AN EDUCATIONAL PERSPECTIVE ON AN INTEGRATED APPROACH IN MITIGATING CLIMATE CHANGE IN MUFULIRA

BY

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A Dissertation submitted to the University of Zambia in fulfilment of the requirements for the award of Master of Education in Mathematics and Science Education.

The University Of Zambia

Lusaka

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DEDICATION

This dissertation is dedicated to my children; Natasha and Michael, my lovely wife Mwaba, and the Kamukwamba family.

DECLARATION

I, Kamukwamba Lawrence, declare that *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira* dissertation is purely a result of my own work and that it has not been previously submitted for the degree of Master of Education or indeed any other programme at any university or similar institution.

Signed: ---------- **Date:** ----------

APPROVAL

The University of Zambia approves this dissertation of Kamukwamba Lawrence as fulfilling the requirements for the award of the Master's Degree in Mathematics and Science Education.

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Examiner: 3: ……. Signature: ……. Date: …..……

Chairperson Board of Examiners: ……..... Signature: …… Date: …..**.....**

Supervisor: ……..……. Signature: ……. Date: …..……

ACKNOWLEDGEMENT

I am indebted to God the Almighty for giving me the opportunity to study and according me good health during the period of study. I would also like to extend my gratitude to my well able and hardworking supervisor Dr. Kabunga Nachiyunde for his guidance, patience and support during the production of this dissertation. I sincerely thank you for your superb supervisory skills and mentorship. I wish to thank you also for your academic and material support during this period. It has not been easy but your intervention made it possible to move forward. God bless you!

The Mathematics and Science Departmental Head Dr. Simeon Mbewe thank you for your patience and willingness to help young researchers in the field of Mathematics and Science Education. Dr. Christopher Haambokoma, Dr. David Sani Mwanza, Dr. Kaulu Goodwell and Mr. Chibesakunda Austin deserve my special recognition. My colleagues Mr. Thomas Chipili, Ms. Kalumba Kasama and Ms. Esther Gondwe thank you so much for the help and trust in me.

To my brothers and sisters, I wish to thank you most sincerely for your moral support and prayers. To my father Mr. Kamukwamba James and my mother Ms. Kamukwamba Daria, I thank you for being my source of strength. *Natotela mukwai!*

Last but not the least, the learners, teachers, parents, administrators in schools and Civil Society Organisations where this study was conducted.

ACRONYMS

BBC	British Broadcasting Corporation
CDC	Curriculum Development Centre
CFC's	Chlorofluorocarbons
DEBS	District Education Board Secretary
ECZ	Environmental Council of Zambia
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
JETS	Junior Engineers Technicians and Scientists
MDG	Millennium Development Goal
MDGPR	Millennium Development Goals Progress Report
MESVTEE	Ministry of Education, Science, Vocational Training and Early Education
MoGE	Ministry of General Education
MSE	Mathematics and Science Education
MTENR	Ministry of Tourism Environment and Natural Resources.
NAPA	National Adaptation Programme of Action
NGOs	Non-governmental Organisations
NOAA	National Oceanic and Atmospheric Administration
REDD	Reduce Deforestation and Forest Degradation
SIDA	Swedish International Development Agency
SOSTAZ	Social Sciences Teachers Association of Zambia
UNESCO	United Nations Educational, Scientific and Cultural Organisation.
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Fund
UNIPCC	United Nations International Panel on Climate Change
UNIPCC	United Nations International Panel on Climate Change
WWF	World Wide Fund for Nature
ZEMA	Zambia Environmental Management Agency
ZIEM	Zambia Institute of Environmental Management
ZNBC	Zambia National Broadcasting Corporation

ABSTRACT

Climate change is a crucial contributing factor to increased heat waves, flooding, droughts, intense tropical cyclones, rising sea levels and loss of biodiversity. Hazards induced by climate change can have detrimental effects on school facilities, educational systems, and interrupt educational continuity. However, the education sector offers an opportunity to combat climate change through contributing to mitigation efforts by implementing awareness programmes, thereby reducing vulnerabilities and building resilient societies. This study explores an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira. The study was qualitative and utilised questionnaires, semi-structured interviews, document analysis, and an observation schedule with a purposively chosen sample in Butondo, Kankoyo, and Kantanshi townships. The study sample included 24 learners (8 from each school, thus; Butondo, Chankwa and Kantanshi Secondary School), 12 teachers (4 from each of the schools mentioned), 12 parents (who had a child or children at any of the schools mentioned) and 4 officers from Civil Society Organisations. Despite increases in scientific understanding of Climate Change Education, the ministry of education in Zambia has done little to raise awareness on mitigating climate change apart from the recent inclusion of the *Environmental Issues and Innovations* category in the Junior Engineers Technicians and Scientists (JETS). The interdisciplinary nature of climate change mitigation demands, in addition to funding, planning and multi-sectoral approach, adequate incorporation across curricula at all levels to ensure learning across the life-cycle, quality Mathematics and Science Education (MSE) and re-orientation of teacher training in order to raise students' awareness and competencies to mitigate climate change. The findings further revealed that traditional pedagogies and rote-learning methodologies must be replaced with problem-solving, inquiry-based and future-oriented learning approaches anchored in the local community. The study recommended the following: adequate allocation of funds to produce teaching and learning materials and teacher training, self-reliance, networking among implementers; policy on integration, positive attitude among learners, provision of literature; and innovative teaching methods.

Key words: *integrated approach, climate change, climate change mitigation*

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BACKGROUND OF THE STUDY

1.1 Overview

This chapter presents the problem under investigation, statement of the problem, purpose of the study, objectives of the study, research questions, and significance of the study. The chapter further highlights the delimitations and limitations of the study, operational definition of terms, and ethical considerations.

1.2 Contextual background

Globally, the innovation of industrial and technological advancements has posed an increase in industrial waste on the environment. The United Nations International Panel on Climate Change (UNIPCC) observes that climate change is progressing and will affect human life and natural systems extensively (Muchanga, 2013). According to the National Academy of Sciences (2012), the overwhelming majority of climate scientists agree that human activities, especially the burning of fossil fuels (coal, oil and gas), are responsible for most of the climate change currently being observed. Namafe (2004) writes that climate change is a crucial causative factor in increased heat waves, flooding, droughts, intense tropical cyclones, rising sea levels, and loss of biodiversity. The human population and particularly children living in poverty in underdeveloped countries with weak governance and poor education systems are the hardest hit by climate change (Chipatu & Namafe, 2016). The effect of the physical consequences include more frequent extreme weather, melting glaciers, and shorter growing seasons, thus, adding to the existing pressures for those societies (UNESCO, 2012). Therefore, the choice of Mufulira was just appropriate because of the following factors; agricultural activities along the Butondo stream as well as the metal-ore smelter and unplanned damp sites which emit methane gas into Kankoyo Township.

Anderson (2010) writes that education offers an opportunity to combat climate change through contributing to mitigation efforts and enhancing the adaptive capacity of education systems and, thereby reducing vulnerabilities and building resilient societies. Over the long term, impacts of climate change combined with factors such as population pressure are likely to lead to

environmental degradation, deterioration in livelihoods, worsen existing socio-economic tensions, and create new ones. This will affect migration, stability, and security at local, national, regional, and global levels.

The United Nations Educational Scientific and Cultural Organisation [UNESCO] (2014) infers that disasters caused by hazard-induced climate change can damage or destroy school facilities and educational systems, threatening the physical safety and psychological well-being of communities and interrupting educational continuity. The economic impacts of disasters reduce school enrolment, as children are kept out of school to help with livelihoods (UNESCO, 2012). The Millennium Development Goals Progress Report [MDGPR] (2008) states that Zambia needs to take bold measures if it is to meet the Millennium Development Goal (MDG) 7: Ensuring Environmental Sustainability. The country is richly endowed with a number of valuable natural resources including minerals, forests, wildlife, and fertile land which have played a significant role for social, economic and political developments but has done little to translate natural resource for poverty reduction (UNESCO, 2012). Instead, natural resource extraction has resulted in rampant degradation of the county's environment.

Reduce Deforestation and Forest Degradation [REDD] (2016) identifies the following as Zambia's environmental challenges; deforestation, wildlife depletion, loss of biodiversity and economic services, land degradation, air pollution, inadequate management of water resources and sanitation as well as natural disaster risk and climate change. In the scientific community there is overwhelming consensus that the main cause of climate change is human activity, in particular the emission of greenhouse gases, (UNESCO, 2012). The Swedish International Development Agency [SIDA] (2010) states that only a small fraction of this climate change can be explained by natural factors such as eruptions of volcanoes, changes in solar activity or deviations in the Earth's orbit around the sun.

1.3 Statement of the problem

Although schools in Mufulira stand in a better position to help fight climate change as they will graduate learners who are literate on environmental issues, they have done little to raise awareness on mitigating climate change among the learners apart from the recent inclusion of the environmental issues and innovations category in the Junior Engineers Technicians and

Scientists (JETS). In other words, schools in Mufulira lack a comprehensive programme that uses innovative educational approaches to help a broad audience (with particular focus on youths) so that they understand, address, mitigate, and adapt to the impacts of climate change, encourage changes in attitudes and behaviours needed to take a more sustainable development path, and build a new generation of climate change-aware citizens. Consequently, Climate Change Education has not been adequately incorporated in the overall context of the education provided to the learners in Mufulira. Furthermore, no deliberate policy has been put in place to include aspects of climate change that suit Mufulira Township which, to a greater extent, depends on the extraction industry. This unfortunate background continues to play down the importance of putting in place stringent measures and educational policies aimed at curbing climate change. Policies on climate change, its impacts and mitigation are seen more often as setbacks rather than solutions to promoting a healthy and safe environment. Therefore, this study sought to explore an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.

1.4 Purpose of the study

The main purpose of the study was to explore an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.

1.5 Study objectives

1.5.1 General objective:

To explore an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.

1.5.2 Specific objectives:

The specific objectives of the study were;

1. To explore educational activities in mitigating climate change in Mufulira.
2. To establish how the relevant stakeholders are collaborated in the implementation of climate change mitigation in Mufulira.
3. To determine the challenges and opportunities faced by the ministry of education in implementing climate change mitigation activities in Mufulira.

1.6 Research questions

1. What educational activities are carried out in mitigating climate change in Mufulira?
2. How are relevant stakeholders collaborated in the implementation of climate change mitigation in Mufulira?
3. What are the main challenges and opportunities faced by the ministry of education in implementing climate change mitigation activities in Mufulira?

1.7 Significance of the study

To date, the majority of research on education and climate change has focused on the impact of climate and its related environmental changes on schooling (UNESCO, 2010). However, other than exploring climate change activities in schools and stakeholder collaboration, the study focused on the main challenges and opportunities faced by the ministry of education in implementing climate change mitigation activities in secondary schools. No study, to the knowledge of the researcher, has been done taking into account the aspects stated above particularly on Mufulira. The Ministry of Tourism, Environment and Natural Resources [MTENR] and others have undertaken extensive research on, and produced considerable documentation in respect of, climate change, but they all focus on scientific approaches as intervention strategies. There is little evidence of a focus on an Educational Perspective on an Integrated Approach in Mitigating Climate Change. Therefore, exploring an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira is crucial to the learners, teachers, parents and Civil Society Organisations.

The study will place the learners in a better position to help fight climate change as they will graduate with knowledge on environmental issues. Among parents, the study will foster changes in attitudes and behaviours needed to take a more sustainable development path. It will also advocate for teachers to undergo in-service training and attend workshops in order to acquire problem-solving, inquiry-based and future-oriented learning approaches anchored in the local community in order to keep abreast of the latest information on climate change. Besides, the study will encourage policy makers and curriculum developers to put in place educational policies aimed at curbing climate change as well as include climate change content into the curriculum at all levels.

Furthermore, the study will encourage Civil Society Organisations to invest in sensitisation programmes and programmes that are in line with the environmental challenges prevailing in different communities. It is a well recognised fact that education is a right for every child and a significant tool for mitigating climate change. As such, it is hoped that the findings would contribute to the existing body of knowledge on educational policies in Zambia. Furthermore, the study would also be valuable to educational practitioners, curriculum developers, policy makers in education, and other stakeholders interested in the understanding of the need to promote an integrated approach and improve efforts aimed at mitigating climate change as well as in drawing recommendations for future improvements on educational activities in mitigating climate change in secondary schools. Lastly, the findings would form the basis for further research.

1.8 Delimitations

Delimitations are used to address how the study would be narrowed in scope (Creswell, 1994). This study limited itself to exploring an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira only. Mufulira district was selected because of the acid and smelting plants in Butondo and Kankoyo townships, respectively. Butondo Township was the home to the acid plant and use of artificial fertilisers and pesticides in agricultural activities along the Butondo stream. Kankoyo Township, South-West of Mufulira town, is ravaged with pollution in the form of particulate matter such as dust and sulphur dioxide from the mines. In addition, the township has numerous damp sites with rotting garbage which constantly emit methane gas into the atmosphere.

1.9 Limitations of the study

Creswell (1998) describe limitations to mean those conditions which are beyond the control of the researcher and may also place restrictions on the conclusions of the study. In view of this, limitations related to this study were two-fold. Firstly, considering that this study was mainly qualitative, the results (findings) cannot be generalised to other secondary schools in other districts elsewhere as they are true only to Mufulira. Secondly, some respondents were not ready to answer the questions without any incentive as they assumed that all researches were sponsored.

1.10 Theoretical framework

The study was guided by two theories, namely; Environmental Determinism and Environmental Possibilism. The Theory of Environmental Determinism was coined by Aristotle and dates back to the 15th century whereas the Theory of Environmental Possibilism was ideated by Strabo in 64BC. Doyle (2011) says determinism is a theory based on the occurrences in nature, or education or psychological phenomena causally determined by preceding events or natural laws. On the other hand, possibilism is the view that the natural environment provides the opportunity for a range of possible educational responses and that people have considerable discretion to choose among them (Dictionary of Human Geography, 1994). In other words, 'determinists' argue that education is not free of the influence of environment - people and their environment are inseparable. The counter writers to the determinists view termed 'possibilists' commonly argue that the natural environment influences education, and that, education also influences the natural environment. Figure 1.1 summarises the Environmental Determinism and Possibilism Theories.

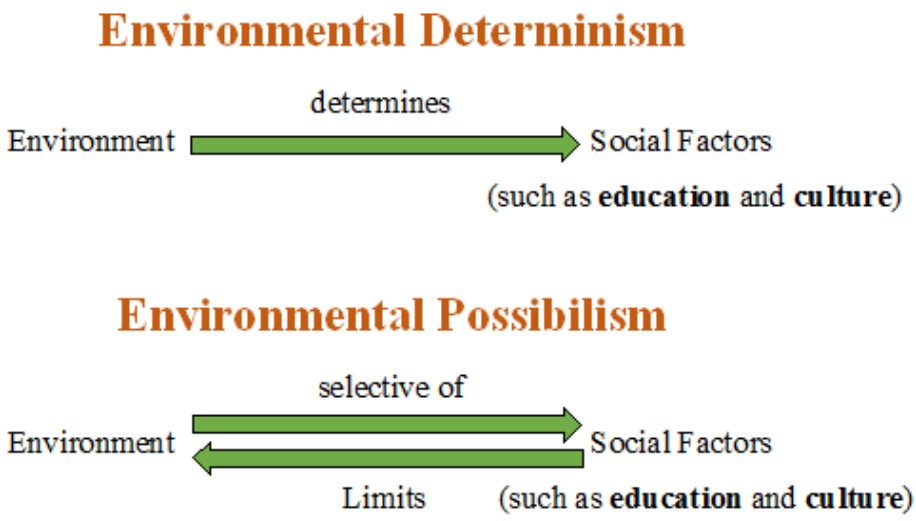

Figure 1. 1: Environmental Determinism and Possibilism Theories

Furthermore, Environmental Determinism and Possibilism are theories put forth not only to comprehend and understand climate change mitigation and adaptation but also the role played by the natural environmental conditions in the emergence and progress of education in a particular location.

1.11 Operational definitions

Integrated approach – Refers to the participation of different groups of people such as the learners, parents, teachers and Civil Society Organisations in curbing climate change.

Climate change – Refers to the average increase in surface temperature by 0.01˚C over a period of 20 years.

Climate change mitigation – Refers to the process of taking measures to fight climate change. These include zero-waste, solar power and wind power as opposed to fossil fuels, using vegetable matter unlike chemical fertiliser and recycling garbage instead of burning it.

1.12 Ethical considerations

The research was conducted on the principle of informed consent from the participants. All the participants were made to understand their role in the research and that the research was meant for academic purposes, hence, their responses would not be used for anything else rather than for the stated purpose. The researcher obtained clearance from the University of Zambia Ethics Committee seeking permission to interview the participants.

1.13 Summary

The overwhelming majority of climate scientists agree that anthropogenic means, such as the burning of fossil fuels (coal, oil and gas), are a major contributing factor to the effects of climate change. The physical consequences of climate change include; increased heat waves, flooding, droughts, shorter growing seasons, intense tropical cyclones, rising sea levels, and loss of biodiversity. The human population and particularly children living in poverty in underdeveloped countries with weak governance and poor education systems are the hardest hit by climate change. Other effects of disasters due to climate change include damaging or destroying of school facilities and educational systems, threatening the physical safety and psychological well-being of communities and interrupting educational continuity. From the economic sphere, impacts of disasters reduce school enrolment as children are kept out of school to help with livelihoods.

It is hoped that the findings of this study will be useful to the learners, educationists, curriculum developers, policy makers in education, Civil Society Organisations, and other stakeholders interested in the understanding of the need to promote an integrated approach and improve

efforts aimed at mitigating climate change in secondary schools. Secondary education has been singled out because it is at that level that learners are able to interface with more technology. The chapter which follows will review literature in relation to the topic under study.

1.14 Organisation of the dissertation

This dissertation comprises six chapters. The first chapter provides the background of the study. The second chapter reviews the relevant literature while the third chapter highlights the methodology used in the study. The findings and discussion of the findings are presented in the fourth and fifth chapters, respectively. Chapter six gives the summary, conclusion and recommendations to an educational perspective on an integrated approach in mitigating climate change in Mufulira.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter reviews various literature for this study which have been organised in three broad categories, namely; an Integrated Approach in Mitigation Climate Change globally, in Africa and further narrowing down to Zambia and Mufulira in particular. Under these headings, the three objectives of this study have been put into consideration.

The Inter-Governmental Panel on Climate Change [IPCC] (2007) defines *climate change* as the variation in average weather conditions over a period of time. It also adds that climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth also called albedo, plate tectonics, and volcanic eruptions. However, natural processes can be explained as the cause of climate change only to a lesser extent (UNESCO, 2010). Human activities such as mining and other industrial activities, especially those that involve emission of carbon dioxide, sulphur dioxide, oxides of nitrogen, and chlorofluorocarbons (CFCs), have also been identified as significant causes of recent climate change, often referred to as global warming (Chipatu, 2011).

Muchanga (2013) writes that rampant deforestation in Zambia plays down efforts to achieve the MDG 7 on Environmental Sustainability. This is because deforestation is closely linked to other environmental problems such as land degradation, wildlife depletion and loss of biodiversity and ecosystem services. Climate change is a global issue and is affecting the provision of education (UNESCO, 2010). For example, droughts affect crop production making it difficult for the majority of subsistence farmers whose livelihood depends on farm produce to take their children to school (Chipatu & Namafe, 2016). Thus, extreme weather events such as floods and tropical cyclones have continued to damage school infrastructure and thereby disturbing the learning process (Hansen, Ruedy, Sato, & Lo, 2010; Sheffield, Uijttewaal, Stewart, & Galvez, 2017; UNESCO, 2012). Therefore, in the context of ecological crisis and environmental deterioration, teaching about Environmental Issues has increasingly become important across the globe (Ko & Lee, 2003).

There is overwhelming evidence on the variations in the Earth's surface temperature. Scientists have been taking widespread measurements of Earth's surface temperature since around 1880. The National Academy of Sciences (2012) states that the data collected has improved steadily and temperatures are recorded by thermometers at various thousands of locations both on the land and over the oceans. UNESCO (2014) adds that different research groups have used these raw measurements to produce records of long-term global surface temperature change. Figure 2.1 shows global surface temperature record compiled by NASA.

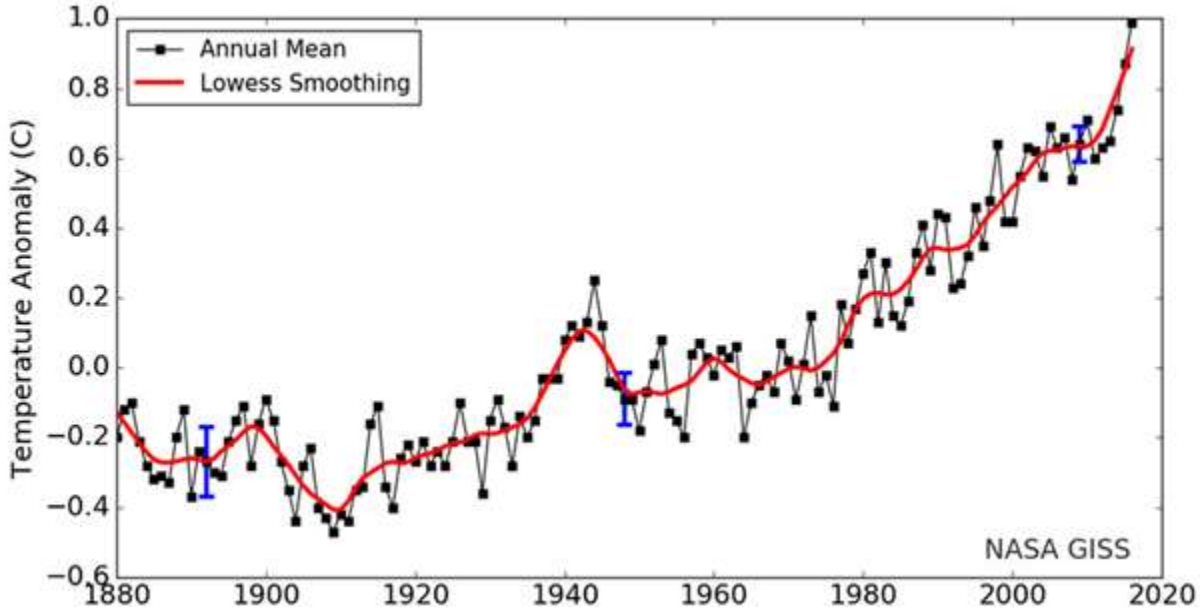

Figure 2. 1: Global Mean Estimates Based on Land and Ocean Data

Land-ocean temperature index, 1880 to present, with base period 1951-1980. The solid black line is the global annual mean and the solid red line is the five-year lowess smooth. The blue uncertainty bars (95% confidence limit) account only for incomplete spatial sampling. Adapted from *"NASA, NOAA Data Show 2016 Warmest Year on Record Globally."* (2017). Retrieved from https://www.ecomagazine.com.

Continents around the world are responding overwhelmingly to the noble global calls for countries to engage the ministry of education in climate change mitigation and adaptation (Anderson, 2010; UNESCO, 2010).Countries have embarked on an agenda to support various educational activities that foster awareness and the development of knowledge among learners so

that they can participate fully in the design and implementation of measures to contain the impact of climate change. World-wide literature suggests that many countries consider the education sector to be a good vehicle of development as it is easily accessible by many people. Loretta (2001) reported that in South America and Asia, studies dealing with the provision of education needed for Sustainable Human Development suggested that there was a need to look at the actual trends in the education provided in terms of quality, skills imparted, costs and the purported gains needed for development. The literature reviewed explores the education sector response to fostering awareness, participation and climate change mitigation in Asia, Europe, North America, South America, Africa and narrows down to Zambia, and Mufulira in particular.

2.2 Climate Change Education in Asia

King, Cole, Tyldesley, and Hogarth (2012) indicated that Asia supports the concept of equal entitlement to the global atmospheric resource. Therefore, the continent has adopted an education system that embraces traditional skills, knowledge and practices, to provide appropriate services and facilitate information sharing on climate change. Despite having earned the title of world's worst polluter because of its huge industrial push of the last few decades, (King et al., 2012), Asia has incorporated the concept of "Learning by doing" into its education system as an effective method of capacity building (Chatterjee, 2002). Narain, Ghosh, Saxena, Parikh, and Soni (2009) added that a few demonstration projects are used in the process. Yun (n.d.) writes that Asia has set goals to use its education system as a resource to combat climate change through drawing regulations, policies, mid and long-term plans and setting up network system in compliance with international trends and foster expertise.

Educational and awareness-raising activities such as quizzes and projects are conducted with a view to bringing together stakeholders with different backgrounds (Chang & Pascua, 2017). Asia offers training programs directed at decision makers and trainers. The continent also promotes professional training to technician and management officers in the area of climate change (UNESCO, 2012). Chang and Pascua (2017) purports that the Asian countries have integrated the topic into mainstream education system, that is, primary and secondary schools, as well as university levels in order to ensure learning through the life cycle. Thus, the media and publishing houses have been given a task to produce educational materials. Asia has the highest installed wind-energy capacity and is among the leading producers of solar panels. King et al.

(2012) deduce that Asia will continue to carry out in an earnest way the education, training and public awareness on climate change as required by Article 6 of the UNFCCC which contain that:

> …parties shall promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organisations, (Valenzuela, 2015, p.4).

2.3 Climate Change Education in Europe

In a study by Zebisch, Grothmann, Schröter, Hasse, Fritsch, and Cramer (2005) long-term weather recordings show that Europe is already affected by climate change. However, the continent has taken a bold stance through the ministry of education in line with the pledge known as the "Energiewende," or energy turnaround (Bosman, 2002). Countries in Europe, such as Germany, have taken the necessary steps to integrate the concept of climate change across all subject areas and into every class. For example, at Emmy-Noether-Schule, a secondary school in East Berlin, educators consider climate change so pressing that they integrate it into every class. Therefore, about a quarter of the content in the 10th-grade English textbook, for example, is about threats to planet Earth.

That means when students learn to use the conditional mood in English, their grammar exercises rely on sentences like this: '*If we don't do something about climate change, more polar ice will start to melt*.' Similarly, in an 11th-grade geography class dedicated entirely to sustainability, students write poetry about climate change. Students also sang songs, played band music and presented speeches about climate change (Worrall, 2015). North America has been at the forefront of education for sustainability and adopted two complementary strategies for the inclusion of Climate Change Education and Education for Sustainable Development, namely, the *'infusion strategy'* and the *'whole institution approach'* (UNESCO, 2015). However, Zambia uses the infusion strategy in which teachers enrich their activities by adding content on climate change and sustainability (Curriculum Development Centre [CDC], 2000).

Most educational institutions begin with the infusion strategy in which teachers incorporate the subject into their classes or the work they do. The strategy does not require them to come up with

anything new (UNESCO, 2015) other than enriching their activities by adding content on climate change and sustainability. Teachers put in context the educational goals sought when delivering climate content even in non-science classes and are able to mention it in any subject being taught while keeping in mind learner's viewpoint. Educators also find ways of activating learner's critical and systematic thinking in relation to the subject matter and giving them the desire to take action. "The content must therefore be placed in a context that is meaningful for the students" (UNESCO, 2015, p. 44).

During an experts meeting on Climate Change Education for Sustainable Development (CCESD) in Latin America and the Caribbean, UNESCO (2015) found that:

> The speaker described her experience in a teacher training institute in Jamaica, with a literature class into which she introduced the subject of climate change. She began teaching on the subject of climate change, and sought out literature and the possibilities it offered. She observed that it was possible to create empathy, generate values through reading and conduct literary exercises on the subject. The students also examined their relationship with climate change. (p. 44)

There is need to promote teacher training and a supportive environment which works with teachers to implement change. Professional development workshops, peer-to-peer learning, and online teacher forums are means of providing teachers with the necessary support. The '*whole institution approach'* is an ideal strategy because it involves not only the curricular content but the entire educational experience. However, Palmer (1998) explained that the strategy involves the integration of those of the curriculum, facilities and cultural activities, be it educators, learners, parents, or members of the community in general. The process requires dedicated leadership, administrative support from the institution and a clear monitoring and assessment system.

2.4 Climate Change Education in North America

South America has been a real leader in making a shift towards renewable energy, and also supporting other continents to make the same transition (King et al. 2012). In 2014, countries in

South America conducted a pilot course to train teachers in Climate Change and Sustainable Development and how to implement the subject in their classes. In September 2014, UNESCO conducted a pilot training project for secondary school teachers on CCESD in Brazil. Alcalay (2015) stated that the course targeted 100 teachers from different disciplines, Secretariat of Education professionals, Directors and Pedagogical schools Coordinators that underwent 36 hours of training and 4 hours of field trip. After the course, teachers were given material to be implemented with their learners. Since then, teachers have continued to conduct field classes, (Alcalay, 2015; Stapp, 1969), considering the value they add to student learning: developing the senses and sharpening curiosity and learning.

2.5 Climate Change Education in Africa

Three countries in North Africa, namely Algeria, Morocco and Tunisia have taken concerted and strongly synergistic action in the area of climate change (Special Report, 2009). These countries, which emit low levels of greenhouse gases, are particularly vulnerable to climate change. The results of the technical studies and research conducted in North Africa show how three key sectors in the region; water, agriculture and coastline might fare over the coming decades, and the consequences to the population if true adaptive policies are not devised and implemented in those countries in the near future. Furthermore, emphasis is put on the need for studies and research to better assess this vulnerability and to determine the most appropriate adaptive actions.

According to Anderson (2010), education is crucial in providing practical work to mitigate climate change though the national climate policy documents, mainly, target industry and the general public. Thus the challenge is given over to the ministry of education to develop and integrate mitigation into education policies. It also calls for the inclusion of the education response to climate change into climate policies and action plans, action areas and reorientation of education policies; develop and use tools, conduct research studies, devise planning models and undertake scenario-setting. Kotecha (2010) states that the tools should include resource guides, training workshops, a competition in projects and quizzes among schools and a national media campaign.

In Algeria, the wider global community benefits from indigenous perspectives and approaches to mitigation through a conscious effort to understanding the nature of climate change in different communities and cultures. Since climate change is a fairly new concept for many, Palmer (1998) suggests that experts should explain and educate communities in the local context such as listening to the stories of how local and indigenous communities contributed to mitigation efforts in the past. This is helping communities in Algeria to fully understand and participate in climate change mitigation (Narksompong & Limjirakan, 2015). Furthermore, learners and communities, as well as teachers and educators invest their time in the planning and design of educational programmes and mitigation activities. Lee and Williams (2001) state that Algeria has integrated the concept of climate change into different forms of arts, such as, photography, music, dance, painting, poetry, video production or other forms of expression in which learners are involved. This necessitates knowledge and information sharing about climate change in simple terms that can be understood by everyone at all levels of education provision. UNESCO (2012) commends that creating a link between Climate Change Education to the arts and culture has a great potential to fostering adaptation and mitigation.

In Morocco, the most vulnerable members of communities have been identified and empowered particularly those who are facing the greatest difficulty accessing information and education (Narksompong & Limjirakan, 2015). These include children and adults, especially girls, women and those with disabilities, those from poor families and communities living in particularly vulnerable locations. The engagement of vulnerable and marginalised groups has been achieved through fostering partnership arrangements between NGOs and the ministry of education, where NGOs address Environmental Education and Climate Change Education needs in remote and marginalised communities and in informal contexts. UNESCO (2012) writes that climate change communication needs to be diversified in order to foster mitigation. The use of information and communication technologies, especially social media and mobile phones, is a powerful resource in facilitating Climate Change Education as it allows active exchange and networking among learners and educators at the local, regional and global levels (Jenkins, 1997). However, the use of such resources should be complemented by a concerted effort to utilise other means to reach populations without internet access, who are often among the most vulnerable to climate change.

In Tunisia, teachers are considered to be agents of change in communities where they operate. They are the best channels of information dissemination and must be equipped with the knowledge and confidence to lead in mitigating climate change (Chacko, 1998). Teachers undergo in-service training and attend workshops in order to keep abreast with the latest information on climate change in their areas of expertise (UNESCO, 2015). Furthermore, Tunisia upholds the concept that 'learning responsibility can only be done through experience' by exposing the learners to hands-on activities through projects on climate change (Sheffield, Uijttewaal, Stewart & Galvez, 2017). Apart from the teachers, various stakeholders such as NGOs are involved not only in providing knowledge, expertise and guidance to the learners but also in the design and implementation of Climate Change Education programmes. Athman and Monroe (2001) write that one of the strategies that the country has employed is the development of pedagogies that support quality education with special emphasis on the development of knowledge, skills, values and competencies required to mitigate climate change among teachers and learners through quality education.

Zambia is one of the countries in Southern Africa facing the effects of climate change. Climate change threatens to present the exact opposite and even reverse the progress made toward meeting the Millennium Development Goals (MDGs) and poses one of the most serious challenges to reducing poverty (MTENR, 2010). Nevertheless, the education sector offers a currently untapped opportunity to fighting climate change [UNESCO, 2010]. There is a clear education agenda in climate change adaptation and mitigation strategies, which require learning new knowledge and skills and changing behaviours in order to reduce the vulnerabilities and manage the risks of climate change. Therefore, investing in quality education to combat climate change is an essential tool in achieving the MDGs (Ministry of General Education [MoGE], 2016).

However, UNESCO (2014) argues that the ministry of education has not adequately dealt with building teacher's and educator's capacities to deliver accurate information, integrate local content, promote critical thinking and take action on climate change mitigation. In addition, little has been done to promote the reform of teacher education institutions while ensuring the immediate delivery of community-oriented in-service training and mentorship for teachers to

gain confidence in teaching the Climate Change Education content. Chipatu and Namafe (2016) argue that traditional, rote-learning methodologies should be replaced with problem-solving, inquiry-based and future-oriented learning approaches anchored in the local community as well as integrating aspects of climate change into Technical, Vocational and Educational Training.

The United Nations International Children's Educational Fund [UNICEF] (2010) indicated that Zambia has adopted a system-wide approach through engaging with sectors other than education, including the private sector to develop a cross-sectoral approach to Climate Change Education. This has resulted in awareness of the benefits of Climate Change Education. However, MESVTEE (2013) contends that the crusade against climate change has been hampered due to lack of funds. The concept of climate change mitigation is interdisciplinary in nature and has been integrated across curricula at all levels to ensure learning across the life-cycle, thus; formal, non-formal and informal education. Chipatu (2011) suggests that the holistic approach must recognise the complexities of climate change, address and take into account disciplines and areas of expertise, including climate science, policy, citizenship education, geography, human rights education, language courses, law, ethics, sociology, economics and culture, and aim for the more effective and inclusive sharing of such knowledge. Phiri (2008) contends that a holistic approach must be guided by considerations of equity and the impact of climate change on society. However, integration should be done without compromising the already overstretched curriculum (MoGE, 2016).

Chipatu (2011) writes that Zambia has not fully enhanced innovative teaching approaches that integrate quality Climate Change Education into school activities through interdisciplinary practices such as science education, whole school approaches and Technical, Vocational and Educational Training. Nevertheless, Brown (1987) contends that education makes an important contribution to learner's awareness and competencies to mitigate climate change. It contributes to the relevance and quality of teaching learners about environmental issues. According to the MESVTEE (2015), strong performance in science and awareness of global environmental problems tend to go hand-in-hand, and both are associated with a sense of responsibility to ensure Environmental Sustainability. On the contrary, weak performance in science is associated with lower awareness of environmental problems (MESVTEE, 2015; WWF, 2009). This implies

that failure in scientific education means less widespread and less informed public debate on issues such as climate change and other global, sustainability challenges.

Ko and Lee (2003) write that it is important that Climate Change Education is integrated into the education curricula, programmes and material. This will result in strengthening knowledge and understanding of climate change and sustainability on the basis of scientific methods, disciplines and evidence (Environmental Council of Zambia, (2001). The Whole-School Approaches must be adopted in the provision of Climate Change Education. These approaches advocate for active and participatory learning and call for the entire institution, thus; learners, educators, administrators and communities, to be actively engaged in working towards climate change mitigation (MESVTEE, 2015). It's time we explored and evaluated an integrated approach to elicit community and stakeholder understanding of climate change and connect diverse community members and local office bearers towards potential action (Ross et al., 2015). Within this complex set of interlocking impacts, Climate Change Education should be integrated across school curricula at all levels to ensure effective learning and deep understanding of the subject matter.

In order to mitigate and adapt to the complex nature of climate change through education, the focus should be on how to respond to societal challenges and needs (Chipatu & Namafe, 2016). Zambia is one of the many countries threatened by the potential and actual effects of climate change. Currently, the mean temperature in Zambia has steadily increased over the last 40 years. Between 1960 and 1990, the mean temperature was 21.57 ˚C, however, projections show that it will be an average of 25.86 ˚C between 2070 and 2099. Similarly, the annual average rainfall was 2.75mm/day between 1960 and 1990, but, between 2070 and 2099, it is projected to drop to 2.61mm/day owing to climatic changes (MTENR, 2010).

2.6 Climate Change Education in Mufulira

Mufulira is one of the towns on the Copperbelt province of Zambia. It has public and private schools which have been faced with increasing levels of environmental problems as a result of human population and economic growth (Environmental Council of Zambia [ECZ], 2001). The environmental problems which are matters of concern in schools include unsound waste management, loss of vegetation cover, soil erosion, declining water tables and other forms of

natural resource depletion and degradation to global concerns such as biodiversity loss, climate change and the ozone layer depletion (Makisa, 2016). Nonetheless, education is an important tool in building community resilience to, and coping strategies for, climate change (Chipatu & Namafe, 2016; Muchanga, 2013). An Integrated Approach in Mitigating Climate Change in Mufulira could help reduce and curb the escalating levels of environmental degradation.

2.6.1 The urgency and need for change

MTENR (2010) explains that climate change is a global issue and its effects are varying and widespread, and are already being felt. UNESCO (2015) states that the urgency of addressing climate change has been a fundamental theme at various global meetings and conferences. Human activities are contributing to escalating levels of climate change and its environmentally-destructive impacts (UNESCO, 2010). This calls for a fundamental shift in thinking and action to address what are ultimately self-destructive human-environmental interactions. There is need to introduce or adapt learning at all societal levels to engage with the new realities of climate change and arrive at new ways of thinking and acting that ensure sustainability of the planet and future generations, (Chipatu & Namafe, 2016). Although there were conflicting views as to the success of the Paris agreement, it was viewed as an important starting point for further action.

UNESCO (2010) highlights differentiated impacts across different social groups, and geographic and temporal scales, and various effects of climate change (including sea level rise and extreme weather events). Literature stresses the necessity to fundamentally transform the economic system, while their suggestions include a shift towards traditional knowledge, tools and attitudes, and the pursuit of low-carbon, green growth (ECZ, 2001; Ministry of Education, 1996). This requires cooperative and collaborative action across the entire global community to address climate change and the causal human-environmental interactions (Ross, et. al., 2015).

2.6.2 Education as a tool for change

Education is a critical tool for change, both for understanding and empowerment hence the need for integration of climate change education throughout the lifecycle, thus, in early childhood, primary, secondary and tertiary education, and beyond, through formal, informal and non-formal education. Education is seen as essential tool for not only youth, but equally as important in the wider community, industry and government. Phiri, (2008) argues that education provides an

understanding of climate change and its root causes, tackles climate apathy and distortions, and promotes advocacy and action for climate mitigation and adaptation. Education is also significant in helping to bridge differences in responsibility and in severity of impacts towards a common goal, acting as a seed for change. In other words, education propels an individual to action, and as an integrated effort, promotes widespread change by fostering a climate conscious and active society and stimulates governments into action. Education plays an important role in preparing people to deal the complexities of climate change, build resilience, and enhance innovation and collaboration in mitigation and adaptation (Namafe, 2004).

2.6.3 Education and economic change

There is a strong interrelationship between climate change, economic activity and education. According to the National academy of Sciences (2012), the influence of economic activity on climate change has been growing since the start of the industrial revolution. This has resulted in the rise to the climatic changes currently being felt which is growing in magnitude (UNESCO, 2012). Low-carbon green growth is essential for climate change mitigation, and to building human resilience and capacity to adapt to the changing environment (ECZ, 2001). Education is a necessary enabler of, and vehicle for green growth; in shaping a workforce with the skills, knowledge and desire needed to transition to a green economy and for sustainable livelihoods.

2.6.4 Need for transformation of the education system

Transformation within the education system itself is a prerequisite for it to be able to effectively engage as a tool to address climate change. Kelly (1998) argues that traditional education is restricted to rigid subjects and methods of teaching, and therefore, not able to effectively address the complexities faced in relation to climate change and other environmental issues. On the other hand, the theories of Environmental Determinism and Environmental Possibilism maintain that both traditional and formal education can bring forth desired results if properly intertwined (Doyle, 2011). Therefore, the role of non-formal and informal education is vital in order for education to reach all citizens and communities. Phiri (2008) recommends that knowledge of climate change can be shared through radio and television programmes, peer-to-peer engagement, participatory exhibitions, and community-based training. Non-formal and informal education can both provide a knowledge-base in relation to climate change, as well as build resilience and empower those reached. Ministry of Education (1996) explains that such

initiatives present a critical means to reach those not engaged in the formal education system, including those in marginalised communities, the wider community, industry and policy- and decision-makers.

Chipatu (2011) argues that such a transformation should create an education system able to better address not just climate change, but other environmental issues. There has been a lot of talk on the said transformations yet little has been realised (UNESCO, 2010). Nevertheless, such a transformation should not alienate education professionals by discounting their work and successes. Hence, there is need for a supportive rather than threatening environment for realisation of such change. Transformation of education does not need to occur abruptly, but through a number of small changes (Phiri, 2008). Regardless of the direction taken, climate change urgently necessitates attention within education.

2.6.5 Integration into school infrastructure

Makisa (2016) highlights the potential within the formal education environment to integrate environmental sustainability into school infrastructure. This include zero-waste, solar power and wind power as examples of ways schools are physically integrating environmental sustainability (Phiri, 2008; Athman & Monroe, 2001). These not only reduce the particular school's ecological footprint, but stimulate learning through teaching by example. The ministry of education has continued to instil the "*Keep Zambia Clean and Green campaign"* among the learners.

2.7 Summary

Climate change threatens efforts aimed at providing universal education. Literature suggests that the education sector offers an untapped opportunity to combat the vice through a clear education agenda in climate change adaptation and mitigation strategies, which require acquiring new knowledge and skills and changing behaviors in order to reduce the vulnerabilities and manage the risks of climate change. Therefore, a thorough investigation into the quality of education to combat climate change is an essential tool in achieving the Millennium Development Goal 7: Ensuring Environmental Sustainability.

Literature suggests that the ministry of education should incorporate the concept of "Learning by doing" into its education system in order to build capacity of the learners. Thus, educational and

awareness-raising activities such as JETS projects and quizzes as well as professional training to technician and management officers in the area of climate change should be promoted. The concept of climate change should be integrated into mainstream education system, that is, primary and secondary schools, as well as university levels in order to ensure learning through the life cycle. The next step is to integrate it into every class.

In addition, traditional pedagogies and rote-learning methodologies should be replaced with innovative teaching and learning approaches that integrate quality Climate Change Education into school activities. Teachers should be able to explain and educate learners in the local context such as listening to the stories of how local and indigenous communities contributed to mitigation efforts in the past. Literature shows that Africa in general and Zambia in particular, show the need to review current policies and actions on climate change and the opportunities to engaging the ministry of education as a tool in discussions on adaptation and mitigation strategies. The next chapter discusses the procedures for data collection and the process of data analysis used in the study.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This section presents an overview of the methods used in the study. It contains the research design, study area site, study population, study sample, sampling techniques, instruments for data collection, procedure for data collection and data analysis.

3.2 Research design

The research design was primarily qualitative in that it aimed at an in-depth understanding of the problem at hand from the point of view of the respondents. Charmaz (2006) describes a research design as a plan for the collection, measurement and the analysis of data to ensure that the information collected enables the researcher to effectively address the problem alluded to as educative as possible. The study used the descriptive design because the collected data was highly descriptive in nature. Excel was employed to yield empirical data in order to substantiate the qualitative data.

3.3Study area/site

The study concentrated on three townships, namely; Butondo, Kankoyo, and Kantanshi in Mufulira District on the Copperbelt Province of Zambia.

3.4 Study population

Tuckman (1991) defines population as all members of any well-defined class of people, events or objects. Creswell (1998) state that a target population refers to all the members of a hypothetical set of people, events or objects to which we wish to generate the results of our research. The targeted population for the study included 24 learners, 12 teachers, 12 parents and 4 officers from Civil Society Organisations.

3.5 Sample size

The study sample consisted of 24 learners (8 learners from Butondo, Chankwa and Kantanshi secondary school), 12 teachers (4 from each school mentioned), 12 parents (who had a child or children at any of the schools mentioned) and 4 officers from Civil Society Organisations.

Table 3.1 shows participants involved in the study.

Table 3. 1: Participants involved in the study

Stakeholders	Number
Learners	24
Teachers	12
Parents	12
Civil Society Organisations	4
Total	**52**

For the learners, an equal number of male and female participated, that is 12 male and 12 females. Among the teachers, 4 were male and 8 female while the parents were 7 male and 5 female, respectively. In the case of Civil Society Organisations, 1 was male while 3 were female. The researcher selected a total of 52 elements. The choice of this number agrees with Creswell (1998) and Strauss and Corbin (1998) who argued that for the studies following the grounded theory approach, sample sizes ranging between 11 and 30 respondents are adequate. The choice of the three townships was purposive based on the following criteria: Butondo is the home to a huge acid plant. Kankoyo was congested with unplanned damp sites, dilapidated sewer system and is near the smelter which constantly release sulphur dioxide into the atmosphere. Kantanshi was the other township situated at the centre of the district. Learners in secondary school, teachers, parents and officers from Civil Society Organisations were purposively selected to represent the other members of the population under study.

3.6 Sampling techniques

The study used purposive sampling. Thus, the population was divided into secondary school learners, teachers, parents and officers from Civil Society Organisations to ensure a fair representation of the stakeholders (White, 2005) because their principle operations are significantly different. The head teachers helped the researcher in selecting teachers who could possibly help with the information needed for the study. The same procedure was applied to all the schools that took part. The learners who participated in responding to questionnaires and they ranged from grade eight to grade twelve. The selection of parents was based on their availability

and readiness to participate in the research. This is because it was extremely difficult at times to get them as most of them were out for work. The Directors for the Civil Society Organisations that took part in the research helped in the selection of their officers who took part in the research.

3.7 Data collection instruments

The data was collected using the following instruments namely; structured questionnaires, semi-structured interview guides, and an observation schedule. In addition, document analysis was also used.

3.7.1 Questionnaires

Satorre (2012) states that a questionnaire is a research instrument comprising a series of questions and other prompts for the purpose of gathering information from the respondents. Lietz (2010) adds that a questionnaire also secures standardised results that can be tabulated and presented statistically. It places less pressure on the study for immediate response and gives more time to the respondents to answer the questions. The questions were both closed and open-ended, as a result, they were helpful in gathering information from the teachers, parents and learners with the aim of obtaining in-depth information on an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.

3.7.2 Semi-structured interview guides

Sidhu (2006) recommends that semi-structured interview guides are a good way of collecting information quickly and are relatively cheaper. The interviewer asked questions (semi-structured ones) and made comments intended to lead the respondents towards giving data to meet the study objectives. The face-to-face interaction between the interviewees and the researcher helped to gather information on an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira. The idea was to get their perspectives on the subject. The digital audio recorder enabled the researcher to gather detailed information from the respondents during semi-structured interviews. Yet, the researcher used procedures to protect the confidentiality of every participant who was recorded.

3.7.3 Observation schedule

Ashworth (1995) writes that an observation schedule is used to gather information that is visible and can be noted without any explanation from the people around. Mostly, it had to do with the physical appearance of the school environment as well as climate change education activities in which learners participated such as projects, quizzes, tree-planting, and the keep Zambia Clean and Green.

3.7.4 Document analysis

The researcher analysed the topics by subject in the revised curriculum. In addition, the "2013 revised curriculum" was analysed in order to understand the underlying principles on Environmental Education and climate change. Hancock, Windridge, and Ockleford (2007, p.19) write that "a wide range of written materials can produce qualitative information. These can be particularly useful in trying to understand the philosophy of an organisation such as policy documents, mission statements and annual reports". In this study, understanding what was written in the earlier mentioned documents was a prerequisite to understanding the role of the ministry of education in mitigating climate change.

3.8 Data collection procedure

To conduct this research, authority was sought from the District Education Board Secretary (DEBS) office. Thereafter, head teachers were approached to seek permission to interview learners and teachers at Butondo, Kankoyo and Kantanshi secondary schools in Mufulira District. Furthermore, permission was sought from the Directors of Civil Society Organisations to interview their officers. Data was collected using structured questionnaires, semi-structured interview guides, and an observation schedule. In addition, document analysis was used. Thus, the researcher distributed the questionnaires to a purposively chosen population for the latter to fill them in - to collect data from the point of view of the respondents (learners, teachers, and parents) in their own time. The semi-structured interview guides were used to collect information from members of the Civil Society Organisations. The interviews lasted between 60 and 90 minutes. Furthermore, the researcher used an observation schedule to collect data on the physical appearance of the school environment as well as Climate Change Education activities learners participated in such as projects and quizzes on Environmental Issues under JETS, tree-planting,

and the keep Zambia Clean and Green. Last but not the least, the researcher analysed topics in the 2013 revised curriculum to ascertain their content on management of Environmental Issues.

3.9 Data analysis

The researcher analysed data in three stages. Firstly, the researcher transcribed data from interviews manually. Secondly, the data was eyeballed to identify emerging themes and in order to create initial categories. The comments obtained from interviews with Civil Society Organisations were transcribed and rearranged in order to put together answers for each interview protocol question. For each answer, the main idea which occurred in the answers was noted. The main ideas were then reviewed to identify ideas which occurred again and again. In other words, the data obtained through interviews was analysed by coding and categorisation of the emerging themes. Consequently, a central phenomenon emerged and data was categorized into more specific sub-themes. This process of categorising data is referred to as axial coding, (Cresswell, 1998; Charmaz, 2006). Quantitative data was analysed using excel. Then, the researcher used colour codes to further analyse data from the questionnaires. By coding the text, the researcher identified phenomena and linkages and grouped different codes into larger, more meaningful categories (Charmaz, 2006). Some qualitative data from questionnaires was converted manually and summarised in order to obtain concise measures of the data by using descriptive statistics. The data was then presented quantitatively in frequency tables using a hand calculator.

3.10 Summary

The study on an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira used mainly qualitative methods during data collection. Excel was used for graphical presentations as well as descriptive statistics in form of frequencies. Structured questionnaires, semi-structured interview guides, an observation schedule and document analysis enabled the researcher to draw rich information for the study. The next chapter will present the findings of the study by giving information that was gathered in the field in an organised and systematic manner in order to provide meaning.

CHAPTER FOUR

PRESENTATION OF THE FINDINGS

4.1 Overview

The chapter presents the findings of the study on an Integrated Approach in Mitigating Climate Change in Mufulira. It also states the participants in the study and their responses under the headings in line with the research questions.

4.2 Understanding climate change

From the findings, most of the respondents had heard about the term "climate change". However, when asked about what they understood by the term, they gave varied responses. It was discovered that all the respondents stated that climate change means pollution while 33 stated that it was loss of biodiversity. However, 48 respondents interpreted climate change as signifying high temperature while 30 understood it as drought and heavy rainfall, respectively.

Figure 4.1 shows responses to the question: *What do you understand by the term 'climate change'?*

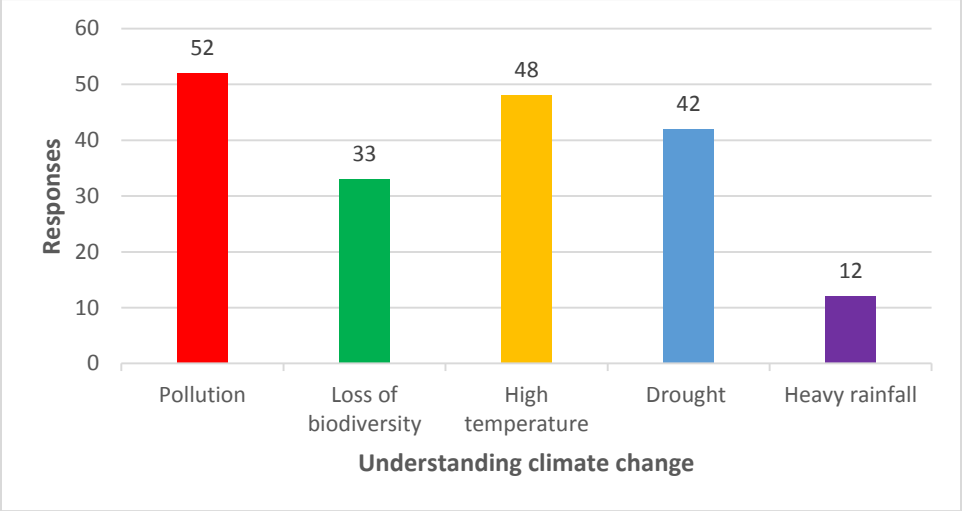

Figure 4. 1: Understanding Climate Change

The researcher observed that respondents understood the term climate change according to the activities that contributed to it and particular climatic events they normally faced. For example,

the respondents close to the mine area interpreted climate change as pollution or loss of biodiversity. Likewise, respondents who engaged themselves into farming activities said that climate change means drought and/or heavy rainfall. In other words, they interpreted climate change in line with its causes and effects on the environment.

4.3 Findings from the learners' questionnaires

With emphasis on the need for conceited efforts to mitigate climate change, the findings revealed that schools stand a better chance as they will graduate learners who are knowledgeable of environmental issues. Figure 4.2 shows learners' responses to the question (see Appendix 1): *Where have you heard of the term 'climate change mitigation'? Tick as many as you wish apply.*

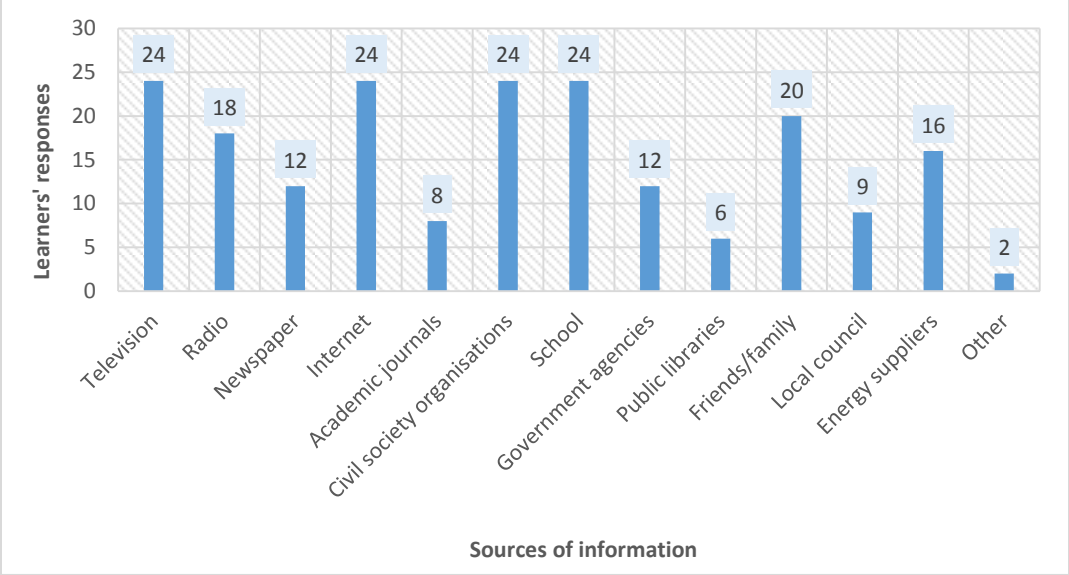

Figure 4. 2: Sources of Information on Climate Change

The findings revealed that learners accessed information on climate change mitigation through various sources which include television, radio, newspaper, internet, academic journals, Civil Society Organisations, school, government agencies, public libraries, family/friends, local council, and energy suppliers. Other sources were Facebook and WhatsApp. A learner stated that, "*I get a lot of information about climate change mitigation as well as adaptation through the Zambia National Broadcasting Corporation, Aljazeera, the British Broadcasting Corporation and many other channels."* Another learner responded that, "*In addition to learning about climate change in class, we participate in projects and quizzes on climate change."*

Furthermore, the researcher wanted to ascertain whether learners learnt about climate change mitigation in school. Table 4.1 shows learners' responses to the question: *Do you learn about climate change mitigation in school?*

Table 4. 1: Whether learners learnt about climate change in school

Gender	Frequency
Yes	24
No	0
Total	**24**

All the learners responded that they leant about climate change in school. These findings were in conformity with the Environmental Possibilism Theory which advocates for learners' involvement in educational activities towards mitigating climate change. Table 4.2 shows responses to the statement: *Your school enables you to participate in climate change mitigation activities.*

Table 4. 2: Whether learners participated in climate change mitigation activities in school

Gender	Frequency
Yes	24
No	0
Total	**24**

"We participate in JETS projects and quizzes as well as the 'Keep Zambia Clean and Green campaign' to contribute to climate change mitigation," a learner responded. From the responses, all the learners participated in climate change mitigation activities through the knowledge they received in class. Civil Society Organisations also collaborated with the ministry of education in sensitising learners on mitigation measures. However, the ministry of education needed to go beyond activities such as projects, quizzes, and sensitisation campaigns on the causes, effects and ways to mitigate climate change to incorporating knowledge of climate change into everyday activities such as class exercises, (Kotecha, 2010). A learner who was working on a JETS project responded that, "*With the knowledge I have received through sensitisation from stakeholders that*

visit our school, I am working on a project that will assist farmers to use organic pesticides made from crops and plants such as tephrosia, chilly and tobacco which are cheap and environmental friendly." The learner added that, "*At the moment I am getting information from textbooks, experts in the field of agriculture and the internet to enable me contribute positively to mitigating climate change in the field of agriculture, especially in crop production. The benefits of using these organic pesticides include the fact that they do not require technical knowledge and expertise to prepare them, as long as someone has the materials to use."* Such projects served as a cornerstone to promoting a safe and eco-friendly environment. The ministry of education was working with other line ministries to provide technical assistance to the learners on aspects that collaborative efforts. Table 4.3 shows responses to the question: *On a typical day, how much time do you spend on climate change mitigation activities?*

Table 4. 3: The time learners spent on climate change mitigation activities in school

Learner's response	Frequency
1-40 Minutes	5
41-80 Minutes	7
81-120 Minutes	12
Total	**24**

It was observed that learners spent varied amount of time on climate change mitigation activities in school. Learners who took part in projects on environmental issues spend more time on climate change activities than those who didn't. Besides, learners responded overwhelmingly when asked whether climate change content has been integration of into the curriculum. They stated that the content was part and parcel of the curriculum in schools, despite participating only in few mitigation activities.

Their responses revealed that climate change is mainly caused by human action and its effects were being felt and hence the need to put measures to mitigate it. One of the advantages for the ministry of education lies in its ability to train a huge population of learners. Therefore, the utilisation of events such as the 'Planting Day' where each learner was expected to plant and

nurture a tree could serve the Earth from global warming. Table 4.4 shows learners' responses to the question*: Does the school curriculum contain information on climate change mitigation?*

Table 4. 4: Whether the school curriculum contains information on climate change

Learner's response	Frequency
Yes	24
No	0
Total	**24**

With emphasis on the provision of quality Mathematics and Science Education, the findings revealed that the ministry of education in Zambia had taken a bold stance towards mitigation by incorporating environmental issues into JETS activities (MoGE, 2016) and integration into some of the topics in the school curriculum. One of the learners responded that, *"The concept of climate change is being taught in some topics so that information can easily be disseminated throughout our communities."* This is aimed at raising awareness about climate change among the learners through competition in various scientific projects and quizzes in order to transform their minds and foster action. *"The provision of quality Mathematics and Science Education is key to overcoming these challenges"*, a learner responded. It is important to note that Climate Change Education fosters learning about strategies for adaptation and mitigation. This is in conformity with the Environmental Possibilism Theory which stresses that education enables learners to alter the environment to best serve their needs through the use of technology.

Learners also responded to the question*:*

> *Mention **two** roles that the ministry of education can play in climate change mitigation.*

One of them responded that, "*The role of the ministry* of *education* is to *promote quality teaching and learning through environmental and Climate Change Education so that we [learners] possess relevant knowledge on environmental issues."* Another learner stated that, *"One of the roles for the ministry of education is to support programmes such as the 'Keep Zambia, Clean and Green campaign' so that learners develop useful skills, attitudes, and behaviours towards*

the environment". Namafe (2004) explains that the ministry of education should address climate change through the use of formal, non-formal and informal education targeting a wide cross-section of stakeholders, including learners, communities, industries and parastatals. Furthermore, another learner stated that, "*Education is as an essential tool for change, both for understanding and empowerment*." This entails that the earlier learners are equipped with the relevant knowledge on climate change, the more they can contribute to mitigation.

Therefore, the findings revealed that education is an essential element of the global response to climate change in that, firstly, it helps learners to understand and address the impact of global warming and increases knowledge of environmental issues among them. Secondly, it encourages changes in their attitudes and behaviour. Thirdly, education helps them adapt to climate change related trends (Ge, Qu, Zeng, & Fang, 2009).

4.4 Findings from document analysis of the secondary school curriculum

The revised curriculum was launched in Zambia's primary and secondary schools in January 2014. This transformation resulted in the paradigm shift in instruction, (MoGE, 2016), from teacher-centred to learner-centred and activity-based. The role of a teacher, therefore, changed from being the centre of instruction to that of a facilitator of the teaching and learning process. In other words, the teachers' main role is to coordinate learners as they choose what they want to learn and how they want to learn it (Namayanga & Sato, 2017). This calls for teachers to possess sufficient skills in developing activities that could promote active learning of environmental issues among learners (Muchanga, 2010).

4.4.1 Topics on the management of environmental issues in the revised curriculum

The ministry of education in Zambia has taken a step to include the environmental issues category in JETS projects so that learners become acquainted with and respond to environmental challenges in their communities through education (MoGE, 2016). Therefore, the researcher analysed the topics on the management of environmental issues in the revised curriculum from which learners came up with projects to present during JETS fairs and other academic platforms. It was established that the revised curriculum contained information on environmental issues. Although the list of samples of topics is not exhaustive because of the dynamic nature of environmental issues such as climate change and global warming, (Chang & Pascua, 2017), it is

imperative to localise the content in order to instill confidence in the learners so that they understand and participate in mitigation activities in their early stages. Table 4.5 shows samples of topics on the management of environmental issues and the subjects in which they have been integrated.

Table 4. 5: Topics on management of environmental issues

Samples of topics on management of environmental issues			
Topic	**Related subject(s)**	**Topic**	**Related subject(s)**
Pollution	Chemistry/Biology	Chemical Reactions	Chemistry/Biology
	Integrated Science		Integrated Science
Soil	Chemistry/Biology	Periodic Table	Chemistry
	Integrated Science		Integrated Science
	Geography		
Environment	Chemistry/Biology	Metals and Non-metals	Integrated Science
	Integrated Science		Agricultural Science
	Geography		Chemistry/Geography
Plants and Animals	Biology	Organic Chemistry	Chemistry
	Integrated Science		Biology
Ecology	Biology	Global Issues	Civic Education
	Integrated Science		
	Agricultural Science		
Enzymes	Biology/Chemistry	Acids and Bases	Biology/Chemistry
	Integrated Science		Integrated Science
	Agricultural Science		Agricultural Science

As already mentioned, the list is not exhaustive in the sense that the concept of climate change is also being taught in other subjects such as English Language when teaching aspects like structure, grammar, composition, comprehension, and summary. This means that when learners learn to use the conditional mood in English, their grammar exercises rely on sentences like this: *If we don't do something about climate change, the earth will continue becoming hotter and hotter.* Such class activities instill the sense of responsibility in the learners and enable them to

participate fully in mitigation (Makisa, 2016). The inclusion of some of the aspects of environmental issues in the curriculum encourages learners to research on climate change and participate fully in mitigation activities. The findings advocated for schools to adopt the 'whole institution' approach as an ideal strategy because it emphasises not only on the curriculum content but also the entire educational experience. Palmer (1998) explains that the strategy involves those responsible for the curriculum, facilities and cultural activities, be it educators, learners, parents, or members of the community to create synergies amongst themselves. The 'whole institution' thrives on dedicated leadership, administrative support from the institution and a clear monitoring and assessment system, (Muchanga, 2013). Figure 4.3 shows a field photo of the learners preparing their project proposals on environmental issues in JETS.

Figure 4. 3: Learners Preparing Project Proposals on Environmental Issues in JETS

Teacher's knowledge of the curriculum content on climate change in schools was also analysed. Table 4.6 shows that all the teacher participants were aware of the inclusion of climate change content in the school curriculum.

4.5 Findings from teacher's questionnaires

From the questionnaire, teachers were asked a question in order to ascertain whether the curriculum in school contained information on climate change mitigation. Table 4.6 shows

teacher's responses to the question (see Appendix 2): *Does the curriculum in school contain information on climate change mitigation?*

Table 4. 6: Whether the curriculum contains information on climate change mitigation

Gender	Frequency
Yes	12
No	0
Total	**12**

Teacher, T4 (pseudo name) responded that, "*The curriculum contains information on the concept of climate change although it has not been well understood by learners because of lack of books.*" From the responses, it was revealed that environmental education, climate change, scientific literacy, disaster risk reduction and preparedness was rooted in the co-curricular and the formal curricula. It was further revealed that the curriculum had a number of topics that contained information on climate change from which learners developed their projects and skills for innovation.

Teachers also responded to the question: *Does the ministry of education have a role to play in mitigating climate change*? Table 4.7 shows their responses to the question.

Table 4. 7: Whether the ministry of education has a role to play in mitigating climate change

Teacher's response	Frequency
Yes	12
No	0
Total	**12**

From the findings, all the teachers agreed that the ministry of education had a role to play in mitigating climate change. Teacher, T8 (pseudo name) responded that, "*The ministry of education promotes innovative teaching approaches in order to enable the learners to participate actively in climate change activities in schools."* A similar response was given by

another teacher, T12 (pseudo name), thus, *"The ministry of education has the capacity to integrate quality Climate Change Education into school activities through interdisciplinary practices such as science education and whole school approaches."*

The findings further showed that education makes an important contribution to learner's awareness and competencies to mitigate climate change. Climate Change Education contributes to the relevance and quality of teaching learners about environmental issues. Similarly, one of the parents, P12 (pseudo name) responded that, "*When learners begin to perform strongly in subjects provided in the curriculum, their awareness of global environmental problems is enhanced and they begin to participate actively in mitigation activities*."

4.6 Findings from teacher's and parent's questionnaires

4.6.1 Stakeholder collaboration in mitigating climate change in Mufulira

In trying to establish stakeholders' collaboration in the implementation of climate change mitigation activities, learners, teachers, parents and Civil Society Organisations were asked whether participation in climate change mitigation activities was everyone's responsibility. Figure 4.4 illustrates a comparison of the parent's to teacher's responses to the question (see Appendix 2 and 3, respectively): *Is participation in climate change mitigation programmes* ***optional*** *to individuals?*

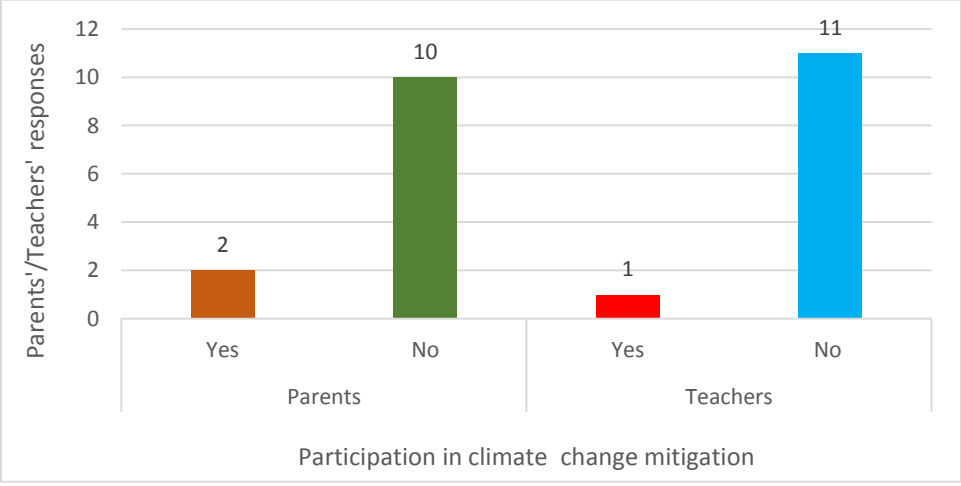

Figure 4. 4: Participation in Climate Change Mitigation

All the learners responded that participation in climate change mitigation activities and programmes was the responsibility of everyone. The same response was recorded from officers from Civil Society Organisations. Similarly, a comparison of the parent's to teacher's responses also showed that climate change mitigation calls for collective efforts. Parent Z (pseudo name) responded that, *"access to information fostered public participation resulting in informed decision-making."* In other words, public participation was directly linked to the right to information and public awareness. Teacher, T3 (pseudo name) added that, "*I am the patron for JETS in my school and I refer to the internet, consult from environmental groups and other researchers for me to guide the learners in their projects. I arrange for them [learners] to meet experts in environmental issues."*

It was further observed that teachers were so busy with work that they had little time to attend sensitisation campaigns. However, they spent some time sharing information with the learners on climate change mitigation. Teacher, T5 (pseudo name) responded that, "*We promote activities such as recycling, use of clean energy such as wind and solar as well as good farming practices to provide opportunities for true participation because these are directly related to the learner's everyday lives. Although the integration of the concept of climate change into the existing school curriculum has been difficult because of its uncertainty, the ministry of education still remains the best tool for promoting behaviour change.* Similarly, teacher T6 (pseudo name) added that: "*We facilitate critical thinking, open-mindedness and problem solving across all subjects in order to develop and sustain learner's capacity to comprehend, analyse and act on the knowledge they received."*

Teacher 4 (pseudo name) explained that, *"One of the advantages that the ministry of education has in mitigating climate change is that it has the capacity to train a multiple of learners who would in turn disseminate information to communities."* Learners, educators, and communities at large were sensitised and taught ways to mitigate climate change. Palmer (1998) writes that collaboration is important in providing solutions to climate change. In addition to attending sensitisation campaigns organised by the Civil Society Organisations, learners accessed information through the subjects they learnt in school. *"Although climate change has not yet*

been introduced as a stand-alone subject, it has been integrated across subject areas for learners to access information throughout their progression in school," a teacher responded.

Parents responded that they were contributing to climate change mitigation by changing their attitudes and implementing the knowledge they received through sensitisation campaigns. "*We participate in sensitisation programmes whenever visitors from NGOs and other organisations come to our area. We also share knowledge and information about climate change with our children when they come back home from school,"* a parent responded. They also provided assistance to the learners in their projects, thus, "*As an Environmental Health Technician, I assist the learners with information on the environment, especially on the causes, effects and ways of mitigating climate change."*

Another parent who was an employee in the Ministry of Tourism and Natural Resources responded in a similar way, "*I help learners with projects on environmental issues such as pollution and global warming."* The knowledge parents shared with the learners resulted in a better understanding of the issues affecting their local environment. This gave the latter confidence to participate actively in climate change mitigation activities. Apart from taking part in the traditional methods of environmental management such as producing compost manure from biodegradable substances, parents also participated in climate change mitigation activities through their expertise. For example, an Environmental Health Specialist explained that the problem of climate change requires constant curriculum review because of its dynamic nature so that learners keep abreast with the latest information by linking it to sensitisation programmes. Such measures help bridge the gap between school and community

4.7 Findings from semi-structured interviews with Civil Society Organisations

The Civil Society Organisations that were interviewed mentioned the risks and challenges caused by climate change such as droughts, rising sea levels and melting of ice caps. Narksompong and Limjirakan (2015) explained that climate change worsens the existing challenges of the learners and were concerned about the unprecedented threats posed by global climate change as many were already experiencing its impacts such as increasing water scarcity, declining food security, and increasing disasters and disease risks. It is against this background that officers from Civil Society Organisation were motivated to participate in mitigation and adaptation activities. They

[officers] further stated that some of the global effects of climate change include increased heat waves, flooding, intense tropical cyclones, and loss of biodiversity. In response to the question (see Appendix 4):

> *Mention some of the climate change mitigation programmes carried out by your organisation.*

C1 (pseudo name) responded that, "*We engage the mining companies to reduce on their emissions because one of the major challenges in our surrounding communities is pollution from the mines. We also sensitise communities on safe ways of disposing their waste such as making compost manure from biodegradable household refuse and taking non-biodegradable waste to the local council collection points in their area."* However, the findings revealed that although the emission of sulphur dioxide into the atmosphere had reduced since the Mopani Company started trapping sulphur dioxide to produce sulphuric acid, communities surrounding the mining area continued to experience its effects because not all it was being trapped. An officer from a Civil Society Organisation, C4 (pseudo name) mentioned that, *"Mopani Copper Mines only captures about 97% of the emissions and the rest goes into the atmosphere."* Thus, the MSVTEE (2015) recommends active and participatory learning and calls for the entire institution, thus; learners, educators, administrators and communities to take action. C1 added that, "*As an NGO we roll out climate change mitigation programmes to schools through drama, sketches, songs and posters. We are also targeting communities where learners come from. Schools have also taken up various initiatives to sensitise communities."*

From the responses given by the officers from the Civil Society Organisations, it was observed that they participated actively in climate change mitigation activities. For example, an NGO called the Green and Justice conducted drama titled '*Our Planet, Our Future,'* at Butondo, Chankwa and Kantanshi secondary school. The organisation also presented sketches and sang songs in line with the environmental challenges prevailing in the area. C2 (pseudo name) explained that, "*We roll out programmes to communities targeting women and children. From the campaigns, we have observed that individuals are now participating voluntarily by taking specific actions such as using vegetable waste as manure in their gardens. We have also*

witnessed remarkable improvements in behaviour change in relation to the way our surrounding communities dispose of garbage." In addition, C3 (pseudo name) explained that, "*We sensitise learners on the importance of maintaining good practices such as recycling as opposed to burning garbage and creating unplanned dumpsites that pollute our environment."*

In this study, it was reported that human activities, especially those that involve the release of toxic fumes from fossil fuels and methane gas from rotting garbage are a major contributing factor to climate change. Temperatures recorded at various locations on the surface of the Earth indicate that the climate is changing. Literature reveals that various treaties have been signed by countries world over to find ways of mitigation, (UNESCO, 2010). It is against this background that the ministry of education in collaboration with other stakeholders such as Civil Society Organisations is putting measures in place to create a sustainable environment through awareness programmes and engaging learners in mitigation activities such as projects and quizzes on environmental issues. In a similar way, a learner explained that, *"Through my project, I advise members of my community to avoid burning waste and promote recycling. The earth is hotter than before due to climate change caused by human activities such as mining which emit sulphur dioxide into the atmosphere, burning fossil fuels and incorrect disposal of garbage, to mention but a few. Surface temperatures are rising to extreme levels."* Figure 4.5 shows the field photo on the effects of pollution on the environment in Kankoyo Township.

Figure 4. 5: Effects of Pollution on the Environment in Kankoyo Township

The findings from face to face interviews corresponded to the responses from some of the learners, thus, "*Apart from what we learn in class, we are sensitised on the measures to reduce the impact of climate change. Usually we receive officers from churches and Non-governmental Organisations who sensitise us take action towards mitigation. We are also sensitised on how to keep our school environment clean and recycle garbage especially biodegradable materials. We participate in singing songs, dancing and presenting poems on climate change. In addition, photographs are taken and videos of activities conducted are produced so that they can be used as resource materials in future,"* a learner responded. The Civil Society Organisations encouraged learners to work on innovations that would bring about Sustainable Human Development. Such projects served as a cornerstone for future developments to be implemented on a large scale for the betterment of society.

One parent responded that, "*The surroundings in Kankoyo do not support much growth, not even grass apart from the wild shrub and a few avocado and mango trees that are resistant to acidic conditions. But when you go to the other side, you would think you are in a different town because the sulphur dioxide emissions do not reach there".* A learner who resided in Kankoyo narrated his experience of inhalation of the sulphur dioxide that was emitted into the atmosphere by the mining industry, *"When sulphur dioxide is released, it irritates our eyes, nose, skin become itchy and the cough starts due to the chocking scent of the emissions."* Furthermore, sulphur dioxide dissolved in rain water to form acid rain which was detrimental to the environment. Furthermore, farming activities practiced along the Butondo stream disturbed aquatic life because of the application of chemical fertilisers and pesticides to crops and vegetables.

In addition, parents, teachers and Civil Society Organisations responded that education makes an important contribution to learner's awareness and competencies to mitigate climate change. Climate Change Education contributes to the relevance and quality of teaching learners about environmental issues. The awareness of global environmental problems tend to go hand-in-hand, and both are associated with a sense of responsibility to ensure Environmental Sustainability (Brown, 1987; MESVTEE, 2015). On the other hand, members of the Civil Society Organisations explained that the ministry of education did not fully engage them in its activities.

This was in response to the question (see Appendix 4): *How does the ministry of education collaborate with your organisation in the implementation of climate change mitigation?*

C4 (pseudo name) lamented that, "*The ministry of education does not involve us in the planning, design and implementation of its policies and programmes on climate change despite the sensitisation programmes that we roll out as well as the teaching and learning materials we distribute to schools."* The officer also mentioned one of the major challenges the organisation faces in rolling out sensitisation programmes to schools, thus, *"We are doing everything possible to reach out to the learners in schools as well as the wider community through sensitisation despite the challenges of financial resources."* This was also echoed by other officers who explained that donors had their own areas of interest where they wanted to spend their resources and this had a negative impact on addressing environmental issues such as climate change in line with the prevailing situation in the country.

An observation carried out at Butondo, Chankwa and Kantanshi secondary school in Mufulira revealed that the ministry of education was not working in isolation but collaborated with other organisations and institutions in mitigating climate change. However, there was need for the ministry to fully involve Civil Society Organisations in its activities. Schools kept record of sensitisation programmes conducted by various stakeholders. The researcher discovered that stakeholders shared the aim of their visit, activities conducted and commented on the successes, challenges and the way forward. The records revealed that the ministry of education collaborated with climate researchers and like-minded organisations such as the Green and Justice and faith-based organisations like the Young Women Christian Association (YWCA), and the Churches Health Association of Zambia (CHAZ). Learners were sensitised on the causes and effects of climate change as well as adaptation and mitigation measures.

4.8 Findings from questionnaires and semi-structured interviews

Tables 4.9 and 4.10 show responses from parent's and teacher's questionnaires to the question:

> *What challenges does the ministry of education face in the implementation of climate change mitigation activities in secondary schools?* The next question was: *Mention its opportunities*. (see Appendix 2 and 3, respectively):

4.8.1 The main challenges faced by the ministry of education

As already stated, the majority of research on education and climate change has, to date, focused on the impact of climate and its related environmental changes on schooling (UNESCO, 2010). However, other than climate change activities in schools and stakeholder collaboration, this research focused on the main challenges and opportunities faced by the ministry of education in implementing climate change mitigation activities in secondary schools.

Teachers and parents stated the following as the main challenges and faced by the ministry of education in implementing climate change mitigation activities in secondary schools: lack of financial resources to support activities such as projects and quizzes on environmental issues; donor dependency; lack of co-ordination among implementers; lack of policy on integration; inconsistencies in learner's attitudes; lack of literature; and lack of human resource. Furthermore, the respondents stated that the knowledge given to learners in schools was more of theory than practical. As a result, learners did not fully put into practice what they learnt. This negatively affected learner's efforts to develop the necessary scientific skills needed for them to contribute effectively to adaptation and mitigation measures.

Table 4.9: The main challenges: A Comparison of parent's to teacher's responses.

Parent's response	Frequency	Teacher's response	Frequency
Lack of financial resources	16	Lack of financial resources	16
Donor dependency	11	Donor dependency	16
Lack of co-ordination	15	Lack of co-ordination	15
Lack of policy on integration	12	Lack of policy on integration	16
Learner's attitudes	15	Learner's attitudes	14
Lack of literature	16	Lack of literature	16
Lack of human resource	16	Lack of human resource	16
Total	**101**	**Total**	**109**

Despite the challenges stated (see Table 4.9), the ministry of education remains key to providing solutions to the changing climate.

4.8.2 The main opportunities faced by the ministry of education

The respondents also stated that the ministry of education has a number of opportunities in implementing climate change mitigation activities in secondary schools. These include promoting self-reliance; enhancing co-ordination among implementers; putting in place policy on integration of Climate Change Education into the school curriculum; fostering change in people's attitudes; provision of literature in schools; and training human resource to deliver climate change content to the learners in schools. Table 4.10 shows the main opportunities faced by the ministry of education in the implementation of climate change mitigation activities in secondary schools.

Table 4.10: The main opportunities faced by the ministry of education

Parent's response	Frequency	Teacher's response	Frequency
Self-reliance	11	Self-reliance	16
Co-ordination among implementers	15	Co-ordination	15
Policy on integration	12	Policy on integration	16
Change in learner's attitudes	15	Change in learner's attitudes	14
Provision of literature	16	Provision of literature	16
Train human resource	16	Train human resource	16
Technological tools for education	8	Technological tools	12
Total	**93**	**Total**	**105**

The challenges and opportunities stated by parents and teachers were similar to those from the learners and Civil Society Organisations (see Appendix 1 and 4, respectively).

4.9 Summary

The findings revealed that there were few educational activities that promoted awareness and the development of knowledge among learners, other than JETS projects, for the learners to participate fully in the design and implementation of measures to contain the impact of climate change. However, learners in secondary schools also participated in sensitisation programmes. In Mufulira, educational and awareness-raising activities such as JETS projects and quizzes were conducted in order to foster knowledge and understanding of environmental issues among the

learners. Other activities in which learners participated include the different forms of arts such as photography, music, dance, painting, poetry, video production to express their knowledge about climate change.

Learners derived activities on the causes, effects and measures to mitigate climate change from topics that contained information about the management of environmental issues in the school curriculum. They also came up with JETS projects based on the prevailing environmental problems in their townships which they used to sensitise communities and suggested measures to ensure Environmental Sustainability. However, such projects were not only presented by learners who were JETS members but also those who participated in other disciplines like Social Sciences. During the Social Sciences Teachers Association of Zambia (SOSTAZ) fair, learners presented projects on the MDG 7 'Ensuring Environmental Sustainability' under the topic called Global Issues in Civic Education. In addition, document analysis of the revised curriculum corresponded with responses from the learners that topics such as chemical reactions, metals and non-metals, organic chemistry, and acids, bases and salts contained information for learners to develop their projects on climate change.

In geography, learners developed and presented projects centred on the extraction industry and explained the effects of particulate matter such sulphur dioxide on the environment. Learners took photos of the environment surrounding the mining area and that which was at a distance. They compared the pictures they took and used them as a point of research on the impact of human activities on the environment. They expressed themselves through singing, drama, dancing, paintings, poetry and video production to sensitise communities on the impact of climate change and measures to mitigate it. The arts improved learner's knowledge and information sharing about climate change expressed in simple terms that were easily understood by everyone at all levels of education provision.

Teachers promoted school-based environmental projects and allowed full learner-participation. They guided learners in their projects so that the latter could continue working on them not only while they were in school but also when they were out of school. Through the subjects they taught, teachers should provide a link between the relevance of Climate Change Education

content and the knowledge imparted in the learners as well as its application to the immediate environment. On the other hand, stakeholder collaboration was vital in fostering climate change mitigation. Parents participated in sensitisation campaigns organised by Civil Society Organisations such as churches and other like-minded organisations. In Mufulira, organisations rolled out sensitisation programmes such as; practicing the 3R (Reduce, Reuse or Recycle), using solar energy and applying natural pesticides, in order to reduce the impact of climate change. Parents also played a big role in advocating for policy on integration of climate change into the curriculum based on the prevailing environmental challenges especially that our country depends highly on the extraction industry which constantly emits toxic substances to the environment. Being professionals in their areas of expertise, parents also provided guidance to the learners in addressing environmental issues.

The findings revealed that the major challenges faced by the ministry of education in fostering Climate Change Education include lack of financial resources, donor-dependency, lack of proper co-ordination among implementers, lack of policy on integration, inconsistencies in peoples' attitudes, lack of literature and lack of human resource. Therefore, education is meant not only to adapt learners to their society but to equip them to take action of their environment. Some of the opportunities for the ministry of education include promoting self-reliance; enhancing co-ordination among implementers; putting in place policy on integration of Climate Change Education into the school curriculum; fostering change in people's attitudes; provision of literature in schools; and training human resource to deliver climate change content to the learners in schools.

CHAPTER FIVE

DISCUSSION OF THE FINDINGS

5.1 Overview

The previous chapter presented the findings of the study. It showed the responses of the learners, parents, teachers, and Civil Society Organisations on an Integrated Approach in Mitigating Climate Change in Mufulira. The responses were centered on the research questions which were used in this study.

This chapter presents a discussion of the research findings based on the three objectives that guided the study. The first objective was to explore educational activities on mitigating climate change in Mufulira. It was revealed that the ministry of education has not fully utilised education as tool to mitigating climate change other than the introduction of the environmental issues category in JETS and sensitisation campaigns carried out by Civil Society Organisations. The second objective was to establish how the relevant stakeholders were collaborated in the implementation of climate change mitigation in Mufulira. The findings showed that the ministry of education did not fully engage other stakeholders especially in the design and implementation of climate change activities in schools. The third objective was to determine the challenges and opportunities faced by the ministry of education in implementing climate change mitigation activities in Mufulira. The study revealed that the ministry of education lacks literature and human resource, among others, which have continued to negatively affect mitigation efforts. However, one of the opportunities for the ministry of education is that education puts learners in a better position to help fight climate change as they will graduate with knowledge on environmental issues and, therefore, equipped to contribute to mitigation efforts. The findings have been discussed in the order of the objectives of the study and in relation to the statement of the problem.

5.2 Understanding climate change

Studies indicate that climate change content must be placed in a context that is meaningful for the learners and the wider community (UNESCO, 2015; Namafe, 2004). In other words, the content must be tailored to the environmental challenges being perceived in the areas where they

live. Kaluba (2015) writes that the mining industry is the main source of pollution in Mufulira. Pollution is the addition of harmful substances which have adverse effects on the natural environment. In this study, pollution takes the form of chemical substances, (Simukanga, 1999), such as sulphur dioxide, carbon dioxide and oxides of nitrogen, toxic run-off, to mention a few, that are detrimental to the environment. Major forms of pollution include: air pollution, water pollution, and land pollution.

There is a strong interconnection between climate change and biodiversity in the sense that biodiversity is affected by climate change (Muchanga, 2013). This results in negative consequences for human well-being. Through the ecosystem services it supports, biodiversity also makes an important contribution to both climate-change mitigation and adaptation (Kaluba, 2015). Therefore, conserving and sustainably managing biodiversity is critical to addressing climate change. Phiri (2008) observed that climate change is likely to become one of the most significant drivers of biodiversity loss. Biodiversity can support efforts to reduce the negative effects of climate change. Conserved habitats can trap carbon dioxide from the atmosphere, thus helping to address climate change by storing carbon. Kaluba (2015) adds that conserving in-tact ecosystems, such as forest reserves can help reduce the catastrophic impacts of climate change such as rising temperatures, flooding, and droughts.

5.3 Educational activities on climate change mitigation

There were very few climate change mitigation activities in which learners participated in schools other than projects and quizzes under the newly introduced category on environmental issues in JETS. In this category, they gathered information and worked on projects that fostered care of the environment. UNESCO (2012) reveals that environmental degradation remains a major challenge to all countries. Therefore, it has been acknowledged that protection of the environment is an important cornerstone of Human and Sustainable Development, (MoGE, 2016). This calls for prudent measures to promote sound environmental management practices. The government of the Republic of Zambia has realised the need for action against environmental degradation (Muchanga, 2013). Therefore, learners in schools developed environmentally friendly projects to provide solutions to environmental problems that were impacting negatively on the social, economic and technological wellbeing of their communities.

The ministry of education has developed processes of inclusion by fighting non-participation and self-exclusion (MoGE, 2016). Non-participation results from inability to take part because of work, the timing, and duration of activities or family commitments. On the other hand, self-exclusion is a voluntary choice not to participate as a result of lack of confidence, fear of reprisals, feelings of having nothing to contribute, or lack of benefit for participating (Liche, 2014). In order to overcome this challenge, the ministry of education has integrated Climate Change Education across subject areas (MoGE, 2016).

In schools, learners learn about the causes and effects of climate change as well as mitigation measures. Zambia, like Asian countries has incorporated the concept of "Learning by doing" through JETS projects into its education system as an effective method of capacity building (Chatterjee, 2002; MoGE, 2016). In European countries such as Germany, educators consider climate change so pressing that they integrate it across subjects and it into every class (Worrall, 2015). With emphasis on the provision of quality Mathematics and Science Education, the ministry of education in Zambia had taken a bold stance towards mitigation by incorporating environmental issues into JETS activities (MoGE, 2016) and integration into the school curriculum. Learners source information on climate change through books, magazines as well as radio and television. The knowledge they acquire gives them confidence because they could compare, make inferences and develop projects on the measures to mitigate climate change.

It was also observed that learner's ideas and knowledge about climate change mitigation depended on their role in school and the subjects they took. Learners who took Agriculture Science, for example, participated in conservation farming in their school gardens through the use of organic manure and pesticides made from organic materials. Organic manure and pesticides were beneficial in the sense that they did not require technical knowledge and expertise to prepare them, as long as a learners had the materials to use. For example, one JETS member prepared an organic pesticide from crops and plants such as tephrosia, chilly and tobacco to get rid of aphids from vegetables. To achieve this, the learner was getting information from experts in the field of agriculture and the internet to contribute positively to mitigating climate change in the field of agriculture, particularly in crop production.

Furthermore, learners participated actively in activities that were in line with what they perceived in their environment. During JETS fairs, learners presented projects on ways to minimise the effects of pollution on the environment. Simukanga (1999) writes that the earth is hotter than before due to climate change caused by human activities such as mining. This conforms with (NAS, 2012; UNESCO, 2014) that temperatures recorded at various locations on the surface of the Earth indicate that the climate is changing due to human activities especially those that involve the release of toxic fumes from fossil fuels and methane gas from rotting garbage. Mining activities emit sulphur dioxide and oxides of nitrogen into the atmosphere.

The burning of fossil fuels contribute to the accumulation of carbon dioxide to the atmosphere which forms a layer resulting in global warming. Sulphur dioxide, oxides of nitrogen as well as Chlorofluorocarbons (CFC's) contribute to global warming by depleting the ozone layer, (Simukanga, 1999). In Kankoyo, rotting garbage from unplanned damp sites release methane gas and its continuous accumulation is detrimental to the environment. In their communities, learners encouraged the use of the 3R (Reduce, Reuse and Recycle) as opposed creating unplanned damp sites and burning of waste. Although learners did not have enough books which contained information on climate change, they were gathering a lot of information about the impacts of climate change through television channels like the Zambia National Broadcasting Corporation (ZNBC), British Broadcasting Corporation (BBC) and Aljazeera.

As already stated, learners also participated in sensitisation programmes which were rolled out to schools by the Civil Society Organisations on mitigating climate change. The activities were done through the different forms of arts, such as, photography, music, dance, painting, and poetry. Learners used the knowledge they acquired from sensitisation programmes that were conducted by stakeholders that visited their schools to come up with projects on mitigating climate change. They spent varied amounts of time on climate change mitigation activities. Learners who spent over forty minutes on climate change mitigation activities were mainly those who were working on projects under the environmental issues category in JETS. Butondo and Kankoyo townships were ravaged with pollution from the mines (Kaluba, 2015; Simukanga, 1999) and unplanned dumpsites which emitted sulphur dioxide and methane gas, respectively,

into the atmosphere. Therefore, learners came up with projects to reduce on accumulation of these toxic gases into the atmosphere.

Although methane was released in small quantities from rotting garbage, constant emission and accumulation of the gas depletes the ozone layer causing global warming. Therefore, learners came up with projects to alleviate the situation despite inadequate literature on climate change in schools. Worse still, books that contained information climate change lacked details on activities to mitigate it. UNICEF (2010) observed that lack of literature affected learners' confidence to participate fully in mitigation because they felt that the information they gathered was not adequate to respond to and put in place measures to mitigate climate change. However, learners derived their confidence and participation in climate change activities from the observable impacts that it had on their environment. The theme of change of attitude and mind set was a major underlying force behind their participation (Muchanga, 2013).

Chatterjee (2002) purports that Asia has incorporated the concept of "Learning by doing" into its education system as an effective method of capacity building while (Narain, et al., 2009) recommends the use of a few demonstration projects in the process. In 2015, teachers in Brazil underwent a training course in Climate Change Education. Alcalay (2015) wrote that the course targeted 100 teachers from different disciplines, Secretariat of Education, professionals, Directors, and Pedagogical schools Coordinators that underwent 36 hours of training and 4 hours of field trip. After the course, teachers were given material to be implemented with their learners. Since then, teachers have continued to conduct field classes (Alcalay, 2015) because they add value to learning, developing the senses as well as sharpening curiosity and learning.

Other research studies (Jenkins, 1997; Brock, 1996) elaborated that when the citizens are scientifically literate, they contribute to decision making about issues that had a scientific dimension whether such issues were personal or more broadly political. One of the advantages for the ministry of education lies in its ability to train a huge population of learners. Therefore, the utilization of events such as what used to be known as the 'Planting Day' where each learner was expected to plant and nurture a tree could serve the Earth from global warming. In the same way, the ministry of education encouraged learners to work on innovations that would bring

about Sustainable Human Development. Such projects served as a cornerstone for future developments to be implemented on a large scale for the betterment of society.

Although the ministry of education has a big role to play in providing knowledge and information to the learners in schools, it requires the collaboration of other stakeholders such as NGOs, churches and other like-minded organisations. It is also important for the ministry to work with other line ministries such as the Ministry of Health and the ministry responsible for local governance to reach out to the learners in schools through sensitisation campaigns. The ministry of education collaborated, to some extent, with the church and various NGOs. Learners were sensitised on the impacts of climate change on the environment and ways to mitigate it.

5.4 Collaboration of stakeholders in mitigating climate change in Mufulira

The ministry of education has created synergies with other ministries, departments and organisations. Schools collaborated with various stakeholders to educate learners on the causes and effects of climate change. They also shared knowledge on measures to mitigate and adapt to the changing climate. Namafe (2004) notes that when knowledgeable and confident, learners are more likely to participate actively in mitigation. However, the problem of climate change requires constant curriculum review because of its dynamic nature so that learners keep abreast with the latest information. This aspect can be amplified by intertwining Climate Change Education with sensitisation programmes in order to bridge the gap between school and the community.

The Civil Society Organisations rolled out climate change mitigation programmes in schools through drama, sketches, songs and posters. They also targeted communities where learners came from. For instance, Civil Society Organisations were working with schools in putting up posters as a way of reminding learners to ensure a safe and sustainable environment. The MSVTEE (2015) recommends active and participatory learning and calls for the entire institution, thus; learners, educators, administrators and communities to take action. Learners participated actively in climate change mitigation activities through sketches and songs in line with the environmental challenges prevailing in communities.

Sensitisation programmes improve learner's understanding of climate change resulting in behaviour change. The sensitisation effect has also led to the widespread of information about climate change because it addresses a large population at a time. In addition, learners expressed themselves and shared ideas freely. However, sensitisation is not the only way through which the ministry of education collaborated with Civil Society Organisations in mitigating climate change. Some of the ways already discussed in this study include advocating for in-service training programmes for teachers on climate change, incorporating climate change content into class activities, and providing guidance to the learners working on JETS projects under environmental issues. This is in an effort to bring together individuals, departments and organisations to share knowledge and provide solutions to the problem.

The Asian and European countries have successfully integrated the topic into mainstream education system at primary, secondary as well as university levels in order to ensure learning through the academic progression (Chang & Pascua, 2017; Worrall, 2015). In Zambia, schools use the infusion strategy in which teachers incorporate the subject into their classes and are able to mention it in any subject being taught while keeping in mind learner's viewpoint (UNESCO, 2015). Through the infusion strategy, teachers enrich their activities by adding content on climate change and sustainability to their daily planning. However, this effort lacks consistency and is not done from time to time. Teachers feel that the whole process is demanding and time consuming as they are required to complete their syllabi before learners sit for their examinations. Stapp (1969) recommended that teachers should undergo in-service training for them to contribute effectively to Climate Change Education because the ministry of education has the ability to train a multiple of learners

Teachers taught learners on the effects of climate change and provided information on ways to minimise it. They also included aspects of climate change in teaching comprehension, summary and used conditional sentences that emphasise on mitigation and adaptation in grammar lessons. Through sensitisation programmes that were organised by Civil Society Organisations, teachers promoted various forms of art as a means of teaching learners about climate change in secondary schools. Arts provide a platform for disseminating information to bigger group of learners than can be accommodated under the classroom situation. Performance in drama, sketches and songs

enables learners to express themselves freely even in community sensitisation programmes. The 1996 policy document "*Educating Our Future*" states that learners must develop holistically. However, the value dimension had not been expanded enough to highlight moral responsibilities to the environment. Therefore, teachers encouraged them to take part in JETS projects meant to reduce the adverse effects of climate change. Teachers and learners attended various awareness programmes on various mitigation and adaptation.

Parent encouraged learners to participate in sensitisation programmes and advocated for the integration of climate change in all the subjects in school. They also participated in sensitisation programmes which were organised by Civil Society Organisations. They also share knowledge and information about climate change with their children. This resulted in a better understanding of the subject matter. Some parents used their expertise to teach learners about the environment, especially on the causes, effects and ways of mitigating climate change. The latter were also guided in their JETS projects and other activities pertaining to the environment.

5.5 The main challenges for the ministry of education in mitigating climate change

Zhao, Yan, Wang, Tang, Wu, Ding, and Song, (2018) stated that one of the main challenges in addressing climate change lies in fact that mitigation and adaptation measures are handled separately - complementarily due to differences in priorities for the measures and segregated planning and implementation policies at international and national levels. This is against the Theories of Environmental Determinism and Possibilism that are meant to comprehend and understand both climate change mitigation and adaptation in relation to the role played by the natural environmental conditions and education in the emergence and progress of knowledge of environmental issues in a particular location. Thus, there is a growing trend that synergistic approaches to adaptation and mitigation could bring substantial benefits to combating climate change, (Daguma, Minang, & van Noordwijk, 2014).

> Mitigation is devoted to the reduction of rate of increase, and scale of changes in greenhouse gas (GHG). Adaptation aims to improve the capacity of defense and resilience, which reduces the passive influence of climate change, (Ge, et al., 2009, p. 369).

Although mitigation and adaptation have different objectives, their integration could indeed make significant contribution to combating climate change. Therefore, collaboration with various stakeholders to educate learners on both mitigation and adaptation is a step in the right direction. On the other hand, the ministry of education faces numerous challenges in providing knowledge on environmental issues including climate change. Some of the challenges include: lack of financial resources; donor dependency; lack of co-ordination among implementers; lack of policy on integration; inconsistencies in learner's attitudes; lack of literature; and lack of human resource.

5.5.1 Lack of financial resources

The ministry of education remains key to providing solutions to the changing climate despite the many challenges that it faces, (UNESCO, 2010), although the knowledge given to the learners in schools was more of theory than practical. Teachers did not possess enough information on climate change. This negatively affected efforts to develop the necessary scientific skills needed for them to impart knowledge of environmental issues in the learners. The provision of finances to the ministry of education would help in putting in place tools that facilitate information sharing. These include resource guides, training workshops, competitions in projects and quizzes among schools and a national media campaign (Makisa, 2016).

The ministry of education lacked the financial capacity to procure and publish books as well as provide in-service training to teachers in environmental issues. Document analysis of the Zambia Education Curriculum Framework 2013 revealed that it was important for the school curriculum to provide for environmental education and climate change so that learners become aware of the ecological aspects of climate change and learn how to contribute towards preventing and combating it. On the other hand, (Makisa, 2016), observed that the framework did not clearly articulate how to moblilise resources coupled with inadequate mechanisms to finance the system at country level to support the development and funding of education activities within existing national climate change committees to work towards fulfilling the commitment to the UNFCCC. UNESCO (2014) explains that the ministry of education has not taken a holistic approach to integrate components of climate change agenda in education and incorporating environmental accountability into the curricula due to lack of financial resources.

5.5.2 Donor-dependency

Civil Society Organisations faced a number of challenges in rolling out sensitisation programmes on environmental issues because of their dependency on funding from the donors. Sometimes funds were not released at the right time and, worse still, donors had their own conditions of disbursement of funds. Even when Civil Society Organisations were funded at the right time, money came with a number of conditions attached resulting in inconsistencies in the implementation of programmes in schools and communities. As a result, donor-dependence had a negative effect and in most cases retarded climate change mitigation programmes. Loretta (2001) reported that the provision of Climate Change Education suggested that there was a need to look at the actual trends in the education provided in terms of quality, skills imparted, costs, and the purported gains needed for development.

5.5.3 Lack of co-ordination among implementers

Research shows that synergistic approaches are vital in the design and implementation of activities and programmes pertaining to environmental issues in schools (Daguma, et al., 2014; Special Report, 2009; Namafe, 2004). The ministry of education did not fully utilise the mutual benefit rooted in proper and sound collaborations with organisations that fostered climate change mitigation programmes in schools. This created gaps in terms of knowledge sharing among the learners during and after leaving school (Makisa, 2016). For instance, education-oriented risk reduction programs involved hazard identification and risk analysis where teachers and learners might not always have the information needed to predict hazards related to future effects of climate change (UNICEF, 2005). This gap can be bridged by enhancing linkages with climate researchers.

Likewise, school-based learning about hazards and the impacts of climate change did not complement the work of researchers and scientists on climate change risks to ensure timely discovery of potential hazards so that the best ways to mitigate them are effectively communicated to schools in order to form a basis for future research. UNESCO (2012) observed that the ministry of education through educational authorities and school administrators, particularly at national level, did not fully engage climate research institutions to ground educational actions in scientific knowledge and expertise.

5.5.4 Lack of policy for integration

The two major climate treaties, the UNFCCC and the Kyoto Protocol, call on governments to support Climate Change Education. To date, the government of the Republic of Zambia has not domesticated these treaties to suit the prevailing environmental challenges in the country which depends on the extraction industry (Kaluba. 2015). In other words, climate change mitigation programmes were not supported by an education policy that had the potential to provide appropriate knowledge, skills, and behaviour change. Although learners learnt, through sensitisation by Civil Society Organisations, about climate change through different forms of arts, such as, photography, music, dance, painting, poetry, and video production, the ministry of education lacks policy to support integration.

Chang and Pascua (2017) wrote that the education policies in Asian countries have been put in place to support the integration of Climate Change Education into mainstream education system, that is, primary and secondary school levels in order to ensure learning through the academic progression. Similarly, Worrall (2015) wrote that Germany had taken steps to integrate the concept of climate change across subject areas and into every class. Zambia must embrace countries that have provided policy for integration of Climate Change Education into their education system in order to ensure environmental awareness and education among learners.

5.5.5 Inconsistencies in learner's attitudes

Learners often times fail to maintain good practices when it comes to environmental issues. They usually backtrack, (UNICEF, 2010), despite sensitisation programmes carried out on the need to minimise practices such as deforestation and burning of waste materials. Generally, communities were not consistent with recycling as opposed to burning garbage and creating unplanned dumpsites. In addition, they were reluctant take garbage to the council's collection points so that it can be disposed of correctly.

5.5.6 Lack of literature

The ministry of education did not provide enough books to foster knowledge and skills on climate change mitigation. As a result, learners encountered a lot of challenges in their quest to contribute effectively to mitigation. Furthermore, communities faced challenges with regard to information about climate change because of the non-availability of materials except those that

had access through other media such as television and the internet. The scope of teaching and learning has left a gap between scientific and local knowledge for the learners to participate fully in mitigation efforts. Some teachers did not deliver climate change content in a confident manner and had a negative attitude towards the implementation of climate change mitigation activities in schools. This is partly because there were few books that contained information on climate change in schools. Kotecha (2010) writes that the gap can be reduced by incorporating relevant scientific knowledge and expertise to support the development of adaptive technologies in secondary schools.

The available teaching and learning materials in schools were not appropriate for developing new climate-friendly and climate-resilient livelihoods for youth and adults. Worrall (2015) agrees that most educational materials lacked an essential component of learning sustainable livelihoods as a strategy to mitigate climate change. UNESCO (2014) recommends that teaching and learning materials should aim at saving lives as a significant way in which education can help climate change adaptation and mitigation.

5.5.7 Lack of qualified human resource

Teachers did not fully deliver climate change content to the learners because the component was missing in their teacher training course. The ministry of education usually focused on hazard identification and risk analysis, but teachers and learners had little access to the information they needed to predict hazards related to the future effects of climate change (MoGE, 2016; UNESCO, 2012). In other words, teachers lacked the knowledge of Climate Change Education for them to deliver the content to the learners. However, if teachers undergo in-service training on environmental issues, they can also teach climate change content. Despite the curriculum content for schools being skill based and practical in both form and content (MoGE, 2016), lack of qualified teachers to offer Climate Change Education hindered the whole purpose of education as a resource to mitigate climate change. UNESCO (2010) argues that nobody should pretend that real educational experiences are taking place in our schools, when there are so many teachers who lack competence and commitment to teach learners climate science. The ministry of education has the capacity to reach out to the grassroots who were the actors in Climate Change Education because schools were found everywhere. Nevertheless, it is very difficult to realise the dream as some educators have little capacity to teach learners about climate change.

Proponents of the Theory of Environmental Possibilism called possibilists still argue that the natural environment influences education, and that the latter also influences the natural environment. In other words, possibilism is the view that the natural environment provides an opportunity for a range of possible educational responses and that people have considerable discretion to choose among them (Dictionary of Human Geography, 1994). Therefore, training teachers in climate change science and other environmental issues improves capacity for education as a tool for climate change mitigation and adaptation. Despite the challenges encountered, education has the capacity to provide solutions to a number of environmental challenges by considering the number of opportunities for the ministry of education to mitigate climate change.

5.6 The main opportunities for the ministry of education to mitigate climate change

There are a number of opportunities for the ministry of education to implement Climate Change Education in secondary schools. These include: promoting self-reliance; enhancing co-ordination among implementers; putting in place policy on integration of Climate Change Education into the school curriculum; fostering change in people's attitudes; provision of literature in schools; and training human resource to deliver climate change content to the learners in schools.

5.6.1 Promote self-reliance

Self-reliance, in this context, means the ability to source financial resources within the country unlike depending on external assistance. The government and other co-operating partners can work together to provide Civil Society Organisations with financial assistance other than leaving them entirely in the hands of donors. The major problem with regard to dependence on donor funding is that donors have their own areas of interest where they would want to spend their money. This has a negative impact on addressing environmental issues in line with the prevailing environmental challenges in the country. Unless Civil Society Organisations are assisted locally, they cannot facilitate educational programmes that are in line with the environmental challenges affecting different communities (Kotecha, 2010). Therefore, the government and its partners in sustainable development must provide funding towards relevant scientific knowledge and expertise in order to support the development of technologies that promote prudent management of the environment (UNESCO, 2010).

5.6.2 Collaboration with other stakeholders

Stakeholder collaboration helps in sharing experiences and lessons learned by communities facing similar problems, develop joint projects, carry out research and conduct workshops and training activities to come up with measures for mitigation. In schools, learners are encouraged to work with experts in coming up with projects on renewable energy infrastructure, such as the use of solar, biomass, and wind energy. Although a lot needs to be done regarding stakeholder collaboration, the ministry of education has continued bringing together expertise and ongoing work in diverse areas ranging from science and technology to agriculture, transport, forestry and disaster risk management, to address both mitigation and adaptation. The overall objective is to maximise existing collaborations and optimise the impact of an Integrated Approach in Mitigating Climate Change.

Education is an effective tool for promoting the implementation of mitigation measures. Schools and Civil Society Organisations have taken an opportunity for regional and international collaboration (UNESCO, 2015). The scientific community has done extensive work to document and project exactly the types of disruptions for different regions in the realm of adaptation (UNESCO, 2010). Similarly, social science research has contributed to the as yet relatively unexplored psychological, communication related, and sociological implications of climate change. According to (Higher education's role, n.d.), public-private partnerships between property owners, non-profit groups, and others have undertaken projects to preserve vital natural and economic resources.

> Education must take place outside the classroom and promote creative problem solving through engagement with the local community, emphasizing learning through action and interaction. As a result, the abstract global scenario and its related threats can be effectively linked to real, first-hand experience, (UNESCO, 2012, p.11).

Other researchers (Palmer, 1998; Chatterjee, 2002; Narain, et al. 2009; Yun, n.d.; King, et al. 2012; UNESCO, 2015; MoGE, 2016) indicate that education officers at district level, teachers

and learners were slowly taking action to reduce Green House Gas (GHG) emissions through partnerships with the government and Civil Society Organisations.

5.6.3 Policy on integration

Climate change is becoming a challenge to developmental efforts. Zambia, in particular, is affected because of dependence on climate sensitive sectors such as farming for livelihoods. Therefore, learners have started possessing knowledge of climate change at an early stage through integration of climate change science into the curriculum in schools. However, Zambia needs a well-elaborate policy document on the need for a holistic development of the learners with an expanded value dimension to highlight moral responsibilities to the environment. Learners who have knowledge of climate change are better placed to shape and sustain future policy-making. Our country can still achieve its goals by intertwining what has been provided in the curriculum and adopting the two complementary strategies for the inclusion of Climate Change Education, thus; the *'infusion strategy'* and the *'whole institution'* approach. The first one implies incorporating the Climate Change Education content into the activities for the learners. The latter means using the entire educational experience as a tool to foster climate change mitigation adaptation.

Policymakers can ensure that education is used as a mechanism to address climate change, (Kotecha, 2010). The Conference on Parties (COP21) Paris Agreement demonstrates recognition amongst policymakers of the urgent need for change, but now requires words to be followed by actions. Phiri (2008) argues that the role of education should not be overlooked in policy development. It requires an understanding of the relationship between climate change and education. Based on this understanding, cross-sector policies can be developed which integrate education and take advantage of the opportunities presented to stimulate green growth, education opportunities, and resilience. Palmer (1998) writes that within the education system, policy can be used as an instrument to integrate climate change into the formal, non-formal and informal education methods. This can result in a society that is equipped with the understanding, values, knowledge and skills to tackle the causes and impact of climate change. A climate conscious and resilient community can advocate for action, motivate policymakers to implement further changes, and be resilient to change (Makisa, 2016: GRZ, 2007).

Education policy can enable learners and the community at large to carry out analysis and evaluation of environmental challenges affecting them. This agrees with the Environmental Determinism Theory which suggests that the natural environment exclusively shapes the education provided in a particular area. The scope of knowledge provided should go beyond adaptation and mitigation strategies but rather familiarise the learners with various International Conventions and Protocols surrounding climate change and most importantly be able to domesticate them. These include United Nations Framework Convention on Climate Change (UNFCCC), Kyoto protocol, and a range of other informal partnerships and dialogues that provide both a framework that supports co-operation and a foundation on which to build further collective action. UNESCO (2014), (see also MoGE, 2013; 2016) recommends that curriculum designers and developers in education must provide the curriculum that meets the requirement of the prevailing environmental challenges in order to add value to educational institutions.

5.6.4 Change of learner's attitude

Education is an essential component of the global response to climate change because it enables learners to understand and address the impact of climate change (MoGE, 2013). It also increases knowledge of environmental issues among them. In addition, education encourages changes in the attitude and behaviour of the learners and helps them adapt to climate change related trends. Muchanga (2013) writes that the sooner the learners become more aware and educated on environmental issues, the more likely they will grow up to become eco-friendly adults who can contribute to a more sustainable future. The general public can maintain good practices when it comes to environmental issues by taking the knowledge they receive through sensitisation programmes seriously. For example, they must be consistent with recycling as opposed to burning garbage and creating unplanned dumpsites.

5.6.5 Production of literature

Learners need basic understanding of scientific concepts with a deeper level of systems thinking such as knowledge of the history and causes of climate change, ability to distinguish between certainties, uncertainties, risks, and consequences of environmental degradation, disasters, and climate change. They also need knowledge of mitigation and adaptation practices that can contribute to building resilience and sustainability. Literature shows that learners also need an understanding of different interests that shape different responses to climate change and ability to

critically judge the validity of these interests in relation to the public good (Chacko, 1998). However, such skills can only be achieved if learners are provided with educational materials because literature is an essential component of learning sustainable livelihoods as a strategy for adapting to and mitigating climate change.

The ministry of education in collaboration with other stakeholders can provide literature on how to promote new climate-friendly and climate-resilient livelihoods for youths and adults in order to help with climate change adaptation and mitigation. Basing on this argument, the Environmental Determinism Theory postulates that education enables learners to possess knowledge needed for climate change mitigation and adaption. Worrall (2015) discovered that in Germany, about a quarter of the content in the 10th-grade English textbook, for example, is about threats to planet Earth. That means when learners are taught to use the conditional mood in English, their grammar exercises rely on sentences like this: *"If we don't do something about global warming, more polar ice will start to melt."* Similarly, in an 11th-grade geography class dedicated entirely to sustainability, learners write poems about climate change. The integration of climate change content into the subjects offered in schools has the capacity to raise awareness among the learners (Makisa, 2016).

5.6.6 Provision of human resource

Studies show that Civil Society Organisations have, to some extent, been incorporated in providing solutions to the changing climate through exchange of ideas particularly in the sensitisation effect (Anderson, 2010). It is within the jurisdiction of the ministry of education to engage them in fully especially in the design and implementation of climate change activities in schools. This will enhance participation of various stakeholders in fostering mitigation measures. Chang and Pascua, (2017) write that these efforts must be coupled with the provision of in-service training to teachers so that they become acquainted with teaching and learning instructions that incorporate environmental issues.

As such, climate change and ultimately Climate Change Education content must be incorporate into the curriculum for teacher training. This will enable teachers to deliver the content confidently (Sheffield, UIjittewaal, Stewart & Galvez, 2017). In addition, knowledge of climate change among teachers will enhance collaboration with other organisations in the fight against

the effects of climate change. Climate change education can only be meaningful if the curriculum content in Teacher Training Institutions puts emphasis on it (UNESCO, 2012). In turn, this places learners in a better position to help fight climate change when they graduate with knowledge on environmental issues (Chipatu and Namafe, 2016).

Phiri (2008) maintains that strong performance in science is associated with higher awareness of environmental issues. In other words, Climate Change Education and scientific literacy offers some opportunities for exchange between institutions across the globe, which could assist with skills and technology transfer as well as capacity building. This includes initiatives such as the long-term efforts in international professional exchange and skill sharing among learning institutions (Chipatu and Namafe, 2016). For example, the University of Zambia/Hiroshima University dissemination seminar, whose purpose is to bring together researchers from Japan, Malawi and Zambia who are interested in exploring and sharing research findings in mathematics, physics, chemistry and biology education has contributed greatly to capacity building among institutions and educators. The Education for All Global Monitoring Report states when learners perform strongly in science, their awareness of global environmental problems is enhanced, and that both are associated with a sense of responsibility to support sustainable environmental management, (UNESCO, 2010).

According to UNESCO (2010) climate change has two parts: *climate and change*. The first is about *raising awareness, building knowledge and skills for climate change.* The latter deals with *educating for change*. Nevertheless, increasing the number of Climate Change Education implementers is related to the latter (Chipatu & Namafe, 2016). The ministry of education has the capacity to change the culture of teacher education institutions in order to mainstream climate change content and pedagogy (Kotecha, 2010). Learners, along with parents and the wider community, must be involved in climate change activities. The study by King, Tyldesley, and Hogarth, (2012) revealed that learning responsibility comes through experience. This means that active participation is achieved when the whole community is involved. For this reason, communities should not be scared with jargon (Fekadu, 2014), but rather be communicated with in their language and learn from the way they have mitigated climate change in the past.

Furthermore**,** a cross-sectoral approach involving sectors other than education is important in creating awareness about the benefits of addressing and incorporating Climate Change Education into national climate change plans and policies (Makisa, 2016). Civil society organisations have the responsibility to raise awareness among the general public. Churches, for example, have realised that they can no longer afford complacency and endless debate. Their love for God, neighbours and the wider Creation, as well as their passion for justice, compel them to an urgent and prophetic ecological responsibility. The church uses improvisational drama to influence the knowledge, attitudes, and behaviour of the youth attending church youth groups and encourages them to take action (Phiri, 2008).

Makisa (2016) adds that linking Climate Change Education to the arts is an effective means for schools to engage communities in climate change mitigation activities. For example, music, drama, and dance are powerful tools that schools use to disseminate information in our communities. Such platforms pull huge crowds and are capable of yielding good results. Another undertaking for the ministry of education lies in increasing human resource through creating links between education and research (GRZ, 2007). The link between education and scientific research is beneficial not only to the learners but also to communities as it empowers them with knowledge of climate change.

Kotecha (2010) recommends active engagement in research endeavors between educational and research communities in designing and promoting educational programmes that accords learners an opportunity to experience their local, social, and natural environments. These education programmes include data collection, analysis, and sharing as well as taking action to address climate change (Kaluba, 2015). This leads to a better appreciation of the environment among learners and researchers as it strengthens their ability to generate essential local data and link their research to education programmes. Although such collaborations require long-term efforts that go beyond the standard project cycle, UNESCO (2012), explains that failure in scientific education means less-widespread and less-informed public debate on issues such as climate change and the wider environmental challenges. Therefore, school libraries should serve as sites for learning and research on environmental and sociocultural aspects of climate change.

5.6.7 Climate change education in schools

The ministry of education provides relevant scientific knowledge, expertise, and support the development of technologies that promote prudent management of the environment (MESVTEE, 2013). As a result, climate science is not a new science in secondary schools (Palmer, 1998; see also NAS, 2012; MESVTEE, 2013; 2015; MoGE, 2016). The different science based disciplines, such as physics, chemistry, biology, and mathematics on which climate science is based, are already being offered in secondary schools (Kotecha, 2010; WWF, 2009; UNESCO, 2014; see also Table. 4.5). Figure 5.1 shows the Marjanovic Model which demonstrates that climate change science is not a new science in secondary schools.

Figure 5. 1: The Marjanovic Model: The Nature of Climate Change Science

Adapted from "*Climate Change, Adaptation and Higher Education: Securing our Future" 2 (4)* p. 73 by P. Kotecha, (Ed.), 2010. Copyright 2010 by the Southern African Regional Universities Association (SARUA).

The Marjanovic model demonstrates the whole system approach to climate change other than working traditionally as isolated disciplines because climate change is so dynamic and complex that traditional approaches are no longer valid in generating solutions (Higher education's role, n.d.). By the time the partial solution for a particular component is generated, the climate change problem would have already changed shape and dimension. Therefore, schools must employ

approaches that integrate these different disciplines to understand how humans affect the patterns and cycles that operate in nature, and their manifestations to society (Valenzuela, 2015). Furthermore, schools have embarked on building a strong foundation in the climate change science. Yun (n.d.) advocates for the education curricula invest in the provision of the necessary tools and skills for tackling the complex and interlinked problem of climate change.

Traditionally, communities have had their own ways of caring for the environment, such as use of organic manure, recycling materials as opposed to burning it, and the application of natural pesticides. Kelly (1999) observed that traditional education guaranteed Zambia of a mob ill-equipped to do anything of quality in life thus adding to the existing problem of poor masses, ill-equipped civil service and more painful, continued state of under-development of the country. However, teaching and learning of environmental issues draws on both scientific and indigenous knowledge for successful mitigation and adaptation.

5.6.8 Technological tools for education

Various technologically-based tools for education offer different ways to view and understand climate change (Palmer, 1998). With the growing trend in the use of social media, diversifying climate change communication has the potential to improve networking among implementers. Prominent examples of social media platforms that have the potential for disseminating information about climate change include Tweeter, WhatsApp, Facebook, and Wikipedia. Narksompong and Limjirakan (2015) established that the use of Information and Communication Technology (ICT), especially social media represents a powerful resource for Climate Change Education because it enables active exchange and networking among learners and educators at the local, regional and global levels. These tools have potential application within the formal education system and beyond (Jenkins, 1997). Furthermore, online courses and other web-based interactive programmes provides an indispensable opportunity to impart knowledge of climate change among learners.

5.7 Summary

The main purpose of this chapter was to discuss the findings on an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira. Temperatures recorded at various locations on the surface of the Earth indicate that the climate is changing. Anthropogenic

means are the biggest contributor to the climate change currently being experienced. This is caused by burning fossil fuels and emission of methane gas from rotting household garbage. Various treaties have been signed by countries world over to find ways of mitigation yet it has been realised that the ministry of education remains an untapped resource in minimising the effects of climate change.

Learners participated in JETS projects and quizzes under the environmental issues and innovations category. They also participated in sensitisation campaigns which were rolled out to schools by the Civil Society Organisations. Zambia has, to some extent, incorporated the concept of "Learning by doing" through JETS projects as an effective method of capacity building. Teachers in secondary schools guided and encouraged participation in learner-led projects derived from a number of topics on the management of environmental issues in the revised curriculum for the learners to present during JETS fair and other academic platforms. However, the ministry of education did not use the whole system as an ideal approach to equip learners with knowledge of environmental issues.

The ministry of education has created synergies with other ministries and Civil Society Organisations such as NGOs, churches and other like-minded organisations. In Mufulira, for example, the ministry of education collaborated with climate researchers and like-minded NGOs such as the Green and Justice and faith-based organisations like the Young Women Christian Association (YWCA), and the Churches Health Association of Zambia (CHAZ). In addition, specialists in different fields such as agriculture, mining, forestry and the corporate world sensitised learners in schools on the causes, effects as well as measures to mitigate and adapt to climate change. Nevertheless, the ministry of education needed to fully engage other stakeholders in the design of Climate Change Education in schools in order to ensure everyone's participation.

On the other hand, the ministry of education faced a number of challenges in implementing climate change mitigation activities in secondary schools. These include lack of financial resources; donor dependency; lack of co-ordination among implementers; lack of policy on integration; inconsistencies in learner's attitudes; lack of literature; and lack of human resource.

Some of the opportunities are promoting self-reliance; enhancing co-ordination among implementers; putting in place policy on integration of Climate Change Education into the school curriculum; fostering change in people's attitudes towards the environment; provision of literature in schools; and training human resource to deliver climate change content to the learners in schools. The Environmental Determinism Theory postulates that the natural environmental problems constrain education whereas the Environmental Possibilism Theory argues that educational responses to the natural environment have the capacity to make a difference. In other words, the Environmental Determinism Theory fosters adaptation to climate change while the Environmental Possibilism Theory encourages both adaptation and mitigation. Although the dualism in Environmental Determinism and Possibilism is considered as an irreconcilable paradox, (Fekadu, 2014), this study considers both theories equally important in the provision of Climate Change Education in secondary schools.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMENDATIONS

6.1 Overview

The main purpose of this study was to explore an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira. The study, therefore, aimed at filling the gap by establishing the educational activities carried out in secondary schools aimed at mitigating climate change and the extent to which the ministry of education engaged other stakeholders as well as the challenges and opportunities faced in fighting climate change in Mufulira. Therefore, it is from this background that this chapter proposes to make the conclusions and recommendations of the study. The conclusions and the recommendations are based on the research findings from the respondents. The sample target of the respondents was 24 learners, 12 teachers, 12 parents and 4 officers from Civil Society Organisations.

6.2 Summary of findings

From the findings and discussions that addressed the three objectives, the study showed that JETS projects and quizzes on climate change were being conducted in secondary schools in Mufulira. However, it was revealed that not all the learners in schools were involved because of lack of funds, lack of literature, limited number of participants to present their projects during science fairs and laxity on the part of the teaching staff. The teachers faced many challenges in teaching Environmental Education in schools which resulted in lapses in the provision of Climate Change Education to the learners. On the other hand, a number of stakeholders such as NGOs and faith-based organisations rolled out their sensitisation programmes to secondary schools. However, there was need for the ministry of education to involve Civil Society Organisations in the design of climate change activities. The study also identified a number of challenges schools faced in the implementation of Climate Change Education. These include; lack of funds to procure books and other research materials; donor-dependence; lack of co-ordination among implementers; lack of policy on integration; inconsistencies in people's attitudes; lack of literature and qualified human resource.

Nevertheless, the ministry of education had a number of opportunities to contribute to mitigation efforts. To begin with, educators were very close to the community and it was very easy to train a multiple of learners. Secondly, teacher training can be re-oriented to include environmental issues including climate change while allocating enough funds to facilitate the procurement of resource materials and to enhance hands-on activities among the learners. Thirdly, the sector can strengthen links with climate researchers, use social media and integrate climate change across the curriculum to ensure learning through the life cycle. Therefore, it was proposed that there was need for providing an education that fosters an Integrated Approach in Mitigating Climate Change in Mufulira.

6.3 Conclusion

The findings showed that the ministry of education has taken a multi-sectoral approach in mitigating climate change but lacks policy for integration into the school curriculum resulting in little climate change activities in schools. Secondly little emphasis was put on methodological shift from the traditional rote learning to learner-centered and activity-based approaches. Last but not the least, available literature promotes sustainable technological inventions among learners, especially through such activities as JETS projects on environmental issues. This is aimed at building their knowledge on recycling; increased use of solar panels and other renewable sources of energy; consuming food grown locally; better education on environmental issues; and more efficient lifestyles. In order to minimise these challenges, schools encouraged learners to come up with projects in environmental issues prevailing in their areas. Teachers must engage themselves in research on Climate Change Education for them to guide the learners in their projects. Although the challenges seem to outweigh possible solutions, Zambia in general and Mufulira in particular has the potential for effective implementation of mitigation strategies through education.

6.4 Recommendations

In line with the significance of this study, it is important to realise that the results of this study would make no difference to society if not accompanied by appropriate action from various stakeholders. Based on the findings of this study, it is recommended that:

- Stakeholders should provide adequate funds to support activities such as projects in environmental issues, publish and procure educational materials containing climate change content such as books for the learners to use because education is a long term investment.
- The ministry of education should create synergies with line ministries, NGOs, churches, and other faith-based organisations in the design and implementation of climate change mitigation activities.
- Policy makers and curriculum developers in education should consider making Climate Change Education content examinable so that both the learners and teachers can take it seriously.
- Stakeholders should promote knowledge on recycling; increased use of solar panels and other renewable energy sources; consuming food grown locally and better education in environmental issues.
- Teachers should use hands-on, problem-solving, inquiry-based and future-oriented learning approaches such as field trips and projects when teaching about climate change.
- The ministry of education through Teacher Training Institutions should provide in-service training because teachers in secondary schools were not trained in Climate Change Education.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE FOR SECONDARY SCHOOL LEARNERS

The University of Zambia

School of Education

Department of Mathematics and Science - Postgraduate

Dear Respondent,

This questionnaire is for academic purposes and your responses will not be used for anything else rather than for the stated purpose. The purpose of this study is to explore *an Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.* We thank you most sincerely for your cooperation. Be free in giving your answers without any reservations.

Date: ……..…. School/level: ……..…… Gender: ……

1. Have you heard of "climate change mitigation"?

   (i) Yes [ ] (ii) No [ ]

2. Where have you heard of climate change mitigation? *Tick as many as you wish apply.*

Television	☐	Government agencies/information	☐
Radio	☐	Public libraries	☐
Newspaper	☐	Friends/family	☐
Internet	☐	Local council	☐
Academic journals	☐	Energy suppliers	☐
Environmental groups (e.g. ZEMA)	☐	Other	☐
School	☐	(*Please write in:* _____)	

3. What do you understand by the term *climate change*?

   _____

   _____

4. Do you learn about climate change mitigation in school?

   (i) Yes [ ] (ii) No [ ]

5. On a typical day, how much time do you spend on activities pertaining to climate change mitigation?

   _____

6. (a) Which climate change mitigation programmes do you carry out at school?
   Tick appropriately.

   Child-led mitigation initiatives in school ☐
   Climate-change-mitigation sensitization programmes ☐
   Participate in the design of mitigation activities ☐
   Giving your views and suggestions on content areas ☐
   Hold clubs to discuss mitigation measures ☐
   Pedagogy and assessment systems that promote higher order thinking in support of climate change mitigation ☐

   (b) If others, please specify.

   _____

7. Your school enables you to participate in climate change mitigation.
   (i) Yes [ ] (ii) No [ ]
8. The school curriculum contains information about climate change mitigation activities.
   (i) Yes [ ] (ii) No [ ]
9. Mention **two** roles that the education sector can play in climate change mitigation.
   (i) _____
   _____
   (ii) _____
   _____

10. What is your role in mitigating climate change?

    _____
    _____
    _____

APPENDIX 2: QUESTIONNAIRE FOR SECONDARY SCHOOL TEACHERS

The University of Zambia

School of Education,

Department of Mathematics and Science - Postgraduate

Dear Respondent,

This questionnaire is for academic purposes and your responses will not be used for anything else rather than for the stated purpose. The purpose of this study is to explore *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira.* We thank you most sincerely for your cooperation. Be free in giving your answers without any reservations.

Age	Sex	Department	Position	City/Township

1. What do you understand by the term *climate change*?

   _____

2. Have you heard of "climate change mitigation"?

   (i) Yes (ii) No

3. Where have you heard about climate change mitigation? *Tick as many as you wish apply.*

Television	☐	Government agencies/information	☐
Radio	☐	Public libraries	☐
Newspaper	☐	Friends/family	☐
Internet	☐	Local council	☐
Academic journals	☐	Energy suppliers	☐
Environmental groups (e.g. ZEMA)	☐	Other	☐
School	☐	(*Please write in:* _____)	

4. What is meant by the term *climate change mitigation*?

   _____

   _____

5. Does the curriculum in school contain information on climate change mitigation?

   (i) Yes [ ] (ii) No [ ]

6. Do learners **LEARN** about climate change mitigation in school?

   (i) Yes [ ] (ii) No [ ]

7. Is participation in climate change mitigation programmes **optional** to individuals?

   (i) Yes [ ] (ii) No [ ]

8. Does the education sector have a role to play in mitigating climate change?

   (i) Yes [ ] (ii) No [ ]

9. If so, mention **two** roles that the education sector can play.

   (i) _____

   (ii) _____

10. What challenges does the ministry of education face in the implementation of climate change mitigation activities in secondary schools?

    (i) _____

    (ii) _____

11. Mention its opportunities.

    (i) _____

    (ii) _____

APPENDIX 3: QUESTIONNAIRE FOR PARENTS

The University of Zambia

School of Education

Department of Mathematics and Science - Postgraduate

Dear Respondent,

This questionnaire is for academic purposes and your responses will not be used for anything else rather than for the stated purpose. The purpose of this study is to explore *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira*. We thank you most sincerely for your cooperation. Be free in giving your answers without any reservations.

Age	Sex	Period of present residence	Department	City/Township

1. Have you heard of the term "climate change mitigation"?
   (i) Yes [ ] (ii) No [ ]

2. If so, state where you heard of climate change mitigation by ticking against one of the listed options.
   [ ] Television [ ] School [ ] Radio [ ] Newspaper

3. What do you understand by the term *climate change*?
   _____
   _____

4. Climate change does **NOT** affect our environment and society at large.
   (i) Yes [ ] (ii) No [ ]

5. Explain your answer to Question 4.
   _____
   _____

6. How does the ministry of education collaborate with you in the implementation of climate change mitigation?

   _____

   _____

7. What do you understand by the term "climate change mitigation"?

   _____

   _____

8. Do learners learn about climate change mitigation in schools?

   (i) Yes [ ] (ii) No [ ]

9. Is participation in climate change mitigation programmes **optional** to individuals?

   (i) Yes [ ] (ii) No [ ]

10. Mention **two** ways in which the education sector can help in climate change mitigation.

    (i) _____

    _____

    (ii) _____

    _____

11. What challenges does the ministry of education face in the implementation of climate change mitigation activities in secondary schools?

    _____

    _____

12. Mention its opportunities?

    (i) _____

    (ii) _____

APPENDIX 4: SEMI-STRUCTURED INTERVIEW GUIDE

The University of Zambia

School of Education

Department of Mathematics and Science – Postgraduate

Topic of research: *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira*

Introduction and welcoming respondents

My name is Kamukwamba Lawrence; a student of Mathematics and Science Education at the University of Zambia, Department of Mathematics and Science Education. I will be the moderator for this interview. The purpose of this discussion is for me to satisfy partial academic requirement for the award of a Master's degree in Mathematics and Science Education (MSE). Thus, all the discussions in this meeting will be confidential.

First and foremost, I would like to thank you for having accepted to be interviewed on the topic: *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira*

What is your position in the organisation?	What are your qualifications?	What is your profession?	Initials	What is your age as at your last birthday?	How long have you been working for this organisation?

1. What do you understand by the term *climate change*?
2. Mention some of the effects of climate change.
3. What is "*climate change mitigation"*?
4. Would you cite some of the climate change programmes carried out by your organisation?
5. Where do you source funds for carrying out climate-change-mitigation related activities?

6. How often does your institution carry out activities on climate change mitigation?
7. Do communities have interest in programmes to mitigate climate change?
8. How does the ministry of education collaborate with your organisation in the implementation of climate change mitigation?
9. Do you charge listeners for the sensitisation programmes that you conduct?
10. Does your organisation training staff on matters of climate change mitigation?
11. Are you doing enough in sensitising the public on issues of climate change?
12. Which audience do you target?
13. How is the feedback from the communities?
14. How adequate are your messages for your target audience?
15. What are some of the successes you scored?
16. What challenges do you encounter in carrying out sensitisation programmes?

Thank you very much for having accepted to participate in this discussion and for availing yourself. Further details on this research could be obtained from either my supervisor or me.

Thank you

APPENDIX 5: AN OBSERVATION CHECKLIST

The University of Zambia

School of Education

Department of Mathematics and Science – Postgraduate

Topic of research: *An Educational Perspective on an Integrated Approach in Mitigating Climate Change in Mufulira*

1. The physical appearance of the building where learning takes place.

(i) Outside view

(ii) Inside view

(iii)The surrounding

2. The nature of Climate Change Mitigation activities in place.

(i) How the learners are appreciating the projects on Climate Change Mitigation in (JETS).

(ii) Content of the projects

(iii) Methodology

(iv) Participation input

3. Maintenance of the Environment.

(i) Planting of trees

(ii) Cleaning of the environment.

(iii)Involvement in production unit.