

## **Traditional Environmental Knowledge among Lozi Adults in Mitigating Climate Change in the Barotse Plains of Western Zambia**

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**Abstract:** *The background to this study had its genesis from the fact 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. The study was guided by the following objectives: i) to find out how communities in Lealui area in the Barotse plains of Mongu District have been affected by climate change; ii) to assess the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Mongu District; and iii) to establish what can be done to enhance traditional environmental knowledge in the Barotse plains of Mongu District to mitigate climate change.*

*This research was a case study. It was conducted in Lealui Ward area in the Barotse plains of Mongu District, western Zambia. Mongu is located in Western Province of Zambia. The sample consisted of one hundred and twenty (120) subjects drawn from the target population: one hundred (100) indigenous Lozi adult respondents who utilize the Barotse plains in Lealui Ward, fifteen (15) 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 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. 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 main conclusion of the study was that traditional environmental knowledge can effectively help the Barotse plains community in Western Zambia, and the world at large, mitigate climate change and enhance sustainable development if valued and utilized by policy makers and other community development agents to incorporate it in climate change science.*

**Keywords:** *traditional environmental knowledge, climate change, mitigation, traditional knowledge systems.*

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### **1. INTRODUCTION**

This study was conducted in 2015 as part of the requirements of the doctoral studies being pursued by the main author at the University of Zambia. The study intended to assess the role of traditional environmental knowledge among Lozi adults in mitigating climate change in Lealui Ward area in the Barotse plains of Mongu District, western Zambia. According to experts, climate change is the long term change in the earth's climate, especially a change due to an increase in the average atmospheric temperatures (IPCC, 2007). The Earth's climate has always changed but because of human activities it is now changing faster than it has for thousands of years. 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 Zambia and other African nations have made. It poses threats to food and water security, to political and economic stability, to livelihoods and landscapes.

The 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 it becoming increasingly difficult for them to support sustainable production, have secure livelihoods and sustainable development.

## **2. BACKGROUND INFORMATION ON THE STUDY**

The background to this study had its genesis from the fact 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. Traditional environmental knowledge which is a cardinal part 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). Indigenous knowledge is, therefore, 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 critical in Africa's adult education. Goals of adult education are individual development and, through this, improvement of family, community and society.

Adult education deals with cross-cutting issues or fields of study that require people to operate effectively and efficiently (Mtonga, 2012). All the multitude of ways in which adult people are helped to learn to help improve themselves are often collectively known as adult education (Banda, 2014). These specific fields greatly contribute to individual, community and national development (Lindeman, 1925; Banda, 2009). Of late, all across the world and in our continent, people are taking action because climate change has serious impacts, locally and globally. For example, in 2007, scientists from the International Panel on Climate Change (IPCC) estimated that Africa experienced warming through the twentieth century at a rate of between 0.26°C and 0.50°C (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°C and 4°C by 2080 (IPCC, 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 may be their traditional knowledge and practices.

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, particularly in the southern and western regions (<http://www.times.co.zm>). The Barotse plains are found in a rural area of this zone in western Zambia.

## **3. STATEMENT OF THE PROBLEM**

Many people of Western province and elsewhere do not precisely know the value of traditional environmental knowledge among Lozi adults in mitigating effects of climate change in the Barotse plains of western Zambia. Although research is gradually recognizing the importance of indigenous knowledge systems like traditional environmental knowledge in many developmental studies including adult education (Salick and Byg, 2010; Woodley, 1991), the role of indigenous knowledge among indigenous people in mitigating climate change has received little attention. This is an aspect of concern. This study was an attempt to fill this knowledge gap.

## **4. PURPOSE OF THE STUDY**

The purpose of this study is to assess traditional environmental knowledge among Lozi adults in mitigating climate change in Barotse plains of Mongu District of western Zambia.

## **5. OBJECTIVES OF THE STUDY**

The study was guided by the following objectives: i) to find out how communities in Lealui area in the Barotse plains of Mongu District have been affected by climate change; ii) to assess the role of traditional environmental knowledge among Lozi adults in mitigating climate change in the Barotse plains of Mongu District; and iii) to establish what can be done to enhance traditional environmental knowledge in the Barotse plains of Mongu District to mitigate climate change.

## **6. RESEARCH QUESTIONS**

In order to achieve the objectives, the study addressed itself to three major questions. These were: i) how have communities in Lealui area in the Barotse plains of Mongu District been affected by climate change? ii) why is traditional environmental knowledge important among Lozi adults in mitigating climate change in Lealui area in the Barotse plains of Mongu District; and iii) how can traditional environmental knowledge in the Barotse plains of Mongu District be enhanced to mitigate climate change?

## **7. SIGNIFICANCE OF THE STUDY**

Through this study, communities in the country may become aware of evidence and contribution of traditional environmental knowledge in mitigating negative effects of climate change in rural Zambia. The findings of the study may also show the significance of traditional environmental knowledge and its potentials to enhance sustainable development in the Barotse plains and surroundings areas of Mongu District. Traditional environmental knowledge among adults is very important in any society and it would add value in the process of sustainable development in the Barotse plains, Mongu District.

The data collected may also benefit the community members of the Barotse plains by providing them with useful literature that may enable them fully participate to devise solution strategies to meet the challenges of climate change affecting their communities. The findings may also contribute information to the existing body of knowledge on significance of traditional environmental knowledge in environmental adult education.

## **8. THEORETICAL FRAMEWORK**

Besides andragogy, this study was particularly guided by transformative learning and iceberg cultural theories. This framework provides the analytical and interpretive lens for the analysis of the findings.

The general theory of adult learning is Malcolm Knowles' (1980) andragogy, characterized by autonomous learner-centredness which encourages participatory approach in all areas concerning adult learning. Andragogy is the science of understanding and supporting lifelong and life-wide education of adults.

Transformative learning theory is an adult education based theory that suggests ways in which adults make meaning of their lives (Mezirow, 1991). The 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 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.

Transformative learning theory could successfully be used as a theoretical framework to analyze the cultural adaptation processes which form major part of this study.

In adult education it is difficult to talk about traditional environmental knowledge outside people's culture. 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 (1976) have even argued that culture can be likened to an iceberg. He 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 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.



**Fig1.** *The Iceberg Theory of Culture*

**Source:** <http://www.ankn.uaf.edu/IKS/Iceberg.html>.

The portion below the surface of the water in the iceberg theory of culture stands for those elements which are not as obvious but cardinal 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.

Thus, this study was also guided by the iceberg theory of culture to help us understand the deep cultural issues in the study area.

## 9. REVIEW OF LITERATURE

Additional information on the subject matter in this study was obtained from past written materials. Literature search was employed because it offers the greatest opportunity to benefit from the experience of others who have conducted similar studies. Documents consulted include books and journals, annual reports for various organizations, government policy documents, international and local publications, and conference, workshop and seminar presentations, oral communication and the Internet.

The literature reviewed in detail relate to three major issues in line with the study objectives:

- Effects of climate change on indigenous people;
- Significance of traditional environmental knowledge in mitigating climate change; and
- Possible approaches to enhance climate change mitigation and adaptation using indigenous knowledge.

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

### 9.1. Effects of Climate Change on Indigenous People

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 (IPCC, 2014; <http://voices.national-geographic.com>). Indigenous people are the ones affected by the climate change the most, although they have contributed little to its causes (Salick and Byg, 2010). 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.

Although a lot of effects on indigenous people elsewhere have been recorded, there is no study that has 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.

## **9.2. Significance of Traditional Environmental Knowledge in Mitigating Climate Change**

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 will cite 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 and cardinal strategies for sustainable development (see; Oakley, *et. al.*, 1991; Johnson, 1992; Nakashima, *et al.*, 2000; Adams, 2003; and Namafe, 2006).

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).

In simple terms, strategies are a plan of action - patterns of actions, decisions and resource allocations to achieve an outcome. 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 and strategies. A number of studies during the 1980s and early 1990s in Arctic Canada were produced by Johnson (1992). Nakashima, *et. al.*, (2000), Adams (2003), Namafe (2006), and Vinyeta and Lynn (2012) 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. Although some examples on the significance of traditional environmental knowledge in mitigating climate change from elsewhere have been cited in this work, no study has 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.

### **9.3. Possible Approaches to Enhance Climate Change Mitigation and Adaptation Using Indigenous Knowledge**

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). Indigenous people and local communities are actively involved in innovative solutions based on their indigenous or traditional knowledge, such as reducing emissions through fire management techniques, adopting renewable energies in their communities, and engaging in resource management projects that reduce pressure on natural resources and enhance local adaptive capacity. 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. To be effective, climate change mitigation and adaptation strategies as part of environmental adult education should, among others, use dialogue education to incorporate both indigenous knowledge and modern scientific knowledge (Banda, 2014).

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). 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 common challenges of climate change will fall short, unless they are grounded in a recognition of the territorial, land, and resource rights of indigenous peoples. The traditional ecological 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 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, so far, no study has been conducted to contribute to literature on possible approaches to enhance climate change mitigation and adaptation strategies using indigenous knowledge among the Lozi people of the Barotse plains in western Zambia. Hence, this study was an attempt to fill this gap.

## **10. METHODOLOGY**

### **10.1. Research Design**

This research was a case study. A case study seeks to describe a unit in detail, in context and holistically (Merriam and Simpson, 1995; Orondho, 2003; Kombo and Tromp, 2006; Yin, 2014). This enables the researcher to involve an in-depth examination of the study in a naturalistic context to come up with a grounded theory. The study employed more qualitative than quantitative approach in data collection and analysis. The study employed both qualitative and quantitative approaches in order to triangulate the data collected.

### **10.2. Study Location**

The main research was conducted in Lealui Ward area in the Barotse plains of Mongu District, western Zambia. Mongu is located in Western Province of Zambia. The Barotse plains are found on both the eastern and western sides of the great Zambezi River. The eastern part of the plains is in Mongu District while the western part is in Kalabo District. A pilot study was conducted in Kalabo District, Western Province of Zambia. Although many ethnic groups are found in the Western Province, it is mainly the homeland of the Lozi people or *Barotse* who were previously known as Luyi or Aluyi. The heartland of the Lozi people are the Barotse plains on the upper Zambezi River, also known as *Bulozi* or *Lyondo*, but it includes the surrounding higher ground of the plateau.

### **10.3. Target Population**

The target population of the study consisted of all Lozi adults in the Barotse plains, local leaders and institutions that provide education in environmental sustainability in Mongu District. According to the Zambia's 2010 census, Mongu had a population of 179,585 people (<http://www.zamstats.gov.zm>).

### **10.4. 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 in Lealui Ward, fifteen (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.

### **10.5. Sampling Procedures**

Two sampling procedures were used in this research. The sampling procedures used were stratified random sampling and purposive sampling. Stratified random sampling involves dividing the target

population into homogenous sub-groups and then taking a simple random sample in each group (Kasonde-Ng'andu, 2013). Purposive sampling is used in research when a researcher intends to get detailed information from key informants. Purposive 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. Purposive sampling was used to select local leaders like village headmen (*indunas*) and 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).

### **10.6. 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.

### **10.7. Procedure of Data Collection**

To obtain the needed data from the sampled participants, the principal researcher got written permission from the University of Zambia authority to be presented to the office of Mongu District Commissioner and the Barotse Royal Authority for introduction and to seek permission to conduct research in the district and the Barotse plains in particular.

The researcher and his 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. The semi-structured interviews and focus group discussions were used to solicit data from adults in villages and townships. The interviews and focus group discussions were recorded using a voice recorder. Questionnaires were used to collect data from leaders of institutions that provide education in environmental sustainability in Mongu District and some educated traditional Lozi local leaders that could read and write in English or Silozi. Field observations were guided by a check list to collect data pertaining to environmental activities in the communities under study. A pilot study was conducted on the western side of the Zambezi River in Kalabo District to assess the validity and reliability of the instruments. This was done before conducting the main research.

### **10.8. 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) in order to obtain frequencies and percentages. This data was summarized using descriptive statistics such as percentages and frequency distributions and was 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. The views of subjects collected in qualitative data was organized in common themes and analyzed by way of narration.

### **10.9. Limitations of the Study**

As it is expected in any research, there were limitations in this study. The purposive 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 eight 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.

### **10.10. Ethical Considerations**

The study took into consideration a number of research ethical issues. To begin with, since this study was part of the requirements for doctoral studies of the University of Zambia, the principal researcher carried a letter written by the Assistant Dean - Postgraduate in the School of Education, University of

Zambia to the authorities in the study area to conduct the study in the community. This was done in recognition of their authority and to gain their support and co-operation during the study. Written consent from the office of District Commissioner and the traditional Barotse Royal Establishment (BRE) allowed the researcher to conduct the study in Mongu District and its Barotse plains community.

It was also imperative for the researcher to get 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 the purpose of the study was explained 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 in the sample and confidentiality was ensured in that no names were indicated on the questionnaires. No resident 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, will remain anonymous.

## **11. FINDINGS AND DISCUSSION**

This section presents findings of the study in relation to the set objectives. The findings included:

### **11.1. Effects of Climate Change on Indigenous People in the Barotse Plains Community**

Although majority of the residents interviewed (89%) 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. When asked if they were aware of climate change, only eleven per cent of the respondents expressed in affirmative while 89 per cent stated that they were not aware of the term. According to the findings of the study, 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 (Mongu has been recording high temperatures of about 38 degrees Celsius in recent years (MTENR, 2007)); 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 (both humans and livestock) 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 such as suspension of the annual traditional *Kuomboka* (to come out of water) 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. These 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. This movement is known as *Kuomboka*. The migration from the plain to high land releases pressure on consumption of natural resources.

Although the indigenous Lozi people of the Barotse plains may not understand the concept of global warming or climate change, they see and feel the effects of seasonal changes in rainfall patterns and extremes of temperature variations in their plains. Climate change touches all the resources that we 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, paddlers, hunters, farmers of rice, maize, cassava, millet, sorghum, sugarcanes, vegetables and swimmers. 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 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 change.

Climate change puts extra burdens on the social and economic challenges that the poorest people in rural communities 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.

### 11.2. Significance of Traditional Environmental Knowledge in Mitigating Climate Change in the Barotse Plains

The study findings revealed that 78 per cent of the respondents in the Barotse plains community 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 1. Throughout the study, most respondents indicated that local traditional environmental knowledge among Lozi adults in the Barotse plains was cardinal in mitigating and adaptation to climate change.

**Table1.** Responses from the Barotse plains on the significance of traditional environmental knowledge

	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 1 that majority of the residents in the Barotse plains community believe that the local traditional environmental knowledge among Lozi adults in the Barotse plains is cardinal in mitigating climate change. It was revealed from the interviews with residents and local leaders, 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 in the Barotse plains was important in mitigating climate change.

The study established that the culture of the Lozi people of the Barotse plains highly encourages and enhances practices that are cardinal in sustainable development. Thus, traditional environmental knowledge among the Lozi people of the Barotse plains 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. To illustrate, the major means of transport in the 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 1 shows the *Nalikwanda* barge of the Lozi indigenous people during *Kuomboka*.



**Plate1.** People paddling the *Nalikwanda* barge used by the Lozi King during the *Kuomboka* ceremony

**Source:** Field data, Barotse plains, western Zambia (photo by researcher, 2011).

## Traditional Environmental Knowledge among Lozi Adults in Mitigating Climate Change in the Barotse Plains of Western Zambia

The study found 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. 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 indiscriminately cutting down of trees, people mostly use cow dung for cooking and drying fish in the Barotse plains. Related to this, it was found that the indigenous people in the Barotse plains have been involved in community tree-planting practices for many years.



**Plate2.** A truckload of logs on a pontoon for ‘export’ to other areas from the edge of the Barotse plains

**Source:** Field data (photo by researcher, 2015).

Field observations revealed the presence of many old and young mango and cashew nut trees in village communities and along the Barotse plains. 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). Many local leaders bemoaned the rate of indiscriminately cutting down of trees at the edge of the Barotse plains by people from towns for their selfish benefits contrary to the indigenous customary laws of the Lozi people.

Local leaders and the discussants involved in focus group discussions in the Barotse plains agreed that trees help humans in many ways. ‘Trees 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. Many scientific studies have shown that trees reduce air pollution and global warming through respiration and removing particulate matter (Adams, 2003). They take in carbon dioxide and give out oxygen that sustains life. Carbon dioxide is one of the major contributing elements to the greenhouse effect. 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.



**Plate3.** A village scenery with old and young trees, houses and canoe-based transport in the Barotse plains

**Source:** Field data (photo by researcher, 2015).

It is important to study and analyze 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.

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. 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 traditional education systems.

Traditional environmental knowledge used by indigenous Lozi people 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 societies many lessons in the sustainable management of resources in complex forests, mountains, wetlands and dry lands ecosystems' (WCED, 1987:12).

### **11.3.Possible Approaches to Enhance Climate Change Mitigation and Adaptation Using Indigenous Knowledge in the Barotse Plains**

The study findings 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 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 to enhance climate change mitigation and adaptation strategies in the Barotse plains.

According to the findings of this study many (49.5 per cent) local leader respondents were of the view that climate change mitigation and adaptation strategies using indigenous knowledge can be enhanced by cross-pollinating local knowledge with other knowledge from outside the Barotse plains. Some local leaders suggested integrating some African indigenous knowledge like those among the Lozi of

## **Traditional Environmental Knowledge among Lozi Adults in Mitigating Climate Change in the Barotse Plains of Western Zambia**

the Barotse plains in the planning of national and regional mitigation and adaptation strategies. The discussants and residents interviewed were also called for the integration of local knowledge with western science to enhance climate change 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 (Banda, 2014). Traditional education 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 educations 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. Traditional education 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 (57.9% of interviewed residents) in the Barotse plains were calling for the integration of modern science with traditional environmental knowledge. Co-ordinated co-operative work between indigenous knowledge systems and western research-generated knowledge can enhance mitigation and adaptation strategies for climate change to help us attain sustainable development. Plate 4 shows a community of indigenous Lozi people on a raised mound in the Barotse plain as defence to protect low-laying lands from rising water level, one of the effects of climate change. Traditional environmental knowledge is a cardinal part of cultural traditional heritage that gives pride to the indigenous Lozi people and Zambia as a cultured African nation.



**Plate4.** *Part of small village constructed on raised mounds in the low-laying Barotse plains, Lealui area, Mongu*

**Source:** *Field data (photo by the researcher, 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 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 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 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 in the Barotse plains of western Zambia.

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. Dialogue education can be 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. 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. 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.

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 civil society and Non-governmental Organizations 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.

The notion of dialogue has been linked as an educational form from times of Socrate, through Plato, Piaget, Dewey and most probably popularized by Paulo Freire (Banda, 2014). Dialogue education shifts the focus of education from what the teacher says to what the learner does, from learner passivity to learners as active participants in the dialogue that leads to learning (Freire, 1973; Vella, 2004). A dialogue approach to education views learners as subjects in their own learning and honours central principles such as mutual respect and open communication (Vella, 2004). The benefits of dialogue have been known since the dawn of history, but few people in the third world are aware that dialogue is a form of conversation and education with the power to transform lives of individuals, families, communities, organizations, nations and the world. A dialogue education experience allows a free-flowing of ideas among members of a group, allowing the group to discover insights not attainable individually. Dialogue differs from discussion in that in discussion one is presenting ideas back and forth with the goal of coming to agreement or conclusion, while in dialogue the goal is to experience the process of deep listening and communicating rather than the outcome of a decision (Banda, 2014). Dialogue education promotes wide community full active participation, critical thinking in the citizenry and creates knowledge in society which can enhance sustainable development.

## **12. CONCLUSION AND RECOMMENDATIONS**

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 of western Zambia 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. Traditional environmental knowledge was found to play a critical role in this regard. Local knowledge systems in the Barotse plains of 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, 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 - will produce

immediate and strategic solutions to challenges associated with climate change. Climate change is 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 science of climate change to help us work together as a human family world-over.

Since the study also found that some aspects of the Lozi culture were being eroded because of influence of Western culture, traditional environmental knowledge in the Barotse plains can greatly be enhanced through dialogue education. Dialogue education in the traditional education systems 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.

In conclusion, this study, therefore, will add value to the traditional education systems 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 in the Barotse plains of western Zambia.

### **12.1.Recommendations**

On the basis of the study findings and literature review, the following were recommended:

- There is need for Government 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 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 contribute to the global reduction in greenhouse gases emissions and promote sustainable development in Zambia.
- The mass media such as the community radios should be effectively utilized to provide traditional education 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. 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.
- The Government and other stakeholders should consider introducing community television stations just as we have community radio stations. 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 can supplement face-to-face dialogue education, also highly recommended in indigenous knowledge systems, to pass on and enhance indigenous knowledge systems among and within generations to enhance indigenous peoples' culture which is being eroded. Use of dialogue education will 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 will 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.

- 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 rich with the information so that future generations could benefit.
- Future research could be undertaken to investigate further on possible 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.

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