult education is the education that is aimed for adults who are already on the jobs, either employed or self-employed. It is the education of the adults whose responsibilities is to make important political, cultural and social decisions; and it is the education which tries to change the attitudes of adults whose old values are incompatible with contemporary social, economic and technological development. Adult education, therefore, could be remedial, innovative and in a sense, a warehouse of cultural values in society. Mtonga (2012) further argues that adult education is the most significant educational aspect of the social adjustment taking place throughout the world today to enhance sustainable development.

Banda (2011) states that the tradition of adult education in Zambia is as old as the civilization itself. Although not called by this name, adult education has existed in Zambia from very ancient days – from the time when the arts of writing and reading were not yet known. In the African traditional system, community education has always been lifelong and all round

(Msimuko, 1987). This is the way through which culture has been passed on from one generation to the other though with some modifications due to Western influence. Zambia had rich multi-ethnic and multi-layered traditions but with the onset of pre and colonial change, the country lost much of this richness (Namafe, 2006). Our culture is something that surrounds us, something that is part of us, and is inextricably linked with the land upon which people have lived for thousands of years. As earlier stated, traditional environmental knowledge is a part of culture of indigenous people found in many parts of the world. Ancient education in Zambia was very rich in terms of meeting community needs; its objective was to fit a man or woman to be a member of such community. It made people live their lives to the fullest unless under natural disaster.

In Zambia, and many other countries in Africa, most of the population still live in rural areas where the majority's livelihood depends on the natural resources (Gyampoh, *et al*., 2007; IPCC, 2014). In order to have quality sustainable life that would enhance development, people in rural areas have to learn how to best use the natural resources for themselves and future generations. Indigenous communities in rural areas depend on their immediate environment to meet most of their basic needs. Therefore, they possess a deep appreciation of the environment and its underlying processes which forms the foundation for decision making in most day-to-day activities. Traditional environmental knowledge becomes cardinal in such societies and adult educators and other educationists need to tap into this knowledge to enhance development in our rural areas. The study of human knowledge is as old as human history itself. Indigenous knowledge is embedded in the daily lives of the people in many parts of rural Africa (Fafunwa, 1974). As part of indigenous knowledge systems, traditional environmental knowledge has been passed down from generation to generation through traditional education, with adults teaching practical knowledge of culture, skills, attitudes, values, skills, the environment and survival through demonstrations and through a wide range of ceremonies, stories, proverbs, songs, village meetings and taboos.

Traditional environmental knowledge is generated by communities, over time, to allow them to understand and cope with their particular agro-ecological and socio-economic environment. Such knowledge – sometimes referred to as 'local,' 'indigenous,' or 'traditional' - can be termed science, because it is generated and transformed through a systematic process of observation, experimentation, and adaptation (Banda, 2014). For

thousands of years, indigenous peoples around the world have used knowledge of their local environment to sustain themselves and to maintain their cultural identity. Traditional environmental knowledge is accumulated through trial and error and purposeful observation. Personal experience is the primary source of new information, but revelation and spiritual insight are also recognized sources. The two most important elements of indigenous knowledge are its origin in the relation between a community and a unique natural environment, and its relation to a historic continuity in a specific location (developed over several generations). The process of developing indigenous knowledge, whether incorporating outside knowledge or not, is accomplished solely by the community.

A community holds a unique relationship with and an understanding of its environment and knows how to adapt any experience or knowledge to its specific context. The integrity of information and knowledge is derived from the personage of the holder of that information and knowledge, rather than from adherence to a suite of protocols and procedures employed, as in Western experimentation, to obtain that information. As Sherry and Myers (2002) put it, there is no separate educational stream for traditional environmental knowledge because indigenous knowledge systems fully integrate all aspects of culture. In this work, traditional ecological knowledge, traditional knowledge, local knowledge and indigenous knowledge are used interchangeably.

Since traditional environmental knowledge is a subset of indigenous knowledge systems, some scholars and political leaders may argue that traditional environmental education is informal education and does not need to be invested in. However, adult educators and many other scholars (see Nakashima, *et al*., 2000 and Bates, *et al*., 2009) are aware that informal education is just as important as the formal one – hence, needs recognition, attention, research and educational investment because it equally contributes to individual, community and national development. Formal education is for the privileged few while informal education caters for everybody in society world-over. Traditional environmental knowledge gained international recognition through such documents as the *World Conservation Strategy* (1980) cited in Johnson (1992) and *Our Common Future* (Brundtland, 1987). Both reports emphasized the need to use directly the environmental expertise of local people in managing natural resources (Banda, 2009).

Recently, academics, scientific researchers and others have 'discovered' that the knowledge which indigenous people hold of the Earth, its ecosystems, the wildlife, fisheries, forests and other integrated living systems is extensive and extremely accurate (Bates, *et al*., 2009). To illustrate this, at the time Europeans first came into contact with indigenous people in Africa, Australia Asia, North and South America, the quality of indigenous peoples' environment was such that their communities had access to ample supplies of clean water, timber and wood, berries and medicinal plants, fish, beaver, muskrat, moose, caribou, geese and other wildlife.

The laws and customs of the indigenous people guided the sharing and management of resources, and ensured that the people could continue to enjoy, on a sustained basis, the resources which provided the needs of their families. These laws and customs are based on generations of observation and knowledge. Their laws and customs of respecting land and resources also form the binding foundation of indigenous people and systems of governance. Indigenous people spend a great deal of their time, through all seasons of the year, travelling over, drinking, eating, smelling and living with the ecological system which surrounds them. Indigenous people often notice very minor changes in quality, odour and vitality long before it becomes obvious to government enforcement agencies, scientists or other observers of the same ecological system.

Europeans came to the resource-rich continents of Africa, Australia, Asia, North and South America after millennia of management and stewardship of the continents' by indigenous people. After 500 years of continuous exploitation and development, guided by science and technological discovery, non-indigenous management systems have created an era of unprecedented opportunity for widespread ecological catastrophe. This unsustainable lifestyle has led to global warming, which in turn is causing climate change.

Currently, issues of climate change are critical world-over and there is need to bring everybody on board. Informal education, like traditional environmental education, can probably be one avenue to use to bring everybody on board to understand issues on climate change and participate in strategies to adapt and mitigate it for sustainable development.

2.1.1 Causes of Climate Change

The term climate comes from the Greek word *klinein*, or 'slope', describing how the angle that the sun hits the Earth varies in different regions (Vinyeta and Lynn, 2012). Climate, like weather, describes the state of the atmosphere in terms of factors such as temperature, wind and rainfall. But whereas weather describes conditions as measured in hours, days or weeks, the climate is *average* weather conditions measured over the longer term: months, years or decades.

The Earth's climate has always changed but because of human activities it is now changing faster than it has for thousands of years (Garvey, 2008). This is what scientists, academics and politicians mean when they talk today of climate change. This climate change is here to stay. It will affect all of our lives and nearly every aspect of society, from our health and food supplies to business and national economies (Kates, 1997). Climate change threatens to reverse many of the development gains that Third World countries like African nations have made. It poses threats to food and water security, to political and economic stability, to livelihoods and landscapes. But it also creates opportunities for African academics, politicians, business leaders, community leaders and communities to act in ways that bring benefits for all. It can create opportunities for new community and business models and innovations, new routes to sustainable development and new ways for ancient indigenous knowledge to have an impact at home in various communities and in the wider world. But right now, the odds are stacked against indigenous communities in Africa and other Third World countries (Vinyeta and Lynn, 2012).

Although there is no universal definition of climate change, in this work, 'climate change' means a change in climate that persists over a sustained period of time. The World Meteorological Organization (WMO) defines this time period as 30 years (IPCC, 2007). Climate change is about the growth of greenhouse gas emissions due to the burning of fossil fuels, resulting mainly from industrial activities and motor transportation, hence, there is a build-up of the carbon dioxide levels in the atmosphere. The carbon dioxide build-up is made worse by the increasing loss of forests, which act as 'carbon sinks' that absorb carbon dioxide gas and prevent the release of the gas into the atmosphere. Further, the increase of carbon dioxide and other gases in the atmosphere also enhances the 'Greenhouse Effect' (in which more heat is generated), thus leading to temperatures rising. Examples of climate change

include increases in global surface temperature (global warming), changes in rainfall patterns, and changes in the frequency of extreme weather events. Changes in climate may be due to natural causes, such as changes in the sun's output, or due to human activities, such as changing the composition of the atmosphere.

Life on Earth depends on energy coming from the sun. About half the light reaching Earth's atmosphere passes through the air and clouds to the surface, where it is absorbed and then radiated upwards in the form of infrared heat. About 90 per cent of this heat is then absorbed by the greenhouse gases and radiated back towards the surface, which is warmed to a life-supporting average of 15 degrees Celsius (59 degrees Fahrenheit) (IPCC, 2014; 2007).

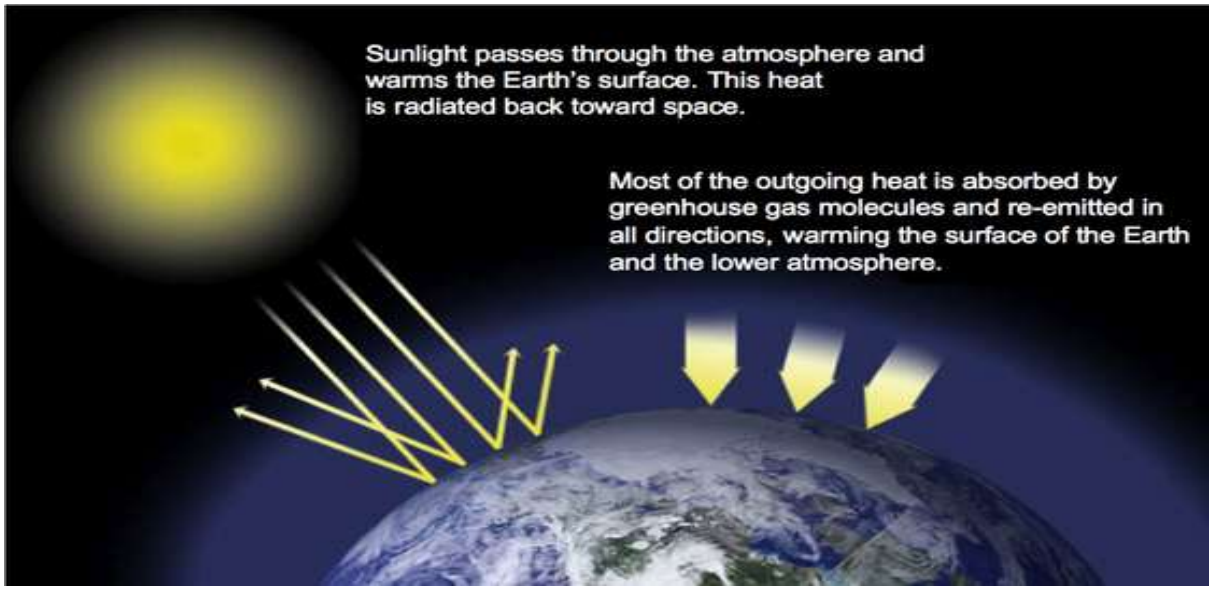

Figure 2: Heat absorbed by greenhouse gases and radiated back towards the surface
Source: http://climate.nasa.gov/causes.

The greenhouse effect occurs as a result of greenhouse gases trapping the sun's heat and keeping it close to the Earth. Anyone who has had parked a closed car in the sun for a few hours on a hot summer day has experienced something like the greenhouse effect. The 'greenhouse effect' refers to how gases in the earth's atmosphere naturally keep the earth warm, similar to how a greenhouse keeps plants warm, hence the name. The Earth's natural greenhouse effect keeps it about 60 degrees warmer than it would be otherwise. This enables us to live comfortably on earth (http://climate.nasa.gov/causes; IPCC, 2014).

Although many 'greenhouse gases' occur naturally, human activities have increased their levels and added new ones. Greenhouse gases of concern include carbon dioxide, methane, nitrous oxide, and fluorinated gases. Scientists say that increased levels of these gases are contributing to climate change (IPCC, 2007). Water vapour is the most abundant greenhouse gas, but human activity is not considered a direct cause of changes in its concentration. However, a warming atmosphere can trigger changes in water vapour levels (IPCC, 2014). Some examples of human activities that contribute to greenhouse gas levels include the following:

i) Burning fossil fuels – oil, petroleum fuels like diesel and petrol, gas and coal;
ii) Industrial processes and mining;
iii) Landfills, septic and sewer systems;
iv) Agricultural practices, including application of chemical fertilizer, manure management and use of pesticides; and
v) Some land use practices, including deforestation.

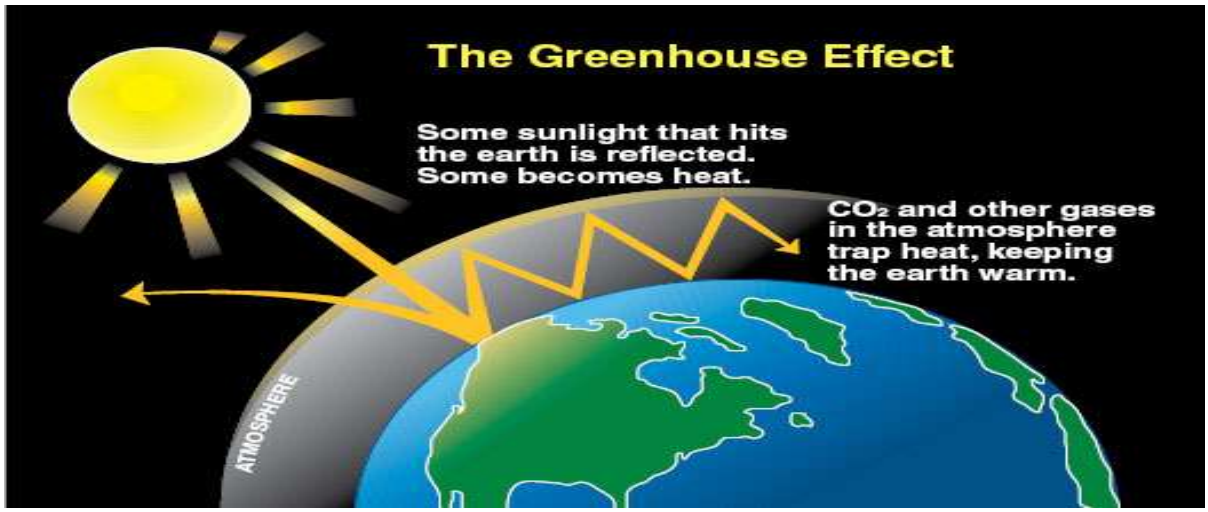

Figure 3: An illustration of greenhouse effect around the Earth surface
Source: http://climate.nasa.gov/causes.

Any human-induced changes in climate will occur against the background of natural climatic variations. Although humans may not completely disrupt the Earth system, we do affect it significantly as we use energy and emit pollutants in our quest to provide food, shelter, and a host of other products for the world's growing population.

Human activities are transforming the global environment, and these global changes have many faces: ozone depletion, tropical deforestation, acid deposition, and increased

atmospheric concentrations of gases that trap heat and warm the global climate. It can safely be said that climate change is currently being caused by human activities which are increasing levels of greenhouse gases in the atmosphere (http://climate.nasa.gov/causes; IPCC, 2014). Most climate scientists agree the main cause of the current global warming trend is human expansion of the 'greenhouse effect' - warming that results when the atmosphere traps heat radiating from Earth towards space (IPCC, 2007). On Earth, human activities are changing the natural greenhouse. Over the last century the burning of fossil fuels like coal and oil has increased the concentration of atmospheric carbon dioxide. This happens because the coal or oil burning process combines carbon with oxygen in the air to make carbon dioxide. To a lesser extent, the clearing of land for agriculture, industry, and other human activities have increased concentrations of greenhouse gases.

These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. Based on data from the United Nation's Intergovernmental Panel on Climate Change, it is estimated that the mean global surface temperature increased by about 0.3 to 0.6 degree Celsius at the end of the nineteenth century. The average global surface temperature warmed by about 0.8° C in the twentieth century and 0.5° C in the past three decades in large part because of human activities (IPCC, 2007). The consequences of changing the natural atmospheric greenhouse are difficult to predict, but certain effects seem likely. A layer of greenhouse gases – primarily water vapour, and including much smaller amounts of carbon dioxide, methane and nitrous oxide – act as a thermal blanket for the Earth, absorbing heat and warming the surface to a life-supporting average temperature. However, human activities have of late accelerated the greenhouse effects: activities like burning fossil fuels, coal, oil and natural gas for transport and electricity generation; and cutting down trees, rainforests and clearing vegetation for various reasons. These activities are causing global warming, which in turn is causing climate change.

Gases that contribute to the greenhouse effect include:

(a) Water vapour. The most abundant greenhouse gas, but importantly, it acts as a feedback to the climate. Water vapour increases as the Earth's atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect.

(b) Carbon dioxide. A minor but very important component of the atmosphere, carbon dioxide is released through natural processes such as respiration and volcano eruptions and through human activities such as deforestation, land use changes, and burning fossil fuels. Carbon dioxide is the primary greenhouse gas that is contributing to recent climate change. Carbon dioxide is absorbed and emitted naturally as part of the carbon cycle, through animal and plant respiration, volcanic eruptions, and ocean-atmosphere exchange. Human activities, such as the burning of fossil fuels, changes in land use and deforestation release large amounts of carbon to the atmosphere, causing carbon dioxide concentrations in the atmosphere to rise. Humans have increased atmospheric carbon dioxide concentration by a third since the Industrial Revolution began (IPCC, 2007). This is the most important long-lived 'forcing' of climate change.

(b) Methane. A hydrocarbon gas produced both through natural sources and human activities, including the decomposition of wastes in landfills, agriculture, and especially rice cultivation, as well as ruminant digestion and manure management associated with domestic livestock. On a molecule-for-molecule basis, methane is a far more active greenhouse gas than carbon dioxide, but also one which is much less abundant in the atmosphere.

(c) Nitrous oxide. A powerful greenhouse gas produced by soil cultivation practices, especially the use of commercial and organic fertilizers, fossil fuel combustion, nitric acid production, and biomass burning.

(d) Chlorofluorocarbons. Synthetic compounds entirely of industrial origin used in a number of applications, but now largely regulated in production and release to the atmosphere by international agreement for their ability to contribute to destruction of the ozone layer. They are also greenhouse gases.

Since so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks. For example, a change in the usual timing of rains or temperatures can affect when plants bloom and set fruit, when insects hatch or when streams are their fullest. This can affect historically synchronized pollination of crops, food for migrating birds, spawning of fish, water supplies for drinking and irrigation, forest health, and more.

2.1.2 The Recent Role of Human Activity

In its Fourth and Firth Assessment Reports, the Intergovernmental Panel on Climate Change (IPCC), a group of 1,300 independent scientific experts from countries all over the world under the auspices of the United Nations, concluded there is a more than 90 per cent probability that human activities over the past 250 years have warmed our planet (IPCC, 2007; 2014). The IPCC was established by United Nations Environment Programme (UNEP) and WMO to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation.

Since the Industrial Revolution began around 1750, human activities have contributed substantially to climate change by adding carbon dioxide and other heat-trapping gases to the atmosphere. These greenhouse gas emissions have increased the greenhouse effect and caused Earth's surface temperature to rise. The primary human activity affecting the amount and rate of climate change is greenhouse gas emissions from the burning of fossil fuels.

The industrial activities that our modern civilization depends upon have raised atmospheric carbon dioxide levels from 280 parts per million to 379 parts per million in the last 150 years. When fossil fuels - coal, oil and natural gas - are burnt they release carbon dioxide into the atmosphere. Because of this the layer of greenhouse gas is getting thicker, which is in turn making the Earth warmer. Thus, the ongoing unlimited burning of fossil fuels is currently the major cause of climate change.

The panel also concluded there is a better than 90 per cent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperature over the past 50 years (IPCC, 2007; http://www.ipcc.ch/pdf/assessment-report). They said the rate of increase in global warming due to these gases is very likely to be unprecedented within the past 10,000 years or more. The panel's full summary for the policy makers report is online at http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

This means the climate will continue changing, becoming warmer and drier in many areas, and wetter in others. Droughts will destroy croplands and millions of people will have to

move to cooler countries. Scientists now suggest that extreme weather events will become more common (IPCC, 2007).

As earlier stated, climate change is not only a consequence of natural causes but also of human activities such as over consumption of fossil fuels, deforestation and raising of excessive herds of livestock. The current scientific consensus is that increasing atmospheric concentrations of greenhouse gases (carbon dioxide, methane and chlorofluorocarbons) are causing global warming. A significant rise in temperature can trigger several situations and events, such as melting of the ice sheets, the death of some significant marine life and other biodiversity, and effects on agriculture, tourism, other economic activities and human health.

The climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them. The countries that pollute most and contribute hugely to climate change, however, are not the ones who suffer most from its impacts. For example, the United States of America's per capita emission level of greenhouse gases is 22 tons while Bangladesh's is a modest 200 kilograms (Adams, 2003).

The rich countries and emerging economies like China, the United States of America, Japan and India pollute enormously, while poor countries like Bangladesh, Uruguay and Zambia contribute less to causes of climate change. At the community level in Third World countries like Zambia and Malawi, major contribution to the cause of climate change is the cutting down of forests. No limit is set to cutting of trees, bamboo and other forest resources, which directly or indirectly have adverse impacts on the environment. Forest degradation and soil erosion mean the increased likelihood of drought, and floods. Natural disaster, whether aggravated by human activities or not, further impacts both the environment and the population, worsening existing problems of poverty in Third World countries.

While the indigenous people may lack formal education and awareness about climate change, they feel, see and understand that some changes are happening, which directly affect their economic production and livelihood.

2.2 Effects of Climate Change on Indigenous People

Some obvious linkages exist between climate change and society, including impacts on the vulnerable populations often unable to withstand long-term reoccurrence of climate hazards

such as drought and floods (Mohamed Salih, 2001). All the regions of the world will be impacted by climate change. However, the nature of the impacts and associated vulnerability will vary geographically, depending on the exposure and development status across regions and their ability to respond and adapt to the likelihood of the changes in the climate. Although climate change has both positive and negative effects, studies so far have shown that negative impacts of global warming on agriculture, food security, health, economy, culture and environment far outweigh any positives (http://www.skepticalscience.com; http://www.worldbank.org).

Climate change is considered to be a critical global challenge and recent events have demonstrated the world's growing vulnerability to climate change. The impacts of climate change range from affecting agriculture to further endangering food security, to rising sea-levels and the accelerated erosion of coastal zones, increasing intensity of natural disasters, species extinction and the spread of vector-borne diseases. Indeed global warming means more than just rising temperatures: climate change affects all aspects of the climate, making rainfall less predictable, changing the character of the seasons and increasing the likelihood or severity of extreme events such as floods and drought.

The precipitous rise in the world's human population and humankind's ever-increasing dependence on fossil fuel-based ways of living have played a significant role in raising the concentration of atmospheric greenhouse gases. As a result, global temperatures are increasing, the sea level is rising, and patterns of precipitation are changing. At the same time, storm surges, floods, droughts and heat waves are becoming more frequent and severe. The consequent decline in agricultural production and other productivity, increasing freshwater scarcity, and spread of infectious diseases, are degrading local livelihoods and diminishing human well-being around the world (http://voices.nationalgeographic.com; IPCC, 2014).

Indigenous peoples are the ones affected by the climate change the most, although they have contributed little to its causes (Salick and Byg, 2010; Garvey, 2008). This is largely a result of their historic dependence on local biological diversity, ecosystem services and cultural landscapes as a source of their sustenance, well-being, and resilience.

The effects of global warming are the environmental and social changes caused (directly or indirectly) by human emissions of greenhouse gases. There is a scientific consensus that climate change is occurring, and that human activities are the primary driver (IPCC, 2014; 2007). Many impacts of climate change have already been observed, including glacier retreat, changes in the timing of seasonal events (e.g., earlier flowering of plants), and changes in agricultural productivity, environment and other human, animal and plant life.

Future effects of climate change will vary depending on climate change policies and social development. The two main policies to address climate change are reducing human greenhouse gas emissions (climate change mitigation) and adapting to the impacts of climate change (http://climatechange.worldbank.org).

Climate change is attracting even more attention from the media, academics, politicians as well as businesses, as evidence mounts about its scale and seriousness, and the speed at which it is affecting the world. However, rarely does its impact on indigenous groups of people get a mention, even though they are among the worst affected. The close relationship of some indigenous people with their natural environment makes them especially sensitive to the effects of global warming. In some cases, people's ways of life and even their very existence are being threatened by climate change. Indigenous people who are mostly found in rural communities, whose livelihoods are intimately tied to the environment, are profoundly affected by the climate, yet have received little attention in the climate change literature. Poor rural communities residents face the challenge of adapting to climate change through a process of building their ability to adapt and reducing their vulnerability to the impacts of climate change.

Climate change touches all the resources that we depend on in life. In particular, the current and future impacts of climate change will hurt the well-being of the poor and vulnerable. Climate change puts extra burdens on the social and economic challenges that the poorest people already face. Their vulnerabilities will be emphasized and increased due to the dependence of their livelihoods on climate sensitive natural resources and their weak social protection structures. By directly eroding the resources that poor people depend on for their livelihoods, climate change makes it easier for such people to fall into poverty and harder for the poorest to escape from it.

Climate change is a major threat to sustainable development in the world, especially developing countries. Climate change is already affecting indigenous communities. The identity of indigenous peoples is inextricably linked with their lands, which are located predominantly at the social-ecological margins of human habitation - such as small islands, tropical forests, floodplains, high-altitude zones, coasts, desert margins and the circumpolar Arctic. Here at these margins, the consequences of climate change include effects on agriculture, pastoralism, fishing, hunting and gathering and other subsistence activities, including access to water.

2.2.1 Climate Change as a Human Rights Issue

For indigenous people, climate change is not only an environmental issue but also a human rights issue and a question of cultural survival. Regional and global assessments confirm that the Earth's climate is changing (IPCC, 2007). Current and projected levels of exposure to climate-related sensitivities, as well as limits and restrictions to adaptive capacity, mean that some environments and peoples are more exposed to climate change and are significantly more vulnerable to its impacts and long-term consequences than others.

As earlier alluded to, indigenous peoples mostly depend on natural resources for their livelihood and they often inhabit diverse but fragile ecosystems. At the same time, indigenous people are among the world's most marginalized, impoverished and vulnerable people. Hence, while indigenous people bear the brunt of the catastrophe of climate change, they have minimal access to resources to cope with the changes. The consequences of ecosystem changes have implications for indigenous people's use, protection and management of wildlife, fisheries, wetlands and forests, affecting the customary uses of culturally and economically important species and resources.

To indigenous people, climate change is, however, not simply a matter of physical changes to the environments in which they live. Many consider climate change a threat to their livelihoods and they fear that their economy and resource use will be threatened, followed by an erosion of social life, traditional knowledge and cultures. Hence, to indigenous peoples climate change is not only an environmental issue but also a human rights issue. Despite the impact of climate change on indigenous people and their traditional knowledge, international experts most often overlook the rights of indigenous people as well as the potentially

invaluable contributions that indigenous people's traditional knowledge, innovations and practices can bring to the global search for climate change solutions.

As the global discourse on climate change focuses on understanding how we can scientifically and technologically adapt to, as well as mitigate climate change, indigenous people are faced with the prospect of climate change further challenging their abilities to adapt to and cope with environmental and social changes.

The consensus of the world's climate scientists is that man-made greenhouse gas emissions are creating significant changes in the global climate system (IPCC, 2007). Higher temperatures, rising sea levels and more extreme storms will fundamentally change where and how we live. International human rights law recognizes and protects the distinct rights of indigenous peoples whose way of life comes under threat from particular circumstances, such as climate change.

At the Seventh Session of the United Nations Permanent Forum on Indigenous Issues, held in April 2008, the issue of climate change and indigenous people was placed firmly on the international agenda. At the session, indigenous peoples from across the globe, shared the concern that they would bear the brunt of climate change impacts, while at the same time being called upon to share their traditional knowledge on biodiversity and land management to develop national mitigation strategies (http://www.un.org/climatechange).

The forum concluded that mitigation and adaptation strategies must be holistic and take into account not only the ecological dimensions of climate change, but also the social impacts, human rights, equity and environmental justice.

2.2.2 Indigenous People's Participation in International Climate Change Discussions

In the national, regional and international processes, such as the UNFCCC, where climate change mitigation policies are discussed, negotiated and designed, indigenous people in many parts of the world have found it very difficult to get their voices heard and their concerns taken into consideration (www.un.org/esa/socdev).

Unlike the Convention on Biological Diversity (CBD), where the International Indigenous Forum on Biodiversity (IIFB) is an advisory body to the Convention, the UNFCCC is not providing similar space for indigenous peoples. In addition to the obstacles to their

participation and influence, most indigenous people find the UNFCCC too scientific and difficult to understand and are not aware of the various processes in the UNFCCC such as the Clean Development Mechanisms (CDM), carbon emissions trading and Reduced Emissions from Deforestation and Degradation.

2.2.3 Indigenous People are especially Vulnerable to Climate Change

Climate change poses threats and dangers to the survival of indigenous communities worldwide. Indigenous people are among the first to face the direct consequences of climate change, owing to their dependence upon, and close relationship with the environment and its resources. Climate change exacerbates the difficulties already faced by vulnerable indigenous communities, including political and economic marginalization, loss of land and resources, human rights violations, discrimination, and unemployment especially among the youths (http://www.culturalsurvival.org/publications).

Indigenous peoples tend to live close to the land. They are mostly subsistence farmers, herders, fishers, and hunters, with millennia of collective traditional knowledge about the ecology of their surroundings. With that knowledge and experience, even tiny changes in water cycles, wildlife, soil, and weather are readily apparent. An indigenous farmer notices that a certain insect is slightly less abundant this year or that a particular flower is blooming a few days earlier than usual.

Unfortunately, the same closeness to the land that has given indigenous people early warning about global warming also means that they suffer the consequences of it to a far greater degree than others. The trends of history and hegemony have left many indigenous people living on land that is already marginal, so even relatively small changes in temperature or rainfall have an outsized consequence.

The Masai in East Africa, who originally grazed their cattle on lush grasslands, have been pushed by colonization and the power of dominant societies onto semi-arid scrubland where their herds can find just enough food under the best of climatic conditions. A drought or heat wave can spell disaster for them. If melting glaciers and reduced winter snowpack in mountains cut the amount of water available in the lowlands, an indigenous subsistence farmer in the valley below often does not have the technical or financial option of drilling

into aquifers or using irrigation, and if his or her crops fail, the consequence can mean starvation for his or her family.

Of course, indigenous people have dealt with climate change and environmental upheaval for thousands of years; adaptability and resourcefulness are the hallmarks of any indigenous culture. Moreover, though not easy, indigenous people collectively have developed considerable skills and presence in international bodies like the United Nations, where they are pressing their case about climate change (http://www.un.org/climatechange).

Impacts of climate change on indigenous people worldwide include the following:

(a) In tropical and sub-tropical areas, an increase in diseases associated with higher temperatures and vector-borne and water-borne diseases like cholera, malaria and dengue fever;
(b) Worsening drought conditions and desertification, leading to more forest fires that disrupt subsistence agriculture, hunting and gathering livelihoods, as well as serious biodiversity loss;
(c) Distinct changes in the seasonal appearance of birds, the blooming of flowers, etc. These now occur earlier or are decoupled from the customary season or weather patterns;
(d) In arid and semi-arid lands: excessive rainfall and prolonged droughts, resulting in dust storms that damage grasslands, seedlings, other crops and livestock;
(e) In the Arctic, stronger waves, thawing permafrost and melting mountain glaciers and sea-ice, bringing coastal and riverbank erosion;
(f) Smaller animal populations and the introduction of new marine species due to changing animal travel and migration routes;
(g) In Boreal Forests, new types of insects and longer-living endemic insects (e.g. spruce beetles) that destroy trees and other vegetation;
(h) In coastal regions and small-island states, erosion, stronger hurricanes and typhoons, leading to the loss of freshwater supplies, land, mangrove forests and dislocation (environmental refugees);
(i) Increasing food insecurity due to declining fish populations and coral bleaching;
(j) Crop damaging pest infestations (e.g. locusts, rats, spruce beetles, etc.), and increasing food costs due to competition with the demand for biofuels; and

(k) Extreme and unprecedented cold spells resulting in health problems (e.g. hypothermia, bronchitis, and pneumonia, especially for the old and young). (http://climatechange.worldbank.org).

A brief overview of climate change effects on indigenous people in selected parts of the world has been outlined in the sections which follow below.

Africa

In the particular case of Africa, studies on the consequences of climate change on the local communities seem scarce. However, Gyampoh *et al*. (2007) have succinctly reported Africa-wide recent experience with negative consequences of climate change. Africa is vast - about as big as the United States of America, China, India and Australia combined. Unfortunately, the continent is facing the greatest catastrophe in human history, climate change. Climate change has been identified as a leading human and environmental crisis of the twenty-first century. Climate change poses a clear danger to lives and livelihoods across Africa. No continent will be struck as severely by the impacts of climate change as Africa (IPCC, 2007). Given its geographical position, the continent will be particularly vulnerable due to the considerably limited adaptive capacity, exacerbated by widespread poverty and the existing low levels of development. The impact of climate change presents a new hurdle in the fight against extreme poverty and disease. Experts predict that in many sub-Saharan African countries, climate change could mean more frequent drought and floods, water scarcity, and increased health challenges such as under-nutrition and various diseases (Gyampoh, *et al*., 2007; Adams, 2003). These new challenges will not only make achieving the Millennium Development Goals more difficult, but could also threaten some of the progress already made in fighting extreme poverty and disease.

Africa's human existence and development is under threat from the adverse impacts of climate change – its population, ecosystems and unique biodiversity will all be the major victims of global climate change. This situation is further worsened by its poor state of economic development and low adaptive capacity. Extreme poverty, frequent natural disasters such as droughts and floods, and heavy dependence of agriculture on rainfall further increases the continent's vulnerability.

The actual and potential impacts of climate change in Africa are large and wide ranging, affecting many aspects of people's everyday lives. Many climate models predict negative impacts of climate change on agricultural production and food security in large parts of sub-Saharan Africa (Adams, 2003). Higher temperatures, the drying up of soils, increased pest and disease pressure, shifts in suitable areas for growing crops and livestock, increased desertification in the Sahara region, floods, deforestation, and erosion are all signs that climate change is already happening and represents one of the greatest environmental, social and economic threats facing Africa: 'The impact of climate change will fall disproportionate on the world's poorest countries, many of them here in Africa. Poor people already live on the front lines of pollution, disaster, and degradation of resources and land. For them, adaptation is a matter of sheer survival' (Gyampoh, *et al*., 2007: 4).

Water resources in particular comprise one sector that is highly dependent on and influenced by climate change. A number of countries in Africa already experience considerable water stress as a result of insufficient and unreliable rainfall that changes rainfall patterns or causes flooding.

Some of the poorest parts of the continent will be the worst hit. The interior of the continent and particularly the Sahara and southern Africa will be most seriously affected, experiencing the most extreme temperature rises coupled with severe fluctuations in rainfall. Global warming in Africa could cause temperature rises double those elsewhere (IPCC, 2007). The consequence would be dramatic declines in rainfall and a fall in crop yields that could make previous famines look like small tragedies. Desertification could accelerate around the Sahara. There are likely to be severe water shortages in many parts of the continent. However, some parts of the continent may experience severe floods. Diseases such as malaria, dengue fever and cholera may increase. As many as 67 million more people could be at risk of malaria epidemics by the 2080s (IPCC, 2014).

Concerns over the negative impact of climate change have strengthened fears that environmental degradation and demographic pressures will displace millions of people in Africa and create serious social upheaval. Most scientists studying the potential impact of climate change have predicted that Africa is likely to experience higher temperatures, rising sea levels, changing rainfall patterns and increased climate variability, all of which could

affect much of its population (see Adams, 2003; Gyampoh, *et al*., 2007; Garvey, 2008; Salick and Byg, 2010).

Climate change is real, and its impact is already being felt. It has affected the people of Africa and its food systems that are already vulnerable. Agriculture, which provides a livelihood for about three-quarters of Africa's population, is mainly rain fed (IPCC, 2014). Severe and prolonged droughts, flooding, and loss of arable land due to desertification and soil erosion are reducing agricultural yields and causing crop failure and loss of livestock, which endanger rural and pastoralist populations. The Horn of Africa's pastoralist areas (Ethiopia-Kenya-Somalia border) have been severely impacted by recurrent droughts (Adams, 2003). Indigenous people point to an increase in human rights violations, displacements and conflicts due to expropriation of ancestral lands and forests for biofuel plantations (soya, sugarcane, jatropha, oil-palm, maize, etc.), as well as for carbon sink and renewable energy projects (hydropower dams, geothermal plants), without the free, prior and informed consent of indigenous people.

Elsewhere studies show that specific instances of indigenous people being harmed by climate change mitigation measures include the case of a Dutch company whose operations include planting trees and selling sequestered carbon credit to people wanting to offset their emissions caused by air travel. In March 2002, its project was certified by the Forestry Stewardship Council (FSC) and from 1999 to 2002 over 7,000 hectares of land were planted in Uganda (http://www.un.org/esa/socdev/unpfii/en/EGM_CS08.html).

The Ugandan Wildlife Authority (UWA), responsible for managing all national parks, forced indigenous people to leave the area. Forced evictions continued to 2002, leading indigenous people to move to neighbouring villages, caves and even mosques. In 2004, over 50 people were reported killed in the process of displacements. (Detailed papers and documentations on indigenous people's displacements are available online at http://www.un.org/esa/socdev/ unpfii/en/ EGM_CS08.html).

Potential climate change impacts on the ecosystem and communities among the Masai indigenous people in East Africa

The Masai are aware that seasons are changing. The rainfall is less predictable. They are being compelled to move their livestock more frequently than they used to. For example, the cold season used to last a month (July) and was also characterized by showers and sometimes moderate rainfall. Nowadays the cold weather lasts from June to end of August and is mostly just cold and dry in this part. From existing records, the area has experienced frequent droughts in the last three decades (Oakley, *et al*., (1991).

Frequent droughts are exerting a major impact on people's livelihoods, increasing their vulnerability to food insecurity by reducing their coping abilities and often leading to massive losses in livestock numbers. Besides the loss of livestock, water sources have been reported to dry up sooner, while other hitherto reliable sources such as rivers and springs continue to dry up, leading to unprecedented scarcity in areas where the commodity had always been plenty or relatively available.

Traditional knowledge about herbs, grasses, fruits, tubers and other knowledge about the environment is diminishing because many of those plants and wildlife are disappearing and so the youth cannot be taught effectively about them. The transformation of economic activities associated with climate change has resulted in the decline, if not loss, of cultural values at the community level.

The study by Oakley and others (1991) reveals that the Masai's *Enturuj* food sharing concept among young men and the traditional practice of *Inkishu lipai* (milk cows) best illustrate this. As livestock and other economic resources have been monetized or given market value, traditional institutions and indigenous systems of relations have been corrupted. As communities adapt to new conditions, they employ new systems of survival, which are hardly grounded on their customary institutions. The market economy has come to define the pastoralists' survival system, which unfortunately continues to erode significant cultural institutions at the community level.

One of the major areas to be affected by climate change in Africa is the Kalahari Desert (Adams, 2003; Garvey, 2008; Salick and Byg, 2010). The Kalahari sands found in the desert also cover much of Western Zambia where we find the Barotse plains. According to Salick and Byg (2010), there are 2.5 million kilometres (km) of dunes in Southern Africa which are

covered in vegetation and used for grazing. However, the rise in temperatures and the expected dune expansion along with increased wind speeds will result in the region losing most of its vegetation cover and, hence, becoming less feasible for indigenous people living in the region. As their traditional resource base diminishes, the traditional practices of cattle and goat farming will no longer survive. There are already areas where indigenous peoples are forced to live around government drilled bores for water and depend on government support for their survival. Food security is a major issue for indigenous people residing in the deserts and they are on the frontline of global climate change (Salick and Byg, 2010).

Asia

Asia is the most populous continent in the world. In Asia, past and present climate trends and variability have been characterized by increasing temperatures. According to the scientists who contributed to the writing of the Fifth Assessment Report of the IPCC, hundreds of millions of people in Asia will be affected by coastal flooding and land loss as global temperatures rise, ice caps melt and sea levels rise (IPCC, 2014). In addition, climate change will slow down economic growth, further erode food security and trigger new poverty traps.

The authors warn that some other climate change effects will be global. Climate change throughout the twenty-first century will lead to increases in ill-health in many regions, as compared to a baseline without climate change. Examples include greater likelihood of disease, and death due to more intense heat-waves and fires; increased likelihood of under-nutrition resulting from diminished food production in poor regions often inhabited by indigenous people; and increased risks from food-borne and water-borne diseases.

Other potential crises highlighted by the IPCC Fifth Assessment Report include the likelihood that yields of major crops such as maize, wheat and rice are likely to decline at rates of up to two per cent a decade, at a time when demands for these crops – triggered by world population increases – are likely to rise by 14 per cent. At the same time, coral reefs face devastating destruction triggered by increasing amounts of carbon dioxide dissolving in sea water and acidifying Earth's oceans (IPCC, 2014).

The report makes grim reading. This comprehensive scientific assessment makes clear that climate change is having a growing impact in Asia and around the world, and that the risks of

catastrophic consequences increase every day as more greenhouse gas pollution is pumped into the atmosphere.

In the Himalaya's high altitude regions of Asia, glacial melts affect hundreds of millions of rural dwellers who depend on the seasonal flow of water. The Himalayas span five countries: India, Nepal, Bhutan, China, and Pakistan, with the first three countries having sovereignty over most of the range. The flora and fauna of the Himalayas vary with climate, rainfall, altitude, and soils. The climate ranges from tropical at the base of the mountains to permanent ice and snow at the highest elevations. The amount of yearly rainfall increases from west to east along the southern front of the range. This diversity of altitude, rainfall and soil conditions combined with the very high snow line supports a variety of distinct plant and animal communities. For example, the extremes of high altitude (low atmospheric pressure) combined with extreme cold allow extremophile organisms to survive (Aitken, 2003).

The unique floral and faunal wealth of the Himalaya mountain range is undergoing structural and compositional changes due to climate change. The increase in temperature may shift various species to higher elevations. The oak forest is being invaded by pine forests in the Garhwal Himalayan region. There are reports of early flowering and fruiting in some tree species, especially *rhododendron*, apple and *box myrtle* (IPCC, 2014).

The Himalayas have the third largest deposit of ice and snow in the world, after Antarctica and the Arctic (Aitken, 2003). The Himalayan range encompasses about 15,000 glaciers, which store about 12,000 km^3 (3,000 cubic miles) of fresh water. Its glaciers include the Gangotri and Yamunotri (Uttarakhand) and Khumbu glaciers (Mount Everest region), Langtang glacier (Langtang region) and Zemu (Sikkim).

Owing to the mountains' latitude near the Tropic of Cancer, the permanent snow line is among the highest in the world at typically around 5,500 metres. In contrast, equatorial mountains in New Guinea, the Rwenzoris and Colombia have a snow line some 900 metres lower. The higher regions of the Himalayas are snowbound throughout the year, in spite of their proximity to the tropics, and they form the sources of several large perennial rivers, most of which combine into two large river systems. There might be more water in the short-term but less in the long-term as glaciers and snow cover shrink (Aitken, 2003).

The Himalayan glaciers cover about three million hectares or 17 per cent of the mountain area. They are the source of water for numerous rivers that flow across the Indo-Gangetic plains. These glaciers store about 12,000 km^3 of freshwater. The Himalayan glaciers form a unique reservoir which supports perennial rivers such as the Indus, Ganges and Brahmaputra, which in turn, are the lifeline of millions of people living in South Asian countries (such as Pakistan, Nepal, Bhutan, India and Bangladesh). The Gangetic basin alone is home to 500 million people, about 10 per cent of the total human population in the region. But these glaciers are receding at a very fast pace, and if the temperatures continue to rise at the present rate, then the likelihood of them disappearing by the year 2035, and perhaps sooner, is very high. Increase in anthropogenic emission of greenhouse gases, high population density near these glaciers, and consequent deforestation and land-use changes have also affected these glaciers adversely (IPCC, 2007).

The 30.2 km long Gangotri glacier has been receding at a very alarming rate in recent years. Scientific studies have shown that between 1842 and 1935, the glacier was receding at an average of 7.3 metre every year; the average rate of recession between 1985 and 2001 was about 23 metre per year. The current trends of glacial melts suggest that the Ganges, Indus, Brahmaputra and other rivers that crisscross the northern Indian plain could likely become seasonal rivers in the near future as a consequence of climate change, and could likely affect the economies in the region (IPCC, 2014).

In Asia's tropical rainforests, a haven for biodiversity, as well as indigenous peoples' cultural diversity, temperatures are expected to rise two to eight degrees Celsius by 2080 (IPCC, 2007), rainfall may decrease, prompting crop failures and forest fires.

People in low-lying areas of Bangladesh could be displaced by a one-metre rise in sea levels. Such a rise could also threaten the coastal zones of Japan and China. The impact will mean that salt water could intrude on inland rivers, threatening some fresh water supplies.

The poor, many of whom are indigenous people, are highly vulnerable to climate change in both rural and urban areas because of their limited access to profitable livelihood opportunities and will be exposed to more flood and other climate-related risks in areas where they are forced to live.

Severe climate change impacts are similarly felt by indigenous peoples in Asia as shown in the cases of Bangladesh, Myanmar, Malaysia, Vietnam, and the Philippines (http://www.culturalsurvival.org). Researchers from these five countries have demonstrated that climate change impacts have effects both on the physical and psychological states of indigenous peoples and the cultural structures of indigenous communities. Indigenous peoples in Asia still maintain spiritual relationships with their lands, territories and resources. This is commonly seen in the research findings from Asia, a region where indigenous communities maintain many sacred sites and groves in their forests and other landscapes, and mainly depend on subsistence farming of diverse food crops as well as on wild food crops and medicinal plants (http://www.culturalsurvival.org).

Meanwhile, some indigenous people in Malaysia and Indonesia have also faced displacements by the aggressive expansion of oil palm plantations for biofuel production. Likewise, nuclear waste sites and hydroelectric dam-building displace indigenous people from their ancestral territories (http://www.un.org/esa/socdev/ unpfii/en/EGM_CS08.html).

Arctic

Polar region of the Arctic is now experiencing some of Earth's most rapid and severe climate change. Indigenous people, their culture and the whole ecosystem that they interact with is very much dependent on the cold and the extreme physical conditions of the Arctic region. Indigenous people depend on polar bears, walrus, seals and caribou, herding reindeer, fishing and gathering not only for food and to support the local economy, but also as the basis for their cultural and social identity (ACIA, 2005). Among concerns facing indigenous people: availability of traditional food sources, growing difficulty with weather prediction and travel safety in changing ice and weather conditions.

According to indigenous people in the polar region, sea ice is less stable, unusual weather patterns are occurring, vegetation cover is changing, and particular animals are no longer found in traditional hunting areas. Local landscapes, seascapes and icescapes are becoming unfamiliar, making indigenous people feel like strangers in their own land (ACIA, 2005).

People across the Arctic region report changes in the timing, length and character of the seasons, including more rain in autumn and winter and more extreme heat in summer. In several Alaskan villages, entire indigenous communities may have to relocate due to thawing

permafrost and large waves slamming against the west and northern shores. Coastal indigenous communities are severely threatened by storm-related erosion due to melting sea ice. Up to 80 per cent of Alaskan communities, comprising mainly indigenous people, are vulnerable to either coastal or river erosion (ACIA, 2005).

A study conducted by the World Bank in Nunavut reveals that elders can longer predict the weather using their traditional knowledge. Due to drop in water levels, indigenous hunters are no longer able to travel by boats to caribou hunting grounds because of shallow waters. Hence, many important summer hunting grounds cannot be reached. Storage of traditional foods for the winter months is also a major issue for indigenous people in the region, especially in the Northwest Territories due to warmer weather. For example, drying and smoking foods is more difficult due to summer heat undermining the storage of traditional foods for the winter (http://climatechange.worldbank.org).

In Finland, Norway and Sweden, rain and mild winter weather often prevents reindeer from accessing lichen, a vital food source, forcing many herders to feed their reindeer with fodder, which is expensive and not economically viable in the long-term. For Saami communities, reindeers are vital to their culture, subsistence and economy (ACIA, 2005).

Climate change's impact on Amazonian indigenous people

Human habitation in the Amazon can be traced as far back as 12,000 years ago or perhaps earlier (http://amazonwatch.org). Over this time, the rainforest's indigenous inhabitants have evolved to become so attuned to the Amazon's physical environment that even mild disturbances to the region's complex ecological systems can pose threats to their welfare and survival. Climate change and its implications on the Amazon region – ranging from increased frequencies of drought and forest fire to potential biome collapse – may therefore spell catastrophe for indigenous subsistence systems, which are intricately tied to predictable and well-established seasons.

According to a World Bank study (http://climatechange.worldbank.org), many indigenous groups in the Amazon are already feeling the effects of climate change as the rainforest's natural rhythms are altered. With temperatures rising, hydrological cycles changing, and seasons occurring outside their usual time of year, the study found that indigenous food production systems in many parts of the Colombian Amazon have been badly hit. The study

indicates that these changes also have direct effects on human health. In addition to decreasing fish stocks, changing patterns of river fluctuation can potentially improve breeding conditions for disease vectors, increasing the prevalence of malaria and other diseases. Moreover, crop failures and declines in the availability of protein in the form of fish, for example, may have irreversible and harmful effects on the growth and development of children in affected regions, which include the Tikuna, Tupi, and Witodo indigenous groups' territories.

In the Xingu National Park of the Brazilian Amazon, the Kamayurá are experiencing similar hardships. An investigation by World Bank and *The New York Times* revealed that the decimation of local fish stocks by rising temperatures and decreasing precipitation has become so severe that Kamayurá people have resorted to eating ants on their traditional flatbreads, in the absence of fish which was their favourite dish (http://www.nytimes.com; http://climatechange.worldbank.org). According to the studies, drier weather conditions result in the Kamayurá also facing the newfound threat of forest fires in an area of the rainforest that previously was too moist to ignite.

For the Yanomami of the Brazilian Amazon, it is clear that climate change is unfolding and that it threatens their very existence. In 2009, during an international indigenous people's rights campaign in Europe, Shaman Davi Kopenawa Yanomami attested to his people's struggle:

> 'You are worried about climate change. It is already with us in the Amazon. The rains come late, the sun behaves in a strange way. The weather is becoming less predictable. The world is ill. The lungs of the sky are polluted. We know it is happening and something should be done by all of us to find solutions' (http://amazonwatch.org).

Central and Eastern Europe, Russian Federation, Central Asia and Trans-Caucasia

Survival of indigenous people in these areas, who depend on fishing, hunting and agriculture, also depends on the success of their fragile environment and its resources. As bears and other wild game disappear, people in local villages will suffer particular hardships. Changes in reindeer migration and foraging patterns, sparked by fluctuating weather patterns, cause problems also in this region, whose indigenous people have witnessed less predictable and unstable weather and shorter winters (Garvey, 2008; http://www.culturalsurvival.org).

According to Vinyeta and Lynn (2012), indigenous people have also noticed the arrival of new plant species that thrive in rivers and lakes, including the small flowered duckweed which has made survival difficult for some fish species. New bird species have also arrived and birds now stay longer than before. Worse, unique indigenous cultures, traditions and languages will face major challenges maintaining their diversity.

2.2.4 Indigenous Knowledge at risk among Indigenous People

Indigenous people world-over rely heavily on the health and integrity of their ecological systems (Atteh, 1992). Their cultures, norms, values and practices revolve around land, water, air, sun, flora and fauna, their relationships with the living Earth, the seen and the unseen, as well as with the past and the future. Thus, changes to the ecosystem brought about by the variability of the climate have affected their life ways.

Climate variability, such as changes in rainfall patterns, have resulted in food insecurity and a significant decline in the practice of agricultural rituals and other productivity activities which are critical in indigenous people's lives. This has seriously impinged on kin relations and other indigenous socio-cultural practices. While indigenous people have developed and used their cosmologies and traditional knowledge systems in their communities even in addressing the adverse impacts of climate change, the basic spiritual and value foundations of these systems are at risk. If their knowledge systems, which are closely linked with their day-to-day relations with their landscapes are undermined, their vulnerability to climate change further increases.

Thus, indigenous people's vulnerabilities to climate change need to be looked at several levels: 1) in terms of its impacts to the physical landscapes and people's physical and social well-being; 2) in terms of the human rights impacts, the psycho-cultural impacts and effects on the traditional knowledge and customary governance systems of indigenous peoples; and 3) differentiated impacts on gender and also on age groups. This multi-faceted way of analyzing the impacts of climate change is important as the usual ways of governments and corporations towards adapting and mitigating climate change employ 'one- size-fits-all' approaches, which are insensitive to cultural, economic, gender and intergenerational specificities, especially among indigenous people. Thus, solutions for mitigating climate change sometimes lead to violations of basic human rights and fundamental freedoms of

indigenous people. Approaches, which basically rely on the markets, are not very appropriate and are very inadequate in addressing these realities of indigenous people.

The United Nations World Commission on Environment and Development found in 1987 that social discrimination, cultural barriers, and the exclusion of (indigenous people) from national political processes makes these groups vulnerable and subject to exploitation. They become the victims of what could be described as cultural extinction (Bates, *et al*., 2009). In Canada, a study conducted by Johnson, (1992) reveals that the process of acquiring indigenous people's lands for agriculture, forestry, mining and settlements was rooted in an official policy of cultural extermination which continued for several generations. In concert with the churches, indigenous people's children were removed from their communities year after year for the entire school season.

The indigenous people like the Dene in the Canadian Arctic regions were prevented from speaking their languages and were prevented from practising their traditional ceremonies in respect for Mother Earth and their ancestors. Separating the children from the grandparents and other elders in local communities resulted in many of indigenous people losing touch with traditional resource uses and knowledge of the land. The Government of Canada did not succeed. The traditions, cultures, languages, institutions and beliefs of many indigenous people like the Dene live on and grow stronger every day.

Two important things have kept the indigenous people of Canada strong and together. The first is their tremendous sense of community and family. Their traditional means of teaching - with the grandparents teaching the young while the parents provide for the family - remains today within their communities; it has ensured that the young people recover, restore and revitalize their traditions, their languages and their way of life. The second is that *most indigenous people in Canada still have the land.* Without the land, indigenous people's knowledge of the land and the respect that they hold for the land, their communities and their way of life would not exist because *the land and the people are one.* A land base and extensive traditional environmental knowledge have ensured the cultural survival of most indigenous people in Canada.

Studies by Bates, *et al*., (2009) reveal that the boreal forest in Manitoba is almost roadless but is home to more than 33,000 treaty indigenous people living in some 30 communities.

To Manitoba's northern people, there are no frontiers, wilderness or empty lands; the forest is their homeland. Manitoba's boreal forest region is almost completely interconnected by trails, rivers, lakes and portages. The region also contains hundreds of spring, summer and winter hunting, fishing, gathering and trapping encampments. The boreal forest provides considerable direct economic value to the communities, values which are largely invisible to resource developers, managers and politicians. In addition to the teaching of skills, each elder maintains continuity and links to the community resource area by transferring a highly detailed oral 'map' and inventory of resource values and land use locations. These individual and family maps knit together into a rich and complete mosaic which provides integrated knowledge of the ecosystems within the community's traditional resource area.

Therefore, major ecological disturbances such as hydroelectric development and large-scale forestry activities have profound cultural impacts by obliterating the reference points and actual resources that these maps are intended to share. Resource developments convert highly valued and sought-after family and community knowledge into memories. The United Nations World Commission describes the disappearance of indigenous cultures as 'a loss for the larger society, from which we could learn a great deal from their traditional skills in managing very complex ecological systems' (http://www.culturalsurvival.org). The same is true for the loss of traditional environmental knowledge.

2.2.5 Value of Education on Climate Change

Climate change threatens to reverse many of the development gains that African nations have made. It poses threats to food and water security, to political and economic stability, to livelihoods and landscapes. But it also creates opportunities for African politicians, business leaders and communities to act in ways that bring benefits for all. It can create opportunities for new business models and innovations, new routes to sustainable development and new ways for ancient knowledge to have an impact at home and in the wider world.

Some gases such as carbon dioxide can trap heat in the Earth's atmosphere, through a phenomenon scientists call the greenhouse effect. Many human activities emit these greenhouse gases. When we burn fossil fuels such as coal and diesel to produce electricity or drive vehicles and other machines, or when we clear forests to grow crops more of these emissions reach the atmosphere. Ever since the start of the Industrial Revolution in the mid-

eighteenth century, these gases have increased in concentration. At the same time the Earth has experienced a gradual warming.

Education on climate change in all its forms is a right, not a privilege, which should be made accessible to those who stand to be most adversely affected by climate change impacts. While it is important to integrate environmental education in the existing formal curriculum as it is being done, emphasis must also be given to the support for non-formal educational services for the sectors who comprise the marginalized majority of our populations and the poorest of the poor in societies. Often, they are the most dependent on these endangered ecosystems for their livelihoods and sustenance and who are located in the most hazard-prone of territories. This is a need vested with all the more urgency in this time of global warming.

Education on climate change is a political and socially-situated practice, embedded with the specificities and relations between and among classes, genders, nations, and races (Garvey, 2008). As such, it has the potential to draw out a consciousness of these power relations and their consequences of these on the use and treatment of the Earth's natural resource base. At the local level, environmental education efforts can be directed towards capability-building of vulnerable communities.

The world has indeed already started experiencing adverse effects of climate change (IPCC, 2014; 2007). Climate change threatens to reverse the gains that have been scored in several sectors of many economies, including wealth creation efforts in most developing countries like Zambia. In general, climate change will affect the basic elements of life for people around the world. This may include access to water, food production, health and the environment. Climate change is not only an environmental problem, but an economic one affecting all the sectors of our economy (Banda, 2009). Indigenous or traditional people often inhabit economically and politically marginal areas, world-over. Their livelihoods depend on natural resources which are directly affected by climate change. Although indigenous peoples' 'low-carbon' traditional ways of life have contributed little to climate change (IPCC, 2014), indigenous peoples are the most adversely affected by it. This is largely a result of their historic dependence on local biological diversity, ecosystem services and cultural landscapes as a source of sustenance and well-being.

According to IPCC (2014; 2007), poor communities such as in sub-Saharan Africa will be most vulnerable because of their low adaptive capacity and great dependency on high climate sensitive resources such as water resources and ecosystems. Africa, a continent of more than 800 million people, is already feeling the effects of climate change. The continent is one of the most vulnerable regions in the world to climate change. This vulnerability and the limitations of poor countries to adapt to climate change challenges were highlighted in *Climate Change 2007*, the Forth Assessment Report of the IPCC. The report established how human activity (burning fossil fuels, deforestation and changes in land-use) is modifying the global climate, with temperature rises projected for the next 100 years that could affect human welfare and the environment (IPCC, 2007). As alluded to earlier, some parts of the continent warmed by 0.7^{o} C during the twentieth century. Rainfall in the Sahel region, just below the Sahara, has fallen by 25 per cent in the last few years. Africa's tropical rainforests have also witnessed a fall in precipitation of 2.4 per cent each decade since the mid-1970s. Droughts in the Sahel and the Horn of Africa have become more regular since the 1960s (IPCC, 2007, 2014).

The indigenous people may not understand the concept of global warming or climate change but they rightly observe and feel its effects: decreasing or increasing rainfall, increasing air temperature, increasing sunshine intensity and seasonal changes in rainfall patterns. In Africa's Ghana area, this is corroborated by a study in 2007 which recorded a remarkable reduction in mean annual rainfall of 22.2 per cent and a gradual rise in average maximum temperatures of 1.3^{o} C or 4.3 per cent rise in t*e*mperature from the 1961 to 2006 (see Gyampoh, *et al*., 2007).

The impact of climate change presents a new hurdle in the fight against extreme poverty and disease. Experts predict that in many sub-Saharan African countries, climate change could mean more frequent drought and floods, water scarcity, low food security and increased health challenges like under-nutrition and various diseases such as malaria (IPCC, 2007). But while climate change is already having a significant impact on the lives of Africans, the climate and weather-monitoring systems needed to track changes on the continent are not in place, and little of Africa's historical climate and weather data is being used to further improve climate forecasting because of a lack of funds. This is where traditional environmental knowledge among people, particularly adults in African communities becomes

cardinal. Gradually, there is increasing realization that indigenous groups are an important source of information on climate change. Most published reports on indigenous observations of climate changes, however, have come from Arctic regions where the co-operation between scientists and indigenous people is strongest (Salick and Byg, 2010).

In conclusion, climate change is already having serious implications on the livelihoods and cultures of traditional and indigenous people worldwide. Even though these people have developed important strategies to adapt to these changes, the magnitude of future hazards may limit their capacity to adapt. And as it was observed during the Copenhagen climate change summit on 2nd November 2014, 'We have the means to limit climate change.' said R. K. Pachauri, the then Chairperson of the IPCC, 'The solutions are many and allow for continued economic and human development. All we need is the will to change, which we trust will be motivated by knowledge and an understanding of the science of climate change.' (http://www.un.org/climatechange).

Although a lot of effects on indigenous people elsewhere have been recorded as it can be seen from the literature, there seem to be no study that had been conducted to record findings on the effects of climate change among indigenous Lozi people of the Barotse plains, Western Zambia. This study, therefore, was intended to fill the knowledge gap.

2.3 Significance of Traditional Environmental Knowledge in Mitigating Climate Change

Every culture and ecosystem on Earth is affected by global climate change. Western scientists and traditional environmental knowledge practitioners all agree that we are only just beginning to feel its effects, and that we can expect more dramatic changes. As Adams (2003) agues, indigenous people in various communities have historically used local traditional knowledge and played an active role in the conservation of eco-systems, crucial to the prevention of climate change such as forests, mountains, wetlands, coastal and marine areas. There is much to learn from indigenous, traditional and community-based approaches to natural disaster preparedness. Indigenous people have been confronted with changing environments for millennia and have developed a wide array of coping strategies, and their traditional knowledge and practices provide an important basis for facing the even greater challenges of climate change.

> Sophisticated knowledge of the natural world is not confined to Western science. Human societies all across the world have developed rich sets of experiences and explanations relating to the environments they live in. These 'other knowledge systems' are today often referred to as traditional environmental knowledge or indigenous, traditional or local knowledge. They encompass the sophisticated arrays of information, understandings and interpretations that guide human societies around the world in their innumerable interactions with the natural milieu: in agriculture and animal husbandry; hunting, fishing and gathering; struggles against disease and injury; naming and explanation of natural phenomena; weather forecasting; and strategies to cope with fluctuating environments (Nakashima, *et al*., 2000: 12).

For millennia, indigenous people around the world have used their traditional knowledge to prepare for, cope with and survive disasters. Their methods and practices have originated within their communities and have been maintained and passed down over generations. Scientists using Western climate science use weather stations, balloons, satellites and other instruments that measure the properties of our climate and atmosphere to create a picture of the current situation. This includes measuring temperature on land and the surface of the sea, the concentration of carbon dioxide and other gases in the atmosphere, the intensity of storms, the density of forests and the sources of greenhouse gas emissions (IPCC, 2014).

Evidence from recent research suggests that local knowledge may contribute to mitigation and adaptation to climate change in a number of ways (Salick and Byg, 2010). There is a lot of literature that shows how indigenous communities are responding, mitigating and adapting effects of climate change. This work has highlighted a few. Traditional Environmental Knowledge is a powerful way of seeing the world and of observing environmental changes that are not always easily detectable by Western science. Traditional cultural perspectives have much to contribute in helping all people to understand how the world is changing and what the consequences may be. Indigenous knowledge systems, to which traditional environmental knowledge is a part, are seen by some development practitioners as a way of promoting a deeper and more meaningful 'development' in the rural communities (see Namafe, 2006; Adams, 2003; Johnson, 1992; Oakley, *et al*., 1991; and Nakashima, *et al*., 2000).

Research on traditional or indigenous environmental knowledge has been undertaken in many countries, often in the context of understanding local oral histories and cultural attachment to place. A number of studies during the 1980s and early 1990s in Arctic Canada were produced by Johnson (1992). Namafe (2006), Adams (2003) and Nakashima, *et al*., (2000) outline the many technical and social issues related to the intersection of different knowledge systems, and the challenge of linking the scales and contexts associated with these forms of

knowledge. With the increased interest in climate change and global environmental change, recent studies have emerged that explore how indigenous knowledge can become part of a shared learning effort to address climate change impacts and adaptation, and its links with sustainability. A number of examples are indicated in this work.

2.3.1 Climate Change Mitigation and Adaptation

With increasing global warming caused by various factors, climate change has become a prime concern for our own existence on Earth. The demand of the moment is probably to adapt to the changing climate and work together to find mitigation options so that no further damage is done. While adaptation aims to lessen the adverse impacts of climate change through a wide-range of system-specific actions, mitigation looks at limiting climate change by reducing the emissions of greenhouse gases and by enhancing opportunities.

The terms 'mitigation' and 'adaptation' are two important terms that are fundamental in the climate change debate. The International Panel on Climate Change (IPCC, 2007: 6) defines adaptation as the, 'adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.' It is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploits beneficial opportunities. It is an understanding of how individuals, groups and natural systems can prepare for and respond to changes in climate or their environment. According to IPCC (2014; 2007), it is crucial to reducing vulnerability to climate change. In short, a system with adaptation measures will be more resilient to damage in case a severe event takes place. This system will suffer lesser damage in an event with same level of severity, compared to another system without adaptation measures.

As earlier alluded to, the two main strategies for reducing the threat climate change poses are mitigation and adaptation. Mitigation can be said to be any activities that reduce the overall concentration of greenhouse gases in the atmosphere. This includes efforts to switch from fossil fuels to renewable energy sources such as wind and solar, or to improve energy efficiency. It also includes efforts to plant trees and protect forests, wetlands or to farm land

in ways that prevent greenhouse gases from entering the atmosphere. Adaptation refers to activities that make people, ecosystems and infrastructure less vulnerable to the impacts of climate change. This includes things like building defences to protect coastal areas from rising seas, switching to sustainable methods of agriculture, planting drought or flood resistant crop varieties, and improving systems to warn of heat-waves, disease outbreaks, droughts and floods.

In simple terms, climate change mitigation can be said to be any action taken to permanently eliminate or reduce the long-term risk and hazards of climate change to human life, property. The International Panel on Climate Change (IPCC, 2007: 8) defines mitigation as: 'An anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases.' IPCC (2014) looks at mitigation as technological change and substitution that reduce resource inputs and emissions per unit of output with respect to climate change, mitigation means implementing policies to reduce greenhouse gases emissions and enhance sinks.

In a broader sense, mitigation refers to the policies and measures designed to reduce greenhouse gases emissions. Measures can include reducing demand for emission-intensive goods and services, boosting efficiency gains, and increasing the use of low-carbon technologies. Another way to mitigate the impacts of climate change is by enhancing reservoirs that absorb carbon dioxide, such as forests or peat bogs (a type of wetland where decomposition is slowed down and dead plant matter accumulates as peat). To design an effective mitigation strategy, we need to know the greenhouse gases emission pattern, available mitigation options, role of technology and market-based mechanisms. We also need to design the mitigation strategy in such a way that it helps ensure sustainable development.

While mitigation tackles the causes of climate change, adaptation tackles the effects of the phenomenon. The potential to adjust in order to minimize negative impact and maximize any benefits from changes in climate is known as adaptive capacity. A successful adaptation can reduce vulnerability by building on and strengthening existing coping strategies.

In general the more mitigation there is, the less will be the impacts to which we will have to adjust, and the less the risks for which we will have to try and prepare. Conversely, the greater the degree of preparatory adaptation, the less may be the impacts associated with any

given degree of climate change. The idea that less mitigation means greater climatic change, and consequently requiring more adaptation is the basis for the urgency surrounding reductions in greenhouse gases. Climate mitigation and adaptation should not be seen as alternatives to each other, as they are not discrete activities but rather a combined set of actions in an overall strategy to reduce greenhouse gases emissions.

For people today already feeling the impacts of past inaction in reducing greenhouse gas emissions, adaptation is not altogether passive, rather it is an active adjustment in response to new stimuli. However, our present age has proactive options (mitigation), and must also plan to live with the consequences (adaptation) of global warming.

2.3.2 Climate Change Mitigation Initiatives

In addition to climate change itself, the international and national climate change mitigation initiatives currently being developed in many parts of the world pose an additional threat to indigenous people's tenure security, livelihoods and economies because their internationally-recognized rights and traditional knowledge are overlooked. The United Nations Food and Agriculture Organization estimates that agriculture is responsible for about 14 per cent of global greenhouse gas emissions (http://www.un.org/climatechange). But by drawing upon several traditional farming principles in a modern-day context, agriculture currently has the potential to reduce up to 6 billion tons of carbon dioxide emissions by 2030 (Adams, 2003; Kates, 1997).

A number of national and international mitigation institutions have been created - institutions which do not necessarily take into consideration the views and interests of indigenous people but which indigenous people, nevertheless, have to relate to and negotiate with.

Zambia is among few countries that have been selected to pilot the United Nations Reduced Emissions from Deforestation and Forest Degradation Programme aimed at reducing deforestation and forest degradation in developing countries, and also to encouraging them to effectively participate in crafting the post 2012 climate change regime (Sikanwe, 2014). This is expected to be achieved by developing and testing standards, methods and guidelines for assessment, monitoring, accounting, reporting and verifying reduction in deforestation and forest degradation. The programme also seeks to build collaborative approaches to land and forest management in Third World countries.

2.3.3 Adaptation to Meet the Challenge

As earlier alluded to, in this work, adaptation is taken to be a processes through which societies make themselves better able to cope with an uncertain future. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes. Adaptation also involves learning to manage new risks and strengthening resilience in the face of change.

Adaptation to climate change is a necessary strategy to complement climate change mitigation effects. Adaptation often produces benefits as well as forming a basis for coping with future climate change. However, experience demonstrates that there are constraints to achieving the full measure of potential adaptation. There are many instances of, maladaptation, such as promoting development in risk-prone locations, which can occur due to decisions based on short-term considerations. The ability of human systems to adapt to and cope with climate change depends on factors such as wealth, technology, education, information, skills, infrastructure, access to resources and management capabilities. As early as April 2007, a report by the IPCC warned that Africa was not acting quickly enough to stem the dire economic and environmental consequences of excessive greenhouse gases (IPCC, 2007).

The scale of the long-term impacts of climate change can be controlled through mitigation, the process of reducing the concentration of greenhouse gases in the atmosphere. However, the effects of climate change are being experienced now. Worse, because of long delays in the climate system, the level of greenhouse gases in the atmosphere today means that further climate change is now unavoidable, regardless of efforts to reduce greenhouse gas emissions. Thus, the need to adapt to the impacts is equally unavoidable. Poor communities therefore face the challenge of adapting to climate change through a process of building adaptive capacity and reducing vulnerability. Building adaptive capacity means incorporating climate change into community-based development and improving the availability of appropriate information and skills, effective institutions, access to technology and opportunities to raise incomes.

Reducing vulnerability to climate change requires the protection of existing assets (including the ecosystems on which communities depend), improving risk management, increasing assets and broadening the available range of livelihood options. The challenge is

simultaneously to protect existing livelihood assets against the new risks posed by climate change, whilst securing more assets that can be accessed to help cope with the disruption and change that climate change brings.

2.3.4 Adaptation: responding to the threats of climate change

Climate change adaptation process must focus on the needs of the people most affected by climate change impacts and aim to secure their livelihoods and reduce the most significant hazards they face. This can be done by letting communities identify communities' own needs and priorities, and valuing their knowledge alongside science-based knowledge is key to development of sound adaptation strategies. The primary role of governments should be that of developing policies that are enabling for local-level action in addition to the national level. However, important adaptation activities, such as planning for reduced food security and management of increasingly scarce water resources, will require coordination and investment at the national and intergovernmental levels.

Climate change is currently causing increased hardship for rural communities in many parts of the world (http://www.un.org/climatechange). Moreover, current global levels of greenhouse gases pollution means that the impacts of climate change are now set to worsen over the coming decades regardless of future emissions. However, whilst the most profound impacts of climate change may still be some years away, our understanding of future climate scenarios means that actions to help prepare communities can be taken now. Importantly, strategies that build community's ability to adapt to climate change can and must be undertaken now: it will be too late to act once the last crops have failed in the world or glacial lakes have burst.

Strategies for adaptation need to focus on the needs of the people most affected by climate change impacts and aim to reduce the most significant hazards they face. Identifying communities' own needs and priorities, and valuing their local or traditional knowledge alongside science-based knowledge is key to developing sound adaptation strategies. Sharing experiences, obstacles and positive initiatives with other communities and development policy-makers must be an integral part of national adaptation strategies worldwide.

The primary role of governments and international processes is in developing and implementing policies that are enabling for local-level action. However, some important

adaptation activities, such as management of increasingly scarce or flood prone water resources, will require coordination at the regional and intergovernmental levels. Development of adaptation strategies at the national level is underway in some Third World countries, including Zambia, where national adaptation programmes of action identify priorities for adaptation projects. To ensure a positive impact on the most vulnerable communities, climate change adaptation should support the development of community-based systems of adaptation. These should be based on sustainable livelihood options and sound management of ecosystems through strengthening capacities, skills and institutions to react and adapt to climate generated changes.

2.3.5 Risks and Impacts of some Mitigation Measures on Indigenous People

The United Nations Framework Convention on Climate Change and the Kyoto Protocol have established that those mainly responsible with mitigation of climate change are the highly industrialized countries (IPCC, 2007). Since these countries are responsible for more than 90 per cent of the greenhouse gas emissions in the atmosphere which the world is suffering from, it is but right that these countries carry the costs of mitigating climate change. Thus, indigenous people, particularly those in Third World countries and even those in these rich industrialized countries, are not expected to bear this cost because they only contribute about 10 per cent of the greenhouse gas emissions. However, they are the ones bearing the costs of the adverse impacts of climate change, even if they did not contribute much in causing this problem. Many studies contained in this work show how they have to cope with the impacts of climate change especially those caused by strong typhoons, cyclones and hurricanes, floods and prolonged droughts (see Bates, *et al*., 2009; and Nakashima, *et al*., 2000).

The key solution to climate change is the shift from the use of fossil fuels (oil, coal and gas), which is the main source of greenhouse gases. This means a shift away from a development path and consumerist, wasteful, high energy lifestyles which are totally dependent on fossil fuel use, whether in industries, transport, energy use, and industrial agriculture, among others. However, instead of moving towards a low-carbon emissions development path, most countries would still opt to maintain the high-energy, high-emissions economic development pathway and use the market-based approach of buying carbon offsets in Third World countries to meet their obligations under the Kyoto Protocol. This is where some of the renewable energy projects, which are being pushed and supported in some Third World countries, come in. While there is no question that renewable energy should be developed to

replace heavy reliance on fossil fuels, the social, environmental and human rights implications of this shift should also be taken into account.

What has been shown in these studies is that some renewable energy projects such as the push of agricultural production and forest projects towards planting of biofuel crops and establishment of hydroelectric mega dams and geothermal plants, are causes of concern for some indigenous people. The increased need for biofuels is leading to the further expropriation of lands, territories and resources of indigenous people as shown in the case of Myanmar, Malaysia, Philippines and Indonesia (see details online on http://www.culturalsurvival.org). There is a significant acreage of lands being devoted to oil palm and jatropha plantations for biodiesel production. Afia Biak Hta Dim's work on 'Taking the Initiative: The Chin on Climate Change in Burma' shows the impacts of a government project for jatropha cultivation in some indigenous Chin communities in Burma (http://www.culturalsurvival.org; Bates, *et al*., 2009). Many of the Chin's lands were confiscated to give way to jatropha plantations.

Bates, *et al*., (2009) reveal that in 2005, Senior General Than Shwe, supreme commander and head of the state's ruling party, decreed that each state and division across the country should allot 500,000 acres to be planted to jatropha. On national television, Shwe announced that in three years, seven million acres across the country should have been planted with jatropha. After Shwe's announcement, the Ministry of Agriculture and Irrigation had stated that the cultivated land for jatropha across the country would extend up to eight million acres. In Chin State, in order to meet the quotas under the General's plan, every man, woman and child would have to plant more than 1.25 acres, since the population of the State is less than 400,000. Because of the biofuel project, the Chin were forced to work in the plantations, their forests deforested and were punished for refusing to plant or purchase jatropha seeds or seedlings. Some solutions being proposed to address climate change, which are oblivious of the human rights, social and environmental impacts, can cause serious problems for indigenous peoples. This example of biodiesel crop production demonstrates what can happen to indigenous people's lands and territories in Southeast Asia and other tropical countries where indigenous people live.

It is important to study and analyze more deeply indigenous people's traditional knowledge systems and livelihoods, which are low in carbon dioxide emissions and which are sensitive

to sustaining and restoring ecosystems, landscapes and waterscapes. Their capacities for resilience and for adapting to adverse climate change impacts are directly proportional to how they are able to continue practicing these knowledge systems and also their customary governance systems, which include ensuring environment-sensitive ways of dealing with their physical territories.

Traditional knowledge systems and local institutions - which are continuously used, adapted, revitalized and developed - will produce immediate and strategic solutions to climate change. One indigenous people's leader once said, '*We have the knowledge that can contribute to finding solutions to the crisis of climate change. But if you're not prepared to listen, how can we communicate this to you?'* — Marcos Terena, Xané leader, Brazil (http://amazonwatch.org).

2.3.6 Climate Change Mitigation and Adaptation using Indigenous Knowledge

Indigenous knowledge is the local knowledge that is unique to a particular culture or society (Atteh, 1992). This knowledge is passed down from generation to generation, usually by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, health care, education, conservation, weather forecasting and the wide range of other activities that sustain societies in many parts of the world. Indigenous people have a broad knowledge of how to live sustainably to enhance sustainable development. The survival of indigenous knowledge as a dynamic and vibrant resource within rural and indigenous communities depends upon its continuing transmission from generation to generation. However, formal education systems have disrupted the practical everyday life aspects of indigenous knowledge and ways of learning, replacing them with abstract knowledge and academic ways of learning. Today, there is a grave risk that much indigenous knowledge is being lost and, along with it, valuable knowledge about ways of living sustainably (Bates, *et al*., 2009).

Traditional environmental knowledge used by indigenous people is based on mutual well-being and sharing. In our severely disrupted global environments, traditional environmental knowledge is now essential for our mutual survival. The benefits of traditional environmental knowledge can be shared when there is respect, understanding, the recognition of traditional rights, and the recognition of existing indigenous stewardship of many regions of the Earth. Indigenous people's 'lifestyles and knowledge can offer modern societies

many lessons in the sustainable management of resources in complex forests, mountains, wetlands and dry lands ecosystems' (WCED, 1987:12).

These marginal ecosystems among indigenous people are often the sources of key ecosystem services (e.g., role of mountain ranges and wetlands in sustaining water balance) and are critical for maintaining the overall resilience and adaptive capacity of social-ecological systems. Importantly, the indigenous knowledge of indigenous peoples is proving critically valuable service to the global community. Observations of ecosystem change by indigenous peoples are acting as a sentinel like warning system for climate change. More importantly, the long-term place-based adaptation approaches developed by indigenous peoples provide valuable examples for the global community of low-carbon sustainable lifestyle, critical to developing local adaptations strategies in the face of climate instability. For example, Johnson (1992) states that the Inuit indigenous people of Northern Canada have observed delays in the autumn freeze, and changing sea ice distribution. Inuit communities have been particularly susceptible to changing climatic conditions documented in the last decades due to their dependence on climate sensitive resources for livelihoods.

Changes in sea ice distribution in turn alter the habitation patterns of seals. Such ecological observations are informing scientists and form part of the science base of studies such as the Arctic Climate Impact Assessment (ACIA) (http://www.culturalsurvival.org; ACIA, 2005). The ACIA, a project of the eight country Arctic Council and the International Arctic Science Committee notes that climate change is foremost a human and cultural issue. The ACIA further notes that the study confirms mainly what the Inuit already knew.

Climate change is indeed considered to be a critical global challenge and recent events have demonstrated the world's vulnerability to climate change. The increase in the warming of the atmospheric temperature has significant effects on both natural environment and human life. As climate changes, everything changes from the natural habitats of wildlife to the culture and sustainability of a region. For indigenous people all over the world, climate change is already a reality and poses threats and dangers to the survival of their communities. Indigenous and marginalized peoples, however, are not just victims of climate change. Their accumulated knowledge makes them excellent observers of environmental change and related impacts. Attentiveness to environmental variability, shifts and trends is an integral part of their ways of life. Environmental awareness, which is very important in addressing climate

change, cannot be addressed adequately through only the formal education system. Awareness must also be created through non-formal and informal education methods, as the national overall literacy rate in formal education for majority of the Third World is still low. Little formal information reaches the semi-literate rural population (UNESCO, 1998).

However, rural people in general, articulate and possess a great depth of traditional environmental knowledge. They have their local traditional environmental knowledge and also feel for environmental issues, as these affect their daily lives. To illustrate, according to the United Nations Educational, Scientific and Cultural Organization (www.unesco.org) indigenous people in Indonesia, Thailand and India survived the destructive Tsunami by using their local traditional environmental knowledge. As calls multiplied for high-tech solutions (such as installation of early warning systems using cutting-edge satellite) as a means of preventing similar disastrous occurrences like the 26th December 2004 ***Tsunami*** off the coast of Indonesia, news began to circulate about how indigenous communities escaped the Tsunami's wrath due to their traditional environmental knowledge.

Unlike numerous persons who were attracted to the shoreline by the unusual spectacle of fish flopping on a seafloor exposed by the sea's withdrawal, the Moken and Urok Lawai people of Thailand's coasts and islands, the Ong of India's Andaman Islands and the Simeulue community of Indonesia all knew to move rapidly inland to avoid the destructive force of the sea. The small villages of the Moken and Ong were completely destroyed, but their inhabitants escaped unscathed. Even more striking was the displacement of more than 80,000 Simeulue people beyond the reach of the ***Tsunami***.

Only seven indigenous people died. The islanders were not alerted by warnings from public announcing system loudspeakers, mobile phones or radio transmission, but recognized the danger signs, due to stories about their devastating impact passed down through generations after a *Tsunami* in 1904. This surprisingly efficient response, striking in its contrast with the frightening losses suffered elsewhere in Indonesia, was acknowledged by the granting of a United Nations' Sasakawa Award for Disaster Reduction to the Simeulue people (www.unesco.org; www.undp.org). This drew world attention to the traditional environmental knowledge of indigenous people and its relevance to the emerging priority domain of natural disaster preparedness and response.

The Moken, Urok Lawai, Ong and Simeulue surprised the world with their resourceful and life-saving response to the destructive force of the Indian Ocean ***Tsunami***. There is much to learn from indigenous, traditional and community-based approaches to natural disaster preparedness. Indigenous people have been confronted with changing environments for millennia and have developed a wide array of coping strategies, and their traditional knowledge and practice provides an important basis for facing the even greater challenges of climate change. While indigenous communities will undoubtedly need much support to adapt to climate change, they also have much expertise to offer on coping through traditional time-tested mechanisms.

The traditional environmental knowledge is influenced by the previous generations' observations and experiments and provides an inherent connection to one's surroundings and environment. Therefore, indigenous knowledge is not transferable but provides relationships that connect people directly to their environments and the changes that occur within it, including climate change (Woodley, 1991). What works as effective traditional knowledge now, has come to be so through years of experimenting and adjusting to a naturally changing environment. It is not just about which practices work, but understanding why others fail is just as important to avoid perpetuating mistakes. As communities live within a given environment for a long period, they acquire a deep understanding and learn to adapt within their environment (Atteh, 1992; Gyampoh, *et al*., 2007).

In November 2013, it was reported that because of predicting a typhoon using indigenous knowledge all the residents of Tulang Diyot Island in a Cebu town of Philippines survived though some 500 houses and other buildings were destroyed by winds and waves from Typhoon Yolanda. More than 1,000 people on a tiny island between Cebu and Leyte survived the onslaught of super typhoon Yolanda because they evacuated a day before the storm hit, according to the United Nations Office for Disaster Risk Reduction (UNISDR) (http://ph.news.yahoo.com). Most residents of the island earned their livelihoods as fishermen or farmers. They were safely evacuated to safer places in time after asking for help from mainland. Yolanda battered Cebu and neighbouring provinces in November 2013, taking more than 10,000 thousands of lives and destroying property with powerful winds and huge waves. It was one of the worst typhoons, one of the most powerful storms on record ever experienced in the world. Typhoon Yolanda, also called Typhoon Haiyan, hit the Philippines' eastern seaboard on 8th November 2013. The winds were reported to have

reached 235 kmh (147mph), with gusts even higher, and waves were as high as 15 metres (45 feet). The storm brought nearly 400mm (15.75 inches) of rain in some places (http://www.bbc.co.uk).

Climate change will continue to affect the Tulang Diyot Island's environment, ultimately impacting residents' lifestyle and spiritual life. But as they learn 'new' Traditional Environmental Knowledge practices, they will be able to work better with nature, survive and continue the process of transferring their 'new' Traditional Environmental Knowledge to the next generation. The residents of Tulang Diyot Island in the Philippines have been learning about nature and its animal and plant life from their parents, grandparents and great-grandparents. Their knowledge stemmed from an intimate relationship with the environment that was formed over generations of time and through generations. Today we call this Traditional Environmental (or in some cases, Ecological) Knowledge.

Plate 1: Following signs based on traditional environmental knowledge, residents of Tulang Diyot Island in a Cebu town being evacuated by ship to larger islands just before the typhoon Yolanda (Haiyan) which hit the Philippines in November 2013

Source: Photo by the courtesy of http://www.bbc. co.uk/news/world-asia.

Indigenous people have been confronted with changing environments for millennia and have developed a wide array of coping strategies – their traditional knowledge and practices provide an important basis for facing the even greater challenges of climate change.

Traditional environmental knowledge has over the years played significant roles in solving environmental problems including climate change. Indigenous people, who live close to the

natural resources, observe the activities around them and are first to identify any changes and adapt to them. Appearance of certain birds or insects, mating of certain animals, or the flowering of certain plants are all important signals of changes in time and seasons that are well understood by traditional knowledge. There is much we can learn from indigenous, traditional and community-based approaches to natural disaster preparedness. Strategies used by indigenous rural people to help predict disasters and mitigate the effects of climate change could be deployed to design large-scale global adaptation efforts, the authors of a study of rural communities in Ghana's Offin River Basin have said (Gyampoh, *et al*., 2007).

Namafe (2006) states that social life moves with every change of the waters and associated changes in weather in the Barotse plains of Zambia. This shows that there is a strong relationship between humans and their natural environment. To illustrate, in 2015 there was no *Kuomboka*, an annual ceremony, probably because there was not enough water in the Barotse plains – among other factors. In simple terms, *Kuomboka* means to come out of water during flooding period. The absence of floods in Barotse plains saddens the Lozi people to the extent that elders go to the shrines to consult their ancestral spirits (Namafe, 2006). The Lozi are usually referred to as the plains people. The plains people's way of living has been greatly influenced by the flooding regime of the Zambezi River. These local people together with their livestock annually move from the wetlands of the Zambezi (locally known as Barotse or Bulozi) floodplains to higher upland homes. This movement is known as *Kuomboka*. The migration from the plains to high land releases pressure on consumption of natural resources in the plains.

The Barotse plains is one of the most important ecosystems in the southern Africa region, a wetland of international importance with significant international value in terms of ecology, botany, zoology, limnology or hydrology. The indigenous Lozi people of the Barotse plains are traditionally conservationists who use resources according to their customary laws based on indigenous knowledge systems (Siamwiza, 2009; www.unesco.org). Village Wetlands Conservation Committees were established with representatives from the structures: existing Barotse Royal Establishment, institutional structures at grassroots level, community, Government and non-governmental organizations. In his historical study of the Barotse plains, Siamwiza (2009) points out that the local people have traditional knowledge about their ecological surroundings which enable them to adjust to the prevailing ecological

conditions. He notes that they use traditional local knowledge to adapt to annual floods. For example, the Lozi people of the Barotse plains use spiders to predict high or normal floods, and the presence of many cobwebs is an indication that the coming season would be one of heavy floods (Siamwiza, 2009).

Although some examples of studies on dynamics of significance of traditional environmental knowledge in mitigating climate change from elsewhere have been cited in this work, it seems no detailed study had been conducted among the Lozi people of the Barotse plains to showcase the significance of the local knowledge in mitigating climate change. It is hoped that the findings of this study would fill the knowledge gap.

2.4 Enhancing Climate Change Mitigation and Adaptation using Indigenous Knowledge

Climate trends and variability are generally characterized by increasing surface temperature, drought, floods and unpredictable rainfall. Indigenous people have been facing these climate variability and trends world-wide. It is a reality for them and the situation will become worse in future.

Many advanced scientific research have concluded that changes in climate will gravely harm the health of indigenous people's traditional lands and waters and that many of plants and animals upon which they depend for survival will be threatened by the immediate impacts of climate change (see Salick and Byg, 2010; IPCC, 2007; ACIA, 2005). It can safely be stated that such conclusions require urgent and unprecedented efforts and interventions from the global community. However, in spite of the fact that these changes are impacting intensely on indigenous people and their communities, they are very rarely considered in public discourses on climate change. Indigenous people are vital to, and active in, the many ecosystems that inhabit their lands and territories and are therefore, in a position to help enhance the resilience of these ecosystems. In addition, 'indigenous people interpret and react to climate change impacts in creative ways, drawing on their indigenous knowledge and other technologies to find solutions, which may help society at large to cope with impending changes' (Salick and Byg, 2010: 4).

The United Nations Framework Convention on Climate Change (FCCC) outlines two key areas for climate policy, mitigation and adaptation, both of which are essential to climate

policy in all regions in the world. However, much of the literature on climate change are not able to reflect adequately the impacts and responses of indigenous people to climate change. Perhaps the best way to address this is for indigenous people themselves to define and conduct their research. Indigenous people may not be familiar with the concept of climate change. They may not think in terms of mitigation strategies, but rather feel and see the effects of climate change and practice resource management that appropriately serves to help them mitigate and adapt to critical environmental situations they face. Mitigation is central to efforts to tackle climate change and lower emission futures will give indigenous people and the ecosystems on which they depend more time to adapt. Furthermore, it is now accepted that some degree of climate change is inevitable, even if atmospheric concentrations of greenhouse gases were dramatically curtailed (IPCC, 2007). Communities, regions, and economic sectors will therefore have to adapt to some degree of climate change. Adaptation offers a tangible way in which vulnerability to current and future climate change effects can be moderated and indigenous people's livelihoods strengthened.

The most authoritative and influential reference on climate change in the world, the IPCC Assessment Reports guide governments, policy-makers and decision-making communities, and non-governmental organizations in planning and implementing their actions. The Fourth IPCC Assessment report (IPCC, 2007) noted that indigenous knowledge is *an invaluable basis for developing mitigation, adaptation and natural resource management strategies in response to environmental and other forms of change.* This was reaffirmed at the later session of the IPCC in 2014 where it was indicated that *indigenous or traditional knowledge may prove useful for understanding the potential of certain mitigation and adaptation strategies that are cost-effective, participatory and sustainable* (IPCC, 2014).

Previous IPCC Assessments, however, were unable to access this type of information because, for the most part, traditional knowledge either appears in grey literature outside of peer-reviewed academic forums, or remains in oral form, thereby falling outside the scope of IPCC process.

Indigenous people are excellent observers and interpreters of change on the land, sea, and sky (Salick and Byg, 2010; Knudtson and Suzuki, 1992; Atteh, 1992). Their community-based and collectively held traditional knowledge accumulated and maintained through practice over countless generations, offers valuable insights into the state of the environment.

Indigenous knowledge possesses chronological and landscape-specific precision and detail that is often lacking from scientific models developed by scientists at much broader spatial and temporal scale, including those used to understand the magnitude of climate change consequences. Moreover, indigenous knowledge provides a crucial foundation for community-based mitigation and adaptation actions that can sustain resilience of social-ecological systems at the interdependent local, regional, and global scales.

Traditional and indigenous communities have for millennia depended on a healthy relationship with their territories and therefore possess a wealth of knowledge, wisdom and practical experience in adapting to long-term changes in their environment (Vinyeta and Lynn, 2012). And yet indigenous communities are extremely vulnerable to the current unprecedented rate of global climate change, with its large-scale external disruptions to the web of life. This threat to traditional communities is a threat to the entire human family. Proposed or implemented responses to the challenges of climate change will fall short, unless they are grounded in a recognition of the territorial, land, and resource rihts of indigenous peoples.

The traditional envieronmental knowledge, wisdom and practices of indigenous people comprise the global bio-cultural heritage that must inform and guide climate change adaptation and mitigation strategies at global, regional and local scales. Evidence from recent research cited in this thesis suggests that indigenous people's local knowledge may contribute to mitigation and adaptation to climate change in a number of ways and deserve recognition.

2.4.1 Indigenous People's Voices on Climate Change

> 'We have the knowledge that can contribute to finding solutions to the crisis of climate change. But if you're not prepared to listen, how can we communicate this to you?' – Marcos Terena, Xané leader, Brazil (http://amazonwatch.org).

In spite of the September 2007 adoption by the United Nations General Assembly of the United Nations Declaration on the Rights of Indigenous People (UNDRIP), indigenous people continue to be excluded from the United Nations climate negotiations – the embodiment of climate injustice.

In many instances, high level meetings and various reports on climate change make only scarce mention of indigenous peoples, and then only in certain regions and as helpless victims of changes beyond their control. Hence, there is *a need to shift the focus so that indigenous people are primary actors within global climate change monitoring, adaptation and innovation*. Indigenous people must have a voice in policy formation and action in the same way they do in other relevant United Nations processes such as the United Nations Permanent Forum on Indigenous Issues, the Convention on Biological Diversity, the World Intellectual Property Organization, the Human Rights Council and, to some extent, the United Nations Framework Convention on Climate Change and others.

Indigenous peoples have engaged and continue to engage with the Climate Change Convention processes, but it is often very difficult to get their perspectives integrated in the final conclusions or the recommendations (http://voices.national-geographic.com). As a result, indigenous peoples attending UNPFCC meetings have called for the creation of an Inter-sessional Ad hoc Working Group on Indigenous Peoples and Climate Change as a mechanism for improved participation within UNFCCC (Salick and Byg, 2010).

The inclusion of indigenous people's voices in issues affecting them is an important issue in regards to the ongoing debates around climate change. The right to participate in decision-making is confirmed in the Declaration on the Rights of Indigenous People and Agenda 21. Article 18 of the Declaration on the Rights of Indigenous People stipulates that 'indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions' (United Nations, 2007: 7). Chapter 26 in Agenda 21 is devoted solely to

recognizing and strengthening the role of indigenous people and their communities and includes a number of references about recognizing indigenous people as a major group with a right to participate at all national and international policy and implementation meetings in regards to sustainable development and other programme areas of Agenda 21 (United Nations, 1992).

At this critical time of global decision-making, indigenous voices have important knowledge and wisdom to contribute to the global discourse on climate change that guides global choices in shaping our collective future. From Manus Islanders in Papua New Guinea working together to save their ocean side homes, to Masai villagers in Kenya responding to a cattle-killing drought in the open grasslands. There is a high level of interest in climate change mitigation within indigenous people's communities.

The important role that indigenous knowledge and practices can play in reducing risk and improving disaster preparedness is now acknowledged by disaster risk reduction specialists, especially since the 2004 Indian Ocean earthquake and Tsunami. However, they have yet to be commonly used by communities, scientists, practitioners and policy-makers.

2.4.2 The Case for Traditional Knowledge in the Global Climate Discourse

One important sign of the indigenous people being largely absent from the climate change policy and decision-making processes is the virtual lack of references to the existing traditional knowledge on climate change in the global, national, and local climate change discussions. To date, valuable insights held by indigenous people world-wide about direct and indirect impacts of, as well as mitigation and adaptation approaches to climate change, remain largely unrecognized. This is particularly apparent in the Intergovernmental Panel on Climate Change (IPPC) Assessment Reports released every few years. Even the Fourth and Firth IPCC Assessment Reports which acknowledges significance of indigenous knowledge, have made a very small mention of the indigenous people's wisdom.

Traditional societies of indigenous people in many cases have built up knowledge over long periods about changes in the environment and have developed elaborated strategies to cope with these changes. However, traditional knowledge systems in mitigation and adaptation have for a long time been neglected in climate change policy formulation and implementation and have only recently been taken up into the climate change discourse. Indigenous people,

who have survived over long periods to many kinds of environmental changes, including climate change, may have valuable lessons to offer about successful and unsuccessful adaptations which could be vital in the context of climate change.

Recent studies show that climate change was a global problem whose solution lay in shared efforts to encourage the *active participation* of communities, civil society and non-governmental organizations (ACIA, 2005; Bates, *et al*., 2009; Salick, and Byg, 2010). Active participation can best be realized when dialogue or discussions among stakeholders are followed by actions to solve identified challenges.

2.4.3 Links between Indigenous Knowledge and Western Science in Mitigating Climate Change

An indigenous knowledge scholar and a pioneer in the reconciling of indigenous knowledge into a Western academic setting, Gregory Cajete (1999) states that indigenous cultures have indeed amassed an enormous knowledge base related to the natural characteristics and processes of their lands through direct experience and participation. The words 'processes' and 'participation' are key in that traditional environmental knowledge is action oriented, and fluid in nature. He is alluding to the fact that traditional environmental knowledge is very much a living organism, something that is ever moving, always changing and involves direct participation within a given environment over a period of time (Cajete, 1999).

A significant body of literature exists describing the use of traditional environmental knowledge in natural and cultural resource management, as well as the similarities and differences between traditional environmental knowledge and Western science. As academics, governments, and communities build their understanding of climate change impacts, an understanding of the role of traditional environmental knowledge in identifying impacts and planning for and adapting to climate change and its relationship to Western science is needed.

Traditional environmental knowledge has the potential to play a vital role in climate change assessment and adaptation efforts that bridge human and environmental systems. Not only does it hold relevance for indigenous groups, it is also being recognized as an invaluable contribution to the larger climate change discussions occurring at regional, national, and international levels (Salick and Byg, 2010; Vinyeta and Lynn, 2012).

A number of studies have shown that indigenous people in many parts of the world utilize the surrounding resources to make their lives more convenient (see Nakashima, Prott and Bridgewater, 2000; Cajete, 1999; Bates, Chiba, Kube, and Nakashima, 2009). This is another example of how indigenous peoples live in harmony with the natural environment and how a culturally-base science concept was developed. The most important thing is that the traditional knowledge of indigenous people is not diverged from the mainstream science knowledge. Indigenous people's long-term interaction with their surrounding environment enables them to efficiently apply resources to expedite the daily practices in their lives, which also exemplified the advancement of technology. The science concept of indigenous people also evolves with time and forms an important science and culture asset.

Indigenous groups of people in many parts of the world have applied traditional environmental knowledge to adapt to the changing environment through time, and there are already examples of groups applying traditional environmental knowledge to adapt to the impacts of climate change. Such examples provide insight into potential adaptation strategies. To illustrate, in his study focused on the people of Sachs Harbour in Canada, Berkes (2008) breaks indigenous adaptive measures into two categories: (1) short-term or coping responses to environmental changes, and (2) cultural practices and adaptive responses to the broader environment. Berkes explores the importance of local and indigenous knowledge as a complement to scientific ecology, and its cultural and political significance for indigenous groups themselves. Sachs Harbour is a rural community located in the Inuvik Region of the Northwest Territories, Canada.

According to his study, Berkes' (2008) short-term responses include aspects such as modifying the timing and location of harvest activity, adjusting the mix of species harvested, and monitoring for dangerous environmental conditions. Adaptive responses include inter-community trade, hunting group mobility through seasonal settlements, sharing mechanisms and social networks, and flexibility of seasonal cycles of harvest and resources use (Berkes, 2008). Knowledge exchanges between indigenous people's communities and others are also occurring.

In their study, Vinyeta and Lynn (2012) found out that architects in the Netherlands are showing the rest of the world a way of turning adversity brought by climate change into opportunity. The inevitable rise in sea level that comes with climate change is going to make

it increasingly difficult to control flooding in low-lying places like the Netherlands. But instead of cursing their fate, architects are designing a new Netherlands that will float on water, and the Dutch government seems willing to try out the scheme. The Netherlands has made other countries begin to question, too, if we can live only on dry land? With the exception of the major highways, you cannot drive more than a km or so in the Netherlands without running into water. It could be the sea; it could be a river; or it could be a canal.

Plate 2: A floating community in the Netherlands, Europe
Source: http://inhabitat.com/huge-modern-floating-dutch-pre-fab-neighbourhood.

Olumuyiwa (2014) states that one good example of a country which has successfully linked indigenous knowledge and Western science in Africa is Nigeria. In a world where changing climate conditions are seeing the rise of sea levels and increased rainfall, disadvantaged waterfront communities are bearing the brunt of consequent flooding and land loss. Makoko, the largest informal settlement in Lagos, Nigeria, is one such community. Teetering atop Lagos Lagoon, the community's wooden structures balanced on stilts stretch out several kilometres over the oily water. The only means of transport are the canoes that bustle along the waterways in between buildings. Most of these canoes are traditional dug-out ones made from local resources using local knowledge.

In Makoko, major flooding occurs three or four times per year lasting up to four days at a time and causing widespread destruction and displacement. The residents of Makoko lacked effective coping strategies for the flooding beyond raising their houses on stilts. Since stilts

are static, they provide limited protection against the surging waters. Olumuyiwa (2014) further reports that when one Nigerian-born architect Kunlé Adeyemi visited Makoko, he found that the local school was not only too small but was also a victim of the regular floods. Inspired by community need and the unique challenges of an informal above-water settlement, Adeyemi and his firm NLÉ Architects devised the Makoko Floating School. Implementation of the Makoko Floating School began in 2012. The three-floor floating school can be seen in Plate 3.

Plate 3: Makoko Floating School in Nigeria, Africa

Source: Photo courtesy of Olumuyiwa, F.F., (2014) 'Makoko Floating School: Informed by the Needs of the Local.' Accessed on 15/03/2015 from http://www.artbaseafrica.org/issue/2/makoko-floating-school-design-informed-by-the-needs-of-the-local.

Located in the Lagos Lagoon, the Makoko community is enclosed by water with little land mass. Its residents live in structures typically built on stilts or make shift boats to withstand the constantly changing water levels. Transportation is realized by canoes, and the community is dependent on fishing as its main source of income. The community is greatly underdeveloped with no running water, no electricity, and no proper infrastructure.

The Makoko Floating School project beautifully meets a very essential need for a community, which has long been lacking in the provision of schools for its populous Lagoon residents. Prior to the Makoko Floating school project, there was only one English-speaking primary school for the community, which regularly flooded due to the constantly changing

water levels, causing disruptions to education, and also a health and safety hazard for the community (Olumuyiwa, 2014).

Makoko Floating School's creator and architect Kunlé Adeyemi, founder of NLÉ Architects firm, is a young Nigerian born architect with vast international project experience. He has brought a fresh and inventive approach to solving an urban problem in his native Lagos, Nigeria. The Makoko Floating School is a cutting edge solution to providing a mobile structure for this Lagoon community. The school uses solar power. Rain water harvest is also used to collect and store fresh clean water for use by pupils, their teachers and other members of the community. Composting toilets were found to be an effective and cost efficient solution for the floating school as they not only reduce the volume of waste but also reduce the contamination of the lagoon. Additionally, there is no need for fresh water to operate a compost toilet which is particularly important in an area like Makoko where fresh water is at a premium. In the school, the waste from the composting toilet is stored in one of the floatation barrels and will only need to be emptied once every second year. The resulting compost can be used to improve the soil quality of the green space.

The primary focus of NLÈ's research and Floating School project has been to contribute to climate change resilient strategies. To start with, this has been achieved by the project's inherent community empowerment and capacity building practice. Makoko Floating School aimed not only to empower the community with skills, but also allowed locals to directly engage with other project partners and stakeholders e.g. United Nations development Programme (UNDP), Heinrich Boll Foundation, and Lagos State Government representatives. That way the local culture of living and working on water was introduced to an extensive interaction with an empowering platform of stakeholders and partners who can further enable plans for future community development. More importantly, however, the participatory design process involved the understanding and integration of local expertise. The floating school was built with locally available materials, labour and indigenous building techniques that were combined with existing relevant global floating technologies, part of Western science (Olumuyiwa, 2014).

This integrative approach resulted in the creation of a building fully responsive to the needs of an aquatic environment. Furthermore, local knowledge of environmental and climatic patterns, such as tidal variations and rainfall patterns, as well as economic and industrial

potential of local aqua cultures, such as fish farming, provided the necessary insights into the project's context. As described by the United Nations definition, 'sustainability' implies responsibility for the social, environmental and economic needs of the present without compromising opportunities for future generations. The community's involvement not only in the conceptual development but also construction and on-going maintenance of the building therefore represented the essence of sustainable urban development, enabling the local community to replicate and further adapt the design of the building to meet their present and future needs.

The community of Makoko is one of the largest 'spontaneous' settlements of West Africa; it is around 48 hectares. The floating community project began in 2012. In the eyes of designers and urban planners, Makoko is an astonishing place. The landscape of the houses on stilts offers serenity above the water (Lagos Lagoon). The smoke coming out of some houses where fish is being smoked while thousands of canoes are being driven peacefully around the water infrastructure. Let us not forget that Lagos is blessed with sunshine most of the year with a warm breeze that surrounds the community. People are happy there; smiling and playful children with an incredible sense of balance are jumping around from one tiny wooden border of a canoe or a house to another as can be shown in Plate 4. Everything that floats which is found in the Lagoon becomes a toy or a mobility device. Everything is useful to build this community (Olumuyiwa, 2014).

The floating school is a flexible, multi-use space that can be used outside school hours by the rest of the community. It is intended to be the first phase of three with the next phase encompassing the construction of floating housing and the third phase being the eventual creation of an entire floating community. It is hoped the floating community of Makoko will provide a prototype of a possible global solution for poor waterfront communities, especially among indigenous people, in a changing world. The Makoko Floating School is a prototype that could be applied to other areas in Africa that face infrastructural and social challenges due to climate change.

Plate 4: A floating community of Makoko in Nigeria, Africa
Source: Photo courtesy of Olumuyiwa, F.F., (2014). Accessed online on 15/03/2015 from http://www.artbaseafrica.org/issue/2/makoko-floating-school-design-informed-by-the-needs-of-the-local.

On a larger scale, the United Nations Permanent Forum on Indigenous Issues inspired indigenous groups to form the Indigenous Peoples' Bio-cultural Climate Change Assessment Initiative (IPCCA) in 2008 as a platform to bring together traditional environmental knowledge and Western science and incorporate indigenous perspectives into global climate change conversations (United Nations, 2008).

Vinyeta and Lynn (2012) stipulate that historically, the differences between these two ways of knowing often hindered collaborative effort. There are many examples now, however, of those who view these differences as complementary to each other rather than mutually exclusive. Traditional environmental knowledge can contribute qualitative, historical field data that Western science may lack, while Western science typically provides more quantitative data. As it pertains to climate change, contributions from both knowledge systems are imperative. Traditional environmental knowledge can identify on-the-ground climate-related changes occurring at a local level and contribute traditional management practices that have been time-tested.

Additionally, as ecosystems experience increased fluctuations and former extremes in variability become more common, traditional environmental knowledge of the 'extreme' or 'atypical' can be used to increase predictability of current and future change. Western science can quantify and document the changes that are occurring and test the validity of

assumptions and potential solutions. Climate change mitigation and adaptation plans, frameworks, or strategies, especially for regions within or surrounding lands critical to indigenous groups of people, have an opportunity to include traditional environmental knowledge, along with Western science, to address the challenges in a holistic way that will maximize the positive outcomes for all parties involved.

Traditional environmental knowledge holders and scientists are beginning to recognize the mutual benefits that can result from collaborating. Many disciplines rooted in Western science now recognize the value of traditional environmental knowledge (Salick and Byg, 2010). Various forms of traditional environmental knowledge are commonly accepted in disciplines such as the social sciences as well as among scientists in fields such as agriculture, soil and water conservation (Vinyeta and Lynn, 2012). Traditional environmental knowledge is also recognized for the contributions it can make to resource management. In recent decades, resource managers have gradually begun to embrace the usefulness of applying traditional environmental knowledge to contemporary stewardship issues in various parts of the world (WCED, 1987). Public agencies and non-governmental organizations in the United States and other few countries around the world are beginning to incorporate traditional environmental knowledge in climate change planning mitigation and adaptation strategies, policies, education, and research (Vinyeta and Lynn, 2012).

The United Nations University (the academic arm of the United Nations) has also addressed the importance of traditional environmental knowledge by creating the Traditional Knowledge Initiative. The initiative seeks to build greater understanding and facilitate awareness of traditional knowledge to inform action by indigenous peoples, local communities, and domestic and international policy makers (United Nations University, 2011). Their efforts include partnerships with other organizations to facilitate the inclusion of traditional environmental knowledge into international endeavours.

It can be stated that evidence from recent research cited in this work suggests that elsewhere indigenous people's local knowledge may contribute to mitigation and adaptation to climate change in a number of ways and deserve recognition. However, to the knowledge of the researcher so far, it seemed no study had been conducted to contribute to literature on possible approaches to enhance climate change mitigation and adaptation strategies using

indigenous knowledge found among the Lozi people around Lealui Ward area of the Barotse plains in Western Zambia. Hence, this study was an attempt to fill this gap.

2.5 Traditional Environmental Knowledge among Lozi Adults in Relation to Climate Change

The genesis of the 'original' Lozi people is a matter for conjecture. Over the last 140 years or so, they have preferred to be known by the name given to them by the invading Makololo but before that were known as Luyi (loosely translated as 'foreigner'), Aluyi or Luyana (Mbikusita-Lewanika, 2001). The early Luyi lived in clusters in Bulozi, the plain of the Upper Zambezi Valley. It is quite likely that the plain was not thickly populated when they arrived, particularly if this was before the seventeenth century, as before this time the plain itself may well have been flooded for most of the year and probably resembled a giant swamp. For most Lozis, but particularly the ruling class, it has been and continues to be important to locate their roots in the original Lozi homeland, Bulozi, the flat floodplain of the Upper Zambezi River and to assert that their ancestors always lived there. The plain was known in the time before the invasion of the Makololo in the 1830's as 'Ngulu' and 'Lyondo', which also mean 'sweet potato' and 'weapons' respectively in Siluyana, the language spoken by the Luyi, now found only in court circles (*Kuta*). For ease of reading, in this work, the early Lozi will be referred to as Luyi or indigenous Lozi and the floodplain by the name it is known now, Bulozi or Barotse plains.

It can be argued that the indigenous Lozis apparently used their traditional environmental knowledge to settle in the plains. Given that Bulozi would have been a very much wetter environment than it is today, having most probably been a semi-permanent lake, it seems likely that there was minimal habitation before the Luyi and other similar groups who the Luyi gradually overcame, went to live there. The Barotse plains were probably chosen as a place for settlement by the indigenous Lozi people because it provided attractions not found on the surrounding higher ground (Kajoba, 2008). The floodplain was treeless which meant that livestock, particularly of the bovine variety, could be reared without fear of the dreaded tsetse fly so prevalent in the rest of the sub-continent. Meanwhile, the annual inundation of the Zambezi River waters meant that a fertile layer of silt was deposited over the underlying Kalahari sand providing fertile and nutrient-rich soil in which crops of a wide variety of fruit and vegetables could be grown. On the surrounding higher ground, by contrast, the Kalahari

sand is exposed at the surface while the predominant vegetation consists of Mopane woodland. Little nutritious vegetation exists for livestock and up to the 1980s the range of the tsetse fly extended virtually to the floodplain edge (Mbikusita-Lewanika, 2001).

As described above, on arrival in Bulozi, the early Luyi lived in small clusters but are generally believed to have collected around the area between the Zambezi River and present-day Kalabo (see Mbikusita-Lewanika, 2001). The present-day village of Libonda is said to have been the first capital and it was here that the first Luyi rulers lived and where the earliest Lozi oral history and creation myths begin. According to some Lozi myths and legends, the Lozi God, Nyambe (literally 'no speaking' or 'one who does not speak'), was living in the Libonda area with his wife, Nasilele ('one associated with long things') and had a daughter, whom they named Mwambwa. Mwamba was the first ruler of the indigenous Lozi in the Barotse plains.

Traditional environmental knowledge and practices vary greatly between countries and regions (Bates, 2009). As earlier alluded to, traditional environmental knowledge is an accumulating body of knowledge, practice, and belief that encompasses the world view of indigenous people which includes ecology, spirituality, human and animal relationships, and more. This knowledge is specific to a location and includes the relationships between plants, animals, natural phenomena, and the landscape that are used for lifeways, such as hunting, fishing, trapping, agriculture, and forestry. Traditional environmental knowledge has become increasingly recognized as being valuable for natural resource management, including adaptation to climate change (Bwaya, 2010). The Lozi people of Western Zambia have had a rich traditional background with good environment management knowledge and cultural practices for thousands of years (see Kajoba, 2008; Namafe, 2006; Mbikusita-Lewanika, 2001; Kalaluka, 1979). The Lozi indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generation to generation and closely interwoven with people's cultural values. Indigenous knowledge reflects how such forms of knowledge address local problems and solutions that are context specific. The indigenous Lozi people have a broad knowledge of how to live sustainably. Indigenous knowledge among the Lozi is local, experiential, holistic, and mostly oral (Siamwiza, 2009). Indigenous knowledge system comprises the local knowledge and practices that are unique to a culture or society. For instance, *Kuomboka* among the Lozi people.

Climate change and variability are hazards that have inspired coping strategies since humans first started settling in numbers in the floodplain (Kalaluka, 1979). Similarly, Namafe (2006) argues that social life moves with every change of the waters and associated changes in weather in the Barotse plains of Zambia. According to Kalaluka (1979), the Lozi have been practicing *Kuomboka* as a way to adapt to changes that take place in the Barotse plains every year. The annual exodus of the Lozi is thought by historians to date back to about 1500 when a remnant of the Luba-Lunda empire in present day Democratic Republic of Congo broke away and migrated southwards to what is today known as the Barotse plains (Siamwiza, 2009). Thus, the history of environmental change in the Barotse plains has been impacted by naturally occurring climate change and the activities of humans since precolonial times. Among Lozi adults, throughout history, the adjustment of natural and human systems to climate change and climate variability has been the rule rather than the exception. As a matter of survival, humans have always adapted to changes. Climate change adaptation is a dynamic social process determined in part by our ability to act collectively.

In his study, Kajoba (2008) states that the Lozi developed about eight different agriculture cultivation systems which were locally referred to as garden-types. These farming systems were intended to exploit the properties of the surrounding environment such as sandy, silt deposition, clay soils, anti-hills, forests, thickets, sunshine and perennial supply of moisture in the floodplain. The various gardens were cropped with maize, sorghum, millet, cassava, sweet potatoes, fruit trees, tobacco and various vegetables. They were continuously and intensively cultivated, ensuring all year round production of food and food security.

Mbikusita-Lewanika (2001) argues that the Lozi cultural practices place high value on natural resource management to enhance environmental sustainability. Zambia's Western Province is distinct for a number of reasons, one of which is the role of the Lozi kingdom in safeguarding natural resources (Namafe, 2006; Kajoba, 2008). Each natural resource – land, fisheries, wetlands, forests, and wildlife – has a designated *induna* (representative of the chief) to supervise its use and management, and they are led by the *Litunga* (Mbikusita-Lewanika, 2001). The legal system is based on five cornerstones, which also govern natural resources: *milao* (laws), *liswanelo* (a body of rights and responsibilities), *litukelo* (rights of a particular position or social status), *mikwa* (methods or ways doing things) and *mulatu* (offence or wrongdoing).

The Lozi are recognized for their unique traditional methods of wetland cultivation, fishing, hunting and forest use. Most notably, the Lozi continue to practice an annual transhumance, when the entire kingdom undertakes a migration marked by the *Kuomboka* ceremony, in which, at the height of floods, the *Litunga* relocates from the dry-season to wet-season capital - Lealui to Limulunga (see Kalaluka, 1979).

Although studies by other researchers concerning the Lozi people's traditional environmental knowledge in relation to climate variability, their dynamics are different from the main focus of this study – the role of traditional environmental knowledge in mitigating climate change.

2.6 Summary of the Literature

Critical interrogation of the literature reviewed here shows that very little or no information is directly discussing studies conducted on the role of traditional environmental knowledge among Lozi adults in mitigating climate in Zambia and Lealui Ward area of the Barotse plains in particular.

Similarly, while there are examples where studies have been conducted to produce the literature in reference, the literature cited above has not discussed current effects of climate change, mitigation and adaptive strategies to the negative effects of climate change around Lealui Ward area of the Barotse plains of Western Zambia. It does not capture the current changes in climate as well as in the environment, and the human responses to these variations. Consequently, this research sought to fill the knowledge gaps by giving a more current assessment of the effects of climate change in the Barotse plains; why traditional environmental knowledge is important among Lozi adults in mitigating climate change; and how indigenous Lozi adults respond to the climate change in the Barotse plains, Western Zambia and around Lealui Ward area, Mongu District in particular.

This study, therefore, might have helped to provide and enhance both literature in theoretical terms as well as evidence on the actual role of traditional environmental knowledge in mitigating climate change around Lealui Ward area of the Barotse plains in Western Zambia.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

The methodology used in this study comprises of the following components: research design, target population, sample population, sampling procedures, data collection and data analysis.

3.1 Research Design

Research can be conducted in a number of ways. In this study, a case study design was used to help the researcher gain more insight into the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Western Zambia. A case study seeks to describe a unit in detail, in context and holistically (Merriam and Simpson, 1995; Kombo and Tromp, 2006; Yin, 2014). The case study offers a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon. Anchored in real-life situations, the case study results in a rich and holistic account of a phenomenon. It offers insights and illuminates meanings that expand its readers' experiences (Yin, 2014). Case studies are often done in the subject's real-world context, which gives researchers a good view of what they really are like. Case studies also allow a researcher to use various sources of data such as documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts (Yin, 2014). Researchers have used the case study method for many years across a variety of disciplines such as social sciences and education (Kombo and Tromp, 2006).

There are several benefits of case study research. For one thing, it allows researchers to study the complex relationship between phenomena, context, and people. A major advantage is that a case study produces more in-depth, comprehensive information. It emphasizes the importance of looking at variables in the natural setting in which they are found. This enables the researcher to involve an in-depth examination of the study in a naturalistic context to come up with a grounded theory. A case study was selected because it allowed the researcher to triangulate the study by using both qualitative and quantitative data collection and analysis methods in order to have in-depth information pertaining to the role of

traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Western Zambia.

This study employed more qualitative than quantitative approach in data collection and analysis. A more qualitative, rather than quantitative approach was chosen because it is considered that many of the key factors in the relationship between climate change and people's culture are socially constructed (Kombo and Tromp, 2006). According to Braun and Clarke (2006: 79) 'qualitative research helps in understanding human behaviour from the participant's own frame of reference'. The main advantage of using the phenomenological paradigm is its ability to enable the researcher to elaborate and embrace several different themes simultaneously to achieve a greater understanding of what is occurring in the phenomena. Researchers who adopt a qualitative perspective are more concerned to understand individuals' perceptions of the world. They seek insight rather than statistical analysis. One fundamental importance to this study is the fact that a more qualitative research helped disclose problems, answers and insights that may go unnoticed in a complete quantitative study using closed or list questions. This may have limited the usefulness of the study and would probably not do justice to the fascinating and dynamic nature of the role of traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains in mitigating climate change.

Qualitative and quantitative designs were employed in order to triangulate the data collected. The study used triangulation to generate the required data. It should be noted that in adult education and the social sciences fraternity, triangulation is often used to indicate that more than two methods are used in a study with a view to double (or triple) check results. This is also called 'cross examination' (Kombo and Tromp, 2006). The use of 'cross examination' in the real sense is farfetched, but was used to collate data that was generated using different methods. Most importantly, methods used can be defined in terms of qualitative and quantitative procedures. Triangulation enhances validity and reliability in data processing.

In research, validity can refer to the extent to which the instruments like questionnaires and interview guides measure what they are intended to measure. Reliability is the consistency with which a measuring instrument yields a certain result when the entity being measured has not changed. Validity and reliability was enhanced in this research mostly through use of

pilot study which helped identify research weakness and improve on them as well as triangulation of data collection and analysis using both qualitative and quantitative methods.

In this study, Likert scales were also used in some questions in the questionnaire and semi-scheduled interviews to enhance reliability data collection and analysis. The Likert Scale was developed by Rensis Likert in 1932 (see Sarantakos, 1993). It requires the individuals to make a decision on their level of agreement, generally on a five-point scale (ie. Strongly Agree, Agree, Disagree, Strongly Disagree) with a statement. The number beside each response becomes the value for that response and the total score is obtained by adding the values for each response, hence the reason why they are also called 'summated scales' (the respondents score is found by summing the number of responses). Likert scales were chosen for this study because they are suitable in attitude measurement. In addition, studies have strongly found out that Likert scales are easy to construct, have high coverage of response categories, i.e., use a five points scale, have high precision and reliability.

Qualitative research is viewed as an investigation that involves studying people's experiences as they occur in their natural setting, the meaning that they attach to the experiences, and the multiple contexts within which these experiences occur. Qualitative research can be used to gain insight into people's culture (Yin, 2014). It can be used to explore and understand people's beliefs, experiences, attitudes, behaviours, value systems, concerns, emotions, aspirations, lifestyles, interactions, relationships of individuals as well as identifying intangible factors. It is concerned with developing explanations of social phenomena. That is to say, it aims at helping us to understand the world in which we live and why things are the way they are. It is concerned with the social aspects of our world and seeks to answer questions about:

(a) why people behave the way they do?
(b) how opinions and attitudes are formed?
(c) how people are affected by the events that go on around them?
(d) how and why cultures have developed in the way they are; and
(e) the differences between social groups.

Qualitative research is concerned with finding the answers to questions which begin with: Why? How? What? In what way? Quantitative research, on the other hand, is more concerned with questions about: How much? How many? How often? To what extent?

It is used in studies with research questions needing either 'yes' or 'no' as the answer (Merriam, 1988). In other words, quantitative research is all about quantifying relationships between variables in a study. It generates numerical data that can be converted into numbers; for example, clinical trials or the national census which counts people and households.

In this study, quantitative methodology was mainly used for close-ended questions in the questionnaires and interviews. Qualitative methodology on the other hand, was used for open-ended questions in the set of questionnaires, semi-structured interviews, focus group discussions, field observations as well as perusal of documentations.

The case study was used in this research for purposes of obtaining in depth information and subjective feelings from the respondents. As earlier alluded to the case study approach is useful in describing and analyzing a situation, event, process or a small unit of people. The theory that will be established from this study will be a grounded theory. The case study was conducted in a naturalistic setting and descriptions of activities and events in relation to the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Western Zambia were captured. In this context, the naturalistic setting implies letting things happen, as they do every day without artificial intervention. In other words, a naturalistic setting is a situation where there are live happenings and the researcher captures the things as they occur naturally.

3.2 Study Location

The main research was conducted around Lealui Ward area of the Barotse plains of Mongu District, Western Province of Zambia (see Figure 5). Lealui is situated on the east of the Zambezi River. Since Lealui Royal Village is the Zambia's traditional headquarters of the Lozi people, it was assumed to be rich in traditional environmental knowledge of the Lozi adults found in the Barotse plains. These floodplains were populated by the ancestors of the present Lozi people who, using the ecological goods and services offered by the plains, produced a strong and vibrant socio-political economy that became dominant in the region, using surplus food with which to specialize, raise an army and take advantage of economic opportunities (Mbikusita-Lewanika, 2001). In some literature, Western Province of Zambia is referred to as Barotseland. Mongu is situated on a small blunt promontory of higher ground on the eastern edge of the 60-kilometre-wide Barotse plains of the Zambezi River running north-south, which in the rainy season often floods right up to the town. Mongu is

the home town of the Lozi (or *Barotse*) people, who speak a language derived in part from that of the Makololo, related to the South African Sesotho language. The Lozi ruler, the *Litunga*, has a dry season palace at Lealui on the floodplain, and a flood season palace on higher ground at Limulunga, about 19 km north-east. The *Kuomboka* ceremony marks the court's transfer between the two locations.

Before Zambia's independence on 24th October 1964, Western Province was called Barotseland. In this work, the two names are used interchangeably. The topographic features of the province are distinct from other parts of Zambia in that Kalahari sand and the Barotse floodplains, which are characterized by seasonal flooding, dominate it. Mongu, the provincial capital, mostly consists of vast Karahari sand and the alluvial rich loam soil in the plains. It generally receives good rainfall. The sandy land is suitable for all savannah type of vegetation. The major rivers are the Zambezi on the west, and its tributary Luena in the north. The alluvial rich loam soil in the plains is suitable for various agricultural activities. The plains are well-known for a variety of fish and are also a tourist attraction such as through the annual *Kuomboka* ceremony which takes place when the plains flood. The ceremony involves the re-location of the Lozi King, the Litunga and his subjects from Lealui on the plain to Limulunga on the upland. This is usually at the end of March or beginning of April. The date is liable to change each year and is kept secret by the Barotse Royal establishment until close to the day when the *Litunga* gives consent to announce the date. The Lozi king is called the Litunga. The title '*Litunga*' is the title of the Lozi king and means 'of the earth' or 'owner of the earth' signifying that the King of the Lozis is caretaker of all the lands of the Lozi kingdom.

Kuomboka is a word in Luyana or Lozi language which literally means 'to move out of water' and that is the essence of the event. The date is set by the *Litunga* who considers the level of floods, the availability of food and the phase of the moon. It is only announced a few weeks beforehand (Mbikusita-Lewanika, 2001). One may wonder why the Lozi chose to settle in a floodplain. The reason is actually quite simple. Most of Western Province is unique because of Kalahari sand and the sand is hot, dry and infertile. However, contrasting this desert sand, is an enormous floodplain of black loam soil that is replenished yearly as the Zambezi River bursts and washes in water, nutrients and fish. This is a very good place to cultivate and grow a variety of crops, rear cattle and enjoy fishing activities. Western Province is one of the ten provinces of the Republic of Zambia (see Figure 4). As earlier

mentioned, before Zambia's independence on 24th October 1964, it was called Barotseland Protectorate. The first known leader of the Lozi was a woman called Mwambwa who was later succeeded by her daughter Mbuyamwambwa. She was succeeded by her son the first *Litunga* (or King) Mboo Muyunda. The state expanded under his leadership by sending his brothers and other relations to the surrounding areas to establish Lozi rule (Mbikusita-Lewanika, 2001).

'Lealui' is a Luyana word which means, 'for the Luyi'. As earlier alluded to, Lealui Royal Village is the traditional administrative capital for Barotseland. It is found in the Barotse plains and lie about 19 km southwest of the winter capital of Limulunga; and about 16 km west of political headquarter of Mongu (see Figure 5). Lealui was first identified by King Sipopa around 1864. He camped there briefly. In 1876, King Lubosi Lewanika established Lealui as a permanent capital of the Lozi Kingdom. Formerly, each king chose his own capital; and this entailed that people had to shift to another location whenever the new king was installed. Western Province is a big and located on the western part of Zambia (see Figure 4). The province consists of 35 ethnic groups that make up what is known as *Ba Malozi* (Lozi people). The Lozi are the dominant group of the ethnic groups who inhabit the Barotseland (www.zamstats.gov.zm). Formerly, the Lozi were known as the Luyana or Luyi up until the early nineteenth century when they were invaded by the Kololo. The Luyana adopted the language of the conquerors and thus the Sikololo became the lingua franca until 1863 when the Kololo regime was overthrown. The Silozi then became the modern lingua franca created out of blending the Luyana (Luyi) and the Kololo (Mbikusita-Lewanika, 2001).

The Barotse plains are sometimes known as the Bulozi plains, Lyondo or the Zambezi Floodplains. The name 'Barotse' recognizes the floodplain as spawning the culture and way of life of the Lozi people, 'Rotse' being a variant of *Lozi*, and 'Ba' meaning 'people' (Mbikusita-Lewanika, 2001). The floodplains comprise extensive grasslands rather than swamps. The wetland is so vast that it is used as a natural flood control in the Zambezi River. The floodplain is also significant in the trapping of sediments as this is the point at which a significant drop in slope is recorded and sand and silt settles resulting in improved annual agriculture of the local residents.

The Barotse plains stretch from the Zambezi's confluence with the Kabompo and Lungwebungu Rivers in the north in Lukulu District, to a point about 230 km south, above the Ngonye or Sioma falls and south of Senanga in Sioma District. Along most of plain's length its width is over 30 km, reaching 60 to 70 km at the widest, just north of Mongu, principal town of the plain, situated at its edge. The main body of the plains covers about 5500 km², but the maximum flooded area is 10,750 km² when the floodplains of several tributaries are taken into account, such as the Luena Flats. The Barotse plains is the second largest wetland in Zambia after the Lake Bangweulu system, which differs in having a large permanent lake and swamps, and a much smaller area which dries out annually (www.zamstats.gov.zm).

Figure 4: A sketch map of Zambia, showing location of Western Province
Source: http://www.maps-streetview.com/Zambia/Mongu/roadmap.php.

Some scholars like Kalaluka (1979) argue that the indigenous Lozi people settled in the Barotse plains because floodplains are perhaps the most biodiverse and potentially productive of all hydrological features and, in the tropical semi-arid zones of Africa, became the scenes for settlement. The Barotse plains then, like other floodplains, are important areas for

settlement, water services, agriculture and biodiversity almost everywhere in the world and Africa is no exception. Over the centuries indigenous African people have learned to use floodplains for their own benefit, not only due to the proximity of water but also on account of the fertility of the plain after deposition of nutrient-rich sediments at each inundation. As in other African socio-ecological systems, in African floodplains, relatively dense populations live interdependently with their biophysical environments.

Figure 5: A sketch map showing main study area in the Barotse plains, Western Zambia
Source: http://www.maplandia.com/zambia/western/mongu/mongu.

Mongu is located in Western Province of Zambia, about 651 km from Lusaka the capital city of Zambia. It is the provincial capital of Western Province in Zambia and was the capital of the formerly-named province and historic state, Barotseland. At the time of conducting the study, Western Province had 16 districts namely Mongu, Limulunga, Nalolo, Kaoma, Luampa, Lukulu, Mitete, Senanga, Kalabo, Sesheke, Shang'ombo, Sioma, Sikongo, Nkeyema, Mulobezi, and Mwandi (http://www.zamstats.gov.zm). Mongu mostly consists of vast Karahari sand and the alluvial rich loam soil in the Barotse plains.

The Barotse plains are found on both the eastern and western sides of the great Zambezi River (see Plate 5). These plains are rated among Africa's great wetlands. The plains are about 60 km wide at the widest point, which formed the major study area. The eastern part of the plains in the study area is in Mongu District while the western part is in Kalabo District. The plains are flats with scattered small hills that become islands during the flooding time. They generally support small stands of *Acacia albida*. Along the main river channel, there are small patches of thicket and *Syzygium guineense*. Riparian vegetation in general is sparse. Plate 5 is an aerial photograph of part of the Barotse plains.

Plate 5: Aerial photo of part of the Barotse plains showing the Zambezi River and some canals
Source: Photo courtesy of Stephen Hall Photography (2012). Accessed from https://www.flickr.com/photos/smak-photography on 12/03/2015.

A pilot study was conducted in Tapo area of Kalabo District, Western Province of Zambia from January to February 2015. Tapo is situated about ten kilometres west of the Zambezi River. The pilot study helped the team of researchers identify some weaknesses in the research instruments in some questions that were misunderstood by respondents. The identified questions were refined for use in the main study. Thus, the pilot study helped the researcher to assess the validity and reliability of the instruments as well as data collection and analysis procedures. Validity and reliability are key aspects of all research. In

order for research data to be of value and of use, they must be both *reliable* and *valid* (Braun and Clarke, 2006). In simple terms, reliability refers to the repeatability of findings. Validity refers to the credibility or believability of the research.

Validity may further refer to the extent to which research findings are a true refelection or representation of reality rather than being the effects of extraneous variables. Validity addresses the degree or extent to which such representations or reflections of reality are legitimately applicable across groups. Reliability is concerned with the consistency, stability, and repeatability of the informant's accounts as well as the investigator's ability to record information correctly.

It may be safe to also mention that in a qualitative study the main data-gathering instrument is frequently the researcher himself. Thus, questions of researcher bias and researcher competency, if unchecked, may influence the trustworthiness of data considerably. The very presence of the researcher may affect the validity of the data provided by subjects. When a new member is introduced into an interaction reactive effects can be expected. Participants may behave abnormally (Kombo and Tromp, 2006). They may seek to reveal themselves in the best possible light or withhold or distort certain information; in other words the researcher has created social behaviours in others that would normally not have occurred. Based on their extensive fieldwork, Braun and Clarke hold that researchers need to be trusted before they will be able to obtain any accurate reliable or credible data (Braun and Clarke, 2006).

The pilot study helped the main study in that the results of the pilot study were similar to those of the main study.

3.2.1 Climate of the Study Area

Although the climate has been fluctuating because of climate change, the study area has an annual average rainfall of 945 mm falling in the rainy season from late October to April. The flood in the Barotse plains usually arrives by January, peaks in April and is gone by June to August, leaving a floodplain green with new grass on which a population of about 179,585 people moves in to graze a similar number of cattle, catch fish and raise crops in small gardens. Mongu is hot from September to December, with a mean maximum for October of 35.4 °C, and cool from May to August, with a mean maximum in June of 26.9 °C and a mean minimum of 10.3° C (http://www.zamstats.gov.zm).

3.3 Target Population

The target population consisted of all Lozi adults in the Barotse plains, local leaders such as village headmen and *indunas* as well as institutions that provide education in environmental sustainability in Mongu District. According to statistics captured in the 2010 national census, Mongu had a population of 179,585 people. Interestingly only about a quarter of this population live in Mongu town, while the majority live in the Barotse plains (http://www.zamstats.gov.zm).

3.4 Study Sample

In this case study, the sample consisted of one hundred and twenty (130) subjects drawn from the target population. The sample comprised one hundred (100) indigenous Lozi adult respondents who utilize the Barotse plains around Lealui Ward, twenty-five (25) local leaders (20 village headmen and five traditional local area *indunas* in the Barotse plains) and five (5) institutions that provide education in environmental sustainability to mitigate climate change in Mongu District.

In order to pick the indigenous Lozi adult respondents, the research team used the village registers obtained from the headman. Twenty per cent of the adult population was then stratified randomly sampled to have both males and females. Names of residents were written on pieces of paper and put in a black plastic bag. After shaking the bag several times, the local leader was asked to pick twenty per cent. Since villages in the Barotse plains are relatively small, few respondents were interviewed in the study. Thus, only 100 indigenous Lozi adults were interviewed in the sampled 20 villages around Lealui Ward area.

3.5 Sampling Procedures

Two major sampling procedures were used in this research. The sampling procedures included stratified random sampling and purposive snowball sampling. Stratified random sampling involves dividing the target population into homogenous sub-groups and then taking a simple random sample in each group (Orondho, 2003; Kombo and Tromp, 2006; Kasonde-Ng'andu, 2013). Purposive snowball sampling is used in research when a researcher intends to get detailed information from key informants. Purposive snowball sampling seeks information-rich cases that can be studied in depth (Patton, 1990).

Stratified random sampling was used to involve both male and female indigenous Lozi adult residents in the various communities in the Barotse plains. In each village community, lists of names were picked from village registers kept by headmen or headwomen. The names and sex of adults who had national registration cards were picked and written on pieces of papers. The pieces of paper were put in a black plastic bag. The village headman or headwoman was asked to pick four pieces of paper in each of the twenty villages were respondents were drawn from. The headmen or headwomen directed and introduced the researcher and research assistants to the people picked to be interviewed. Although time consuming, the stratified random sampling procedure was chosen because it provides each individual and sex in the population an equal chance to be selected as a study sample (Kombo and Tromp, 2006).

Purposive snowball sampling was used to select local leaders like village headmen or headwomen, senior traditional local leaders (locally known as area *indunas*) and heads of institutions that provide education in environmental sustainability as typical or key informants on the subject under study. In this procedure the researcher purposely targets a group of people, institutions or organizations believed to have typical characteristics for the study (Orondho, 2003). After interviews, respondents (*indunas* or managers of institutions) were asked to indicate or show the research team where else other *indunas* resided or other managers of institutions that provided education in environmental sustainability where found within their community.

3.6 Research Instruments

The quality of research depends, to a large extent, on the quality of the data collection tools. This study used a mixture of data collection instruments. Semi-structured interview guide, focus group discussion guide, field observation sheet and questionnaires were used to collect data. The questionnaire had few closed and more open questions.

A semi-structured interview guide is a document with logically arranged questions, which the researcher uses to conduct the interview. The researcher may probe but the structure of questions has to be followed (Merriam and Simpson, 1995; Kombo and Tromp, 2006). On the other hand, a questionnaire involves writing answers by the researched on the document. Essentially, the questionnaire is impersonal and interaction is between the

respondent and the document itself even when the researcher is present. The questionnaire can even be mailed to the researched.

3.7 Procedure of Data Collection

To obtain the needed data from the sampled participants, the researcher obtained written permission from the University of Zambia authority which was presented to the office of Mongu District Commissioner and the Barotse Royal Authority (BRE) for introduction and to seek permission to conduct research in the district and communities in the Barotse plains.

Data for this case study came from six major sources: documents, archival records, interviews and focus group discussions, direct observation, questionnaires, and physical artifacts in the study area in the Barotse plains, Western Zambia.

The researcher and research assistants administered semi-structured interviews, focus group discussions and a set of questionnaires. The study only used research assistants who could fluently communicate in local Silozi language of Mongu as well as English.

Interviews and focus group discussions involving female respondents were administered by female research assistants in line with the Lozi culture. Similarly, those involving male respondents were administered by the researcher and male research assistants. Between six and eight people of the same sex were used in the focus group in this study. A focus group discussion is a rapid assessment and semi-structured data gathering method in which purposively sampled participants gather to discuss issues and concerns based on the key themes drawn by the researcher (Orondho, 2003). Listening to other group members' views encourages other participants to voice out their own opinions. The researcher and research assistants stayed in the Barotse plains communities during the period of data collection as participant-observers. Semi-structured interviews and focus group discussions were used to solicit data from Lozi adults in villages and townships. The interviews and focus group discussions were recorded using a voice recorder. The data collected in Silozi language was translated into English by the research assistants. The translated information and recorded data were further taken to a senior *induna* at Limulunga Royal Village for verifications of the translation.

Questionnaires were used to collect data from leaders of institutions and organizations that provide education in environmental sustainability in Mongu District and some educated traditional Lozi local leaders (*area indunas*) who could read and write in English or Silozi.

Most archival records were obtained from Nayuma Museum and Resource Centre located at Limulunga. Field observations on the physical artifacts were guided by a check list to collect data pertaining to environmental activities in the communities under study. Various documents and records from various institutions and organizations concerned with environmental sustainability in Mongu and the Barotse plains were also used for data collection.

A pilot study was conducted on the western side of the Zambezi River in Kalabo District from January to February 2015 to assess the validity and reliability of the instruments. This was done before conducting the main research on the eastern side of the Zambezi River in Mongu District.

Data collection for the main study was conducted from the first week of March up to the end of May 2015. Upon completion of data collection, the researcher carried out the process of data cleaning and thereafter proceeded to analyze and compile it.

3.8 Data Analysis

The purpose of data analysis is to process raw data for interpretation. Quantitative data collected in this study was analyzed using the Statistical Package for Social Sciences (SPSS) Version 22 in order to obtain frequencies and percentages. This data was summarized using descriptive statistics such as percentages and frequency distributions and presented in tables. The SPSS was chosen for quantitative data because it helps to obtain frequencies and percentages in an accurate, precise, easier and fast way. In order to obtain the required information, numbers were assigned to response categories. To illustrate this, sex of respondents as a variable was divided into two categories namely male and female. The number one (1) was assigned to male and two (2) to female. Scoring consisted of counting the number of the respondents who indicated that they were either male or female. The scores were expressed in tables consisting of frequencies and percentages.

In questions requiring respondents to indicate the degree of agreement or disagreement, a Likert scale involving the allocation of a score to each point on the scale was assigned.

A positive item was scored by the following key: Strongly agree (SA) = 1, Agree (A) = 2, Undecided (U) = 3, Do not agree (DNA) = 4 and Strongly do not agree (SDA) = 5. The negative item was scored by the following key: SA = 5, A = 4, U = 3, DA = 2 and SDA = 1. Thereafter, responses for all respondents were added up in order to determine the percentage of respondents with positive and negative views on a question. The Likert scales have been chosen in this study because they are suitable in attitude measurement. In addition, studies have found out that the Likert scales are easy to conduct, have a high coverage of response categories, that is, use a five point scale, and have high precision and reliability (Orondho, 2003).

Qualitative data collected was analyzed using thematic analysis. In order to do this, the views of subjects collected in qualitative data were organized according to common themes and sub-themes that emerged and analyzed by way of narration. Generally, thematic analysis is the most widely used qualitative approach to analyzing interviews (Howitt and Cramer, 2007). The conceptual framework of the thematic analysis for this study was built upon the theoretical positions of Braun and Clarke (2006). Acording to them, thematic analysis is a method for 'identiying, analyzing and reporting patterns (themes) within the data (Braun and Clarke, 2006: 79)'. This study used thematic analysis for qualitative data because 'rigorous thematic approach can produce an insightful analysis that answers particular research questions (Braun and Clarke, 2006: 97)'.

Thematic analysis is historically a conventional practice in qualitative research which involves searching through data to identify any recurrent patterns. A theme is a cluster of linked categories conveying similar meanings and usually emerge through the inductive analytic process which characterizes the qualitative paradigm. Thematic analysis can be used to make sense of seemingly unrelated material. It can be used to analyze qualitative information and to systematically gain knowledge and empathy about a person, an interaction, a group, a situation, an organization or a culture.

Researchers use thematic analysis as a means to gain insight and knowledge from data gathered. The method enables researchers to develop a deeper appreciation for the group or situation they are researching. By using thematic analysis to distill data, researchers determine broad patterns that will allow them to conduct more granular research and analysis.

It is highly inductive: themes emerge from the data that is gathered and are not imposed or predetermined by the researcher.

3.9 Ethical Considerations

In research, when collecting data through human interaction, it is important to pay attention to ethical issues. Chilisa and Preece (2005) define research ethics as a set of standards that guide researchers on how they should interact with the researched in order to successfully access data from the latter. Ethics are also regarded as confidentiality, avoiding deception and seeking informed consent. This study took into consideration a number of research ethical issues. To begin with, the researcher obtained and carried a letter written by the Assistant Dean - Postgraduate Studies, in the School of Education, University of Zambia to the authorities in the study area to carry out the research in the community. This was done in recognition of their authority and to gain their support and cooperation during the study. Written consent from the office of District Commissioner and the traditional Barotse Royal Establishment (BRE) allowed the researcher to conduct a study in Mongu District and its Barotse plains community. The researcher had also earlier obtained research ethical clearance from the Human and Social Sciences Research Ethics Committee (HSSREC) of the University of Zambia.

In the field, the researcher and his research assistants introduced themselves and explained the purpose of the study to respondents. The respondents were informed that they were free to withdraw from the interview at any stage should they so wish to. In addition, verbal permission was sought from each participant who was selected to take part in the face-to-face interviews in the sample and confidentiality was ensured in that no names were indicated on the questionnaires. No resident or local leader was forced to give information when he or she was not willing to do so. The names of the participants have not been included in the study report. All participants in this study, therefore, remain anonymous. Consent was also sought for all photographs in this work.

3.10 Summary of the Chapter

The study on the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Zambia used more qualitative than quantitative methods during data collection and

data analysis. Questionnaires, focus group discussion guides, interview guides and field observation sheets were used to collect data from the respondents that included Barotse plains residents, traditional local leaders, and management of various institutions and organizations related to environmental issues based in Mongu District. The researcher collected data using multiple sources, that is, through questionnaires, focus group discussions, field observations, perusal of documents and semi-structured interviews. Using multiple sources of data helps to confirm the emerging findings as a strategy to ensure internal validity. Consequently, literature was used to help in formulating questions for the respondents as a form of external validity measure. A pilot study was used to help test the research instruments and these were fine-tuned where necessary. The pilot study further helped the research team in fine-tuning the data collection procedures as well as analysis, thus enhancing reliabity and validity of the study.

The chapter which follows will describe, analyze and discuss the findings of the study. It will give the information that was gathered in the field in an organized manner in order to provide meaning.

CHAPTER FOUR

PRESENTATION OF FINDINGS

4.0 Introduction

This chapter presents findings of the study on the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Zambia. Mongu is the main homeland of the Lozi (or *Barotse*) people, who speak a language derived in part from that of the Makololo, related to the South African Sesotho language. The findings are presented according to research questions of the study. The specific research questions are:

i) how have Lozi adults around Lealui Ward area of the Barotse plains been affected by climate change;
ii) what is the role of traditional environmental knowledge among Lozi adults of Lealui Ward area of the Barotse plains in mitigating climate change; and
iii) how can traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains be enhanced to mitigate climate change?

In investigating these, critical aspects of environmental adult education such as the inter-relationship between indigenous people and their environment; opportunities and constraints indigenous Lozi adult rural residents face were also examined.

The findings presented in this chapter were obtained through questionnaires administered to Government officials, managers of some non-governmental organizations and institutions related to environmental issues based in Mongu, and other local traditional leaders; interviews with indigenous Lozi adult residents in the Barotse plains; focus group discussions for indigenous Lozi adults; study of annual reports, archival records as well as other relevant documents; and field observations. Findings are presented according to research questions.

4.1 Data Interpretation

Thematic analysis was used to analyse qualitative data. For instance, themes and sub-themes were established and views of respondents were grouped in such themes and described. On the other hand, quantitative data was analysed in three phases. First, data was entered in Microsoft excel. Secondly, software known as SPSS Version 22 was employed to analyse the

data. Finally, data was presented in form of generated tables showing frequencies and percentages. The SPSS was chosen because it helps to obtain frequencies and percentages in an accurate, precise, easier and fast ways. Interpretation of quantitative data involved the use of frequencies and percentages. Data presented in tables was subjected to cross-tabular analysis for purposes of ranking and comparing the frequencies and percentages. This type of analysis enabled the researcher to generate conclusions about a phenomenon under study by critically examining the frequencies of numerical data percentages.

4.2 Background Characteristics of Respondents

This section presents some socio-demographic characteristics of respondents which were obtained from 100 Lozi adult residents of Lealui Ward area. Gender of respondents was important in this study because males and females play different roles among the Lozi people (Kalaluka, 1079), just like among many other indigenous African societies. The differences in gender roles may be assumed to have affected the perceptions of the role of traditional environmental knowledge among Lozi adult respondents. It should be mentioned that although both males and females participated in the study, the different roles of men and women in the study area seemed to influence their knowledge of value and use of various traditional environmental knowledge, practices and natural resources.

4.2.1 Gender of Respondents

Most of the respondents who took part in the in-depth interviews were male (76 per cent). Only 24 per cent of the respondents were female. It was found that in cases where a couple was asked to take part in the interview, the husband answered all questions while the wife remained silent except in situations where the man consulted his wife. Table 1 shows the gender of people who were willing to take part in the study's interviews around Lealui Ward area of the Barotse plains.

Table 1: Gender of respondents who took part in the interviews around Lealui Ward area of the Barotse plains

Response	Frequency	Per cent
Male	76	76
Female	24	24
Total	100	100.0

Source: Field data (2015).

These findings tally with the general scenario in Zambia where most leadership and decision-making positions were still occupied by males (Lungu, 1989).

4.3 How have Lozi Adults around Lealui Ward Area of the Barotse Plains been Affected by Climate Change?

The first research question sought to find out how the Lozi adults around Lealui Ward area had been affected by climate change. When asked if they were aware of the concept of climate change, majority of the respondents (89 per cent) indicated that they were not aware of the concept. Only eleven per cent of the resident respondents interviewed expressed in affirmative. These findings are presented in Table 2.

Table 2: Awareness of climate change among Lozi adult respondents

Response	Frequency	Per cent
Yes	89	89
No	11	11
Total	100	100.0

Source: Field data (2015).

Table 2 shows the findings on the awareness of the concept of climate change by indigenous Lozi adults in Lealui Ward area communities. Although the majority of the residents were not aware of the concept of climate change and could not explain what it meant or its causes, they clearly expressed how they had been affected by the climate change.

4.3.1 Negative Effects of Climate Change around Lealui Ward Area of the Barotse Plains

While climate change has some positive effects, this study mostly brought out the negative effects mentioned by respondents and observed in the field in the study area.

According to the findings of the study, it was evident that the indigenous Lozi adults around Lealui Ward area of the Barotse plains had already started being affected by the effects of the climate change. The main negative effects mentioned by respondents included:

i) increase in atmospheric temperature and excessive heat in the plains (for instance, Mongu has been recording high temperatures of about 40 degrees Celsius in recent years (MTENR, 2007));

ii) floods;
iii) prolonged dry spells;
iv) reduction in precipitation;
v) unexpected changes in seasons and their durations;
vi) reduction in food production, food security, water supply, and income;
vii) increase in diseases (both humans and livestock) like malaria and diarrhoea among humans and heat stress in livestock;
viii) perceived extinction of some species of plants, insects, animals (eg., varieties of tortoise like *Sin'ombwe*, *Simembe*, *Mpaya*, *Kulu-tou*), birds (eg., *Liya* (pelican), *Liowanyi* (crane), *Mucatomu*) and fish (eg., *Mitome* – eels); and
ix) erosion of indigenous cultural social life of the Lozi people such as suspension of the annual traditional *Kuomboka* (to come out of water) ceremony due to insufficient water in the plains in recent years.

Excessive heat, drought, reduction in food security, water and income

Many residents interviewed expressed sentiments which showed that people's lifestyles around Lealui Ward area of the Barotse plains had been negatively affected by the climate change. One senior citizen in Liyala Village lamented:

> 'My son and grandchildren can no longer catch fish to sell. Fish has become difficult to catch because of the fluctuation of water levels in our river and canals. How do we get money we so much need to buy mealie-meal, salt and soap to survive?'

Similar sentiments were echoed by discussants in a focus group discussion:

> 'We can't find clean drinking water because we share the same drying up water sources with cattle and other animals. It is also becoming difficult to rear cattle which we used to sell to send children to school because the grass which our animals graze in the plains is drying early. The cattle gives us very little milk for our consumption and sale nowadays.' (FGD, Lyeneno Village).

Another senior citizen interviewed in Kashowelela Village had this to say:

> 'In my 72 years the climate here has changed a lot, particularly since 1990s. Unpredictable rainfall is leaving people hungry and poor. The seedlings of maize, millet, sorghum and vegetables we planted in my field died because of the hotness of the soil. It has become hotter than previous years. I won't have food to feed my family this year.'

A majority of Zambians who live in rural areas like Lealui Ward area of the Barotse plains heavily depend on subsistence rain-fed agriculture, and relying on a single maize or other crop harvest for their livelihoods (Zambia National Adaptation Programme Action, 2007).

This situation makes them very vulnerable to climate related natural calamities and disasters, such as floods and droughts, which directly affect agricultural productivity. Heat was cited as a particularly noticeable 'change' as opposed to variability. Mongu has been recording high temperatures of about 40 degrees Celsius in recent years (MTENR, 2007).

Field observations in the cultivated fields around Lealui Ward area of the Barotse plains showed poor-looking withered maize and rice crops (see Plates 6, 7 and 8). Droughts, irregular rain patterns and reduction in precipitation had caused crop failure and largely reduced food security around Lealui Ward area of the Barotse plains. Food and Agriculture Organization (1996) defines food security as when all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life. In other words, the core focus of food security is sustainable access to safe and adequate food at all times. Stable food availability, food access, nutritional value and safety are important aspects of food security.

Food and Agriculture Organization (2007) states that climate change will affect all four dimensions of food security: food availability, food accessibility, food utilization and food systems stability. It will have an impact on human health, livelihood assets, food production and distribution channels, as well as changing purchasing power and market flows. Its impacts will be both short-term, resulting from more frequent and more intense extreme weather events, and long-term, caused by changing temperatures and precipitation patterns. People who are already vulnerable and food insecure are likely to be the first affected. Agriculture-based livelihood systems that are already vulnerable to food insecurity face immediate risk of increased crop failure, new patterns of pests and diseases, lack of appropriate seeds and planting material, and loss of livestock.

Agriculture is important for food security in two ways: it produces the food people eat; and (perhaps even more important) it provides the primary source of livelihood for about 36 per cent of the world's total workforce. In the heavily populated countries of Asia and the Pacific, this share ranges from 40 to 50 per cent, and in sub-Saharan Africa, two-thirds of the working population still make their living from agriculture (Food and Agriculture Organization, 2007). People living on the coasts and floodplains and in mountains, drylands and the Arctic are most at risk. In the food and agriculture sector, climate change mitigation

and adaptation often go hand in hand, so adopting an integrated strategic approach represents the best way forward.

Plate 6: A field of withered maize in Lealui Ward area of the Barotse plains
Source: Field data (2015).

Maize and rice were singled out as the most difficult crops to produce around Lealui Ward area of the Barotse plains due to climate change. Maize as a result of not being drought or flood resistant and rice due to withering of the crop during prolonged drought periods and drowning of the crop during excessive flood periods associated with climate change.

Plate 7: A field of withered maize at the edge of the Barotse plains in Mongu, Western Zambia
Source: Field data (2015).

Problems with agriculture were universally reported around Lealui Ward area as was food insecurity. People complained that the onset of the rainy season had become less predictable:

> ‘When you expect rain – no rain; when you don’t need a lot of rain, that’s when there is more rain,’ an area *induna* stated.

Much was also said of extreme weather such as excess heat and harsh sun that dried seedlings after germination and the soil they were growing in as the rainy season had become intermittent.

Plate 8: Cattle grazing in a withered rice field in Lealui Ward area of the Barotse plains, Western Zambia
Source: Field data (photo by researcher, 2015).

Some participants in focus group discussions had this to say:

> ‘To tell you the truth, we don’t know what the world is coming to. We can no longer plan our seasonal activities. We no longer know when to expect rain, or hot season. This is March, but it is already hot as if we were in October or November.’ (FGD, Indoo Village).

> ‘In olden days when we were still young, we used to have a lot of food for ourselves and animals. This is no longer the case.’ (FGD, Nalusa Village).

Traditional leaders interviewed echoed similar sentiments. An elderly senior *induna* at Lealui Royal Village complained:

> ‘The Barotse plains are becoming a more difficult place to live, rear cattle and cultivate as the climate change impacts worsen each day. We do not even know when to sow our rice or maize seeds because we no longer know when to expect rain in the plains. When we expect rain, it doesn’t come; when we don’t expect it, the plains flood and wash away crops.’

Similarly, an area *induna* at Lwatile near Lealui Royal Village lamented:

> 'This is March when we expect rain but there is no rain. It is very hot already. What will it be like in October when we normally expect heat in *Libala* (the Barotse plains)?'

> 'We are now in April when we expect to celebrate our very important traditional *Kuomboka* ceremony. There is no water in the plains. This means we may not have the ceremony,' bemoaned a village headwoman.

Another senior citizen in Kashowelela Village mentioned loss of emergency food sources as one of the negative effects of climate change around Lealui Ward area of the Barotse plains:

> 'Even our natural fruits are being damaged by the extensive heat we are experiencing these years... Our natural traditional fruits are being damaged by drought; our natural fruits are our drought fruits but these days there are less natural fruits than before.'

The study also established that climate change had negatively affected income among Lozi adults around Lealui Ward area. Since many activities and ventures which helped the people in the study area earn a living were negatively affected, incomes which used to come from these also went down. To illustrate, fishermen and fish traders lost some income when the catch of fish reduced because of low levels of water in the Zambezi River and its associated canals, ponds and tributaries. Discussants in the focus group discussion also confirmed:

> 'This year has been very difficult for us who earn a living through fish business. In the past years we used to make as much as between K150 and K200 per day after sales in Mongu. This year, however, we only make between K50 and K100 because fish is hard to catch in low levels of water in the river, ponds and canals.' (FGD, Lyatolo Village).

There might be many other factors which could have contributed to mentioned economic loss in the fish industry around Lealui Ward area of the Barotse plains. However, in simple terms, it can be argued that the local Lozi adults involved in fish industry around Lealui Ward area lost approximately 50 per cent income partly because of low fish catch due to fluctuations of water levels associated with climate change.

Many small scale farmers in the study area also complained loss of income when their crops failed either because of drought or excessive floods. The most affected farmers were maize and rice growers. Some discussants had this to say:

> 'Crops we normally cultivate are now failing to mature as expected. We will die of hunger. The natural fruits and even mangoes fail to fruit the way they used to. Fish is also becoming hard to catch. How do we survive?' (FGD, Lealui Royal Village).

Erosion of indigenous cultural social life of the Lozi people

The Lozi adults around Lealui Ward area are very particular and proud of their culture. 'We are proud of our culture and some of us are ready to do anything to preserve it,' emphasized one *induna at* Lealui Royal Village. However, the study revealed that climate change was one of the contributing factors to the erosion of some Lozi traditional norms. Drought, one of the effects of climate change, for instance was cited to have negatively affected the transhumance tradition of the Lozi adults around Lealui Ward area. Prolonged dry spells and reduction in precipitation experienced in recent past had contributed to low volume of water levels in the Zambezi River and its associated Barotse plains. This made it difficult to have *Kuomboka* ceremony, a major tradition aspect of the Lozi people. This was brought out by some discussants:

> 'Our children may not understand the value of *Kuomboka* because it has not been practiced in recent years. *Kuomboka* is not just a ceremony, it is part of life of the Lozi people.' (FGD, Lealui Royal Village).

The study also revealed that some cardinal aspects of the Lozi culture, including traditional environmental knowledge were being eroded and needed to be re-strengthened, by reuniting family ties and community unity as used to be the case in olden days.

Many discussants involved in the focus group discussions and residents interviewed bemoaned that some aspects and best practices of Lozi culture were being eroded in their communities. Some indicated that many young people in the Barotse plains no longer seem to have time to spend with elders to learn the wisdom and skills of the Lozi plain people. Many such young people spend much time trying to make ends meet by trading in various things or catching fish to sell in towns unlike what used to happen in the past. Thus, much local Lozi wisdom, traditional ethics and skills were rarely passed on to younger generations by the senior citizens. Apparently, since climate change has affected food production and rural people's income, the younger generation have been forced to concentrate on trading in towns - abandoning their village cultural way of life.

> 'Much of our traditional wisdom and specialized traditional skills like rain-making go to the graves when our elderly people die because there are few young people who have time to acquire such wisdom and skills in our communities nowadays,' bemoaned one village headman.

The discussants during focus group discussions further echoed that children rarely spent time with their grandparents to learn the Lozi culture through story telling or riddles:

> ‘Many children nowadays spend their day time looking for money in town and their evenings watching various television programmes which do not portray our Lozi culture, but often full of foreign movies.’ (FGD, Mukoko Village).

Field observations showed that it was common to find many youths involved in trading business and the few homes with solar-powered televisions were often full of children eagerly watching television in the evenings around Lealui Ward area of the Barotse plains.

Food insecurity and erosion of Lozi cultural norms leading to increased deforestation

The study also interestingly established that although it is generally believed that deforestation is one of the causes of global warming, it was also mentioned by many respondents as an effect of climate change around the study area because besides people who came from outside the province, some poor and hungry local people in rural areas of Western Province had resorted to cutting down trees – against their Lozi cultural norms – to sell to outsiders to earn themselves a living (see Plates 9 and 10). Food insecurity in Lealui Ward area probably resulted from a combination of negative factors like drought, excessive heat, reduction in precipitation, fluctuations in duration of seasons, prolonged floods – all effects of climate change.

Many residents interviewed and local leaders in the study area bemoaned the rate of indiscriminately cutting down of trees at the edge of the Barotse plains by people from outside the country, cities, and towns for their selfish benefits contrary to the indigenous customary laws of the Lozi people. Some discussants argued that people from outside the province took advantage of local youths who were in need of money and used them to cut down trees and sale so that they could buy whatever they wanted.

Some discussants were of the view that God was not happy with them and had probably decided to punish the Lozis using climate change for departing from their traditional way of caring for their environment and its abundant natural resources. This is part of what they had to say:

> ‘*Nyambe* (God of the Lozi people) may not be happy with us *Malozi* (the Lozis), hence, punishing us by not giving us rain. We have allowed the non-indigenous people to be destroying our environment such as through indiscriminately cutting down a lot of trees which used to provide shade to *Nyambe*’s creations. People cut trees for charcoal, firewood and worse still, everyday we see people coming to *Bulozi* (Western Province) to cut and take many big logs to cities and outside the country like South Africa and China to make furniture and medicines which are again sold to us at high prices.’ (FGD, Mukoko Village, edge of Barotse plains).

'This area is called *Mabumbu* (colony of group of trees) because it used to be a collection of *Libumbu* (group of trees in an area). Many precious indigenous trees have been cut down, leaving us with mango and cashew nut trees which we planted for their fruits and nuts, and provide us with shade in our villages.' (FGD, Mabumbu Village, edge of Barotse plains).

'Many selfish foreigners involved in logging use our poor local youths to indiscriminately cut down trees and pay them little money. Unfortunately, our youths use this money on useless things like beer which in turn destroys their lives. These youths have begun to forgo our Lozi cultural norms of conservation of natural resources.' (FGD, Kashowelela Village).

Plate 9: A truck full of big logs showing deforestation in Western Zambia
Source: Field data (2015).

Field observations and interviews with Forestry Department senior staff confirmed that a lot of trees were indiscriminately being cut down in and around Mongu District, Western Zambia. Apart from seeing canoes loaded with bags of charcoal and firewood from the upland into the plains, the researcher observed a number of truckloads of logs being ferried from various parts of Western Province including the edge of the Barotse plains in Mongu District to other parts of the country and for 'export' outside Zambia. Plates 9 and 10 are few examples of the destruction of trees in the province.

Moreover, according to the Government of Zambia's *Forests Act No. 4 of 2015* (Government Printer, 2015), individuals and organizations are invited to apply for issuance or renewal of

large, medium or small scale cutting, felling or processing of timber in identified potential concession areas across the country, legally encouraging deforestation. In Western Province, the concession areas are in all districts: Mongu, Kalabo, Kaoma, Lukulu, Luampa, Nkeyema, Mitete, Senanga, Sikongo, Nalolo, Sioma, Shang'ombo, Sesheke, Mwandi and Mulobezi. Individuals and organizations were also encouraged to apply for Timber Merchant Permit from the Ministry of Lands, Natural Resources and Environmental Protection (Government Printer, 2015). The permit allows export of timber from Zambia. This is contrary to the traditional laws of Barotseland which highly enhance protection of natural resources like timber.

Plate 10: A truckload of logs on a pontoon for 'export' to other areas from the edge of the Barotse plains
Source: Field data (2015).

Local leaders and the discussants involved in focus group discussions in the Barotse plains agreed that trees help humans in many ways. One traditional local leader had this to say:

> 'Tress provide us with fruits that we eat, traditional medicine which we use here in the plains, shelter for us and our animals, poles to construct houses and canoes, they breath in the carbon dioxide we breathe out and give us oxygen in return which we breathe in to sustain our lives,' stated one area *induna* in Lealui Royal Village.

Similarly, this was confirmed by focus group discussions as the following typical excerpts illustrate:

> 'Trees are very important in our life among *Malozi*. That is why even our customary laws do not allow indiscriminately cutting down of tress. Our tradition also encourages tree planting at the edge of the plains to protect it because the Lozis and the plains are inseperable.' (FGD, Mabumbu Village, edge of Barotse plains).

> 'Trees are life to us. Without trees around us, we would all be dead.' (FGD, Lealui Royal Village).

Many scientific studies have shown that trees reduce air pollution and global warming through respiration and removing particulate matter (Bwalya, 2010; Adams, 2003). Trees take in carbon dioxide and give out oxygen that sustains life. Carbon dioxide is one of the major contributing elements to the greenhouse effect.

Floods

Another negative effect of the climate change mentioned by the respondents in the Barotse plains was flooding, the opposite of drought (see Plates 11 and 14). Although the indigenous Lozi people have been living with the flooding scenario for centuries, some still felt that it negatively affected their development. Some discussants had this to say:

> '*Kuomboka,* the traditional method we use here among the Lozi to get out of water to dry upland, does not solve all the problems associated with flooding in our area. Our children cannot effectively concentrate at school because they have to stop schooling from December to July. During flooding our children relocate to live with relatives in the upland and stop going to school. Meanwhile, they write the same school examinations with children who learn all year round. How do you expect them to pass and progress at school?' (FGD, Tungi Village).

The nearest school for the Tungi village community is Malabo Primary School. Records at the District Education Board Secretary's office and head teacher's office revealed that the school had an enrolment of over 200 pupils, from grade one to seven. However, at the time of data collection for this study, the school only had two reed-walled, grass-thatched roofed classroom to accommodate the children.

It was revealed that the school was deserted whenever the plains were flooded (see Plate 9). It is undoubtedly clear that education has a crucial role to play in the social and economic development of Zambia in general and Mongu District in particular. At its most basic level, education is important because it gives people the baseline skills to survive as adults in the world. These skills include basic literacy and numeracy, as well as the ability to communicate, complete tasks and work with others. Education is essential for nearly every type of job or career, and in many cases, education makes the difference between being able to perform a job safely and accurately and being unable to perform a job at all.

However, many people believe that education is important in life for reasons beyond basic survival skills. For instance, Delors *et al*. (1998) famously said that education is essential to good citizenship and that education is important to life because it enables people to contribute to their community and their country. Others believe education is important because it helps to answer life's big questions, including questions of how to live, work and love. Still others believe that education is important because it teaches people about the world around them.

Fortunately, at the time of data collection, the United Nations Children's Fund (UNICEF) had started the construction of the first floating school in the Barotse plains to ease the challenges of school children at Malabo Primary School. It could be hoped that many such floating infrastructure and communities could be designed and constructed in the Barotse plains.

Plate 11: A primary school abandoned by leaners and teachers when it became inaccessible during flood in Lealui Ward area
Source: Field data (2015).

Perceived extinction of some species of plants, fish, insects and animals

A number of elderly respondents indicated that change in climate in recent years had also led to extinction of some species of important medicinal and food plants, insects, fish and animals. One senior citizen in Lubama Village had this to say:

> 'Some of our important varieties of fish, birds, medicinal plants and animal species have disappeared from the plains. This is very worrisome.'

Similarly, some elderly discussants in focus group discussions complained:

> 'With these changing times related to climate change, we have lost some of our important medicinal plants which our ancestors taught us to use whenever we were sick and for treating our animals. We have also lost a number of animals, varieties of fish, birds and insects which were useful in our society.' (FGD, Tungi Village).

> 'We have lost our precious *Liowanyi*, *Mitome*, *Liya*, *Kulu-tou*, *Simembe*, *Sin'ombwe*, and *Mpaya* besides medicinal plants among others all because of change of climate in our land these years.' (FGD, Lealui Royal Village).

Some of the creatures which were named as having gone into extinction include varieties of tortoise like *Sin'ombwe*, *Simembe*, *Mpaya*, *Kulu-tou*), birds (eg., *Liya* (pelican), *Liowanyi* (crane), *Mucatomu*,) and fish (eg., *Mitome* – eels). However, this perceived extinction may need to be researched upon further for verification.

Increase in diseases among humans and livestock

Some respondents reported that diseases had increased among people and livestock in Lealui Ward area because of effects of climate change. Diseases among humans cited included malaria, diarrhoea, severe headache and high blood pressure probably attributed to excessive heat and stagnant water during floods. Discussants in focus group discussions also indicated that their cattle worked less in the fields when it was very hot. They also complained that some cows had stopped producing more milk for them to sell and earn an income. Moreover, others complained that many calves born during hot and rainy seasons died from mysterious diseases. Some residents interviewed also complained of increase of mosquitoes in the plains. This is what one Lozi adult respondent in Kashowelela Village lamented:

> 'Look, our once well maintained old traditional canal system no longer functions. The stagnant water in these canals and ponds have led to an increase of diseases like malaria and diarrhoea in our communities.'

Similar sentiments were echoed by discussants during focus group discussions:

> 'Mosquitoes have increased and though we have been provided with mosquito nets, malaria cases have continued among us in these plains. We don't have a clinic nearby. We have also lost our traditional medicinal plants we used to use.' (FGD, Mukoko Village).

> 'Cattle is very important to us here. However, of late our cows give us very little milk. When it is hot, they tend to refuse to work and appear weak. We don't have money to be taking them to Mongu where there are veterinary officers.' (FGD, Tungi Village).

Stagnating water during prolonged rainfall shortages left many community members more vulnerable to diarrheal diseases and malaria as mosquito population increases. Records at a rural health centre at Lealui Royal Village also showed an increase in the number of people who had received treatment of malaria. However, this may not just be attributed to climate change because the population of people in the study area seemed to have also increased as a result of influx people who from time to time came from cities and other towns to buy fish, Mongu rice and other cultural artifacts found in the Barotse plains.

As regards diseases among livestock, records at the district veterinary office for few treated animals confirmed that heat stress was common among cattle in Mongu. Livestock and fish are important sources of proteins in the Barotse plains. Fieldwork by the team of researchers witnessed a lot of livestock grazing in the plains in open sun light without shade during hot periods of the day (see Plate 12). Moreover, a senior veterinary officer in Mongu stated that livestock seemed to have mostly been affected by heat stress attributed to climate change:

> 'Climate change may be contributing to a number of challenges faced by our small scale farmers in Mongu. For example, although this area has a lot of cattle, heat stress has become common resulting in low reproduction rate in cows, reduced milk production and even death; these could imply reduction of income levels among farmers,' said one senior veterinary officer.

Plate 12 A number of livestock reported to have been affected by heat stress attributed to high temperatures and low levels of clean drinking water in Lealui Ward area
Source: Field data (2015).

Literature show that heat stress is mostly caused by very high temperatures as well as humidity and has negative impact on cattle (Hristov, *et al*., 2013). The first sign of heat stress is increased breathing followed by open mouth breathing (panting), and slobbering. As the heat stress becomes severe, cattle tend to tremble and lose coordination. If the cattle go down, they most likely may not recover. Heat could also have implications which may not be seen immediately. Heat stress annually causes major economic losses in both beef and dairy herds, and its impact on reproduction is often much worse than on milk production and milk quality. A study conducted by the Institute for Dairy Technology at the Milk Producers' Organization of South Africa and the Department of Animal Sciences at the University of Illinois in Botswana between 2012 and 2015 established that heat stress could cause conception rates among cows to fall by up to 40 per cent, forcing farmers to spend a lot of money to use more artificial insemination than they would have under more favourable climatic conditions. If you are in breeding season with your cow herd, heat stress could result in greater losses in the first few weeks after conception. For bulls preparing for breeding season, the high temperatures could impact semen quality two to four weeks or more later, resulting in lower conception rates a month after the heat stress event. Heat stress can also affect reproduction by causing cows to calve before their due dates. These 'early' calves tend to have a lower body weight and weaker immune system than calves carried a full term. As a result, they are also more susceptible to diarrhoea and other diseases (http://www.agweb.com/article/prevent-heat-stress-in-feedlot-cattle-illi-university-news-release). Although the conditions which prevailed in Botswana could not be the same as those in Lealui Ward area, similar challenges to livestock might apply.

Cows become more susceptible to diseases – such as mastitis and udder infections – when they experience heat stress, and milk production could also drop by up to 40 per cent, depending on the severity of stress. Milk quality is affected, with milk fat dropping by up to 30 per cent solids and milk protein content could fall by up to 20 per cent (http://www.agweb.com/article/prevent-heat-stress-in-feedlot-cattle). The ability of white blood cells to destroy bacteria in the udder is also affected, resulting in increased somatic cell counts. This in turn could result in economic losses, as farmers around Lealui Ward area often receive a premium for milk and sell of beef cattle.

4.4 What is the Role of Traditional Environmental Knowledge among Lozi Adults of Lealui Ward Area of the Barotse plains in Mitigating Climate Change?

The second research question sought to investigate the role of traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains of Mongu District in mitigating climate change. In order to establish the role of traditional environmental knowledge among Lozi adults around Lealui Ward area, the researcher collected data from residents through interviews and focus group discussions, traditional leaders using an interview guide, and managers of institutions that provide education of management of environment in the Barotse plains using a questionnaire. The study findings revealed that 78 per cent of the respondents interviewed strongly believed, and another 20 per cent were of the view that traditional environmental knowledge among the Lozi adults was important in mitigating climate change and enhancing environmental sustainability. The findings are presented in Table 3. Throughout the study, most respondents indicated that local traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains was cardinal in mitigating and adaptation to climate change. Traditional environmental knowledge is vital for sustainability of biodiversity including floodplains, forests and agro ecosystems across landscapes spanning from households through villages and wilderness among Lozi adults in Lealui Ward area of the Barotse plains.

Table 3: Significance of traditional environmental knowledge in Lealui Ward of the Barotse plains

Response	Frequency	Per cent
Strongly agree	78	78.0
Agree	20	20.0
Undecided	1	1.0
Do not agree	1	1.0
Total	100	100.0

Source: Field data (2015).

It is evident from Table 3 that majority of the residents around Lealui Ward area of the Barotse plains community in Mongu District believed that the local traditional environmental knowledge among Lozi adults in the Barotse plains was cardinal in mitigating climate change. Only one per cent said traditional environmental knowledge among Lozi adults was not important in mitigating climate change.

4.4.1 Culture of Environmental Sustainability among Lozi Adults of Lealui Ward

Through in-depth interviews, focus group discussions, field observations and peruse of literature, the study found that the Lozi indigenous people had a rich culture rooted in good environmental management system which helps in mitigating climate change. It was revealed that the Lozi people's indigenous Barotse Royal Establishment traditional cultural system highly values traditional environmental knowledge as a cardinal key to the sustenance of humans and the entire environment (see Plates 13 and 14). Traditional environmental knowledge found among Lozi adults was generated by communities, over time, to allow them to understand and cope with their particular agro-ecological and socio-economic environment.

Plate 13: Part of Lealui Ward area with cashew nut and mango trees planted along the edge of the plain
Source: Field data (2015).

According to Kajoba (2008), in the traditional society of the Lozi people, people in rural communities of Western Province of Zambia have utilized wetland and forest biodiversity for their livelihood for as long as they have lived in this area. They have accumulated centuries-

old resilience knowledge, evolving by adaptive processes and handed down through generations by cultural transmission at least as far back as the second half of the nineteenth century and maybe much further. Collective actions have been institutionalized in forms of traditional knowledge systems. Some traditional practices and beliefs found in African societies such as Lealui ward area of the Barotse plains are important and contribute to environmental sustainability as well as our well-being.

When respondents were asked what they thought was the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains, the following responses were noted from focus group discussions:

> 'The Lozi people and their natural environment have always been intricately intertwined; you cannot separate a Lozi from the plains' land and its water environment because the two are inseparable.' (FGD, Mabuto Village).

> 'Historically the use of the natural resources in Barotseland was locally controlled by cultural norms and rules, enforced through traditional leaders empowered by the Barotse Royal establishment structures. The Lozi have rich unique traditional knowledge and cultural practices that enhance sustainability in many areas of life.' (FGD, Lubama Village).

> 'Our traditional major modes of transport like canoes, ox-carts and bicycles do not use fossil fuels like diesel or petrol which pollute the air; our traditional governance system encourages conservation of natural resources; our *Kuomboka* tradition helps reduce pressure on natural resources; ….you see, we plant mango, cashew nut and other fruit trees along the edge of the Barotse plains all the way from Lukulu down to Senanga to protect and maintain the plains highly valued among the Lozi; we practice economic conservation and organic agriculture in our small gardens on raised mounds which helps mitigate climate change by maintaining and improving the environment.' (FGD, Lealui Royal Village).

In many parts of the world local knowledge systems have been found to contribute to sustainability in diverse fields such as biodiversity conservation and maintenance of ecosystems services, tropical ecological and bio-cultural restoration, sustainable water management, genetic resource conservation and management of other natural resources (Atteh, 1992). Local knowledge established by the study in Lealui Ward area can also be said to be useful for ecosystem restoration and often has ingredients of climate change mitigation and adaptive management.

Plate 14: A village scenery with old and young trees, houses and canoe-based transport in the Barotse plains
Source: Field data (2015).

It was revealed from the responses obtained from key participants through in-depth interviews with local leaders like *indunas* and elder residents, responses from leaders of various institutions that provide education in environmental sustainability in Mongu District, the discussants in the focus group discussions and field observations that traditional way of life around Lealui Ward area of the Barotse plains was important in mitigating climate change. One senior *induna* at Lealui Royal Village declared how the Lozi culture deeply respects nature as a sacred from God:

> 'Our Lozi tradition believes that years before *Nyambe* (Lozi God) created humans, he created the land, plains, rivers, woodland, fish, animals, birds and insects. When humans were created nature took care of humans by providing shelter, water and food for survival. Therefore, we now have a responsibility to protect and preserve nature. Traditionally, our wildlife was hunted or used mainly for subsistence only.'

The Lozi's culture, just like many other traditional African view of the world is profoundly religious, and it forms the basic attitudes that characterize most, if not all, spheres of life. Many things on Earth are held in great esteem for religious reasons, especially where they are thought to be dwelling places for spirits. These may include such things as mountains, waterfalls, rocks, trees and some areas of the wetlands, forests, animals, birds and insects.

The study established that the culture of the Lozi people of the Barotse plains highly encouraged and enhanced conservation of natural resources through cultural practices that are cardinal in enhancing sustainable development. It should also be mentioned that both male and female respondents who participated in the study had profound knowledge relating to the role of local traditional environmental knowledge and utilization of natural resources,

principally because these communities highly depended on wetland and forest resources for their livelihood. The knowledge about vegetation use seemed to be obtained at an early stage in the life of an individual, either from parents or through other interactions. The different roles of men and women seemed to influence the knowledge of value and use of various natural resources.

It was revealed that cultural lifestyles that seek to promote conservation were still prevalent in the Lealui Ward area of Western Province such as the *Kuomboka* ceremony that maintains the Lozi identity. Respect for sacred landscapes and sustainable harvest of forest products are commonplace among the communities of Mongu. Headmen and other *indunas* regulate the commercialization of fruit trees on markets. While there has been dilution of traditional governance system by the modern democracy in Zambia, it was evident that local people still value their local leadership. Hence, rules made by the council of headmen on utilisation of resources were respected to some extent. Traditional forest laws under the Barotse Royal Establishment were well known by indigenous Lozi people and have an influence on perceptions of the local people towards forest use. Certain trees (names were not mentioned for cultural reasons) were never cut because of traditional beliefs. Local people in the Lealui Ward area still believe that bad omens were expected to fall on would-be violators. However, there was general understanding that traditional conservation practices were steadily declining among the Lozi community especially among the young people.

On the question of how the Lozi adults learnt traditional environmental knowledge, it was established that many adults learnt traditional environmental knowledge as a lifelong process through their close interactions with cultural life, and dialoguing with family members, community members, friends, colleagues and associates. Traditional environmental knowledge was found to play a critical role in mitigating climate change in the Barotse plains.

> 'This Barotse plain you see is our school given to us by *Nyambe* (the Lozi name for God). And we are all learners and teachers according to our Lozi culture. We learn how to sustainably take use and take care of our environment,' proudly elaborated one elderly man at Kashowelela Village.

Traditional environmental knowledge among the Lozi adults around Lealui Ward area is important in mitigating climate change because it encourages and enhances practices and technologies which are cardinal in sustainable development such as use of low carbon

emission practices, and low release of other greenhouse gases into the atmosphere in communities as well as preservation of natural resources. To illustrate, the major means of transport in the Barotse plains are non-polluting canoes on the water and bicycles and ox-carts on the land. The canoes are paddled and no use of any emission-producing engine is used. Even the large barge used by the Lozi King during the annual *Kuomboka* traditional ceremony is paddled by people, not driven by an engine. Plate 15 shows the *Nalikwanda* barge of the Lozi indigenous people during *Kuomboka*. Kalaluka (1979) observed that during *Kuomboka*, the King uses the *Nalikwanda* while his subjects use small canoes to evacuate from the flood plains when the water levels reached their zenith.

Traditional environmental knowledge can also be viewed as a system of self-management, an extremely valuable source of environmental information that allows indigenous communities such as the Lozi adults around Lealui Ward area to protect and preserve their way of life. It is the basis for local decision-making in agriculture, hunting and gathering, nutrition and food preparation, resource management, education and health as well as social, economic, and political organization. This is now recognized as 'the inextricable link between cultural and biological diversity' (Bwalya, 2010: 13).

Plate 15: Paddling of the Nalikwanda barge during the Kuomboka ceremony
Source: Photograph courtesy of Nayuma Museum, Limulunga.

The study found out that many houses of local 'affluent' people in villages in the Barotse plains use solar energy for lighting, radios, televisions and fridges. Solar energy is renewable and there is plenty of sunshine in Zambia to support the use of solar energy. People who could not afford a complete solar energy system used small solar-powered lighting lamps in their homes. Furthermore, since the Lozi culture, through the *induna* (equivalency of minister) responsible for lands and natural resources, discourages unnecessary burning of grass in the plains, indiscriminately cutting down of trees, and people are mostly encouraged to use cow dung, not firewood, for cooking and drying fish in the Barotse plains. Sunshine is also extensively used for drying fish in the Barotse plains. Related to this, the study found that the indigenous people in the Barotse plains have been involved in community tree-planting practices for many years. To illustrate, field observations revealed the presence of many old and young cashew nut and mango trees in village communities in and along the edge of the Barotse plains. Interestingly, cashew nut trees are evergreen (see Plate 16). Thus, they take in carbon dioxide throughout the year, reducing the greenhouse effect. The cashew nut trees act as all-year-round effective 'carbon sinks' that absorb gases and prevent their release into the atmosphere.

Plates 13 and 16 shows some cashew nut trees planted along the edge of Barotse plains as well as in villages by the indigenous people. These trees have survived indiscriminately cutting down because they are rarely used for charcoal burning or logs to be processed for furniture.

Plate 16: Evergreen cashew nut trees at the edge of the Barotse plains
Source: Field data (2015).

Trees are important, valuable and necessary to our very existence. Trees are like the lungs of the planet. They breathe in carbon dioxide and breathe out oxygen. Trees are essential to life as they are the ground troops on an environmental frontline. Our existing forest and the trees we plant work in tandem to make a better world. When you cut down trees, you increase land temperature (Banda, 2014).

4.4.2 Traditional Laws for Conserving Natural Resources in the Barotse Plains

The study established that although Zambia is facing a lot of Western cultural influence including laws, customary laws which promote conservation of natural resources were still firmly established in the Western province due to its special status, autonomous history and strongly centralized traditional laws and court system (Mbikusita-Lewanika, 2001; Gluckman, 1941). The Barotse Royal Establishment is the custodian of the traditional laws and court system. The establishment is headed by the *Litunga* who is assisted by the *Ngambela* (equivalency of Prime Minister) and various *indunas*, starting from the central government to village level. The Lozi people have very high regard for the Barotse Royal Establishment. All important sectors of life such as land, health, education, canals, natural resources, forestry, fisheries, and wildlife have an *induna* responsible for it. At traditional central government level an *induna* can be said to be an equivalent of a cabinet minister.

Responsibilities of the Barotse Royal Establishment traditional government

The main responsibilities of the Barotse Royal Establishment traditional government can be summed up as follows:

(i) To conserve natural resources for the benefit of present and future generations.

(ii) To provide every subject with suitable land for building a home and farming.

(iii) To allow every subject to utilize of the specific natural resources according to laws, rules and regulations pertaining to utilization of the specific natural resource.

(iv) To distribute previously unallocated land to subjects who are short of land and to newcomers.

(v) To repossess all land which has been abandoned or for which family heirs cannot be traced.

(vi) To make laws, rules and regulations.

(vii) To prosecute people found to be contravening laws, rules and regulations.

(viii) To adjudicate land disputes and other related cases.

4.4.3 Culture of Monitoring Wetlands and other Natural Resources

The *Litunga* in consultation with the *Ngambela* appoints an *induna* to be in-charge of specific natural resources. The following are the main functions of *indunas* responsible for specific natural resources:

(i) advise the *Litunga*, chiefs and the citizenry on all issues concerning specific natural resource;

(ii) perform all the administrative work pertaining to the specific natural resource;

(iii) plan, control and monitor the utilization of the specific natural resource; and

(iv) plan, manage, monitor and control the harvest, cropping and utilization of natural resources in terms of place, duration, timing and number of participants.

Structure of the Barotse Royal Establishment government

Barotse system of government is of five tiers or levels. Starting from the central government to the village level. The structure of the Barotse government is as follows.

Namuso: The first tier of government is referred to as *Namuso* (literary the Mother of governments). This is the central government of Barotseland. It has the *Litunga* as the Head of State and the *Ngambela* as Prime Minister. The *Ngambela* is the political, administrative and judicial head of the Barotseland. Second to the *Ngambela* is the *Natamoyo*. This title means 'Master-of-Life' or 'Redeemer'. He has the power of sanctuary or refuge for those in need. The *Ngambela* works with other *indunas* (ministers) in-charge of specific sectors such as health, education, land, forests, canals, wildlife, to mention a few.

Lwambi: The second tier of government is the regional government of the southern part of Barotseland, which is headed by the *Litunga-La-Mboela*, which means the *Litunga* of the South. She has the *Sambi* as the political, administrative and judicial head of the southern region of Barotseland. The government of *Lwambi* has its own *Natamoyo* and other *indunas.*

Chiefdoms: Barotseland is sub-divided into eleven Chiefdoms each headed by a Chief. A Chief has a team of *indunas* to assist him/her in governing the area. This is a tier of government. In each chiefdom an *induna* acts as political, administrative and judicial head.

County Administrative Areas: In every Chiefdom there are County Administrative Areas referred to as *Lilalo*. The *Silalo* (singular) has an *induna* who is its political, administrative and judicial head.

Villages: A *Silalo* has a number of villages (*Minzi*). *Munzi* (singular) has an *induna* who is its political, administrative and judicial head.

4.4.4 Role of Kuta in the Mitigation of Climate Change in the Barotse Plains

Each level of government in Barotseland has a *Kuta*. The main responsibility of the *Kuta* is to carry out political, administrative and judicial functions of each tier of government. The study found out that the *Kuta* makes and enforces local indigenous system's laws which are cardinal in the conservation of natural resources, besides others. The adherence of community members in the conservation of natural resources in the Barotse plains greatly mitigates climate change.

The Barotse traditional legal system is based on *milao* (laws), *liswanelo* (rights), *litukelo* (rights of particular position or social status), *mikwa* (methods or ways of doing things), and *mulatu* (an offence or wrongdoing). The five cornerstones of the Barotse Legal System have been existence since the beginning of the kingdom. However, most laws were institutionalized during the reign of King Mulambwa in the eighteenth century. This included laws pertaining to acquisition, use and disposal of natural resources (Gluckman, 1941).

• *Milao*: According to the Barotse Legal System, *Milao* are legislative rules that need to be followed. These rules touched all aspects of life in Barotseland including the use of natural resources.
• *Liswanelo*: A body of rights that one enjoys according to gender, age and other situations. This includes access to and utilization of natural resources. They also include ones responsibilities.
• *Litukelo*: A body rights that one enjoys according to their position or social status. This includes access to and utilization of natural resources. They also includes ones responsibilities.

• *Mikwa*: Accepted methods or ways of doing things. This includes acquisition, use and disposal of natural resources.
• *Mulatu*: To be found guilty of going against *milao, liswanelo, litukelo,* and *mikwa*.

4.4.5 Administration of the Barotse Royal Establishment Judiciary

As earlier alluded to, the administration of the judiciary in Barotseland is done through *Kutas* (Mbikusita-Lewanika, 2001). *Kuta* is where *indunas* and the public meet to look at all matters pertaining to Barotseland be it of administrative or judiciary nature. In other words, *Kuta* is a parliament as well as a court of law. The main business of the *Kuta* consists mainly in the hearing and settlement of cases and promulgation of laws and orders for public works. There is a *Kuta* at every level of the Barotse Royal Establishment government. Persons not satisfied with judgment at lower *Kutas* have the right to appeal to the *Sikalu Kuta* at *Namuso*.

• *Sikalu Kuta* (Supreme Court): At *Namuso*, the *Ngambela*, or one next to him in rank during his absence, acts as the Judge and submits judgment to the *Litunga* for approval. The rest of *indunas* acts as assessors. An important member of the *Sikalu* is the *Natamoyo*. As earlier mentioned, he has the power of sanctuary or refuge in his person and house. He must be a member of the Royal Family, but from a line of female descendants. He sits next to the *Ngambela* in the *Kuta*. He can release any offender who is sentenced to any punishment, fine or death if he sees that the sentence is rather heavy for the offence.

• Chiefdom Level *Kuta*: Every Chiefdom has a *Kuta* with less powers than the *Kuta* at *Namuso*. This *Kuta* at chiefdom level has powers to settle cases except ones the *Kuta* considers difficult that are referred to as *Sikalu*. In the *Kuta* there must be someone to act as *Natamoyo*.

• *Silalo Kuta*: Every *Silalo* has a *Kuta* with less power than the Chiefdom *Kuta*. The *Kuta* at *Silalo* has powers to settle cases except ones the *Silalo Kuta* considers difficult which are referred to Chiefdom *Kuta* (see Mbikusita-Lewanika, 2001 and Gluckman, 1941).

4.4.6 Kuomboka as a Strategy to Mitigate Climate Change in the Barotse Plains

The *Kuomboka* ceremony of the Lozi people in Western Zambia which evolved as a movement from water to higher grounds, to escape the encroaching waters of the Zambezi and its tributaries is an example of an indigenous knowledge system practice promoting its

value which is broader than cultural as it contributes to Zambia's indigenous way of mitigating climate change as well as enhance national unity and foreign exchange earnings.

Kuomboka is one of the biggest, colourful and most famous of Zambia's ceremonies. The event marks the journey of their King, the *Litunga* as the mighty Zambezi River temporally floods leave his winter palace at Lealui, about 16 km west of the town of Mongu, to dry land at the summer Limulunga palace. The subjects also leave the plains for the higher lands following the King. According to literature, dating back over 300 years, the *Kuomboka* ceremony is surrounded by interesting myths and legends (Mbikusita-Lewanika, 2001; Kalaluka, 1979).

Although *Kuomboka* was already a long-standing tradition, it was *Litunga* Yeta III who in 1933 first made the move from the winter palace in Lealui to the summer Limulunga palace a major and colourful ceremony it is today. He built a palace on permanently dry land at Limulunga.

The ritual is necessitated by the annual flood of the Zambezi River which turns the farmlands of the *Malozi* into a mighty lake so that the people must move to higher ground. *Kuomboka* is annual exodus, which occurs about the beginning of March, takes the form of a ceremonial procession of small boats and dugout canoes led by the massive royal barge of the *Litunga*. The legends tell that before the time of the first known male chief, Mboo, there came a great flood called *Meyi-a-Lungwangwa*, meaning 'the waters that swallowed everything'. The vast plain was covered in the deluge, all animals died, and every farm was swept away. People were afraid to escape the flood in leaky dugout canoes only, so it was that the high god, *Nyambe*, ordered a man called Nakambela to build the first great canoe, *Nalikwanda*, which means 'for the people'. Then, as now, the canoe was painted in huge black and white stripes: white symbolizing spirituality and black the people. Before voyaging out on the stormy waters the canoe was loaded with every type of seeds and animal dung. At the place where the first *Nalikwanda* landed, the seeds were scattered to become the progenitors of the plants as we know them today, and the animals once again sprang forth from the animal dung (Kalaluka, 1979).

As earlier alluded to, the Lozi are usually referred to as the plains people. The plains people's way of living has been greatly influenced by the flooding regime of the Zambezi

River (Namafe, 2006). The local people together with their livestock annually move from the wetlands of the Zambezi flood plain to higher upland. This movement is called *Kuomboka*. The migration from the plain to high land releases pressure on consumption of natural resources. When people and their livestock move from the plains to the higher upland, vegetation, soil and water bodies in the wetlands are relieved from consumption and allowed to revitalize. This enhances conservation of natural resources and mitigates climate change using organized community-based indigenous knowledge.

Besides the *Kuomboka*, periodically public announcements pertaining to cropping of natural resources in the Barotse plains in specified areas were made by the Barotse Royal Establishment. There are three types of cropping: *sitindi* (fish) *sitaka* (birds) and *lisulo* (wild animal). The cropping of natural resources is a controlled activity in terms of place, duration, timing and number of participants (Mbikusita-Lewanika, 2001).

• *Sitaka*: Periodically birds in a specified location were cropped. Only adult birds were killed. It was not allowed to kill nursing birds or its chicks (Plate 17 shows some birds in the Barotse plains).
• *Sitindi*: Organized public fishing using special spear in specified lagoons and lakes on a selected day. Traditional fishing spears were used because they mostly target big fish, conserving the young ones for future use.
• *Lisulo*: Once in a long while a hunting expedition would take place in a specified area. During the *lisulo* only specified animals would be killed. Nursing animals and their young ones were not killed.

Plate 17: A variety of bird species captured around Lealui Ward area
Source: Field data (2015).

From a traditional perspective, the study found out that natural resources in Barotseland were used for home consumption and for the common good of the community. Benefits accrued from natural resource were shared in such a way that the local community had a portion and people in authorities at all levels had their portions too. People in authority distributed part of their portions to the vulnerable that is *namukuka* (single women), widows and the elderly and contributed to homes, which had visitors. Hence, the Siluyana saying, '*Kwa lya mbumu kwa mu bika*' which means people have a share from the King's food plate. Some portions were stored for 'rainy days', needy areas and ceremonies (Mbikusita-Lewanika, 2001).

Many studies have shown that the best method of natural resources monitoring is community-based whose main thrust is to ensure that benefits of conservation accrue to the people who are directly involved in the management of natural resources (see Berkes, 2008; Adams, 2003). The traditional systems of natural resources monitoring found in the Barotse plains is such method.

Local communities in the Barotse plains have high respect for their traditional responsibility which include ensuring that strict observation of the timing of burning of fields, protection of trees, canals, water bodies and wildlife following the laws of their traditional authorities, and

fair distribution of the benefits of the community's natural resources. The Lozi indigenous people are traditionally conservationists who use resources according to their customary laws based on indigenous knowledge systems.

The study also found out that Village Wetlands Conservation Committees were established in the Barotse plains with representatives from various structures in the community: existing Barotse Royal Establishment, institutional structures at grassroots level, community development committee, Government agents and non-governmental organizations committed to conservation of natural resources. Siamwiza (2009) also mentions the presence of these committees in the Barotse plains. The main function of the committees is to monitor the conservation of the natural resources at grassroots level. This greatly contributes to mitigation of climate change.

4.4.7 Conservation Agriculture as a Strategy to Mitigate Climate Change in the Barotse Plains

Through focus group discussions and field observation, the study revealed that a lot of indigenous farmers around Lealui Ward area of the Barotse plains practice conservation agriculture which encouraged cultivation of indigenous crops like sorghum, cowpeas, cassava and millet (see Plate 18). Principles of conservation agriculture are not completely new in African societies like the Barotse plains of Western Zambia. For thousands of years African societies have used knowledge of their local environments to sustain themselves and to maintain their cultural identity (Kennes, 1991). However, only recently has this knowledge been recognized by the Western scientific community as a valuable source of environmental and social information. Today, large quantities of information exist which demonstrate the existence of effective indigenous strategies for ensuring sustainable use of resources. Such information suggests that indigenous knowledge and its application to enlightened environmental assessment and management should be taken seriously. The phenomenon that indigenous societies have a rich understanding of their resources, and that they are skilled at experimenting and adapting to changes over time has led to the development of the notion of indigenous knowledge systems.

Plate 18: Millet being grown at the edge of the Barotse plains as one of the indigenous crops under conservation farming – mitigation and an adaptation to climate change effects
Source: Field data (2015).

Conservation agriculture is reported be one of the most viable mitigation strategies to reduce the climate change impacts (Delors *et al*., 1998; FAO, 2007). This is so because conservation agriculture is an approach to farming that seeks to increase food security, alleviate poverty, conserve biodiversity and safeguard ecosystem services. Conservation agriculture practices can contribute to making agricultural systems more resilient to climate change. In many cases, conservation agriculture has been proven to reduce the farming systems' greenhouse gas emissions and enhance its role as carbon sinks.

4.5 How can Traditional Environmental Knowledge among Lozi Adults around Lealui Ward Area of the Barotse Plains be Enhanced to Mitigate Climate Change?

The third research question sought to obtain suggestions from the respondents on how traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains could be enhanced to mitigate climate change. The study revealed that climate change mitigation and adaptation strategies using indigenous knowledge could be enhanced through cross-pollination of knowledge, co-operative work and concerted effort between the indigenous people around Lealui Ward area of the Barotse plains and other stakeholders.

The study also established that some cardinal aspects and best practices of the Lozi culture, including traditional environmental knowledge being eroded needed to be re-strengthened, by reuniting family ties and community unity as used to be the case in olden days using interactive traditional dialogue education to enhance climate change mitigation and adaptation strategies in the Barotse plains.

Table 4 presents data showing how local traditional leaders (*indunas*) around Lealui Ward area suggested what could be done to enhance mitigation and adaptation strategies using traditional environmental knowledge among Lozi adults. According to the findings of this study many (60 per cent) local leader respondents were of the view that climate change mitigation and adaptation strategies using indigenous knowledge could be enhanced by cross-pollinating local knowledge with other knowledge from outside the Barotse plains.

Table 4: Enhancing traditional environmental knowledge in mitigating climate change according to local leaders

Response	Frequency	Per cent
Integrating with Western science	15	60
Lozi traditional environmental knowledge alone	4	16
Integrating with other African traditional environmental knowledge	6	24
Total	25	100.0

Source: Field data.

This was confirmed by focus group discussions among Lozi adults as the following typical excerpts illustrate:

> 'Although our Lozi customary laws encourages sustainable use of natural resources, there is room to have them enhanced to march with the ever changing world by cross-pollinating our local knowledge with that of other people, including good aspects from Western science.' (FGD, Lealui Royal Village).

The discussants and residents interviewed also called for the integration of local knowledge with Western science or other African societies to enhance climate change mitigation and adaptation strategies. Some local leaders even suggested integrating some African

indigenous knowledge like those found among the Lozi adults of the Barotse plains in the planning of national and regional mitigation and adaptation strategies. A lesson for Zambia to learn from the above findings is that, deliberate initiatives to encourage full citizen active participation at local community level and create a responsive education for all, not only through formal learning, have been marginalized for a long time yet are necessary to enhance all citizens chances of being educated in a holistic manner.

It must be accepted that one positive solution to the problem of mitigating climate change is to provide the means of educating and training all the citizens of the nation. This can be achieved through mass education which employs dialogue education, a critical component of adult education (Banda, 2014). Indigenous knowledge systems in which we find traditional environmental knowledge is also a part of mass education because it is informal and non-formal in nature. Informal and non-formal education are a part of holistic lifelong education which can be acquired by all people including the indigenous people who might not have had opportunity to undergo formal Western education. Indigenous knowledge systems are responsive to the ever changing needs of society (Knudtson and Suzuki, 1992). Responsive education and training which encourages active community participation like indigenous people help citizens to be creative, to be more productive, self-reliant and contribute to sustainable development. The critical task for policy makers at various national and regional levels and corporate leaders is to find ways to meet both economic and environmental goals which promote sustainable development, without sacrificing either.

Two main strategies for reducing the threat climate change poses are mitigation and adaptation. Mitigation can be said to be any activities that reduce the overall concentration of greenhouse gases in the atmosphere. This includes efforts to switch from fossil fuels to renewable energy sources such as wind and solar, or to improve energy efficiency. It also includes efforts to plant trees and protect forests, wetlands or to farm land in ways that prevent greenhouse gases from entering the atmosphere such as sustainable conservation farming. Adaptation refers to activities that make people, ecosystems and infrastructure less vulnerable to the impacts of climate change. This includes things like building defences to protect low-laying areas from rising water levels, switching to sustainable methods of agriculture, planting drought or flood resistant crop varieties, and improving systems to warn of heat-waves, disease outbreaks, droughts and floods.

The study established that many respondents (58 per cent of interviewed residents) in the Barotse plains were calling for the integration of modern Western science with traditional environmental knowledge. When asked what could be done to enhance local traditional environmental knowledge in mitigating climate change in the Barotse plains, the residents gave the following responses shown in Table 5.

Table 5: Enhancing traditional environmental knowledge in mitigating climate change among Lealui Ward respondents

Response	Frequency	Per cent
Integrating with Western science	58	58
Lozi traditional environmental knowledge alone	20	20
Integrating with other African traditional environmental knowledge	22	22
Total	100	100.0

Source: Field data.

As earlier stated, the study revealed that traditional environmental knowledge and Western science can work as complementary knowledge systems, especially in African communities like the Barotse plains. Plate 19 shows a village community of indigenous Lozi people on a raised mound in the Barotse plains as defence to protect low-laying lands from rising water level, one of the effects of climate change. Villages in the Barotse plains were built on man-made mounds known as a '*suuba*' as part of traditional environmental knowledge, to keep them above the flood waters. The villagers also use local material like grass and reeds obtained from their environment in the Barotse plains. Reeds and grass used in the construction of the houses and toilets are eco-friendly as the rarely pollute the environment. The materials are also used to make compost manure when the building are brought down. The compost manure are used to fertilize vegetable gardens and other crop fields in the Barotse plains. Traditional environmental knowledge found among Lozi adults around Lealui Ward area of the Barotse plains is a cardinal part of cultural traditional heritage that gives pride to the indigenous Lozi people and Zambia as a cultured African nation.

Plate 19: A village constructed using reeds as local materials on raised mounds in the low-laying Barotse plains, Lealui Ward area, Mongu
Source: Field data (2015).

With increasing global warming caused by various factors, climate change has become a prime concern for our own existence. The demand of the moment is probably to adapt to the changing climate and work together to find mitigation options so that no further damage is done. While adaptation aims to lessen the adverse impacts of climate change through a wide-range of system-specific actions, mitigation looks at limiting climate change by reducing the emissions of greenhouse gases and by enhancing opportunities.

While mitigation tackles the causes of climate change, adaptation tackles the effects of the phenomenon. The potential to adjust in order to minimize negative impact and maximize any benefits from changes in climate is known as adaptive capacity. A successful adaptation can reduce vulnerability by building on and strengthening existing coping strategies.

In general the more mitigation there is, the less will be the impacts to which we will have to adjust, and the less the risks for which we will have to try and prepare. Conversely, the greater the degree of preparatory adaptation, the less may be the impacts associated with any given degree of climate change. For people today, already feeling the impacts of past inaction in reducing greenhouse gas emissions, adaptation is not altogether passive, rather it is an active adjustment in response to new stimuli. However, our present age has proactive

options (mitigation), and must also plan to live with the consequences (adaptation) of global warming. The idea that less mitigation means greater climatic change, and consequently requiring more adaptation is the basis for the urgency surrounding reductions in greenhouse gases. Climate mitigation and adaptation should not be seen as alternatives to each other, as they are not discrete activities but rather a combined set of actions in an overall strategy to reduce greenhouse gases emissions.

As indicated earlier, the study also revealed that some cardinal aspects of the Lozi culture, including traditional environmental knowledge being eroded could be re-strengthened, by reuniting family ties and community unity as used to be the case in olden days. Many discussants involved in the focus group discussions and residents interviewed bemoaned that some aspects and best practices of Lozi culture were being eroded in their communities. Some indicated that many young people in the Barotse plains no longer seem to have time to spend with elders to learn the wisdom of the Lozi plain people. Many such young people spend much time trying to make ends meet by trading in various things or catching fish to sell in towns unlike what used to happen in the past. Thus, much local Lozi wisdom, traditional ethics and skills were rarely passed on to younger generations by the senior citizens.

> 'Much of our traditional wisdom and specialized traditional skills like rain-making go to the graves when our elderly people die because there are few young people who have time to acquire such wisdom and specialize skills in our communities nowadays,' bemoaned one village headman.

The discussants during focus group discussions further echoed that children rarely spent time with their grandparents to learn the Lozi culture through story telling or riddles. 'Many children nowadays spend their evening time watching various television programmes which do not portray our Lozi culture, but often full of foreign movies.' Field observations showed that it was common to find the few homes with solar-powered televisions full of children eagerly watching television in the evenings around Lealui Ward area of the Barotse.

At the local level within communities in the Barotse plains, the climate change mitigation and adaptation strategies can be enhanced through the strengthening of family and community ties and sharing ideas using dialogue education. Adult education often uses dialogue education as an effective tool to use to retain indigenous knowledge in such communities which are a part of the global village infiltrated by Western technology like televisions, the Internet and other social media. In rural communities like the Barotse plains, dialogue

education can be used as an effective and efficient media for indigenous knowledge systems like traditional environmental knowledge among peers, gender groups and generations. As Banda (2014) puts it, adult education aims at helping adults learn to learn to achieve self-actualization by unlocking their potential and attaining their goals wherever they are.

Some of the characteristics of people that are self-actualized are reality-centered, emotionally well-adjusted and strong ethics. These are what you get in co-operators, those who actively participate in dialogue education. We need to cultivate a spirit of living in peace with ourselves, our neighbours, associates and colleagues as well as the natural environment on which humanity is enormously dependent. Men and women should work co-operatively. If we are to save life on this planet Earth and achieve self-actualization, we must unite the heart and the mind, feelings and thoughts, intuition and sensation in each one of us. This is what we may also call participatory education. The goal of participatory education is to help groups of people and communities learn to use reflections on their everyday experiences to analyze the social-political context in which they live, and to develop a sense that they can work effectively to change that context. Dialogue education does just this in communities.

For thousands of years, indigenous people around the world have used knowledge of their local environment to sustain themselves and to maintain their cultural identity (Johnson, 1992). Today, a growing body of literature attests not only to the presence of a vast reservoir of information regarding plant and animal behaviour but also to the existence of effective indigenous strategies for ensuring the sustainable use of local natural resources (Banda, 2009). The traditional ecological knowledge, wisdom and best practices of indigenous people comprise the global bio-cultural heritage that must inform and guide climate change adaptation and mitigation strategies at global, regional and local scales.

As earlier alluded to, indigenous people are excellent observers and interpreters of change on the lands, waters, and sky (Salick and Byg, 2010; Knudtson and Suzuki, 1992). Their community-based and collectively held traditional knowledge accumulated and maintained through practice over countless generations, offers valuable insights into the state of the environment. Indigenous knowledge possesses chronological and landscape-specific precision and detail that is often lacking from scientific models developed by scientists at much broader spatial and temporal scale, including those used to understand the magnitude of climate change consequences. Moreover, indigenous knowledge provides a crucial

foundation for community-based mitigation and adaptation actions that can sustain resilience of social-ecological systems at the interdependent local, regional, and global scales. The successful incorporation of traditional environmental knowledge into climate change efforts depends not only on bridging traditional environmental knowledge and Western science; ultimately, it calls for institutional practices and policies to accommodate knowledge exchanges, and the development of a workable policy framework that guides Government agencies and organizations towards the culturally sensitive incorporation of traditional environmental knowledge into climate change planning and policy.

A number of recent studies show that climate change was a global problem whose solution lay in shared efforts to encourage the *active participation* of business communities, civil society as well as various government ministries and agents (see Vinyeta and Lynn, 2012; Salick and Byg, 2010; Namafe, 2006; Nakashima, *et al*., 2000; Oakley, *et al*., 1991). Active participation can best be realized when concerted efforts and co-operative discussions include indigenous people among stakeholders. The dialogues should be followed by actions which are co-operatively monitored and evaluated by all stakeholders to solve identified challenges. The role of the dialogue among civilizations and the establishment of new ways of working together are paramount in this endeavour: it is only through a constructive and inclusive dialogue that the means to eradicate poverty, to preserve biodiversity, enhance strategies to mitigate climate change, enhance innovative strategies to adapt to climate change, sustain cultural diversity and disseminate knowledge can be identified and shared.

4.6 Summary of the Findings

This chapter presented findings of the study on the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Zambia.

According to the findings of the study, it is evident that the indigenous Lozi people of the Barotse plains community in Western Zambia had already started being affected by the effects of the climate change. The main negative effects included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected changes in seasons and their durations; reduction in food production, food security, water supply, energy and income; increase in diseases like malaria

and diarrhoea among humans; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people.

Through the study, it was established that traditional environmental knowledge among the Lozi adults around Lealui Ward area of the Barotse plains was important in mitigating climate change. The indigenous Lozi people and local communities in Mongu District are actively involved in innovative solutions based on their traditional knowledge, such as reducing emissions through fire management techniques, adopting renewable energies in their territories, and engaging in resource management culture and projects that reduce pressure on natural resources and enhance local adaptive capacity. The study findings further showed that climate change mitigation and adaptation strategies using indigenous knowledge can be enhanced through co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders.

The next chapter will present the summary, conclusion and recommendations of the study based on the key findings of the study on role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District in Western Zambia.

CHAPTER FIVE

DISCUSSION AND ANALYSIS OF FINDINGS

5.0 Introduction

This chapter focuses on the discussion and analysis of the findings of the study using research objectives, literature review and andragogy theory, transformative learning theory and the iceberg theory of culture which guided the study. Once again the reader will remember that the main purpose of the study was to investigate the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Zambia. The order of the discussion follows the order in which the findings have been presented in the previous chapter. This order is in line with the study's three main research objectives which guided the study:

i) to explore how Lozi adults around Lealui Ward area of the Barotse plains of Mongu District had been affected by climate change.

ii) to investigate the role of traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains of Mongu District in mitigating climate change.

iv) to establish what could be done to enhance traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains of Mongu District to mitigate climate change.

The findings were obtained during focus group discussions, in-depth interviews as well as through completing semi-structured questionnaires. Findings from field observations and documentations are also discussed and analyzed.

5.1 Background Characteristics of Respondents

In terms of gender, the study revealed that most of the responded who took part in the interviews in the study were male (see Table 1). Only 24 per cent were female. As alluded to in Chapter four, these findings tally with the general scenario in the country where most leadership and decision-making positions are occupied by males. This seems to stem from customary law in Zambia which generally asserts that males are heads of households and are better equipped to deal with decision-making, especially in rural areas (Lungu, 1989).

This interesting finding around Lealui Ward area of the Barotse plains tells a lot about deep-rooted Lozi culture where males are still somewhat considered superior to the females in their society, an aspect of deep culture according to the Iceberg Theory of Culture (Hall, 1976). This aspect of deep culture can be reflected even through the less chances the female folk are accorded leadership positions as heads of villages or the kingdom. To illustrate this, only two (10 per cent) of the twenty villages visted by the study research team were headed by women. Moreover, according to archival records at the Nayuma Museum and Heritage Centre only the first two leaders of the Lozi monarch were female: Mwambwa and her daughter Mbuyuwamwambwa. Mbuyu's successor was her son Mboo Muyunda as the first male *Litunga* (Mbikusita-Lewanika, 2001; Gluckman, 1941).

As earlier mentioned in Chapter Three, the name '*Litunga*' is the title of the Lozi king and means 'of the earth' or 'owner of the earth' signifying that the King of the Lozis is caretaker of all the lands of the Lozi kingdom. The first *Litungas* or rulers of Barotseland were females. Literature has it that the first rulers of the Luyi people who were the earliest known of the Lozi people present today in Western province were led by women when they first arrived on the Bulozi flood plain after a staged migration from the Lunda kingdom, part of the famous Lunda-Luba empire of the Katanga region in present day Democratic Republic of Congo (DRC) in 1650 (Mbikusita-Lewanika, 2001). The earliest known of these queens is remembered by the name of Mwambwa who bore a daughter called Mbuyu wa Mwambwa - 'Mbuyu of Mwambwa'. It is from this queen under whose leadership the Luyi or Aluyana settled in Kalabo district area of the Barotse plains. The name Luyi or Aluyana means 'people of the river or foreigner'. Lozis were called Luyi by the people they defeated in the plains. When the Luyi reached the plains, they found, defeated and incorporated other people like the Nyengo, Makwamashi, Totela, Kwangwa and Subiya. During the reign of Mbuyu, one of her sons, Mboo was selected to be the first male monarch and from that time forwards, only males have occupied the Kingship. Mbuyu transferred leadership to her son Mboo Muyunda in 1780 (Gluckman, 1941).

There is long history embedded in the Lozi culture of the potential of women and their ability to lead. Women are recognized in Barotseland as unbiased leaders. The first male *Litunga* was Mboo Muyunda also known as Mwanasilundu. He took over from his mother, Mbuyu wa Mwambwa usually referred to as Mbuywa-Mwambwa or Mbuywamwambwa. Mboo proved himself to be a good leader and saved the credibility of men. Female *Litungas*

continue to rule to this day at Libonda and Nalolo. *Mande hai tubeha* or when the *Litunga* passes away, a female *Litunga* from Libonda Royal Capital, Mbowanjikana usually takes interim leadership in order to maintain order and peaceful transition while a male *Litunga* is being sort. It is also noteworthy that women in Barotseland had a democratic voice in the pre-colonial era and were even rulers. For instance, the post of the third senior chief, Mukwae Mbowanjikana, ruler of the southern part of the kingdom, has been reserved for women for centuries and they continue to occupy it to this day. (See Appendix 2 for the list of the *Litungas*).

5.2 Effects of Climate Change on Communities around Lealui Ward Area

The reader may be reminded that the first research objective sought to ascertain how Lozi adults around Lealui Ward area of the Barotse plains had been affected by climate change. The focus group discussions, questionnaires, field observations and in-depth interviews with Lozi adult residents and local leaders around Lealui Ward area communities revealed that the main negative effects of climate change included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected changes in seasons and their durations; reduction in food production, food security, water supply, income; increase in diseases like malaria and diarrhoea among humans and heat stress among livestock; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people.

While climate change has some positive effects, this study mostly brought out the negative effects mentioned by respondents and observed in the field in the study area. Many residents interviewed expressed sentiments which showed that people around Lealui Ward area of the Barotse plains had been negatively affected by the climate change.

The study revealed that climate change has far reaching implications for all aspects of the Lozi adults around Lealui Ward area of the Barotse plains' local lifestyle. Climate includes patterns of temperature, precipitation, humidity, wind and seasons. As earlier alluded to in Chapter Two, climate change affects more than just a change in the weather, it refers to seasonal changes over a long period of time. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that depend on them.

Some short-term climate variation is normal, but longer-term trends now indicate a changing climate. Since so many systems are tied to climate, a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, availability and use of water, and health risks. For example, a change in the usual timing of rains or temperatures can affect when plants bloom and set fruit, when insects hatch or when rivers and streams are at their fullest. This can affect historically synchronized pollination of crops, food for migrating birds, spawning of fish, water supplies for drinking and irrigation, floodplain or forest health, and more. IPCC (2007) has reported that extreme events, including floods and droughts, are becoming increasingly frequent and severe. Certain regions of Africa such as southern parts where Zambia is located are more prone to such extreme events than others. It is probable that the increased frequency of recorded disasters is a result of a combination of climatic change and socio-economic and demographic changes.

The most common sentiment and observation among the indigenous Lozi adults around Lealui Ward area of the Barotse plains was that the weather was no longer easily predictable: elders within a single generation were unable to predict weather patterns as their forefathers once did. For instance, the following is part of what one elderly senior *induna* had to say:

'... When we expect rain, it doesn't come; when we don't expect it, the plains flood and wash away crops.'

Climate change has far reaching implications for all aspects of the indigenous Lozi people's lifestyle, most importantly fishing, crop cultivation, health and sanitation, animal husbandry and hunting.

The reader may be reminded that negative effects recorded in Chapter Four of this work included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected changes in seasons and their durations; reduction in food production, food security, water supply and income; increase in diseases (both humans and livestock) like malaria and diarrhoea among humans, and heat stress in livestock; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people such as suspension of the annual traditional *Kuomboka* ceremony due to insufficient water in the plains in recent years. The consequences

of climate change effects agriculture and other production occupations, pastoralism, fishing, hunting of animals and birds, human and animal health, plant life, gathering of local fruits and other subsistence activities of economic and cultural value, including access to water for agriculture, animals, home consumption and sanitation in the plains.

Problems with agriculture related to effects of climate change were universally reported around Lealui Ward area of the Barotse plains as was food insecurity. Crop failure such as maize and rice, therefore, entails pending hunger, food insecurity, low income and increased poverty among the indigenous Lozi people of the Barotse plains. Maize is a staple food for most people in Zambia. One of the reasons maize is a staple food across the world is its high nutritional value, with high levels of starch and also valuable proteins and oils.

Depending on the variety, maize may contain a number of important B vitamins, folic acid, vitamin C, and pro-vitamin A (i.e., precursor to vitamin A). Maize is also rich in phosphorus, magnesium, manganese, zinc, copper, iron and selenium, and has small amounts of potassium and calcium. Maize is a good source of dietary fiber and protein, while being very low in fat and sodium (salt). However, maize is naturally deficient in lysine and tryptophan, which are two of eight amino acids regarded as essential for humans, so it needs to be part of a balanced diet. Maize has tremendous variation in content and composition of several coloured pigments collectively known as carotenoids (see also carotenoids). Notably, the carotenoid beta-carotene (or pro-vitamin A) is converted to vitamin A by normal metabolic processes in the body (Anderson and Brown, 1952). Vitamin A is very important to human health, but most especially for vision, and as an antioxidant. Therefore, maize can be especially important to people who cannot get fresh vegetables year round. Different types of maize may vary in their nutritional content. Sweet corn types have more sugar, while darker yellow varieties may have more Vitamin A.

Apart from varieties of fish, the Barotse plains are well-known for the tasty '*Mongu rice*' which indigenous Lozi people cultivate on the fertile land as a cash crop besides for their household food. The land in the Barotse plains, with its alluvial soils, is so fertile that people have for centuries maintained it and built mounds on the plains where they have established villages and planted various crops in gardens.

The Mongu rice needs a lot of water in the field to grow well. However, during the study, much of the crop had withered in the fields because of lack of water resulting from prolonged

dry spells experienced in Western Zambia. The scenario could lead to poor harvest and low food security and income. Besides maize, rice is another very popular cereal consumed throughout the world. It is a staple food for many people residing in Asia and on other continents. It is available in many varieties. Rice is a good source of protein, phosphorus and iron. It also contains some amount of calcium. Most of the nutrients and minerals in rice are concentrated in the outer brown layers known as the husk and germ. Therefore, brown rice, which is rice from which only husk has been removed, is the most nutritious type of rice. As Kennes (1991) puts it, there is no other food item that provides calories and energy to the world as much as rice. It is not wrong to say that most of the people in the world are able to do their daily activities due to rice. Rice has about 345 calories per 100 grams. Furthermore, it is very easy to digest rice and hence most of these calories are absorbed by the body. The nutritional value of rice makes it good for the treatment of indigestion, diarrhoea, dysentery, nausea, skin disorders, and high blood pressure (Kennes, 1991).

Although many indigenous Lozi adults around Lealui Ward area of the Barotse plains may not understand the concept of global warming or climate change, they have seen and felt the effects of seasonal changes in rainfall patterns and extremes of temperature variations in their plains. Climate change touches all the resources that the Lozi people in the plains depend on in life. The close relationship of the Lozi indigenous people with their natural environment in the Barotse plains makes them especially sensitive to the effects of global warming. The floodplain determines and dominates the way of life, economy, society and culture of the Lozi, who are skilled boat-builders, pastoralists, fishermen, swimmers, paddlers, hunters, and farmers of rice, maize, cassava, millet, sorghum, sugarcanes, and various vegetables. As it has been revealed in this study, in many cases, people's ways of life and even their very existence and cultural attributes as Lozi people were being threatened by climate change. Indigenous people who are mostly found in rural communities, whose livelihoods are intimately tied to the environment, are profoundly affected by the climate change. Survival of these indigenous Lozi people around Lealui Ward area of the Barotse plains area, who depend on fishing, agriculture, cattle rearing, traditional crafts and hunting, also depends on the success of their fragile environment and its resources – all effected by the climate change.

The fishing industry is very important among Lozi adults around Lealui Ward area of the Barotse plains. However, the study found out that the fish industry has greatly been effected directly and indirectly by the climate change. The residents complained that they were

finding it difficult to catch fish compared to past years mostly because of the fluctuation levels of water in the Zambezi River and its canals, ponds and tributaries. Apart from being a major source of natural proteins, the fish industry provides employment and income to many people in the Barotse plains. Even though it is not possible to generalize the impacts of climate change on fisheries in communities in the Barotse plains from this study, they share something in common – climate change could very likely lead to fluctuations in fish variety stocks and their distribution. Fluctuations in fish varieties stocks and distribution may have major economic consequences for many vulnerable communities and national economies that heavily depend on fisheries. According to Food and Agriculture Organization (1996) the African continent is particularly vulnerable to climate change. In fact, with 80 per cent of the African population dependent on agriculture and related industries such as fisheries for their livelihoods, it could cost as much as US$ 50 billion a year for Africa to adapt to the effects of climate change. Moreover, climate change could also mean a 50 per cent decline in jobs related to fisheries. The diversity of the habitats in river or floodplain systems and the species they support respond differently to different impacts of climate change.

Climate change puts extra burdens on the social and economic challenges that the poorest people in rural communities in Third World countries like Zambia already face. Their vulnerabilities will be emphasized and increased due to the dependence of their livelihoods on climate sensitive natural resources and their weak social protection structures. By directly eroding the resources that poor people depend on for their livelihoods, climate change makes it easier for such people to fall into poverty and harder for the poorest to escape from it. Climate change is a major threat to sustainable development in the world, especially developing countries and rural communities. Climate change is already affecting indigenous people's communities. The identity of indigenous peoples is inextricably linked with their lands, which are located predominantly at the social-ecological margins of human habitation - such as the floodplains considered homeland of the Lozi people of Western Zambia.

It can be safely be stated that as can be evidenced from the findings of this study, the consequences of climate change has negatively affected agriculture and other production occupations, pastoralism, fishing, hunting of animals and birds, human and animal health, plant life, gathering of local fruits and other subsistence activities of economic and cultural value, including access to water for agriculture, animals, home consumption and sanitation in Lealui Ward area of the Barotse plains.

Some of the findings of the present study tally with Namafe (2006) who states that social life moves with every change of the waters and associated changes in weather in the Barotse plains of Zambia. This shows that there is a strong relationship between humans and their natural environment in the Barotse plains. Western Province of Zambia comprises about 35 ethnic groups (Mbikusita-Lewanika, 2001) that make up what is known as *Ba Malozi* (Lozi people). The Lozi people are usually referred to as the plains people. The plains people's way of living has been greatly influenced by the flooding regime of the Zambezi River (Namafe, 2006). The local people together with their livestock annually move from the wetlands of the Zambezi flood plain to higher upland. As earlier alluded to, this movement is known as *Kuomboka* among the Lozi people. The migration from the plain to high land releases pressure on consumption of natural resources besides being a tourist attraction cultural ceremony.

Other effects are also serious. In some places, floods or drought could become more frequent and more severe. Even seemingly less dramatic local changes in temperature, precipitation and soil moisture could severely impact many things important to human life and all life around us, including:

i) natural ecosystems
ii) agriculture and food supplies
iii) human health
iv) animal life
v) forestry
vi) water resources and availability
vii) energy use
viii) transportation

Many scholars are concerned that we are losing time to make a difference. Climate change and its effects may be irreversible (see Cajete, 1999; Walter, 2004; Berkes, 2008; Bwalya, 2010). Life could become very difficult for some populations - plant, animal and human. Species, cultural norms, resources and many lives could be lost.

There is new and stronger evidence that most of the warming over the last 50 years is due to human activities. Ice cores taken from deep in ancient ice of Antarctica show that carbon dioxide levels are higher now than at any time in the past 650,000 years. More carbon

dioxide in the atmosphere means warming temperatures. In its 2007 report to the United Nations, the Intergovernmental Panel on Climate Change concluded that it is more than 90 per cent likely that the accelerated warming of the past 50-60 years is due to human contributions (Walter, 2004; IPCC, 2007).

These contributions include increased levels of 'heat-trapping' gases commonly known as greenhouse gases such as carbon dioxide in the Earth's atmosphere. One of the biggest ways people contribute to greenhouse gases is by burning fossil fuels. Many people especially in urban areas use petroleum fuels, coal, oil, and natural gas to generate electricity, heat our homes, power our factories, and run our vehicles every day.

Changing land use patterns contribute, too. For instance, clearing a forest for various human activities like agriculture and industrialization can lead to deforestation. Trees and other plants use carbon dioxide and give off oxygen. When trees are cut down for infrastructure development, mining, agriculture, and other purposes, they are no longer available to take carbon dioxide out of the air, and actually release carbon dioxide as they decay or burn. As the levels of carbon dioxide and other greenhouse gases increase, more heat is 'trapped' and global temperatures rise. This causes significant changes in the timing and length of the seasons as well as the amount and frequency of precipitation (IPCC 2007).

5.2.1 Impact of Climate Change Related to Increased Deforestation in Western Zambia

It was revealed in the study that there was increased deforestation in Western Zambia practiced by non-indigenous people and indigenous Lozis through indiscriminately cutting down of trees. The indigenous Lozi people who were reported to be involved in indiscriminately cutting down of trees did so against their traditional laws and cultural practices, thereby eroding the Lozi culture which promotes sustainable conservation of natural resources. It was revealed that most Lozi people who were involved in tree cutting were used by 'foreigners' to earn themselves a living and sustain themselves and their families because their main livelihoods like fishing and agriculture had been negatively affected by climate change.

Increasing climate change and other vectors of socio-ecological change are therefore able to have a more devastating impact than would have been the case had the power to police the ecosystem from a socio-ecological point of view been allowed to remain entirely under the

local cultural administration. Thus, a central argument here is that socio-ecological resilience might be improved if management and administration of ecosystems are re-focused on local communities and their responsible leaderships, a dynamic often referred to as community based natural resource management (Bwalya, 2010).

The Barotse plains ecosystems are some of the most vulnerable of these physical environments given their dependence on inputs and processes generated and mediated outside of the floodplains.

As earlier alluded to, indiscriminately cutting down of trees highly contributes to deforestation and accelerates climate change. Unfortunately, many truckloads of logs were seen during the study period going to cities and even crossing the Zambezi River from Western Province for export to neighbouring Namibia or South Africa, Europe and China via Sioma, Katima Mulilo and Sesheke to be processed (see Plate 10).

Trees trap carbon dioxide from the atmosphere and make carbohydrates that are used for plant growth. Trees play an important role in maintaining a moderate climate by lowering air temperature. They provide shade and conserve energy. They help to reduce noise pollution through absorbing and blocking noise from the urban environment. Besides, providing shelter and food for generations of birds and wildlife they reduce soil erosion too. Trees reduce runoff and erosion by storing water and breaking the force of rain as it falls. Trees have been providing the wood required for various purposes from firewood to building huge structures. Trees also attract rain-bearing clouds. Forests play a crucial role in the economies of many communities in African countries, providing timber and industrial material as well as contributing to tourism, recreation and cottage industry. Tropical forests also help regulate global climate through the absorption of carbon dioxide.

Studies conducted elsewhere show that across the Amazon, the Congo basin and many parts of south-east Asia, forests have been stripped out at a dizzying rate to line the pockets of foreign logging companies and their supporters in government. Forest communities – often among many Third World countries' poorest – are robbed persistently of the resources they rely on for life and livelihood (Bwalya, 2010; Adams, 2003).

According to recent statistics, deforestation is responsible for 20 per cent of greenhouse gas emissions as forests are cleared for agricultural and industrial use (IPCC, 2014). Saving the trees could slow climate change, new research shows. Trees absorb greenhouse gases like nitrogen dioxide, sulfur dioxide, ozone, carbon dioxide and carbon monoxide (Bwalya, 2010). They also convert carbon dioxide to oxygen through photosynthesis. Each year, nearly 33 million acres of forestland around the world is cut down, according to the Food and Agriculture Organization of the United Nations. Tropical felling of trees alone contributes 1.5 billion metric tons of carbon - some 20 per cent of all man-made greenhouse gas emissions - to the atmosphere annually. If such losses were cut in half, it could save 500 million metric tons of carbon annually and contribute 12 per cent of the total reductions in greenhouse gas emissions required to avoid unpleasant global warming (IPCC, 2007). Furthermore, Bwalya (2010) is of the view that if forests are managed effectively, they can become net carbon sinks because they are able to absorb about one tenth of global carbon dioxide emissions into the biomass, soil and forest products. Curbing deforestation and reforesting damaged areas is seen as a cost-effective way of mitigating climate change, while enhancing the security and livelihoods of forest-dependent people.

The study found out that there was evidence of deforestation in Western Province of Zambia (see Plates 9 and 10 in Chapter Four). Deforestation is clearing Earth's forests on a massive scale, often resulting in damage to the quality of the land. Forests still cover about 30 per cent of the world's land area (Bwalya, 2010). Forests are cut down for many reasons, but most of them are related to money or to people's need to provide for their families. The biggest drivers of deforestation are agriculture, logging and development of cities and other settlements. Farmers clear forests to provide more room for planting crops or grazing livestock. Deforestation is the second largest anthropogenic (human-caused) source of carbon dioxide to the atmosphere after fossil fuels. Deforestation and land use change contribute approximately 20 to 25 per cent of the carbon emissions that cause climate change (Bwalya, 2010). In addition, more than 1 billion people living in extreme poverty depend on these forests for water, fuel, and livelihoods. Deforestation devastates the lives of people who are poor.

People of different cultures around the globe living in natural environments rely on the use of plants in all aspects of daily life, from food and shelter to medicines and for religious purposes (Bwalya, 2010). People are culturally and historically attached to forests that are

essentially important habitats for terrestrial biodiversity. Forests serve many purposes: 70 per cent of Earth's animals and plants live in forests, trees serve a crucial role in the water cycle by returning water vapour back into the atmosphere, trees keep forest soil moist by blocking the sun, and most importantly - trees absorb the greenhouse gases that fuel global warming (Kates, 1997; Bwalya, 2010). Trees help to keep moisture both in the soil and in the atmosphere. When trees are cut, the rain run-off causes soil erosion and less soil moisture content. Cutting of forests also contributes to declining rainfall and drought in a particular area. Proper care of trees can provide many benefits for sustainable development.

Nothing survives by itself in nature, for everything is interconnected and inter-dependent. By the messages that nature gives us, we can evaluate the effects of our actions on the earth's ability to support life. We should listen to nature, which does not speak to us in words but in signs that we can see, such as drought, floods, the diminishing of plant species, animal, bird or fish varieties and stocks from the streams, the increasing difficulty to find or afford fuel, the contamination of water, increase of temperature, to mention just a few.

The deforestation of trees not only lessens the amount of carbon stored, it also releases carbon dioxide into the air. This is because when trees die, they release the stored carbon. Carbon is not the only greenhouse gas that is affected by deforestation. Water vapour is also considered a greenhouse gas. The impact of deforestation on the exchange of water vapour and carbon dioxide between the atmosphere and the terrestrial land surface is the biggest concern with regard to the climate system. Changes in their atmospheric concentration will have a direct negative effect on climate sustainable development.

Deforestation has many negative effects on the environment. The most dramatic impact is a loss of habitat for millions of species. As earlier alluded to seventy per cent of Earth's land animals and plants live in forests, and many cannot survive the deforestation that destroys their homes.

Deforestation also drives climate change. Forest soils are moist, but without protection from sun-blocking tree cover they quickly dry out. Trees also help perpetuate the water cycle by returning water vapour back into the atmosphere. Without trees to fill these roles, many former forest lands can quickly become barren deserts. If no corrective measures are taken

soon, Western Zambia where this study was conducted may become an extension of the expanding Kalahari Desert.

Removing trees deprives the forest of portions of its canopy, which blocks the sun's rays during the day and holds in heat at night. This disruption leads to more extreme temperatures swings that can be harmful to plants and animals. Trees also play a critical role in absorbing the greenhouse gases that fuel global warming. Fewer forests means larger amounts of greenhouse gases entering the atmosphere - and increased speed and severity of global warming.

The quickest solution to deforestation would be to simply stop cutting down trees. Though deforestation rates have slowed a bit in recent years, financial realities make this unlikely to occur. A more workable solution is to carefully manage forest resources by eliminating clear-cutting to make sure that forest environments remain intact. The cutting that does occur should be balanced by the planting of enough young trees to replace the older ones felled in any given forest. The number of new tree plantations is growing each year, but their total still equals a tiny fraction of the Earth's forested land.

Sustainable development in Africa cannot be addressed effectively without accounting for the negative impacts of climate change on agriculture, fishing, many other livelihoods and disease patterns, all of which have particular impact on the rural poor like the majority indigenous Lozi adults around Lealui Ward area of the Barotse plains in Western Zambia. The challenge many traditional rural communities face is the current fast rate of environmental change against the slow rate at which their practices evolve.

Caring for the environment does not mean that development should not take place. On the other hand, while we are developing our communities and countries, we should ensure that in the process, we do not damage nature on which we rely for our survival. In other words, decisions on the type of development to be brought to an area should consider the positive and negative effects on people and on the environment.

In order to protect the environment, the laws of Zambia now require that a particular form of development should go ahead only when the impacts of that development are well understood, and when the people are well informed. We should plan, then, for ways in which the negative aspects of development can be minimized. For instance, if such development

involves an industry, it should be clear where the waste products will be taken when the industry starts to operate. If new buildings or roads are to be built in an area of forest, it should be emphasized that it is not the whole forest that should be cleared. If it is a forest that has water sources, or a forest that has populations of some rare animals or plants, or one that the community depends on, then the road or the building should be put somewhere else.

5.3 Traditional Environmental Knowledge among Lozi Adults for Mitigating Climate Change

The second research objective sought to explore the role of traditional environmental knowledge among Lozi adults in mitigating climate change. The study findings presented in Chapter Four established that traditional environmental knowledge among the Lozi adults around Lealui Ward area was important in mitigating climate change and enhancing environmental sustainability. Indigenous Lozi people and local communities around Lealui Ward area of the Barotse Plains in Mongu District were actively involved in innovative solutions based on their traditional knowledge, such as reducing emissions through adopting of renewable energies in their territories, fire management techniques and engaging in resource management culture, traditional laws and projects that reduce pressure on natural resources and enhance local adaptive capacity. Traditional environmental knowledge and practices are cardinal in community-based adult education activities to mitigate climate change and enhance sustainable development in African communities like the Lealui Ward area in Western Zambia. Natural resources such as wild plants, wildlife and fish were not only the main resources the early inhabitants of the Barotse plains depended upon but also continued to play an important role in the livelihoods of many contemporary people in the region.

According to Mbikusita-Lewanika (2001) all the land and natural resources in Barotseland (present Western Province of Zambia) is entrusted to the *Litunga*. It is for this reason that the *Litunga* is referred to as the owner of land and cattle (*Minya-Mupu-Na-Ngombe*) and the King of the earth (*Mbumu-Wa-litunga*). In close consultation with local people through the *Kuta* (judiciary), and with the views from *indunas* (headmen or local chiefs), the *Litunga* administers the general governance of Barotseland. He is the custodian of the customary land. His rights are clearly defined by the mandate of the local people through the recognition as the owner. Traditionally, Lozi people say that the King is the owner of *Bulozi*

or Barotseland and its trees and animals, while the *Ngambela* (Prime Minister) is owner of the Lozi people (*Mbumu to minyo Uluyi ni itondo nabika ni ngombe, Ngambela to minyo Aluyi*). This saying emphasizes the importance of the *Litunga* as the giver of material wealth and the importance of the *Ngambela* as the leader of the nation. The Barotse Legal System is based on *milao* (laws), *liswanelo* (rights), *litukelo* (rights of particular position or social status), *mikwa* (methods or ways of doing things), and *mulatu* (an offence or wrongdoing). The five cornerstones of the Barotse Legal System have been in existence since the beginning of the kingdom. However, Kalaluka (1979) states that most laws were institutionalized during the reign of King Mulambwa in the 18th century. (See Appendix 2 for the list of the *Litungas*). This included laws pertaining to acquisition, use and disposal of natural resources. Given this rich background on an elaborate governance system that draws much support from the subjects, it becomes much sensible to design natural resources that boarders on the already existing structure. Thus, collaborative management of natural resources with the people becomes the only panacea to sustain biological diversity in Western Province. This conservation of natural resources enhances mitigation of climate change.

The relationship among environment, resources and society is one of the most important challenges currently faced by humans on Earth (Adams, 2003; Bwalya, 2010), especially those in rural areas like the Barotse plains of Western Zambia. It seems from the study findings that majority (78 per cent) of the respondents around Lealui Ward area of the Barotse plains community in Mongu District strongly believed, and another 20 per cent were of the view that traditional environmental knowledge among the Lozi adults was important in mitigating climate change. The findings are presented in Table 3. Throughout the study, most respondents indicated that local traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains was cardinal in mitigating and adaptation to climate change. The study revealed that among Lozi adults around Lealui Ward area of the Barotse plains just like in many other traditional African societies, adult education's purpose was to holistically enable the individual to play societal roles. Both the individual and society were at the centre of learning. This is similar to what was observed by Msimuko (1987).

As earlier alluded to in Chapter Two, traditional environmental knowledge can be said to be an academic term referring to indigenous, or other forms of traditional knowledge regarding local environmental resources. It can be said to be a cumulative body of knowledge, practice,

and belief, evolving by adaptive processes and handed down through generations by cultural transmission. It concerns the relationship of living beings, including human beings, with one another and with their environment. More specifically it contains the indigenous people's knowledge of species of both animals and plants, and biophysical characteristics of the environment through space and time.

Indigenous communities in many parts of the world have long been recognized as being particularly vulnerable to the impacts of climate change due to the close connection between their livelihoods, culture, spirituality and social systems and their environment (see Salick and Byg, 2010; Sherry and Myers, 2002). At the same time, however, this deep and long-established relationship with the natural environment affords many indigenous people with knowledge that they have long used sustainably utilize their environment as well as adapt to environmental changes, and are now using it to mitigate climate change and respond to the impacts of climate change.

There is increasing recognition of the significance of how traditional environmental knowledge can inform our understanding of the impacts of climate change and strategies for mitigation and adaptation. Indigenous people bring a collective knowledge of the land, sky and sea and provide a crucial foundation for community-based adaptation and mitigation. Indigenous knowledge has been long recognized as a key source of information and insight in domains such as forestry, traditional medicine, biodiversity conservation, resource management, impact assessment, and natural disaster preparedness and response. In many traditional societies, an essential function of culture has been to establish and transmit a body of knowledge, practices, and believes regarding the use of locally available natural resources to improve health and nutritional status of all people in communities.

It is important to study and analyse more deeply indigenous people's indigenous knowledge systems and livelihoods, which are low in carbon dioxide emissions and which are sensitive to sustaining and restoring ecosystems, landscapes and waterscapes, cardinal in sustainable development. Their capacities for resilience and for adapting to adverse climate change impacts are directly proportional to how they are able to continue practicing these knowledge systems and also their customary governance systems, which include ensuring environment-sensitive ways of dealing with their physical territories.

In Africa, traditional environmental knowledge (as similar to other indigenous societies around the world) is traditionally applied in harmony with the natural and spiritual world. These African traditional knowledge and cultural practices are ingeniously designed to address local ecological limitations by maintaining a sustainable utilization and protection of commonly shared natural resources. This 'ecosystem view' of many indigenous or traditional societies throughout Africa appears to be in contrast with the modern Western knowledge system which is represented by most universities, research institutions and private firms etc. However, recent research (see Namafe, 2006; Gyampoh *et al*, 2007; Salick and Byg, 2010) has shown that around the world, African indigenous knowledge connection to the local land and wildlife, is both symbolic (knowledge systems based on spiritual ritual, religious practices, taboos and naming etc.), and experiential (travel, foraging, residence etc.).

Indigenous knowledge, to which traditional environmental knowledge is a part, is the local knowledge that is unique to a culture or society like among the Lozi people of the Barotse plains in Western Zambia. This knowledge is passed down from generation to generation, usually by word of mouth and cultural rituals, and has been the basis for agriculture, food preparation, health care, education, conservation, weather forecasting and the wide range of other activities that sustain societies in many parts of the world occupied by indigenous people. Indigenous people have a broad knowledge of how to live sustainably to enhance sustainable development. The survival of indigenous knowledge as a dynamic and vibrant resource within rural and indigenous communities depends upon its continuing transmission from generation to generation.

Traditional environmental knowledge established among the Lozi adults around Lealui Ward area is cardinal in the sustained survival and development of the people who have lived in the plains for thousands of years. It consists of knowledge, innovations and practices of Lozi indigenous people and local communities, developed and shared through experience gained over time and adapted to the local traditional structures, culture and environment. Such knowledge tends to be collective in nature. It is usually communicated through the indigenous people's way of life, such as, customary laws, norms, practices, language, stories, songs, folklore, proverbs, taboos, cultural and religious values, rituals and other ways of transmission. This knowledge is normally of practical nature and covers areas such as traditional livelihoods, health, medicine, plants, animals, fish, weather conditions and environment management. Moreover, such knowledge is not merely a collection of facts and

observations; it includes analysis and understanding of the subject matter from a practical perspective. Consequently, adverse external impacts on indigenous and local communities' way of life, social structures, culture, and habitat might also affect their knowledge, innovations and practices. Traditional environmental knowledge among the Lozi adults around Lealui Ward area is viewed as the process of actively participating fully and responsibly in such relationships between people and their total environment. Equally, traditional environmental knowledge is inseparable from the people who hold it. Once traditional environmental knowledge is separated from its original holders, it loses much of its original value and meaning.

Traditional environmental knowledge - a critical component of adult education in Africa - used by indigenous Lozi adults around Lealui Ward area of the Barotse plains is based on mutual well-being and sharing in communities. In our severely disrupted global environments, traditional environmental knowledge is now essential for our mutual survival. The benefits of traditional environmental knowledge can be shared when there is respect, understanding, the recognition of traditional rights, and the recognition of existing indigenous stewardship of many regions of the Earth. Indigenous people's 'lifestyles and knowledge can offer modern Western societies many lessons in the sustainable management of resources in complex forests, mountains, wetlands and dry lands ecosystems' (WCED, 1987:12).

For thousands of years, indigenous peoples around the world have used knowledge of their local environment to sustain themselves and to maintain their cultural identity as well as sustenance of indigenous knowledge systems (Atteh, 1992; Vinyeta and Lynn, 2012). Traditional environmental knowledge is accumulated through trial and error and purposeful observation. Personal experience is the primary source of new information, but revelation and spiritual insight are also recognized sources.

The wisdom and skills maintained by the 'keepers of indigenous knowledge' (as applied in the traditional practices of farmers, hunters, gatherers, fishermen, artisans etc.), are based on a dynamic and sophisticated understanding of their local surroundings. Change in the use of this knowledge is not random, but rather predicated upon conscious efforts by people to define their problems and seek solutions through local experiments and innovation, including evaluating and learning from appropriate technologies elsewhere.

As Sherry and Myers (2002) put it, there is no separate educational stream for traditional environmental knowledge because traditional environmental knowledge systems fully integrate all aspects of culture. As a consequence, no hierarchy of information or knowledge exists and all members of the community contribute to traditional environmental knowledge. Elders are, however, generally considered to have greater wisdom and perhaps greater knowledge, but not necessarily more or better information. Greatest credibility is given to the observations and views of individuals who are considered by the community to have the greatest knowledge and understanding of the item under consideration. Communication is the most fundamental aspect of knowledge sharing. Dialogue education plays a pivotal role to enhance communication in a community. The entire community must be embraced because of the inclusiveness of traditional environmental knowledge, which is part of lifelong learning. Learning transforms who we are as people, not just because it gives us knowledge we otherwise would not have had, but also because it gives us confidence in our ability and transforms our attitudes as a result. With the power of learning we have the ability to do whatever it is we want.

Traditional environmental knowledge is a cardinal feature of indigenous knowledge systems and an important aspect of community-based adult education in Africa. Adult education in Africa is intertwined with lifelong learning. Everyone should remember learning does not - and should not - stop when we reach adulthood. Adult education can provide us with the knowledge, skills, attitudes, values and confidence we need to make life changing decisions or take us further in our life. We all learn new things every single day that contribute to our personal life, family life, community, professional and societal growth which help us become better at what we do to positively contribute to sustainable development.

Traditional knowledge of the Earth is based on thousands of years' experience and cannot be left out of the formula for environmental management. The Lozi culture has had well organized environmental management system for years (see Mbikusita-Lewanika, 2001). As earlier alluded to, their traditional governance system emphasizes a lot on conservation of natural resources, starting from the local grassroots level up to the top establishment level of the Barotse Royal Established. The study established various traditional laws and customs presented in Chapter Four for conserving natural resources around Lealui Ward area of the Barotse plains.

From a traditional perspective, the study established that natural resources in Barotseland were used for home consumption and for the common good of the community. Benefits accrued from natural resource were shared in such a way that the local community had a portion and people in authorities at all levels had their portions too. People in authority distributed part of their portions to the vulnerable single women, widows and the elderly and contributed to homes, which had visitors. Some portions were stored for needy days, needy areas and ceremonies (Mbikusita-Lewanika, 2001).

Many studies have shown that the best method of natural resources monitoring is community-based whose main thrust is to ensure that benefits of conservation accrue to the people who are directly involved in the management of natural resources (see Berkes, 2008; Adams, 2003). The traditional systems of natural resources monitoring found in the Barotse plains is such method. Local communities in the Barotse plains have high respect for their traditional responsibility which include ensuring that strict observation of the timing of burning of fields, protection of trees, canals, water bodies and wildlife following the laws of their traditional authorities, and fair distribution of the benefits of the community's natural resources. The Lozi indigenous people are traditionally conservationists who use resources according to their customary laws based on indigenous knowledge systems. The study also found out that Village Wetlands Conservation Committees were established in the Barotse plains with representatives from various structures in the community: existing Barotse Royal Establishment, institutional structures at grassroots level, community development committee, Government agents and non-governmental organizations committed to conservation of natural resources. Siamwiza (2009) also mentions the presence of these committees in the Barotse plains. The main function of the committees is to monitor the conservation of the natural resources at grassroots level. This greatly contributes to mitigation of climate change.

Undoubtedly, one community that is still steeped in traditional environmental knowledge is the Barotse plains in Western Province of Zambia. Traditional environmental knowledge is often used to sustain local populations in many rural areas like Lealui Ward area of the Barotse plains in Western Zambia and maintain resources necessary for survival. However, it can be weakened or invalidated in the context of rapid climate change, environmental impact, or other situations in which significant alterations of ecosystems render traditional environmental knowledge weak or obsolete.

Indigenous people have historically played an active role in the conservation of eco-systems crucial to solutions and the prevention or reduction of climate change such as forests, wetlands, floodplains and coastal and marine areas. Long ago, the traditional environmental knowledge sciences foretold the severe impacts of Western 'development' models based on indiscriminate tree clear-cutting, oil exploitation, mining, carbon-emitting industries, persistent organic pollutants and the insatiable consumption of the industrialized countries. These unsustainable models threaten the very life of our Earth and the lives of all.

Many scientists of Western society have dismissed traditional environmental knowledge as sentimental and superstitious and accused it of being an obstacle to development. Paradoxically, those that previously turned deaf ears to traditional environmental knowledge's warnings about global warming, now are dismayed because their own model of 'development' endangers our mother Earth.

5.3.1 Conservation Agriculture as a Strategy to Mitigate Climate

Conservation agriculture is one of the most viable mitigation strategies to reduce the climate change impacts (Delors *et al.*, 1998; FAO, 2007). As earlier alluded to in Chapter 4, conservation agriculture is to conserve, improve and make more efficient use of natural resources through integrated management of soil, water, crops and other biological resources. Conservation agriculture is an approach to farming that seeks to increase food security, alleviate poverty, create wealth, conserve biodiversity and safeguard ecosystem services. Conservation agriculture practices can contribute to making agricultural systems more resilient to climate change. In many cases, conservation agriculture has been proven to reduce the farming systems' greenhouse gas emissions and enhance its role as carbon sinks (FAO, 2007).

Conservation farmers in indigenous African communities like the Lealui Ward area of the Barotse plains have for many years used traditional simple conservation tillage methods to establish their staple crops and also grow legumes like groundnuts in rotation with their other crops. Legumes, depending on the varieties grown, fix nitrogen, improve fertility, break soil pans and are an excellent source of protein for the family and community. Conservation farmers recognize the value of trees and live in harmony with the land rather than destroying it. Farmers can plant a larger area because they are not moving or turning over the soil before

they plant. Indigenous knowledge is the basis for local level decision-making in many rural communities of Africa (Gyampoh, *et al*., 2007). Its value is not only for the culture in which it evolves, but also for Western scientists and planners striving to improve conditions in rural localities. Incorporating indigenous knowledge into climate change policies can lead to the development of effective mitigation and adaptation strategies that are cost-effective, participatory and sustainable.

African communities and farmers in particulars have always coped with changing environments. They have the knowledge and practices to cope with adverse environments. The enhancement of indigenous peoples' capacity is a key to the empowerment of local communities and their effective participation in development processes. Local farmers in several parts of Africa like Lealui Ward area have been known to conserve carbon in soils through the use of zero-tilling practices in cultivation, mulching, and other good and reliable soil management techniques (http://www.culturalsurvival.org/publications). Natural mulches, moderate soil temperatures do suppress diseases and harmful pests and conserve soil moisture.

The widespread use of indigenous plant materials such as agrochemicals to combat pests that normally attack food crops, has also been reported among small-scale farmers (Adams, 2003). It is likely that climate change will alter the ecology of disease vectors, and indigenous practices of pest management would be useful adaptation strategies.

Other indigenous strategies that are adopted by local farmers in many parts of Africa include controlled bush clearing; using tall grasses for fixing soil surface nutrients which have been washed away by runoff; erosion-control to reduce the effects of runoff; restoring lands by using green manure; constructing stone or mud dykes; managing low-lying lands and protecting river banks (IPCC, 2007). African women are also particularly known to possess indigenous knowledge which helps to maintain household food security, particularly in times of drought and famine. They often rely on indigenous plants that are more tolerant to droughts and pests, providing a reserve for extended periods of economic hardships. For example, in southern Sudan, women are directly responsible for the selection of all sorghum seeds saved for planting each year (see Bates, Chiba, Kube, and Nakashima, 2009; Adams, 2003). They preserve a variety of seeds that will ensure resistance to the range of conditions that may arise in any given growing season.

Studies elsewhere have shown that conservation agriculture highly mitigates climate change (see http://www.culturalsurvival.org/publications; Adams, 2003; Berkes, 2008). As alluded to earlier in this work, mitigation refers to any strategic intervention and human action taken to remove the greenhouse gases released into the atmosphere, or to reduce their amount, to reduce any risk and hazards of climate change to human life and environment. The Intergovernmental Panel on Climate Change (IPCC, 2007) defines climate change mitigation as technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce *greenhouse gases* emissions and enhance sinks.

Conservation agriculture also helps to maintain and improve the environment. Tractor use is substantially reduced when cultivation is eliminated, thus reducing emissions of greenhouse gases and other pollutants. Moreover, under zero tillage, soil moisture conservation and wind and water erosion are reduced because the soil surface is not ploughed and residues, crowns, and roots from previous crops and pastures protect the soil. There are even cost benefits: zero tillage reduces the need for tractors and thereby lowers use of polluting fossil fuels and labour costs. Conservation agriculture encourages diversification of activities by farmers such as planting of different crops like maize, sorghum, millet, cassava and legumes, livestock rearing, aquaculture, agroforestry and bee-keeping. Cassava is next to maize as Africa's most important staple crop, its high nutritional value, starch content and resilience to climate change makes it one of the most versatile crops (Kennes, 1991; Sikanwe, 2014). Thus, it enhances food security and sustainable development.

A case study on Zambia by Samuel Bells and colleagues (2012) in the Luangwa valley in Eastern Province on small farming lands showed that combining conservation agriculture with tree cultivation increases crop yields by 240 to 400 per cent, enhances soil carbon sequestration and improves resilience to climate shocks. In addition, the biomass that is produced can be used for feeding livestock. Similarly, small, mixed conservation farming lands found in the Barotse plains seem to be a model of sustainability.

These traditional or cultural practices found among indigenous Lozi adults around Lealui Ward area of the Barotse plains are dynamic and indigenously designed to address local

ecological challenges by maintaining a sustainable utilization and protection of commonly shared natural resources as well as mitigating climate change.

5.3.2 Traditional Environmental Knowledge and Climate Change among Lozi Adults

Traditional environmental knowledge and other indigenous knowledge systems such as natural resource management practices, and adaptation strategies are all considered important tools for both mitigating and adapting to climate change. However, best practices for integrating these practices, which cut across sectors including agriculture, fishing, hunting, water supply and sanitation, forestry, and governance, into other processes are still emerging and brought out through studies.

The processes through which traditional environmental knowledge is transmitted and put into action include social learning, knowledge sharing, and collaborative natural resource management or decision-making. Also important is the close link between indigenous scientific practice (the way through which indigenous people observe, interpret, and build knowledge from their interactions with the environment) and the cultures in which it is embedded, as these are often seen as indivisible.

Many Lozi customs and practices related to fishing, hunting and planting of various crops are dependent on the capacity to predict changes in weather and climate. In Lealui Ward area of the Barotse plains, the calendar is based on observations of environmental change and not astronomical events. Thus, extreme weather and climatic events play an important role in seasonal decision-making: elders often rely on changes in plant, bird, insect and animal behaviour to predict floods and drought, and thus prepare to cope with the oncoming weather.

The majority of the Lozi adults in Lealui Ward area rural livelihood strategies are built on traditional knowledge systems, which allow them to cope with adverse and unpredictable conditions. They depend on the floodplains, agro- and forest biodiversity for their day-to-day lives, i.e. for food, fuel, water, fodder for livestock, building materials and health among other services. According to Berkes (2008), such communities may be termed ‘ecosystem people’ who are motivated not only to utilize natural resources prudently, but also conserve them in the long term through cultural social behaviour and practices that tend to exhibit resource use restraints. Their dealings with nature are hedged by manifold prescriptions as to what, when, and how much is to be left undisturbed. These prescriptions are part of the rich

tapestry of the traditional culture of societies of ecosystem people. The Lozi people in rural communities like Lealui Ward area of the Western Province of Zambia have utilized floodplains and forest biodiversity for their livelihood for a very long time. For as long as the local people have managed natural resources, they have engaged in centuries-old resilience systems and contributed to mitigation of climate change. Collective actions have been institutionalized in forms of traditional systems.

Although Western science has contributed much in recent years to our comprehension of global climate change and its implications for ecosystems, the experiences and observations of indigenous peoples over generations have also greatly contributed to an increased understanding of this global phenomenon. Since many indigenous people depend directly on their environment for their livelihoods, they are the ones most likely to be the 'miner's canaries' of climate change.

Every culture and ecosystem on Earth is affected by global climate change. Scientists and traditional environmental knowledge practitioners all agree that we are only just beginning to feel its effects, and that we can expect more dramatic changes, from glaciers melting at a rapid pace and oceans rising, to deteriorating protection from the ozone layer, resulting in increased incidents of cancer and crop difficulties in regions currently most affected (Bwalya, 2010). Rainfall patterns are shifting, leading to droughts and floods, while warming oceans are changing sea life in every body of water on the planet.

Traditional environmental knowledge is the lifelong process of knowledge, innovations and practices of indigenous and local communities, developed and shared through experience gained over time and adapted to the local structure, culture and environment. Such knowledge tends to be collective in nature. It is usually communicated through indigenous people's way of life such as stories, songs, folklore, proverbs, taboos, rituals, customary laws, practices and traditions, cultural and religious values, languages and other ways of transmission. This knowledge is normally of practical nature, and covers areas such as traditional livelihoods, health, nutrition, medicine, plants, animals, weather conditions, environment and climate conditions, and environmental management. As communities live within a given environment for a long period, they acquire a deep understanding and learn to adapt within their environment.

People interact with their environment through their behaviour (Bwalya, 2010). We will use the word 'behaviour' in this study to refer to the decisions, practices, and actions of people, both as individuals and in groups. Many behaviours affect natural resources and the environment. Individuals at all levels - from subsistence farmers to fishermen, hunters, honey and edible caterpillars and wild fruit collectors, project managers, chiefs and politicians - make decisions and engage in practices that affect natural resources. The behaviour of individuals and social groups forms the interface between ecological systems and social systems. Similar examples occur throughout Africa. Growing irrigated crops, grazing livestock, clearing plains and forests for cultivation, making charcoal for sale, deferring to traditional leaders in land-use decisions, guiding wildlife tourists, maintaining ancestral graves, and avoiding certain areas because of taboos, all affect natural resources in a complex mix of positive and negative ways. These traditional practices somehow resemble the modern or formal strategies adapted for natural resource management (also see Brundtland, 1987; Berkes, 2008). The findings of this study demonstrate the richness and variety of indigenous sustainable natural resource management among Lozi adults around Lealui Ward area of the Barotse plains which enhances mitigation of climate change. Techniques range from simple to highly sophisticated culturally systems. Many – though not all – indigenous practices are based on thorough ecological knowledge, are environmentally sound, and enable communities in the study area to maintain ecological equilibrium with their environment.

It could as well be stated that traditional environmental knowledge is not merely a collection of facts and observations; it includes analysis and understanding of the subject matter from a practical perspective. Consequently, adverse external impacts on indigenous and local communities' way of life, social structures, culture and habitat might also affect their knowledge, innovations and practices.

Traditional environmental knowledge may be viewed as the process of participating fully and responsibly in such relationships involving people and their total environment. Among the Lozi adults around Lealui Ward area of the Barotse plains in Western Zambia, traditional environmental knowledge is not just about understanding relationships, it is the relationship between people and the entire creation. Equally, it should be noted that traditional environmental knowledge is inseparable from the people who hold it. Once traditional

environmental knowledge is separated from its original holders, it might lose much of its original value and meaning.

Indigenous people globally have sustained their unique world views and knowledge systems like traditional environmental knowledge for ages even in the face of transformative forces beyond their control. The connection to their land is an important source of resilience for indigenous communities, but this resilience depends on an ability to nurture and manage this relationship.

The potential of indigenous traditional environmental knowledge for informing observations of, and responses to climate change is an area of growing interest, particularly for those working at community level such as adult educators and other agents of change where access to other forms of 'scientific' knowledge like Western science are inaccessible or incomplete, but increasingly in international forums such as UNFCCC and IPCC as well. While this potential is exciting and may offer new ways to directly engage local communities in action on climate change, it also brings with it important concerns about power, rights, and ethics in engaging with these kinds of partnerships. This key issue guide provides resources for better understanding the relationship between indigenous knowledge and climate change, the potential this relationship may hold, and the challenges that may underlie it.

It is clear to Western scientists and traditional environmental knowledge experts alike that we are still unable to predict all the far-reaching effects of climate change on species and natural processes. But local effects that are appearing in native communities have been tracked for decades by indigenous peoples and their observations will assist our predictive capabilities. Likewise, local solutions may help guide Western science in finding ways to mitigate larger-scale climate change effects while at the same time, scientific solutions may help indigenous communities with their adaptation, mitigation and survival. As adult educators, there is much we can learn from indigenous, traditional and community-based approaches found around Lealui Ward area of the Barotse plains to mitigate climate change and other natural disaster preparedness. What works as effective traditional environmental knowledge around Lealui Ward area of the Barotse plains now, has come to be so through years of experimenting and adjusting to a naturally changing environment. Indigenous Lozi people around Lealui Ward area and their communities and other local communities in the Barotse plains have a vital role

in environmental management and development because of their knowledge and traditional practices.

Indigenous African traditional knowledge systems may not necessarily be better suited to making long-term predictions of change, but indigenous knowledge (as observed in traditional survival strategies) may have some advantages in recognizing the onset of change and finding ingenious ways to accommodate and mitigate them at early stages, within the community decision-making structures. Modern Western techniques and practices among many community change agents such as environmental adult educationists and community development officers have a lot to learn from traditional knowledge and practices found among indigenous people around the world such as the Lozi adults around Lealui Ward area of the Barotse plains.

It can safely be stated that in line with findings of this study, traditional environmental knowledge is a 'way of life'; rather than just the knowledge of *how* to live, it is the actual *living* of that life. Indigenous Lozi adults around Lealui Ward area have acquired traditional environmental knowledge over generations as a survival strategy. Local traditional environmental knowledge around Lealui Ward area of the Barotse plains is vital for preserving bio-diversity, which is considered a very successful mitigation strategy.

5.4 Enhancing Climate Change Mitigation and Adaptation using Indigenous Knowledge among Lozi Adults in the Barotse Plains

The third objective sought to obtain possible suggestions on how to enhance traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains in mitigating climate change. The findings presented in Chapter Four revealed that cross-pollination of knowledge, co-operative work and concerted effort between the indigenous people around Lealui Ward area of the Barotse plains and other stakeholders could enhance mitigation and adaptation strategies for climate change around Lealui Ward area of the Barotse plains. It is increasingly realized that mitigation and adaptation should not be pursued independently of each other but as complements (see Vinyeta and Lynn, 2012). Integrating mitigation and adaptation into climate change concerns is not a completely new idea in many African societies where the local populations in this region, through their indigenous knowledge systems, have developed and implemented extensive mitigation and

adaptation strategies that have enabled them to reduce their vulnerability to past climate variability and change. However, this knowledge is rarely taken into consideration in the design and implementation of modern mitigation and adaptation strategies. Adaptation to climate change compliments climate change mitigation in that it is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

This study's findings showed that climate change mitigation and adaptation strategies using indigenous knowledge could be enhanced through cross-pollination of knowledge, co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders. The study further established that some cardinal aspects and best practices of the Lozi culture, including traditional environmental knowledge being eroded needed to be re-strengthened, by reuniting family ties and community unity as used to be the case in olden days to enhance climate change mitigation and adaptation strategies in the Barotse plains. Moreover, there is need to policy makers and implementers to learn to appreciate the value of indigenous local knowledge.

The introduction of Western formal education, and new religious, political, socio-economic, and administrative systems are the main factors responsible for the decline of indigenous technical knowledge (Atteh, 1992). Early European explorers, missionaries and colonial officers regarded local knowledge as primitive. Even today, some well-educated civil servants and professionals often look down upon rural people and consider their knowledge as backward. As Atteh (1992) argues, it is not surprising that many aspects of indigenous knowledge continue to be undermined and shunned upon as a sign of lack of civilization. It seems most government officials involved in resource use planning or management are not posted in the district long enough to be able to gain long-term experience and understanding of the unique ecosystem of the Barotse plains and its specifically adapted local resource management strategies. As modern Western scientific knowledge is regarded as superior, they only make very limited use of the wealth of local knowledge readily available in the communities.

The study revealed a variety of coping strategies applied with mixed success, which suggests that local traditional knowledge could provide the basis for development of more effective strategies. Integrating the knowledge, values and interests of the diverse actors and

stakeholders requires participation from all levels. This integration could enhance cross pollination of knowledge and can strengthen climate mitigation and adaptation strategies. Although many are considered poor and often the most politically and economically marginalized of any stakeholder group, rural indigenous people have the most direct interest in the local natural resources base and their active involvement and participation is especially important at all times in planning, implementation, monitoring and evaluation projects and community-based activities. Local people in rural communities often have:

i) *rights* to local natural resources;

ii) indigenous, local *knowledge* about how to manage local natural resources sustainably; and

iii) the *power* to implement and sustain natural resources management activities over the long-term.

In many rural parts of Africa like the Lealui Ward area of the Barotse plains in Western Zambia, people depend heavily on natural resources for their livelihoods. For those people, sustainable use of natural resources and human well-being are inextricably linked. Local residents often have a tremendous wealth of indigenous knowledge about the natural resources in their environment and about how to manage them sustainably.

It is, therefore, safe to hold the views that environmental adult education needs to include traditional knowledge of local people and has a specific responsibility to revive and promote such traditions. Traditional environmental knowledge is a potentially powerful medium in which to teach environmental education and has the potential for influencing transformative learning in rural communities, especially in Africa where traditional knowledge system is still highly valued.

Although many educators agree that one of the focuses of environmental adult education is adult transformation, this has not been extensively explored in the context of Third World communities' traditional environmental knowledge which is mostly still found among the elder members of these communities. Specifically, there has been very little work done in immersion courses where non-indigenous and part-indigenous students and researchers learn from local and indigenous experts. Elders' traditional knowledge is increasingly being seen as the potential foundation stone by which younger generations may cope with an ever more complex world of potential resource scarcity, ecological uncertainty, environmental

insecurity, increased state based management of renewable resources, social change and associated complex social problems like climate change within indigenous people's communities due to the multifaceted effects of globalization. Traditional elders' knowledge should be seen as having value in terms of indigenous history, culture and identity.

Co-ordinated co-operative work between indigenous knowledge systems and Western research-generated knowledge could enhance mitigation and adaptation strategies for climate change to help us attain sustainable development. Organizing local people for projects to enhance sustenance activities such as agricultural resiliency to climate change must make effective use of traditional skills and knowledge, thus improving prospects for community empowerment and self-reliant development in the face of climatic variability.

There is need to adopt the bottom-up participatory approach, in line with the decentralization policy recently introduced in Zambia, that encourages the highest level of local participation in climate change programmes designed for the rural communities as this provides valuable insight into how communities and households interact and share ideas and allow the intended beneficiaries to develop the skills, attitudes and practices necessary to forge their own path and sustain projects.

While mitigation tackles the causes of climate change, adaptation tackles the effects of the phenomenon. The potential to adjust in order to minimize negative impact and maximize any benefits from changes in climate is known as adaptive capacity. A successful adaptation can reduce vulnerability by building on and strengthening existing coping strategies.

In general the more mitigation there is, the less will be the impacts to which we will have to adjust, and the less the risks for which we will have to try and prepare. Conversely, the greater the degree of preparatory adaptation, the less may be the impacts associated with any given degree of climate change. For people today, already feeling the impacts of past inaction in reducing greenhouse gas emissions, adaptation is not altogether passive, rather it is an active adjustment in response to new stimuli. However, our present age has proactive options (mitigation), and must also plan to live with the consequences (adaptation) of global warming.

The idea that less mitigation means greater climatic change, and consequently requiring more adaptation is the basis for the urgency surrounding reductions in greenhouse gases. Climate mitigation and adaptation should not be seen as alternatives to each other, as they are not discrete activities but rather a combined set of actions in an overall strategy to reduce greenhouse gases emissions.

It is clear to Western scientists and traditional environmental knowledge experts alike that we are still unable to predict all the far-reaching effects of climate change on species and natural processes. But local effects that are appearing in local communities have been tracked for decades by indigenous peoples and their observations will assist our predictive capabilities. Likewise, local solutions may help guide Western science in finding ways to mitigate larger-scale climate change effects while at the same time, Western scientific solutions may help indigenous communities enhance their adaptation, mitigation and survival.

At the local level within communities in the Barotse plains, the climate change mitigation and adaptation strategies could be enhanced through the strengthening of family and community ties and sharing ideas using dialogue education. Environmental adult education often uses dialogue education as an effective tool to use to retain indigenous knowledge in such communities which are a part of the global village infiltrated by Western technology like televisions, the Internet and other social media. In rural communities like the Barotse plains dialogue education can be used as an effective and efficient media for indigenous knowledge systems like traditional environmental knowledge among peers, gender groups and generations. As Banda (2014) puts it, adult education aims at helping adults learn to learn to achieve self-actualization by unlocking their potential and attaining their goals wherever they are. Some of the characteristics of people that are self-actualized are reality-centered, emotionally well-adjusted and strong ethics. These are what you get in co-operators, those who actively participate in dialogue education.

We need to cultivate a spirit of living in peace with ourselves, our neighbours, associates and colleagues as well as the natural environment on which humanity is enormously dependent. Men and women should work co-operatively. If we are to save life on this planet Earth and achieve self-actualization, we must unite the heart and the mind, feelings and thoughts, intuition and sensation in each one of us. This is what we may also call participatory education. The goal of participatory environmental adult education is to help groups of adult

people and communities learn to use reflections on their everyday experiences to analyze the social-political context in which they live, and to develop a sense that they can work effectively to change that context. Dialogue education, a cardinal component of adult education, does just this in communities.

For thousands of years, indigenous people around the world have used knowledge of their local environment to sustain themselves and to maintain their cultural identity (Johnson, 1992). Today, a growing body of literature attests not only to the presence of a vast reservoir of information regarding plant and animal behaviour but also to the existence of effective indigenous strategies for ensuring the sustainable use of local natural resources (Banda, 2009).The traditional ecological knowledge, wisdom and best practices of indigenous people ccomprise the global bio-cultural heritage that must inform and guide climate change adaptation and mitigation strategies aat global, regional and local scales.

As earlier alluded to, indigenous people are excellent observers and interpreters of change on the lands, waters, and sky (Salick and Byg, 2010; Knudtson and Suzuki, 1992). Their community-based and collectively held traditional knowledge accumulated and maintained through practice over countless generations, offers valuable insights into the state of the environment. Indigenous knowledge possesses chronological and landscape-specific precision and detail that is often lacking from scientific models developed by scientists at much broader spatial and temporal scale, including those used to understand the magnitude of climate change consequences. Moreover, indigenous knowledge provides a crucial foundation for community-based mitigation and adaptation actions that can sustain resilience of social-ecological systems at the interdependent local, regional, and global scales. The successful incorporation of traditional environmental knowledge into climate change efforts depends not only on bridging traditional environmental knowledge and Western science; ultimately, it calls for institutional practices and policies to accommodate knowledge exchanges, and the development of a workable policy framework that guides government agencies and organizations towards the culturally sensitive incorporation of traditional environmental knowledge into climate change planning and policy.

A number of recent studies show that climate change was a global problem whose solution lay in shared efforts to encourage the *active participation* of business communities, civil society as well as various government ministries and agents (see Vinyeta and Lynn, 2012;

Salick and Byg, 2010; Namafe, 2006; Nakashima, *et al*., 2000; Oakley, *et al*., 1991). Active participation can best be realized when concerted efforts and co-operative discussions include indigenous people among stakeholders. The dialogues should be followed by actions which are co-operatively monitored and evaluated by all stakeholders to solve identified challenges. The role of the dialogue among civilizations and the establishment of new ways of working together are paramount in this endeavour: it is only through a constructive and inclusive dialogue that the means to eradicate poverty, to preserve biodiversity, enhance strategies to mitigate climate change, enhance innovative strategies to adapt to climate change, sustain cultural diversity and disseminate knowledge can be identified and shared.

At a more local level like the Barotse plains community in Western Zambia, sustainability is to be understood to mean how humans live and will live within the limits of the capacity of local ecosystems (including sustaining the mutual interdependence of endemic biodiversity as well as judicious and equitable use of natural resources) to support human livelihoods and other members of the ecosystem over the medium and long-term. Sustainability is, thus, a combination of understanding natural ecological limits and capacity on the one hand, and assuring peaceful coexistence of diverse peoples and their economic and consumption patterns on the other, world-over. Dialogue education elements in andragogy (Banda, 2014) and dynamics of the transformative learning and iceberg cultural theories play critical roles in the success and sustenance of indigenous knowledge systems.

5.4.1 Integrating Traditional Environmental Knowledge into Mitigation and Adaptation Strategies among Lozi Adults

The indigenous knowledge systems found among Lozi adults around Lealui Ward area in the Barotse plains is an amalgamation of strategies, skills, rules, and techniques gained through shared adaptive man-environment interactions to make a living and survive natural and economic hardships. Indigenous knowledge, practices and skills have been adapted to new conditions and demands whenever tangible livelihood benefits for society and individual members of a community can be derived from their application. Hybridized with modern Western knowledge systems, traditional knowledge can co-exist to meet the changing demands and challenges of sustainable rural and national development.

Traditional environmental knowledge should be seen as applicable and as one of a number of tools in planning, decision-making, and monitoring of the use of natural resources at local level. The use of a participatory bottom-up planning focused on local priorities, needs, constraints, and abilities is an attempt to activate and incorporate indigenous knowledge and get local support for the implementation of resource management plans. Traditional environmental knowledge can only be incorporated as an asset for sustainable rural development and resource conservation if government officials, planners, decision makers, researchers and other scientists improve communication links with local communities, recognize the value of traditional environmental knowledge, and develop a positive attitude towards it.

A careful amalgamation of indigenous and foreign knowledge would be most promising. In order to integrate indigenous traditional environmental knowledge into formal climate change mitigation and adaptation strategies, certain steps must be taken. The first step is to acknowledge that indigenous traditional environmental knowledge has provided communities such as around Lealui Ward area of the Barotse plains with the capability of dealing with past and present vulnerabilities to climatic extremes and other stresses. Second, one must adopt the bottom-up active participatory approach that encourages the highest level of local participation. The benefits of this are that (i) provides valuable insight into how communities and households interact and share ideas, and (ii) it allows the intended beneficiaries to develop the skills and practices necessary to forge their own path and sustain the projects. Third, the local communities should be seen as equal partners in the development process. It is basically an internal process, which only may be enhanced by outside assistance. Local actors should progressively take the lead while external partners back their efforts to assume greater responsibility for their development. Reducing vulnerability entails the strengthening of adaptive capacities of vulnerable individuals and groups. Capacity building should emphasize the need to build on what exists, to utilize and strengthen existing capacities. Indigenous knowledge plays a significant role in the sum total of what exists in a local community. Fourth, in as much as we acknowledge the importance of indigenous practices in climate change mitigation and adaptation, they should not be developed as substitutes of modern techniques. It is important that the two are complements and learn from each other in order to produce ‘best practices’ for mitigation and adaptation (Walter, 2004).

A best practice is the result of articulating indigenous knowledge with modern techniques - a mix that proves more valuable than either one on its own. The interaction between the two different systems of knowledge can also create a mechanism of dialogue between local populations and climate change professionals, which can be meaningful for the design and implementation of projects that reflect people's real aspirations and actively involve all major stakeholders in communities. However, it is important to note that not all indigenous practices are beneficial to the sustainable development of a local community; and not all indigenous knowledge can provide the right solution for a given problem at a given time. Therefore, before adopting indigenous knowledge, integrating it into development programmes, or even disseminating it, practices need to be scrutinized for their appropriateness just as any other technology. In addition to Western scientific proof, local evidence and the socio-cultural background in which the knowledge and practices are embedded also need consideration in the process of validation and evaluation.

5.5 Summary of the Discussion

This chapter discussed and analyzed the findings on traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Z*a*mbia. The study had three objectives: to find out how communities around Lealui Ward area of the Barotse plains of Mongu District had been affected by climate change; to investigate the role of traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains of Mongu District in mitigating climate change; and to establish what could be done to enhance traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains of Mongu District to mitigate climate change. The three objectives and research questions were answered through the revelations of the findings discussed in is chapter.

The findings from the study population revealed that it is evident that the indigenous Lozi people of the Barotse plains community in Western Zambia have already started being affected by the effects of the climate change. The main negative effects included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected changes in seasons and their durations; reduction in food production, food security, water supply, energy and income; increase in diseases like malaria and diarrhoea among humans; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people. The study also

revealed that traditional environmental knowledge among the Lozi adults was important in mitigating climate change. Indigenous Lozi people and local communities in Mongu District are actively involved in innovative solutions based on their traditional knowledge, such as reducing emissions through fire management techniques, adopting renewable energies in their territories, and engaging in resource management culture and projects that reduce pressure on natural resources and enhance local adaptive capacity. The study findings further showed that climate change mitigation and adaptation strategies using indigenous knowledge can be enhanced through cross pollination of knowledge, co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders.

5.6 Critical Refrections on the Research Process of the Study

Research can be conducted in a number of ways. This study was a case study investigating the role of traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains in Western Zambia. The study attempted to answer three research questions formulated from the objectives. In order to collect and analyze data, the study employed more qualitative than quantitative methods. A pilot study was conducted in Tapo area of Kalabo District.

Although a pilot study helped to test and fine tune research instruments, data collection and analysis procedures, more such pilot studies could have been better. This might have clearly shown the research team that the research intruments could have been better developed using the local Silozi language than English. The use of English made the data collection and analysis proceses somewhat difficult because the questions had to be translated to the respondents who did not understand the language. Similary, recorded responses had to be translated from Silozi into English – making the data collection and analysis process take longer. Translations tend to misrepresent interpretation of some information.

The size of sample size used in the study may not be large enough to generalize the findings to the large Barotse plains. Moreover, since the study was more qualitative than quantitative, the findings findings might be more subjective than objective – thus making it difficult to generalize the findings.

Since the study investigated a culture of the indigenous Lozi people mitigated climate change, a pure qualitative study without any quantitative aspects might have still answered

the study research questions. More time and resources could have been needed to conduct a complete qualitative study. It could have been better for the research team to spend more time like a yea or two among the indigenous people in the Barotse plains. As Howitt and Cramer (2007) put it, the extent of your data collection process would be influenced by the amount of time you have for your study. This may seem a rather negative approach, but there is no point in producing a grandiose scheme that requires a year or two and a team of researchers if you are your own, have limited funds and in any case have to hand in the project report in a short specified number of months.

The next chapter presents the summary, conclusion and recommendations of the study based on the findings and discussions on traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter presents a summary of, and conclusion to, the findings of the study on the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District in Western Zambia. The chapter tries to answer the research questions in relation to the outcome of research analysis. The practical implications of the study are also discussed in this chapter. The chapter further gives recommendations, based on the findings, which could act as a guide to future implementations of recognition of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains. This may contribute to cooperative and coordinated utilization of mitigation and adaptation strategies for climate change in the study area than it was at the time of the research. In conclusion, the chapter gives suggestions and implications for future research.

The overall objective of the study was to investigate the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District in Western Zambia. This was to be achieved by answering the specific research questions which centred around investigating how Lozi adults around Lealui Ward area of the Barotse plains had been affected by climate change; why traditional environmental knowledge among Lozi adults was important in mitigating climate change around Lealui Ward area in the Barotse plains; as well as ascertaining how traditional environmental knowledge around Lealui Ward area of the Barotse plains of Mongu District could be enhanced to mitigate climate change.

6.1 Summary of Findings

Using the triangulation approach, the study proved beyond reasonable doubt that the indigenous Lozi people of the Barotse plains community in Western Zambia had already started being affected by the effects of the climate change. The main negative effects included increase in atmospheric temperature and excessive heat in the plains; floods; prolonged dry spells; reduction in precipitation; unexpected changes in seasons and their durations; reduction in food production, food security, water supply, income; increase in

diseases like malaria and diarrhoea among humans and heat stress among livestock; extinction of some species of plants, insects, birds and fish; and erosion of indigenous cultural social life of the Lozi people.

Through the study, it was established that traditional environmental knowledge among the Lozi adults was important in mitigating climate change. It can safely be stated that just as in many other indigenous peoples' communities in the world, indigenous Lozi people's traditional environmental knowledge and use of biodiversity in the Barotse plains is central to environmental management, sustainable livelihoods and mitigation of climate change.

Lifelong learning, a critical component of adult education's andragogy, transformative learning and iceberg cultural theory play pivotal roles in sustenance of traditional environmental knowledge. It was found that Lozi adults learnt traditional environmental knowledge through their close interactions with cultural life, and dialoguing with family members, community members, friends, colleagues and associates. Traditional environmental knowledge was found to play a critical role in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District. Local knowledge systems in the plains have evolved from ongoing experimentation to resolve settlement, agricultural, environmental, health, and other social problems in a particular agro-ecological and socio-cultural context. This could greatly improve environmental sustainability whose emphasis is on the proper use of natural resources and regeneration of the ecosystem so that future generations have the same opportunities as the present ones, not only in the Barotse plains but worldwide.

The study findings further showed that climate change mitigation and adaptation strategies using indigenous knowledge could be enhanced through cross-pollination of knowledge, co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders. It is cardinal to incorporate both indigenous knowledge and modern Western scientific knowledge to effectively mitigate climate change and enhance sustainable development, being promoted by environmental adult education.

6.2 Conclusion

The conclusion is closely tied to the purpose of the study, which sought to investigate the role of traditional environmental knowledge among Lozi adults in mitigating climate change around Lealui Ward area of the Barotse plains of Mongu District, Western Zambia. Global warming which results in climate change is a universal problem but the response, whether

adaptation or mitigation, needs to be tailored to local contexts. For indigenous peoples like the Lozi of the Barotse plains in Western Zambia, climate change was already a reality and posed threats and dangers to the survival of their communities, culture and livelihoods. Therefore, in rural areas of developing countries like Zambia, indigenous knowledge systems such as traditional environmental knowledge is critical in solving many environmental challenges. What works as effective traditional knowledge now, has come to be so through years of experimenting and adjusting to a naturally changing environment.

In line with the purpose of the study, it can be concluded that, the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains is cardinal. This study revealed that although majority of the residents in the Barotse plains were not aware of the concept of climate change and could not explain what it meant or its causes, they clearly expressed how they were affected by the climate change. However, this is only a 'tip' of the iceberg of the effects of climate change in the Barotse plains. Traditional environmental knowledge was found to play a critical role in mitigating climate change because it enhanced sustainable use and conservation of natural resources. Local knowledge systems around Lealui Ward area of the Barotse plains in Western Zambia have evolved from ongoing experimentation to resolve settlement, agricultural, environmental, health, and other social problems in a particular agro-ecological and socio-cultural context.

Currently, issues of climate change are critical world-over and there is need to bring everybody on board. Lifelong education and informal education in particular like traditional environmental education found in traditional environmental knowledge and adult education, can probably be one avenue to use to bring everybody on board using dialogue education to understand issues on climate change and participate in strategies to adapt and mitigate it for sustainable development. Indigenous knowledge systems and local institutions - which are continuously used, adapted, revitalized and developed - might produce immediate and strategic solutions to challenges associated with climate change. Climate change was already having serious implications on the livelihoods and culture of indigenous Lozi people in the Barotse plains. Even though these people have developed important strategies to adapt to these changes, the magnitude of future hazards may limit their capacity to adapt. Possible effective strategic solutions to enhance climate change mitigation and adaptation are many and allow for continued sustainable economic and human development. All we need is the will to change, which we trust would be motivated by knowledge and an understanding of

traditional environmental knowledge of indigenous people and the Western science of climate change to help us work together as a human family world-over. Mitigating climate change means reducing greenhouse gas emissions and sequestering or storing carbon in the short-term, and of even greater importance, making development choices that might reduce risk by curbing emissions over the long-term. Although the entire food system is a source of greenhouse gas emissions, primary production is by far the most important component. Incentives are needed to persuade crop and livestock producers, agro-industries and ecosystem managers to adopt good practices for mitigating climate change.

Since the study also found that some aspects of the Lozi culture were being eroded mainly by some effects of climate change and probably because of influence of Western culture, traditional environmental knowledge among Lozi adults around Lealui Ward area of the Barotse plains could greatly be enhanced through coordinated efforts highly stimulated through dialogue education. Dialogue education which is common in the indigenous knowledge systems and adult education would greatly help sustain indigenous peoples' holistic all inclusive participatory co-operative culture. This would further improve the value and perceptions of the Lozi culture and other African culture among indigenous people including traditional environmental knowledge which helps in environmental sustainability, a critical component in sustainable development, whose emphasis is on the proper use of natural resources, mitigation of climate change and regeneration of the ecosystem so that future generations have the same opportunities as the present ones.

The study also revealed that incorporating some traditional environmental knowledge found among Lozi adults around Lealui Ward area of the Barotse plains into climate change policies could lead to the development of more effective mitigation and adaptation strategies that are cost-effective, participatory and sustainable. One community that is still steeped in traditional environmental knowledge is among Lozi adults around Lealui Ward area of the Barotse plains in Western Province of Zambia.

In conclusion, this study, therefore, could add value to the indigenous knowledge systems, a critical component of adult education in Africa and has helped to provide and enhance both literature in theoretical terms as well as evidence on the actual role of traditional environmental knowledge in mitigating climate change among Lozi adults around Lealui Ward area of the Barotse plains in Western Zambia.

6.3 Recommendations

The present study highlighted that climate change was already impacting negatively the environment and life among Lozi adults around Lealui Ward area of the Barotse plains and posed threats and dangers to the survival of their communities, culture and livelihoods; traditional environmental knowledge among Lozi adults around Lealui Ward area was cardinal in mitigating and adapting to climate change as it enhanced sustainable use and conservation of natural resources; and climate change mitigation and adaptation strategies using indigenous knowledge systems among Lozi adults could be enhanced through cross pollination of knowledge, co-operative work and concerted effort between the indigenous people of the Barotse plains and other stakeholders.

On the basis of the study findings, this study recommends the following options to be considered:

i). In order to cushion the negative impacts of climate change experienced in the study area, there is need for the Government of Zambia and other policy-makers to always consult and involve local people in communities including indigenous people like Lozi adults in rural areas to mitigate and adapt to climate change successfully. This can greatly enhance policy and project planning, policy-making, project implementation, monitoring and evaluation stages to achieve sustainable development by all and for all people.

ii). In order to enhance mitigation of climate change strategies in the Barotse plains, there is need to undertake intensified energy switching initiatives mainly from fossil fuels like diesel to solar, wind, mini-hydropower; enhance actualization of practicing conservation agriculture, organic farming, conservation of natural resources and sustainable forest management. These projects could contribute to the global reduction in greenhouse gases emissions and promote sustainable development in Zambia.

iii). To sustain and enhance traditional knowledge systems being eroded among the Lozi people around Lealui Ward area of the Barotse plains, the mass media such as the community radios could also be effectively utilized to provide indigenous knowledge systems such as traditional environmental knowledge, environmental sustainability and climate change mitigation and adaptation in local languages in communities with

high illiteracy such as many rural areas in the study area. Listening groups could be formed in communities among members of community environmental clubs, village development committees, ward development committees and district development committees. These listening groups could reflect on environmental-related themes and share with other members of community including family members. It is also cardinal to document traditional environmental knowledge found among surviving elders for both cultural preservation of the Lozi culture and use by young Lozi generations.

iv). The Government of Zambia and other stakeholders should also consider introducing community television stations just as we have community radio stations to enhance use of dialogue education revealed in the study area. It seems many children and youths prefer watching television to listening to radio. These television stations could include interactive programmes which could educate people indigenous knowledge systems like traditional environmental knowledge. Such programmes could also be broadcasted in local languages so that children and adults who do not understand English could also benefit.

This arrangement could supplement face-to-face dialogue education around Lealui Ward area to pass on and enhance indigenous knowledge systems among and within generations to enhance indigenous peoples' culture which is being eroded among the Lozi people in the Barotse plains. Use of dialogue education helps to ensure that transformative, holistic, lasting lifelong learning takes place among all people in communities and society. With dialogue education, the lifelong learning atmosphere is safe and respectful, a place where people are both challenged and supported to maximize learning. As a result, you would experience a higher, more organic retention of skills and knowledge for the long-term. When people have the power to be active decision-makers in their own learning using dialogue education, they are likely to experience real and lasting sustainable development.

Moreover, the Government could develop and incorporate in education curriculums indigenous environmental knowledge to foster acceptance and consciousness of conservation among the younger generations which was found to be losing some cardinal cultural norms of the Lozi people.

v). In order to curb deforestation revealed in the study around the study area, the Government of Zambia and other stakeholders could intensify promotion of tree-planting in communities to enhance mitigation of climate change. Moreover, deforestation could be reduced by strengthening of local regulations under the Barotse Royal Establishment that encourage sustainable use of forest resources and encourage more community-based natural resources management at grass-root levels.

vi). In order to help restock lost fish around Lealui Ward area, the Government and other stakeholders could encourage and support fish farming in the Barotse plains.

vii). In order to reduce the impact of drought revealed around Lealui Ward area of the Barotse plains, the Government of Zambia and other stakeholders could consider promoting and investing in irrigation development support to enhance food security in the plains and other parts of the country as well as contribute to sustainable development.

viii). In order to curb impacts of flooding associated with climate change which destroys infrastructure like schools and health centres around Lealui Ward area of the Barotse plains, the Government of Zambia and other stakeholders could consider promoting construction of floating communities in the Barotse plains and other wetlands so that people do not always have to relocate in times of floods. Education and health institutions like primary schools and health clinics could be constructed to pilot floating community projects.

ix). In order to enhance climate change mitigation and adaptation strategies using indigenous knowledge systems in the Barotse plains, it is important to integrate traditional environmental knowledge with good Western science to aid mitigation and adaptation to climate change as well as live in harmony with the natural environment.

6.4 Future Research

In line with the findings of this study, the following areas of future research are suggested:

i). A study on a similar topic could take a comparative approach. Comparisons could be made on the role of traditional environmental knowledge among indigenous people in other parts of Zambia. Such research could also endeavour to document traditional environmental knowledge available in our Zambian communities, especially rural areas, when we still have elderly people who are rich with the information so that future generations could benefit.

ii). Future research could be undertaken to investigate further on perceived extinction of some plant, bird, fish and animal species related to effects of climate change, not only in the Barotse plains, but also in other parts of Zambia highly effected by climate change.

6.5 How the Study might Impact Adult Education Programmes and Pratices

The findings of this study may impact positively to a number of adult education programmes and practices:

i) The study revealed that the culture of indigenous Lozi adults around Lealui Ward area in the Barotse plains has some good aspects to enhance environmental sustainability. This could be cross-pollinated with positive western science and tradititional environmental knowledge fro other parts of the world. Environmental sustainability is critical to enhance sustainable development of any community or society. It is cardinal for adult education practitioners and other agents of development to gain more recognition of the value of indigenous knowledge systems and local people when planning, implementing, monitoring as well as during evaluation of various programmes like literacy programme and projects in communities.

ii) Adult educators should take a deliberate policy to incorporate indigenous knowledge systems such as traditional environmental knowledge in their programmes with clients, particularly in rural communities. To summarize the methods of environmental adult education programmes, environmental adult educators should strive to instill learners with:

(a) knowledge of environmental problems like climate change and their causes;

(b) the skills to engage in social activism to combat those problems;

(c) the attitude of respect and love of the natural world; and

(d) a desire to change from destructive practices to protect the planet Earth.

iii) Sensitization of the population in various cummunities in environmental conservation and sustainability and the need for sustainable development in society is the only option if the effects of climate change are to be reversed in Zambia and the world at large. Use of non-formal and informal education in adult education such as dialogue education and theatre for development could effectively do this task.

iv) A lesson for adult educationists and other Zambian policy makers to learn from the findings of this study is that, deliberate initiatives to encourage full citizen active participation at local community level and create a responsive education for all, not only through formal learning, have been marginalized for a long time yet are necessary to enhance all citizens chances of being educated in a holistic manner. Lifelong education and informal education in particular like traditional environmental education found in traditional environmental knowledge and adult education, could probably be one avenue to use to bring everybody on board using dialogue education to understand issues on climate change and participate in strategies to adapt and mitigate it for sustainable development.

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APPENDICES

Appendix 1

A Letter of Introduction for Fieldwork from the University of Zambia

THE UNIVERSITY OF ZAMBIA
SCHOOL OF EDUCATION

Telephone: 291381
Telegram: UNZA, LUSAKA
Telex: UNZALU ZA 44370

PO Box 32379
Lusaka, Zambia
Fax: +260-1-292702

==========

Date 15/01/2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: FIELD WORK FOR MASTERS/ PhD STUDENTS

The bearer of this letter Mr./~~Ms~~ STEPHEN BANDA Computer number 513805371 is a duly registered student at the University of Zambia, School of Education.

He/She is taking a Masters/PhD programme in Education. The programme has a fieldwork component which he/she has to complete.

We shall greatly appreciate if the necessary assistance is rendered to him/her/.

Yours faithfully ASSISTANT DEAN (PG)

THE UNIVERSITY OF ZAMBIA
15 JAN 2015
SCHOOL OF EDUCATION
P.O. BOX 32379, LUSAKA

Daniel Ndhlovu (Dr)
ASSISTANT DEAN POSTGRADUATE STUDIES- SCHOOL OF EDUCATION

Cc: Dean-Education
Director-DRGS

Appendix 2

A List of *Litungas*

Below is a list of *Litungas* in chronological order starting with the first male. There are variations on this list and the reader might wish to consult other documents or historians for comparison. The dates of the reigns of the various kings are somewhat vague up to the time of Lewanika. All pictures of the *Litungas* in this work were obtained with courtesy of the Nayuma Museum at Limulunga Royal Village, Limulunga District and Mbikusita-Lewanika (2001).

- **Mboo** - also known as **Mwanasilundu Muyunda** - Mboo may have been a nickname added after his overdue birth.
- **Inyambo** - older brother to Mboo
- **Yeta** - an uncle to Mboo and Inyambo, sister of Mbuyu
- **Ingalamwa**
- **Ngalama** - son of Ingalamwa
- **Yeta Nalute** - son of Ngalama
- **Ngombala** - son of Ngalama
- **Yubya**
- **Mwanawina**
- **Mwananyanda**
- **Mulambwa** - : c1780 - c1830
- **Silumulume** - son of Mulambwa
- **Mubukwanu** - son of Mulambwa

Makololo interregnum

- **Sibitwane** : died 7th July 1851
- **Mamochisane** - daughter of Sibitwane, said to have handed the chiefship over very quickly.
- **Sekeletu** - son of Sibitwane 1852 - 1864
- **Mamili**
- **Mbololo** - brother of Sibitwane 1864 - 1864

- **Sipopa** - also: **Lutangu** 1864 - 1876

- **Mwanawina** 1876 - 1878
- **Lubosi**: 1878 - 1884 (b. c1842 d. Feb. 1916)

- **Tatila Akufuna**: 1884 - 1885

- **Lubosi** - now known as **Lewanika** 'the uniter': 1885 - 1916. The name Lewanika is a transliteration of Siluyana emanating from 'Liwaneka'. Kuwaneka means to unite.

- **Litia - became Yeta III** - son of Lewanika: 1916 - 1945 (June).

- **Imwiko**: son of Lewanika 1945 - 1948 (June).

- **Mwanawina III**: 1948 - 1968 (b. c1888 d. 13th Nov 1968).

- **Mbikusita** - son of Lewanika: 1968 (15th Dec) - 1977 (b. c1907 d. 1977).

- **Ilute** - sometimes referred to as Yeta IV - son of Yeta III: 1977 - 2000 (died on 7th July 2000)

- **Lubosi II** - son of Imwiko: 2000 (October) - presently reigning as His Royal Highness (Mbikusita-Lewanika, 2001).

Appendix 3

Focus Group Discussions (FGDs) Guide for Mongu's Barotse Plains Community Residents

At the beginning of the meeting, the researcher or research assistant will introduce himself or herself as facilitator and introduce the recorder. (The study will use research assistants that can fluently communicate in Silozi, the language mostly used in the study area.) The participants will be asked to introduce themselves with whatever names they wish to use. The researcher or research assistant will put the participants at ease and explain the purpose of the FGDs, the kind of information needed, and how the information will be used (for academic purpose only). Permission to use a tape-recorder will be sought from the participants, and let people hear their own voices before the session starts.

Date: Time: Place:

Guiding questions:

1. Have you ever heard of the term climate change?
2. What do you understand by the term climate change?
3. What do you think are the causes of climate change?
4. What are the major sources of energy used for cooking in your community?
5. What are the major modes of transport used in the Barotse plains?
6. In your view, can you say you have been affected by the climate change?
7. Do you know of any negative impacts of climate change in your community?
8. Do you know of any positive impacts of climate change in your community?
9. Do you think local traditional knowledge is important in mitigating climate change?
10. In your view, why is local traditional knowledge among Lozi adults in your community important in helping to mitigate climate change in the Barotse plains?
11. In your view, what examples of local traditional knowledge among local Lozi adults can you give that helps mitigate effects of climate change in the Barotse plains and surrounding areas?
12. How do you learn traditional environmental knowledge?
13. What type of agriculture methods do you practice in the Barotse plains?
14. What strategies have been devised among Lozi adults using local traditional knowledge to mitigate climate change in the Barotse plains?
15. What can be done to improve our care for the natural resources and the environment in the Barotse plains communities?
16. In your view, what can be done to enhance local traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains?

At the end of the meeting, the researcher or research assistant will take time to summarize, check for agreements as well as disagreements and thank the participants for their time and co-operation.

Appendix 4

Questionnaire for Government Officials, Managers and other Local Leaders

Dear Respondent,

I am a postgraduate student at the University of Zambia pursuing doctoral studies in Adult Education. I am carrying out research to investigate the role of local traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains in Mongu District. The research is in partial fulfillment of my studies. In this regard, you have been selected to participate as a respondent. I would be grateful if you accept to be one of the respondents. The results of this research will be used for the improvement of adult education.

Please write down your answer/s in the space provided in the following questionnaire as carefully and as honestly as possible. Tick in the appropriate box for your response to the questions or statements with boxes in the questionnaire. The information written on this questionnaire will be treated with the highest confidentiality and it will be used for academic purposes only. **Please do not write your names on the questionnaire.**

I thank you most sincerely in advance,

Stephen Banda (student)

Date: Sex of respondent: Male [ ] Female [ ]

A. Respondent's Identification

1. Which organization do you work for?

   _____

2. How long have you been working in Mongu District?

   _____

B. Questions related to the role of traditional environmental knowledge among Lozi adults in mitigating climate change.

3. What do you understand by the term climate change?

   _____

4. What do you think are the causes of climate change?

   _____

   _____

5. What are the major sources of energy used for cooking in the Barotse plains?

   _____

6. What are the major modes of transport used in the Barotse plains?

_____

_____

7. List any negative impacts of climate change in your community?

_____

_____

_____

8. List any positive impacts of climate change in your community?

_____

_____

9. What kind of climate change mitigation programmes are you and your organization or community involved in?

_____

_____

10. In your view, do you agree that local traditional environmental knowledge among Lozi adults in the Barotse plains helps to mitigate effects of climate change in their communities?
Strongly agree [ ] Agree [ ] Undecided [ ] Do not agree [ ] Strongly do not agree [ ]

11. If you do not agree, state why.

_____

_____

12. In which way(s) are the local people in the Barotse plains involved in programmes concerning mitigation of effects of climate change?

_____

_____

13. What strategies are you aware of that have been devised using local traditional environmental knowledge to mitigate effects of climate change in the Barotse plains?

_____

_____

14. In your view, why do you think local traditional environmental knowledge is important to mitigate climate change in the Barotse plains?

_____

_____

_____

15. What, in your view, can be done to increase the participation of the local adult residents in the Barotse plains in the environmental sustainability programmes to mitigate effects of climate change?

_____

_____

_____

16. In your view how can the care for the natural resources and the environment in the Barotse plains community be improved to mitigate climate change?

_____

_____

17. In your view, in which other ways can residents of the Barotse plains learn about how to take care of their natural environment?

_____

_____

18. In what ways are the local people in the Barotse plains involved in programmes of climate change mitigation in their communities?

_____

_____

_____

19. In your opinion, what examples of local traditional environmental knowledge among local Lozi adults can you give that helps mitigate effects of climate change in the Barotse plains and surrounding areas?

_____

_____

_____

20. In your own opinion, what are the advantages of involving local traditional environmental knowledge in mitigating climate change in the Barotse plains?

_____

_____

_____

21. What main difficulties do you face in trying to educate the residents on issues to do with the environment?

_____

_____

_____

22. In your opinion, what can be done to enhance local traditional environmental knowledge in mitigating climate change in the Barotse plains?

(a) Integrating it with Western science_____

(b) Enhancing local knowledge in isolation from other forms of knowledge_____

Thank you for responding to the questionnaire.

For any queries, please contact Stephen Banda on cell number 0977480944 or 0966480944.

Interview Guide for Residents of the Barotse Plains Communities

Dear Respondent,

My name is Stephen Banda. I am a postgraduate student pursing doctoral studies in adult education at the University of Zambia. I am carrying out research to investigate the role of local traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains in Mongu District. The research is part of my studies. I would be grateful if you allow to be interviewed.

Note: The information that will be discussed, collected and recorded will be used for academic purposes only and confidentiality on the part of the respondent shall be upheld. As a respondent, you may withdraw from the interview at any stage. May I continue with the interview?

Date: Sex of respondent: Male [ ] Female [ ]

A. Respondent's Identification

1. Where do you live?

   _____

2. When were you born?

   1900-1920 [ ] 1921-1940 [ ] 1941-1960 [ ] 1961-1980 [ ] 1981-2000 [ ]

3. How long have you been living in Mongu District?

   _____

B. Questions related to how adults learn about environmental sustainability

4. What do you do to sustain your livelihood and your family?

   _____

   _____

5. What major problems do you face to sustain your livelihood?

   _____

   _____

6. What would you suggest to be done to solve the problems?

   _____

7. What are the major sources of energy you use for cooking in your community?

_____

_____

8. What are the major modes of transport used in the Barotse plains?

_____

_____

9. Are you aware of the climate change?
   Yes [ ] No [ ]

10. What do you think are major causes of climate change?

11. In which ways are you and your community affected by the climate change?

_____

_____

_____

12. What major difficulties do you face on issues to do with the natural environment in your community today?

_____

_____

13. Do you agree that Lozi adult residents in the Barotse plains are aware of need for environmental sustainability in their community?

    Strongly agree [ ] Agree [ ] Undecided [ ] Do not agree [ ] Strongly do not agree [ ]

14. If not, state why.

_____

_____

15. In your opinion, what can be done to curb environmental degradation in your community?

_____

_____

16. In what ways do you contribute to protect, preserve and improve the natural resources in your community?

_____

_____

_____

17. In your opinion, do you agree that local traditional environmental knowledge among Lozi adults in the Barotse plains helps in mitigating effects of climate change in the community?
Strongly agree [ ] Agree [ ] Undecided [ ] Do not agree [ ] Strongly do not agree [ ]

18. How do you learn traditional environmental knowledge?

_____

_____

19. In which way(s) are the local people in the Barotse plains involved in programmes concerning mitigation of effects of climate change?

_____

_____

20. What strategies are you aware of that have been devised using local traditional environmental knowledge to mitigate effects of climate change in the Barotse plains?

_____

_____

_____

21. What, in your view, can be done to increase the participation of the Lozi adult residents in the Barotse plains in the environmental sustainability programmes to mitigate effects of climate change?

_____

_____

22. What can be done to improve our care for the natural resources and the environment in the Barotse plains community?

_____

_____

23. In your view, in which other ways can residents of the Barotse plains learn about how to take care of their natural environment?

_____

_____

24. In what ways are the local Lozi people in the Barotse plains involved in programmes of climate change mitigation in their communities?

_____

_____

25. In your opinion, what examples of traditional environmental knowledge among local Lozi adults can you give that help mitigate effects of climate change in the Barotse plains and surrounding areas?

_____

_____

_____

26. In your own opinion, what are the advantages of involving local traditional environmental knowledge in mitigating climate change in the Barotse plains?

_____

_____

27. What main difficulties do you face in trying to educate the residents on issues to do with the environment?

_____

_____

28. In your opinion, what can be done to enhance local traditional environmental knowledge in mitigating climate change in the Barotse plains?

(a) Integrating it with Western science_____

(b) Enhancing local knowledge in isolation from other forms of knowledge_____

We have come to the end of our interviews.

Thank you for your time and cooperation.

Appendix 6

TIME FRAME FOR THE STUDY PROCESS

Activity	2013	2013	2014	2014	2014	2014	2014	2015	2015	2015	2016	2016	2016
Collection and review of literature	x	x	x	x	x	x	x	x	x	x	x	x	x
Designing and finalizing data collection instruments	x	x											
Production of data collection instruments			x										
Presentation of research proposal (defending the proposal)				x	x								
Field visits (pilot study and data collection)						x	x						
Data analysis								x					
Compilation of research report and publishing of article									x	x			
Finalizing writing and editing of the research report											x		
Presentation of the research report (defending the thesis)												x	
Correcting and finalizing the thesis													x
Binding and handing in the thesis													x

Appendix 7

RESEARCH BUDGET

DESCRIPTION	QUANTITY	UNITY COST (ZMK)	TOTAL COST (ZMK)
STATIONERY COSTS			
1.Paper	10	40.00	400.00
2.Folders	2	20.00	40.00
3. Pens	15	5.00	75.00
4. Note books	5	10.00	50.00
5. Photocopying and printing	1000	4.00	4,000.00
6. Internet	50	10.00	500.00
Sub-Total			5,065.00
DATA COLLECTION COSTS			
1. Secondary data costs (e.g. Buying reports)	20	100.00	2,000.00
2. Primary data collection costs (Printing of research instruments)	200	10.00	2,000.00
3. Research equipment (tape recorder and camera)	2	300.00	600.00
4. Hiring Research Assistants	2	1,250.00	2,500.00
Sub-Total			7,100.00
TRANSPORT COSTS (to & from Barotse Plains - Western Province by hiring 4x4 vehicles, boats and ox-carts)			1,261.00
Sub-Total			1,261.00
PRESENTATION OF RESEARCH RESULTS COSTS			
1. Poster Development	1	300.00	300.00
2. Printing Journal Article	3	100.00	300.00
3. Binding Journal	3	96.70	290.00
4. Compact Disk for Journal Article	1	86.00	86.00
Sub-Total			976.00
COMPILATION OF FINAL THESIS COSTS			
1. Binding of thesis			450.00
Sub - Total			450.00
GRAND TOTAL			**14,852.00**