AN INVESTIGATION INTO ADOPTION OF MITIGATIVE AND ADAPTIVE STRATEGIES TO CLIMATE CHANGE: A case of construction materials manufacturing Business Enterprises in Lusaka Province.

By

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OF

COMPUTER NO.

717819342

A DISSERTATION SUBMITTED TO THE UNIVERSITY OF ZAMBIA IN PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE AWARD OF

MASTER OF BUSINESS ADMINISTRATION (MBAZ)

AT

UNIVERSITY OF ZAMBIA

INSTITUTE OF DISTANCE EDUCATION (IDE)

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Abstract

Climate change is a global problem that affects not just the physical existence of the world but the less physical aspects such as the economy. It is caused by both natural processes and by man's industrial activities. These causes results in the emission of greenhouse gases that eventually elevate the earths global temperature consequently affecting weather patterns causing extreme weather events such as droughts, floods, hurricanes and more. These disruptions negatively affect communities and businesses causing risks to not just human life but to business operations. The sectors that contribute toward economic progression have been affected by climate change due to extreme weather events that have caused shifts in how many activities have normally been carried out in the past. The construction sector which contributes to a country's economy through GDP contribution has equally been affected. Business enterprises that specialise in manufacturing of construction materials (located in Lusaka Province) are of particular interest in this research as that they feed into some of the inputs that the construction sector uses such as steel and concrete. These inputs are used in infrastructure development such as roads, buildings and bridges which positively contribute to the economic development of a country. However, these inputs also contribute to climate change via greenhouse gas emissions both during their production and as finished products. It is for this reason that this research endeavoured to establish what adaptive and mitigative strategies business enterprises are adopting and to reveal the influence that the lack of comprehensive implementation of climate change policy has had and to establish whether Change Management theories are being applied by business enterprises to guide them in their efforts to survive in the era of climate change challenges. The research used a descriptive type of research design with a case study approach. The data was collected using questionnaires with both open and closed ended questions. The analysis used mixed methods with tools such as Microsoft excel and SPSS version 20. The findings revealed that a significant number of enterprises lacked knowledge on the existence of climate change policy, further many of them did not use any change management strategies. Those that were knowledgeable claimed that there was a lack of finances to adopt climate smart strategies as these were seen to be expensive as such policy implementers provide more awareness and support systems.

Key words: *Business enterprises, climate change, policy, adaptation & mitigation and change management.*

Acknowledgements

I wish to acknowledge the assistance received from the following people who made it possible for this document to be finalised.

My supervisor, Dr. (Eng.) Matthew Saili, who tirelessly and promptly gave me guidance in conducting and compiling this dissertation. My husband Mr Siachaamba and two children Muyoba and Buumi, who encouraged and patiently endured the challenges that necessitated the completion of this work. I also want to thank the course coordinator for UNZA-ZOU Distance Graduate studies; Mr Donald Fulai and Dr William Phiri for their guidance.

Lastly but not the least, I also want to express my gratitude to the contact persons at Zambia Association of Manufacturers and Zambia Environmental Management Agency for their assistance in providing the information that built this research. Special thanks also goes to my classmates from the MBA class of 2017 to date.

Declaration

I, **Changa Katati**, do hereby declare that this work is my own, and that to the best of my Knowledge, it has never been produced or submitted before at this University or any other institution for academic purposes, and that all sources of information have been duly acknowledged.

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7NDP	Seventh National Development Plan, 2017 to 2021
CRS	Climate Resilience Strategies
DMMU	Disaster Mitigation and Management Unit
GDP	Gross National Product
GHG	Green House Gases
GRZ	Government of the Republic of Zambia
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Plan of Action
NASA	National Aeronautics Space Administration
NCCRS	National Climate Change Response Strategy 2010
NPCC	National Policy on Climate Change
NPE	National Policy on Environment
PMRC	Policy Monitoring Research Centre
SDG	Sustainable Development Goals
SNC	Second National Communication
TNA	Technology Needs Assessment
ZAM	Zambia Association of Manufacturers
ZEMA	Zambia Environmental Management Agency

CHAPTER 1: INTRODUCTION

1.0 Overview

This chapter presents the background on climate change, its causes and effects on the business enterprises in Zambia and world over. It stretches out a statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, limitations of the study, theoretical framework, conceptual framework, and operational definitions. The subsequent chapter will review literature that is relevant to the implications of climate change on business enterprises with special emphasis on the construction materials manufacturing enterprises.

1.1 Background to the Study

Climate change is defined as gradual changes in all the interconnected weather elements on our planet over approximately 30 years (National Geographics, 1996-2022). Moore (2017) describes climate change as a 'tide of commitment to justice and human rights, a swelling affirmation of moral responsibility to the future and to Earth's fullness of life'. One of the factors of climate change in an increase in the earths atmospheric temperature. This is caused by Greenhouse gases which are emitted from the earth's natural processes and by human activity. This then alters the climatic patterns of the earths regions, some experience droughts while others too much rainfall (NASA, 2020).

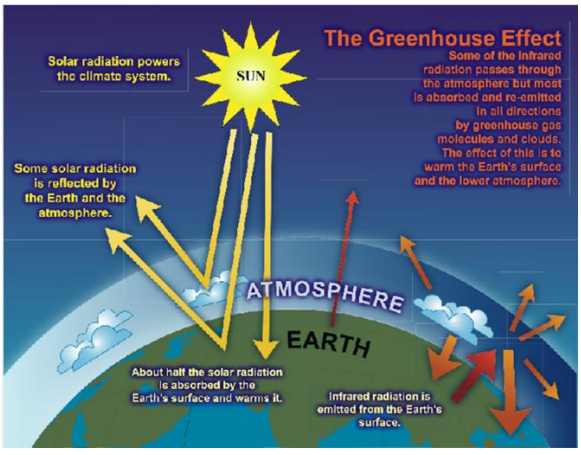

***Figure 1**: The greenhouse gas effect (source IPCC 2007)*

The frequency and intensity of climate events is expected to rise in future, with negative impacts on the economy and consequently people's livelihoods (Ministry of National

Development Planning, 2017). Countries around the world have now come on board to apply strategies that can help to manage and reduce the effects of climate change adaptation and mitigation. However, depending on the economic status of different countries, this will determine their ability to manage the challenges of climate change. Bulkeley & Newel (2015) in their book on governing climate change states that those who have contributed least to the problem of climate change in the past, including most of the world's poor, are those most susceptible to its worst effects now and in the future. They further add that, Meanwhile, richer countries are better placed to adapt to the climate impacts that they will suffer. (Besada, et al., 2009) affirms that climate change will affect Africa profoundly, but the continent lacks the resources of the developed world to cope with its effects. Developing countries such as Zambia which struggles with socio economic development is equally affected by climate change (GRZ, 2016). In Zambia, the effects of climate change have been documented in several reports and as such, this has become a matter of concern. The Disaster Management and Mitigation Unit (DMMU) which is a statutory government agency reported in their 2009/10 national contingency plan that 43 districts were likely be affected by floods and that these floods were likely to affect six sectors namely agriculture and food security, education, health, water and sanitation, habitation and human shelter and infrastructure (DMMU, 2009). Zambia like many countries depends on its various economic sectors for sustenance of its economy, among which are agricultural, mining, construction (which is closely tied to infrastructure), and many others.

The construction industry is an important sector of a country. In Zambia, it contributes to a relatively large proportion of the nation's Gross National Product (GDP). GDP is a measure of economic growth (GRZ, 2019). To this effect it is important to take keen interest in the players that exist within this industry and how their existence affects or contributes to climate change which has now become a global problem and has a bearing on the prosperity of world economies as it changes the normal ways of life for all stakeholders as the effects of climate change affect the whole world.

A study conducted in Kenya on Vulnerability and Adaptation Levels of the Construction Industry to Climate Change reveal the findings indicating that there is great need to initiate early warning systems, incorporate rigorous risk assessments to determine infrastructure vulnerability levels, integrate adaptation measures and strengths for infrastructure and buildings to continue functioning in a changing planet,

and avert retrogression and mark-timing development wise (Onkangi et al, 2018). The construction industry plays an integral part in the development of the economy and is one of the important catalysts for growth. Activities in the industry are driven by public and private projects, such as roads, stadia, hospitals, schools, and residential and commercial property (Ministry of National Development Planning, 2017). This fact in itself places emphasis on why the construction industry is of particular interest in this research. The industry continues to grow over the years at a steady annual average rate and may be directly attributed to increased public and private sector investment on infrastructure development.

Infrastructure development hugely depends of the use of construction materials which are a product of manufacturing activities and in their own production process and lifespan contribute to climate change adverse effects through emission of greenhouse gases. Despite great contributions of the construction industry's business enterprises, a number of challenges are faced by the industry, which required innovative solutions to overcome (Ministry of National Development Planning, 2017). These challenges include rising project costs, which could be attributed to the rise in prices of raw materials, labour and depreciation of the local currency in progressive years (Ministry of National Development Planning, 2017). This situation places business enterprises, that operate in the construction industry particularly those in manufacturing business, in a position to brace themselves for impact brought about by climate change thereby necessitating the use of strategies and adherence to policy that guides to help mitigate and adapt to effects of climate change. Business enterprises are faced with a number of risks due to climate change which include risks to business operations, risk to reputation, risk supply chains and so on.

These risks brought about by climate change, need to be covered through application of practices that will reduce their effect and also ensure the survival of the business enterprise by way of adaptation. The extent to which these business enterprises adapt to sustainable practices will dictate where the Zambian economy is headed years from now. Thus an investigation into the same can help improve Strategies and reveal areas of policy improvement for the betterment of the economy in future. The ability of business enterprises to respond to climate risks depends in no small measure on factors that can be shaped through policy intervention (Crick, 2017). Addressing global climate change requires concerted efforts from all nations – both developed and developing.

These efforts include assessing, planning and implementing relevant technologies and best practices, in a cost-effective manner to unleash mitigation and adaptation potentials in all sectors (Cam, 2012).This ultimately means that Zambia has to subscribe to Sustainable development which is a concept of utmost importance, for the survival of the earth. This has led to a global fight for sustainable development, with guidance of statutory instruments and policies that that been formulated in the quest to strategically manage the climate change challenges. Climate change is increasingly becoming a threat to future development plans, sustainability of existing infrastructure, and biodiversity conservation. The World Bank (2008) affirms that climate change is a serious environmental challenge that could undermine the drive for sustainable development. Assessment of vulnerability levels, adaptation measures, models, and climate change variables have majorly focused on biological systems. Besides biodiversity, the construction industry faces equally high threats from climatic changes with enormous carbon price-related risks.

Human activity has resulted in damage to the environment. This damage has affected all sectors of the world at national level and international level ultimately affecting even the strongest of world economies. This is evident in the changes of weather patterns which have emerged as a consequence of the industrial activities of man in production processes in diverse sectors. These changes in weather have caused extreme weather variations, some aligned to excessive rains resulting in floods, while others have cause droughts that have impacted the availability of food due to reduced harvests or damage to crops (GRZ, 2016).

Construction in the developing nations is gaining momentum and is a development indicator as well as a major contributor to GDP. However, infrastructure is very vulnerable structurally and financially to extreme weather conditions and events. This calls for a paradigm shift in conducting business in the construction industry in developing countries. The production of construction materials is among some of the activities that transpire in the construction industry. These materials contribute to climate change concerns as most of them result in emission of greenhouse gases during production and further during their use or life span. Examples of such materials are steel and concrete. It is therefore important to investigate what strategies are being employed by business enterprises to counter the effects of their activities on climate change and other activities that they have implemented in their operations to help

mitigate the challenges that come with climate change. There is even greater need to look at the climate change policy and how it helps or impedes climate change mitigation strategies of business enterprises with regards to adaptation. Some business enterprises have had to revisit their strategies on supply chain management or the use of climate smart technologies as these have helped them survive in this robust economic world confounded by climate change policy and climate change weather effects that have disrupted or changed business as we know it. Government has mandated specific institutions to provide policy guidelines and implementation. However, the climate change agenda in Zambia is not only a donor construction: Although the issue is not high on the political agenda, there are de facto government interests related to climate change (Funder et al, 2013). He also adds that donors have played a central role in nurturing and influencing the climate change agenda in Zambia, and in developing the institutional framework for disaster management and climate change.

In Zambia, policies and programmes on climate change are largely in place together with relevant governance and institutional structures, but the challenges of integration of climate change across all sectors, as well as implementation of policies remain (ZCCA, 2016). Climate change challenges in Zambia has generally been attributed to a lack of capacity. In addition, lack of information on climate change that is suitable for different audiences is said to be slowing down the pace for adoption of adaptation strategies and coping against climate change (Fumpa-Makano, 2011). However, without clearly defined methodologies for assessing both climate change risks and opportunities, the material financial impacts of climate change and associated adaptation initiatives will continue to go unreported and unmeasured (West & Brereton, 2013). In view of this, the current study investigated the adaptation and mitigation strategies of business enterprises in the wake of climate change and explored the relevant policies that exist in Zambia to fill a knowledge gap that will provide information relevant for all stakeholders with regards to climate change.

1.2 Statement of the problem

A lack of comprehensive implementation of climate change policy will influence adoption of mitigation and adaptation measures to climate change in 'construction materials' manufacturing business enterprises in Lusaka Province.

To investigate this phenomenon, it entailed looking closely at the adaptation strategies that business enterprises are employing to counter the effects or challenges of climate change and to also look at climate change policy. Additionally, there is no known study conducted in Zambia on business enterprises, specifically those in the business of manufacturing construction materials with regards to climate change. This created a knowledge gap that this study sought to fill. Climate change assessments, identification of vulnerability, and risk management are the first line of defence towards developing adaptation measures. Adaptation would not be possible in the absence of reliable and timely data. This information is expected to be sourced from policy documents and enhanced through comprehensive implementation and monitoring of activities of business enterprises to ensure adherence to guidelines.

1.3 Aim of the study

This study aimed to investigate the level of adoption of mitigative and adaptive strategies to climate change with special emphasis on business enterprises that manufacture construction materials in Lusaka Province.

1.4 General Objective of the Study

The general objective of this research was to emphasise the role of business enterprises in climate change adaptation and mitigation while examining the policy guidelines that exist in Zambia.

1.4.1 Specific Objectives of the study

a) To establish the current adaptation and mitigation measures to climate change being employed by business enterprises that manufacture construction materials in Lusaka Province.
b) To examine the current policy guidelines that support climate change adaptation and mitigation measures by business enterprises in Zambia.
c) To establish the existence of any Supportive mechanisms that encourages business enterprises to engage in adoption of adaptation and mitigation strategies.

1.5 Research Questions

The following research questions were explored in order to provide guidance and focus on the subject matter:

a) What are the current adaptation and mitigation strategies to climate change being employed by business enterprises that manufacture construction materials in Lusaka Province?
b) What are the current policy guidelines that support climate change adaptation and mitigation measures by business enterprises in Zambia?
c) What Supportive mechanisms exist that encourages business enterprises to engage in adoption of adaptation and mitigation strategies?

1.6 Significance of the Study

The significance of this study was to provide current information on the state of business enterprises in relation to their role to help curb climate change challenges. This information would be usable to the formulators of policy documents, the regulators of the environment such as the Zambia Environmental Management Agency to the very manufacturing enterprises, who will learn from each other on how best climate change can be managed. The research study endeavoured to establish the level of adoption of mitigative and adaptive strategies by business enterprises, and to establish whether lack comprehensive of implementation of climate change policy was an influencing factor. Further, the study sought to inform and inspire companies to anticipate and adapt to climate change and to engage policymakers to support business enterprise's contributions to climate change adaptation for more resilient communities and societies; and also encourage civil society organizations, universities and research institutes, and other non-governmental actors to see business enterprise's as key partners in contribution to economic development.

1.7 Limitations of the Study

This study was limited to Lusaka province and captured business enterprises that manufacture construction materials.

1.8 Theoretical Framework

A theory can be used to test or run an enquiry during the study which is either qualitative, quantitative or both (Creswell & Creswell, 2018). The theoretical framework shows the relationship of variables of a research study and how these interact with each other hence giving the study some kind of form (Swanson & Chermack, 2013). The former author also notes in another 2007 publication of his, that 'theory framework' must articulate

researcher and practitioner perspectives in language, components and structure. The theoretical Framework is said to be able to take different forms depending on the researchers conceptualisation of society or an ideology (Gilbert, 2008). This research used the Change Management Theory.

1.8.1 Change Management Theory

Change management theory articulates, in a systematic way, how strategies, activities or programmes contribute to a set of specific outcomes through a series of intermediate results. It describes the pathway through which change will come about. It also describes the underlying assumptions and conditions necessary to bring about this change (Ministry of National Development Planning, 2017). Climate change is a form of change that many business enterprises will have to reckon with. This is in the context of how the economy can be diversified; what results are needed to attain diversification; and what interventions will bring about these results. Change of any kind especially that which is revolutionary or radicle, requires strategies and innovations on the part of the affected party in order to ensure survival and ability to thrive in a new or dynamic environment.

There are many theories of change management out there especially in an age dominated by digital change and transformation. According to (Bruce, 2013) Change management models can include theories that:

a) Describe group psychology and group dynamics
b) Explain processes and procedures
c) Offer step-by-step action plans

1.8.2 Features of Change Management theory

The best models of Change Management theory are those that include: Ideas grounded in psychology, social dynamics, business, and other disciplines, Practical action plans designed to execute change and Frameworks that act as a lens, which helps practitioners understand why they do what they do.

Change management principles, models, and theories are very useful to change practitioners. These models give change managers the materials they need to succeed in organizational change (Bruce, 2013). The best ones include:

a) Frameworks that act as a lens, which helps practitioners understand why they do what they do.
b) Ideas that are grounded in psychology, social dynamics, business, and other disciplines.
c) Practical action plans designed to execute change.

(Bruce, 2013) further explains the following models on change management:

1. **The Lewin Change Model-** This model has been applied greatly in change management and organizational change and is easy to grasp.

   Kurt Lewin is considered to be one of the forefathers if not the forefather of change management, organizational development, and social psychology. Of all the theories of change Management, Kurt Lewin's ideas have been criticised the most and although simple in nature, his models are quite powerful. Change practitioners who use this theory exclusively can leverage its simplicity, then create their own roadmaps and tactics. However, people who want step-by-step action plans will likely prefer one of the theories mentioned below.

   Every change, he says, follows a 3-step process that starts by addressing existing mind-sets. These steps are:

   a) Unfreezing – First, a process must shift away from its current state. This is accomplished to overcome inertia, bypass defence mechanisms, and dismantle current viewpoints.
   b) Transition – The second stage is where the change occurs and It can involve confusion and uncertainty. The end goal is not always clear.
   c) Freezing – The final stage of transition involves replacing the old ways of thinking and operating. People begin to return to their comfort zone and feel more comfortable with this new status quo during this stage.

2. **Kotter's 8-Step Model for Change-** This change model is useful for those who want more than just theory but also want a framework to follow.

John Kotter's theory of change management is specifically tailored for change management and organizational change. He is a leading authority in the change management industry. It is applicable, straightforward, and easy to map out making it easy to follow and implement. His theory has the following 8 steps:

i. Create a sense of urgency
ii. Build a guiding coalition
iii. Form a strategic vision and initiatives
iv. Enlist a volunteer army
v. Enable action by removing barriers
vi. Generate short-term wins
vii. Sustain acceleration
viii. Institute change

3. **Prosci's ADKAR Model-** The ADKAR framework is another change management model that was developed by Jeff Hiatt, the founder of Prosci. This theory is designed as a roadmap and execution plan. Similar to Kotter's model, this change model is ideal for change managers who want theory plus application.

   It consists of 5 stages:

   i. Awareness of the need to change
   ii. Desire to support change
   iii. Knowledge of how to change
   iv. Ability to demonstrate skills and behaviour
   v. Reinforcement to make the change stick

The theories above can be applied in the adoption process by using a step by step process to initiate change by use of a combination of models. This will establish how enterprises are formulating their strategies to ensure that the respective strategies have a guiding framework that ensures proper execution and desired results.

1.9 Conceptual Framework

The conceptual framework of this research borders on two main variables, the first variable being independent and the second dependent. These respectively are: the lack comprehensive implementation of climate change policy, and the poor adoption of adaptive and mitigative measures to climate change by business enterprises. There are other variables that are present in the conceptual framework as shown in the figurative representation which are the moderating and intervening variables. A supportive policy environment is essential to catalyse broader private sector engagement and facilitate scale-up and replication of effective approaches already underway (United Nations, 2012). According to change management theories, there exist barriers that hinder change in any environment. Climate change is a kind of change and it affects the whole world from households to businesses, even the overall economy has been affected by climate change. Business plays a crucial role in building resilience within economies and societies and contributing to environmental protection (CRS, 2011). This research asserts that use of change management theory in the adoption of adaptive and mitigative measures to counter climate change can help to ensure that business enterprises embrace change. Why is it important to embrace change in this situation? The answer is simple- Business enterprises contribute a great deal to the economy of a country not just through its operations that generate revenue that ends up as tax paid to government which is used for various development projects but also through the provision of products that are used in construction of infrastructure. This being said the construction industry is a great contributor to the national economy. Hence, because of this nexus, there is need to ensure that business enterprises are equipped with the necessary tools to enhance their ability to positively contribute to national economic growth by monitoring and guiding on sustainable processes and products that are climate friendly, this mandate is safely placed in the hands of selected regulatory bodies whose role is to implement climate change policy. Simatele (2010) urges that the challenges emanating from severe weather will always be an immense task and will compromise both local and national development if climate change specific legislation is not strengthened. However, even with the existence of these regulatory bodies there is still a trend of most business enterprises to not subscribe to adoption of adaptive and mitigative measures, such as resorting to alternative power options or green processes, and reducing greenhouse gas emissions resulting from operations. Hence, there exists a close

relationship between the development of an economy and the various manufacturing enterprise's operations. Worldwide, a growing number of companies are beginning to pursue adaptation measures designed to anticipate, avoid, absorb and recover from climate impacts (Cameron, 2019).

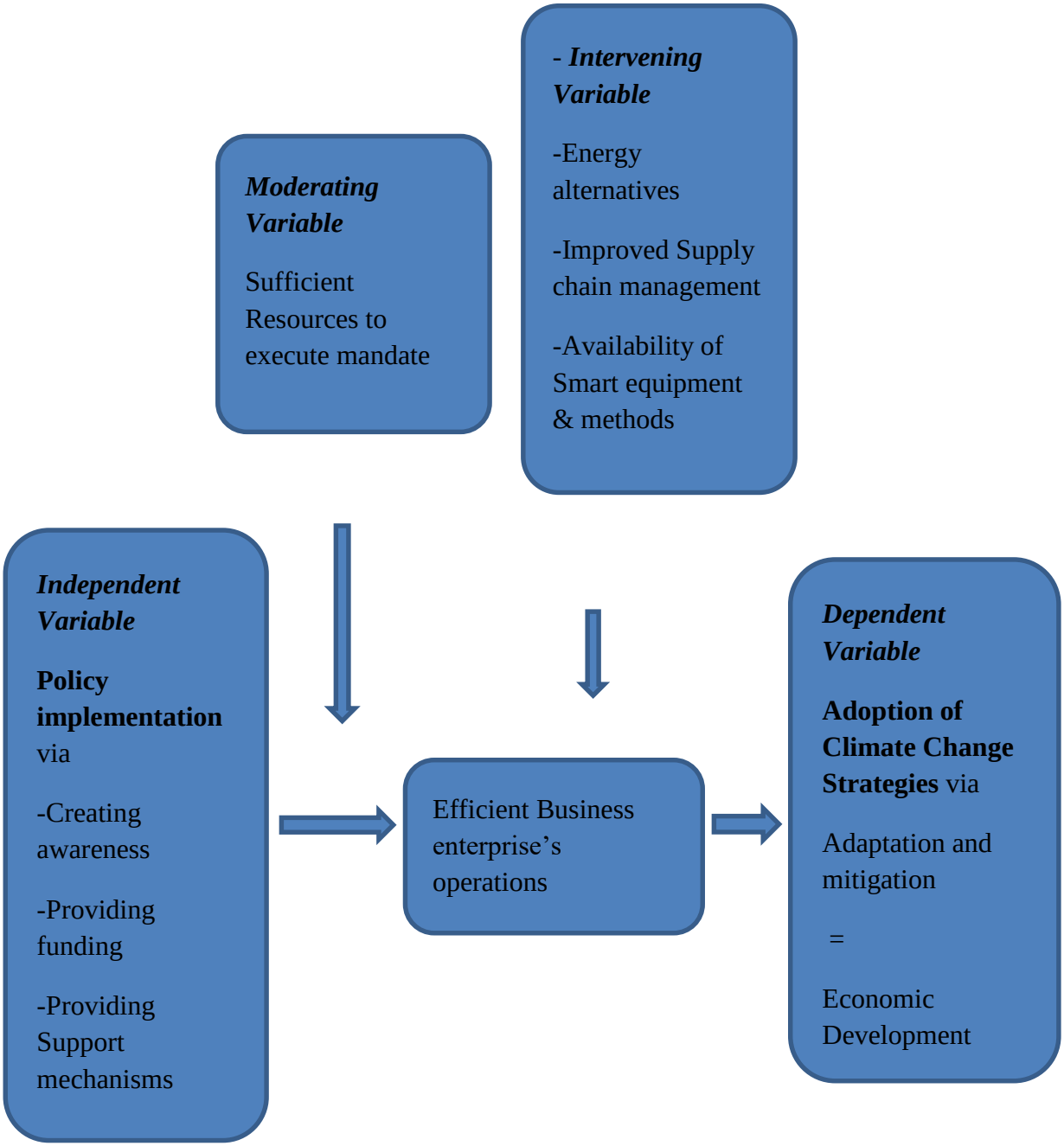

***Figure 2**: Conceptual Framework*

Source: Self designed representation to show Conceptual framework

1.10 Operational Definition of Terms

Construction materials means major material used in the construction process of infrastructure like buildings or other civil works i.e. concrete/cement and steel.

Policy means any formal documents that guide stakeholders on how to behave or act with regards to climate change.

Adaptation: means any methods, strategies or processes that are used to mitigate or counter the effects of climate change by business enterprises. It involves adjusting to actual or expected climate change effects. This includes managing risk and exploiting opportunities.

Mitigation focuses on limiting the speed and scale of climate change. It has typically received the most attention in policy circles, such as debates over carbon pricing as a mechanism to reduce GHG emissions across the economy.

Business Enterprises shall mean any registered business, entity that deals in manufacturing of construction related materials by ZAM

1.11 Ethical Considerations

Saunders et al (2012) states that ethics are standards of behaviour that guide a researcher work in relation to right or wrong. (McLaughlin, 2012) cites a named author in his book on the topic of ethics, he adds that knowledge and skills for ethical practice include the moral concepts of rights, responsibility, freedom, authority and power. This simply means that the participants rights and freedom must be upheld, allowing them to freely participate without prejudice and allowing them the freedom to discontinue at will. In the course of a research, researchers need to be able to adequately prepare themselves of the emergence of ethical issues by stating that consideration of ethical issues is critical to the success or failure of any high-quality research involving humans (Berg, 2001). Hence, clearance was gotten from the University of Zambia Ethics Committee to ensure that ethics were upheld during the conduct of the research. The researcher also obtained informed consent before administering the questionnaires and enlightened participants of their freedom to withdraw should they feel the need to and assured them that confidentiality would be upheld. This is important to avoid bringing the University of Zambia's good name to disrepute.

CHAPTER 2: LITERATURE REVIEW

2.0 Overview

The preceding chapter presented an introduction to this study. This chapter reviews literature on what climate change is, its causes, worldwide effects of climate change, the Zambian scenario of climate change, policy framework and effects of climate change on business enterprises in the same vein.

Literature review can be said to simply be a collection of information that the researcher wishes to analyse and use as a point of reference in their own research. It helps the researcher to establish which methodology is suitable for a particular research. This information can come in various forms that are either or both published and unpublished from previous authors who have written about a similar issue to that which the researcher intends to investigate. Creswell & Creswell (2018) adds that literature review helps the researcher to determine whether a topic is worth studying and provides insight into ways which the researcher can limit the scope to a needed area of inquiry.

Review of literature, mostly through secondary data, will look at relevant literature to establish findings reveal from other studies done on the role of business enterprises in climate change adaptation and mitigation in Lusaka province of Zambia. Secondary data will include; reports, similar documents, articles, Magazines, papers, journals, and published books.

2.1 Back ground on Climate Change

Increasing levels of carbon dioxide in the earth's atmosphere have been recorded and been attributed to the industrial processes done by human (NASA, 2020). The foregoing statement necessitates an investigation into the adaptation and mitigation measures employed by manufacturing industries in the construction industry in the wake of climate change which has paused a number of risks for the business enterprises.

Climate change can result from natural processes and factors and more recently due to human activities through our emissions of greenhouse gases. Examples of natural factors include;

i. Changes in the sun's intensity.

ii. Volcanic eruptions, or slow changes in the Earth's orbit around the sun.

iii. Natural processes within the climate system such as changes in ocean current circulation.

However, the current global aim is to tackle climate change resulting from human activities whose greenhouse gas emissions are changing the composition of the earth's atmosphere. Intergovernmental Panel on Climate Change (IPCC) which is a United Nations body for assessing the science related to climate change, prepares comprehensive Assessment Reports about the state of scientific, technical and socio-economic knowledge on climate change, its effects and impending risks, and possibilities for decreasing the rate at which climate change is taking place. IPCC in the Third Assessment (2001) report states that;

'Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic (produced by humans) greenhouse gas emissions'. Examples of human activities contributing to climate change include;

i. Carbon dioxide emissions through burning fossil fuels such as coal, oil and gas and peat.

ii. Methane and nitrous oxide emissions from agriculture.

iii. Emissions through land use changes such as deforestation, reforestation, urbanization & desertification.

These emissions that are changing the composition of the earth's atmosphere are termed the Greenhouse effect. The burning of fossil fuels, such as coal and oil, and deforestation have caused the concentrations of heat-trapping greenhouse gases to increase meaningfully in our atmosphere. These gases prevent heat from escaping to space. Hence, this research aims to investigate the adaptation of manufacturing industries in the construction industry in the wake of climate change which has paused a number of risks for the business world as it affects the survival of not just the earth but the business world.

The effects of climate change have a bearing on all events that take place in the world. Human activities that support economic development have been identified as one of the

major causes of climate change. Most of these activities such as industrial waste, harmful burning of fossil and certain agricultural practices can result in not just pollution but damage to the environment. Cameron (2019), adds that climate change will likely lead to serious, systemic, and global consequences, posing risks to economic activity and development aspirations across the globe. The consequences are said to be global, meaning that even countries that do not have advanced manufacturing industries will be affected. Bulkeley & Newel (2015) affirms this fact. Besada et al (2009) adds that climate change will affect Africa profoundly, but the continent lacks the resources of the developed world to cope with its effects. The continent is known to grapple with a lack of skilled labour, immense levels of poverty and weak institutional frameworks that contribute to poor policy formulation and implementation (Besada, et al., 2009). The IPCC report of 2014 narrows down a sad development that it is the underprivileged whose subsistence emanates from agriculture compounded by a lack of basic necessities of life such as water, that will be affected the most. Watson et al (2013) reveal that Zambia depends heavily on rain fed agriculture on which the majority of the population relies for their livelihoods. He adds that Zambia has large climate variability across the country making it difficult to predict climate change impacts. Further, the increased frequency and severity of floods also threaten Zambia's existing and planned infrastructure. Business enterprises that manufacture building materials are an important component to infrastructure which has a nexus with construction, which is a great contributor to GDP.

To narrow the effects of climate change to the economy of a country, it is necessary to investigate how climate change affects business enterprises and how they are adapting to sustainable practices to ensure their survival and mitigation measures to reduce of their carbon foot print.

The Seventh National Development Plan documents Zambia's vulnerability to climate change (Ministry of National Development Planning, 2017). Fumpa-Makano (2011) also notes that Zambia had the highest rate of deforestation (851, 000 ha) in Southern Africa, which alone accounted for almost half the deforestation in the SADC region making it even more vulnerable to climate change impacts. The 2009 DMMU report reveals that changes in weather patterns caused abnormal rainfall resulting in serious floods that led to displacement and loss of property of over a million people (DMMU,

2009). Therefore, climate change adaptation and mitigation will, therefore, promote social wellbeing, including better health, growth of the economy and at the same time reduce environmental risks, such as shortage of water, air pollution and other effects (GRZ, 2017). Inadequate infrastructure – Inadequate levels and low quality of infrastructure development lead to low economic activity and high production costs which result in low competitiveness (DMMU, 2009). Critical infrastructure, such as housing, electricity, feeder roads, rail, air and water transport and water supply and sanitation has not been adequate to facilitate the desired levels of economic transformation and leverage private investment (GRZ, 2017). A study done in 2021 examine the risks from climate change that are currently being experienced and further explores current and future adaptation strategies and barriers to adaptation (Rawlins & Kalaba, 2021). However, colossal sums of money are estimated to be needed to embark on the journey to address adaptation, costing above 5 billion (MTENR, 2010).

The adverse effects on business enterprises dictates that a move in the right direction to ensure survival of the economy world over be made, thereby necessitating the phenomenon of sustainability through adaptation and mitigation to ensure development despite the status quo.

The BBC news documents on their webpage submitted in 2013 on the history of climate change, which goes as far back as the 1700's. It is only after the creation of the first steam engine by British ironmonger Thomas Newcomen that births Industrial Revolution and industrial scale use of coal. In the consecutive years in 1824 that French physicist Joseph Fourier describes the Earth's natural "greenhouse effect". This started the awareness of climate change effects and eventually in 1988, the Intergovernmental Panel on Climate Change (IPCC) was formed to collate and assess evidence on climate change (BBC News, 2013). Thereafter, several international organisations came on board to see how best the earth could be saved by formulating sustainable solutions to reduce emissions of greenhouse gases so as to reduce climate change effects. Among these is the United Nations. The United Nations are strong advocates for building green economy's. They alongside other stakeholders formulated Development goals among which are those designed to create awareness about climate change and further mainstream it into several national policies of countries around the world. Several events document some of the adverse effects of climate change below.

In the year 2017 Houston experienced its third "500-year flood" in less than forty years, California suffered five of its 20 worst wildfires ever and parts of the Indian subcontinent were submerged for days following epic monsoon downpours. One study found that accounting for physical risks to corporate assets would shave 2-3% off the total market value of over 11,000 globally listed firms. That is less than many stocks move in a given day, and a fraction of the estimated 15% downward effect of a transition to cleaner energy. Different from the energy transition, though, some physical harm to corporate assets is all but certain. Not only that, but the risks rise as the world warms.

Some companies may have to invest significant funds into upgrading polluting facilities and installing emission control systems in order to conform with increasingly stern regulations on the emission of greenhouse gases into the atmosphere. Under this pollution reduction legislation being considered by Congress, companies would be allotted a certain amount of emissions credits, allowing them to legally release only a certain quantity of greenhouse gases into the air. Companies that emit more than their credits allow would be required to buy additional credits, hurting profitability. On the other hand, companies with excess credits could sell them for additional cash. Unfortunately, companies that do not produce much pollution may be indirectly affected by climate change laws since their suppliers and/or customers may be affected. It is quite possible that there could be wide-ranging changes in prices caused by things like increased transportation costs or higher electric rates. The combination of changing prices and changing weather patterns would likely cause changing demand for goods.

From the above, it can be seen how climate change has had an impact on the world. This has necessitated the birth of international agreements and standard instruments that nations have ratified to provide guidance on how to manage climate change. To this effect, the Paris Agreement was adopted on 12th December, 2015 at the 21st session of the conference of the parties held in Paris, France, following successful negotiations by 195 Parties to the United Nations Framework Convention on Climate Change-UNFCCC. This agreement commits parties to implement determined efforts to combat climate change and adapt to its effects while promoting sustainable development. Several other statutory documents have been brought forth to provide detailed guidance on environmental protection issues such as the CERES Principles and

ISO14001. The Paris Agreement of 2015 also considers developing countries via enhanced support and seeks to bring all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.

2.2 Climate Change and Global implications for business enterprises

There are variations on how climate change will impact business enterprises. Those located in certain geographic areas might be more impacted by climate change than others. Similarly, it's clear that not all businesses and business sectors will be equally exposed to climate risks (Forfás, 2010). A study conducted in Ireland in 2017 on adaptation to climate change summarises the implications of climate change on business enterprises to hinge on the following:

i. Markets: climate change could change demand for goods and services.

ii. Logistics: climate change could increase vulnerability of supply chains, utilities (in particular water and energy), transport arrangements and communications.

iii. Premises: climate change (such as more frequent flooding events, storms, coastal erosion, etc.) could impact on location, materials, building design, construction, maintenance and facilities management.

iv. Finance: climate change could have implications for investments, insurance and stakeholder reputation.

v. People: climate change could have implications for workforce, customers and changing lifestyles.

vi. Processes: climate change could have impacts on production processes (in particular cooling requirements) and service delivery.

These potential climate change impacts expose business enterprises to various risks which need to be approached cautiously with adequate information, comprehensive policy guidelines and support. There are variations on how climate change will impact business enterprises. Those located in certain geographic areas might be more impacted by climate change than others. Similarly, it's clear that not all businesses and business sectors will be equally exposed to climate risks (Forfás, 2010). Some of the impacts on business are indirect, like changes in how insurance firms assess natural disaster risk,

while others are clearly direct, such as Coca-Cola's fear of water scarcity and IKEA's dread of deforestation. These and more immediate physical impacts are leading companies to invest in new processes and technologies to mitigate risk they are exposed to as a result of climate change. Less intuitive impacts also exist that relate to the transition to a carbon-free economy, as well as new developments in how customers, investors, business partners, and regulators make decisions.

There are multiple impacts of climate change on companies, other than risks alone, climate change creates a series of new business opportunities (Forfás, 2010). Besides the most obvious physical risks (for example, the operational impacts of extreme weather events, or supply shortages caused by water scarcity), companies are exposed to transition risks which arise from society response to climate change, such as changes in technologies, markets and regulation that can increase business costs, undermine the viability of existing products or services, or affect asset values. Climate change also offers business opportunities were companies can aim to improve their resource productivity through energy efficiency which reduces. Further, climate change can spur innovation, inspiring new products and services which are less carbon intensive or which enable carbon reduction by others. Furthermore, companies can enhance the resilience of their supply chains, for example by reducing dependence on price-volatile fossil fuels by shifting towards renewable energy. Together, these actions can foster competitiveness and unlock new market opportunities.

Globally business enterprises have been affected by climate change due to the risks that they are faced with as a consequence of climate change adverse effects. A report on climate change adaptation done in 2011 in Asia lists the following as the risks businesses are exposed to due to climate change adverse effects;

a) **Risks to core business operations**: These stem from direct impacts on physical structures and assets such as production facilities or buildings. Impacts such as temperature changes or weather extremes can influence the "effectiveness or efficiency of production processes, the cost of operations and maintenance activities, or the quality of a product".

b) **Risks to the value chain (including the supply and demand network):** These include risks related to the availability of production inputs, changing consumer

demands, and consumer access to products. Climate change could affect the availability and quality of natural resources, particularly water, utility services, logistics networks, and the health and safety of workers. In the U. S., heat waves and drought significantly affect agricultural production, including corn, wheat, soy and cotton. Without adaptation, some estimates show crop yields in Midwestern and Southern counties declining more than 10% during the next 20 years. A shortage of drinking water or food can affect companies in parts of the world prone to droughts, heat waves or pollution.

c) **Risks to local communities:** These include risks that directly impact the local labour force and indirectly impact corporate community investment programmes that support local community development. As business comes to recognise the strategic importance of thriving communities, climate change impacts that negatively impact local livelihoods will become more relevant in business continuity planning.

d) **Risks from economic and social changes**: In developing countries highly vulnerable to climate change there is a risk of humanitarian crises, conflicts, and instability. Climate change can contribute to a situation where environmental refugees will be forced to migrate, competition over scarce resources will increase, and ethnic tensions can be exacerbated. Recent storms and floods have already led to temporary and long-term dislocation of millions of people in the Philippines and Sri Lanka. Additionally, some authors include other risks as below:

e) **Risk of Physical Damage to Buildings and Operations**-Supplies and equipment as a result of flooding or other extreme weather events can be costly. Extreme weather events can also disrupt business by halting manufacturing or making it impossible for employees to get to work. Companies around the world are preparing for climate change and as a result, they are investing in resilient buildings that can better withstand damage from storms, strong winds and flooding. Developing countries may offer investment opportunities in new construction and infrastructure projects that are built to hold up under extreme weather events. In the U.S., investments can include companies that help refit existing buildings and reinforce energy infrastructure for more resilience.

f) **Risk to Business Opportunities-** Investors are now looking into companies that are on the leading edge of creating products that help the environment and also help other companies get out of “dirty” industries. Companies that stick with processes and products that are seen as environmentally “dirty” can miss out on new opportunities for growth. In 2017, Morgan Stanley launched the Climate Change Mitigation Index, which highlights the potential for innovations that mitigate climate change and provides potential market-rate returns. As economies around the world transition to lower carbon economies, investors could benefit from investing in companies that are positioning themselves for this transition and mitigating the effects of climate change.

g) **Risk to Reputational**-Reputation is enormously important to many businesses. Many firms today are working hard to promote a green image. BP is one company that has invested heavily in this trend with its "Beyond Petroleum" campaign. The company has also invested billions in renewable energy projects to prove its sincerity. Companies are exposed to potential liability for emitting greenhouse gases (GHG) and as a result, there has been an increase in the number of legal cases brought directly against fossil fuel companies and utilities in recent years, holding them accountable for the damaging effects of climate change. Customers may shun a company that is involved in an environmental or public relations crisis. Companies with the best quantitative and qualitative disclosure and management practices would be an attractive investment area. Investors who have a goal of achieving positive environmental impact can look to green bonds for an accessible way to invest in low-carbon assets that may receive a similar return to a regular bond.

The types of businesses that are most at risk from climate change include:

a) Businesses dependent on climate or weather-sensitive resources: Agriculture, forestry, agro-forestry, fishing, aquaculture, and tourism sectors are already experiencing impacts from increased climate variability. Changing seasonal precipitation patterns, droughts, and floods are affecting yields and profits throughout the region.

b) Businesses that make long-term investments and operate long-life assets: These include utilities such as energy or transport, industrial facilities, and ports with a long operational life. Future climate change impacts pose risks to the efficiency and service delivery of these systems and will challenge their robustness and resilience.

c) Businesses with extended supply chains: These include businesses that rely heavily on logistics and supply networks. Those who practice lean manufacturing based on just-in-time delivery and single source supply chain management are particularly vulnerable to disruptions that will restrict their flexibility and challenge their ability to adapt.

d) Businesses that are global in nature: Global supply chains increase a company's vulnerability to disasters since natural hazards at one location can trickle through the supply chain and create significant business disruptions. Strong interdependencies in the production process also increase the likelihood of business interruptions following a flood or storm.

e) Businesses that are labour intensive and highly dependent on local workers: Local climatic disruptions may affect workers' abilities to work or even to stay resident in a particular location. Agricultural sector businesses are among such.

f) Small, medium, and microenterprises: The impact of a natural hazard can put these types of enterprises out of business since they do not have the capacity or resources to cope with and recover from major business disruptions. The bulk of business enterprises are small scaled enterprises.

2.3 Global Adaptation and mitigation for manufacturing business Enterprises

Globally Businesses have become increasingly aware of the critical role they play in enabling effective, timely, and appropriate adaptation. They recognize the risks that climate change poses, not only for their operations, but also to their suppliers, employees, customers, and people living in the areas in which they operate. Businesses have also begun to recognize opportunities to expand operations and increase their market share through developing climate-resilient products and services to help people, other businesses, and governments adapt.

Business contributions to climate change adaptation play a very important role in supporting sustainable development and efforts to build the green economy, while also promoting a company's viability, profitability, and competitive edge. Some international market-leading businesses have started to analyse climate change risks and opportunities, and important efforts are already underway to implement adaptation measures in many of the world's emerging economies and developing countries, which represent valuable markets for new business opportunities. Business-led adaptation interventions are particularly important in developing countries, where poor communities have significant exposure to climate change impacts. The ten case studies in this report represents a wide range of industries, from financial services to construction to consumer products, and adaptation solutions applied across the globe, from Bolivia to Kenya to the Philippines. The cases illustrate how companies contribute to climate change adaptation in three spheres of action by:

a) Instituting new practices within their own operations to manage climate risks and impacts;
b) Developing products and services that help vulnerable countries and communities adapt to climate risks and impacts; and
c) Engaging with governments, communities, and other stakeholders to put policies and ground-level practices in place that contribute to long-term resilience.

The importance which Businesses assign to climate resilience is influenced by business strategies, management priorities and risk perceptions (Crick, 2017). Most invest in renewable energy such as installing solar panels and other efforts to lower their carbon footprint

Romdhani et al (2008) declares that Climate change is slowly being introduced into Zambian development policies, such as urban planning and national development strategies. He further says that the shift is taking place because climate change related droughts and floods have had significant effects on the country, and because international aid is increasingly directed toward climate change policies. It is estimated that the impact of climate change will cost Zambia approximately 0.4 percent of annual economic growth. It is further estimated that without action, rainfall variability alone could lead to losses of 0.9 percent of GDP growth over the next decade, thereby keeping

a significant section of Zambia's population below the poverty line. In addition, the fall in the country's hydro-power generation in the recent period by about 600 MW is mainly attributed to poor rainfall patterns. The lower supply of electricity has hampered growth prospects of Zambia's productive sectors of the economy, including agriculture, manufacturing, mining and services. Other adverse effects have led to increased costs of treating climate-related diseases such as malaria and the loss of natural environments, damage to infrastructure and disruption of biodiversity.

The manufacturing businesses lie in the subset of manufacturing industries. These industries produce a wide range of products whose production process requires huge amounts of electricity and water. According to the International Labour organisation on their website asserts that utilities are essential services that play a vital role in economic and social development, it adds that they are a prerequisite for effective poverty eradication.

Many developing countries face rapidly increasing water demand in future (Bijl, et al., 2015). In the US according to the Energy Information Administration survey of 2017, 32% of energy consumption emerges from the industrial sector of which manufacturing is a subset. In German, 50% of total electricity produced is consumed by industrial uses (Javied, et al., 2015). A study conducted in Ghana by Abokyi, et al (2020), recommends that government should also strengthen its energy efficient measures, which ensure that firms in industrial sector avoid the use of obsolete and inefficient equipment and machinery or ban their import into the country.

Studies have shown that without sustainable practices mismanagement of utilities have negative implications both on the environment and on the cost of manufacturing in which case when water resources become scarce, the suppliers of electricity have to charge higher tariffs in order to meet demand. This ca further result in power rationing which can negatively affect manufacturing processes. Lafarge Zambia reported in their 2015 annual report that their profits were down by 25% due to rising costs of power and other inputs (Ahmed, et al., 2019).

A 2012 report by the UN Global Compact and UN environment programme entitled '*Business and Climate Change Adaptation: toward Resilient Companies and Communities*' presented ten case studies from a broad range of Caring for Climate and CEO Water Mandate companies. These cases illustrate how businesses are responding creatively and effectively to address climate change opportunities, risks, and impacts in

developing countries and emerging economies. Among the ten case studies is Hindustan Construction Company-HCC whose concern is the growing water scarcity and drought in India, this prompted it to consider "sustainable water resource management. HCC adopted a rigorous, company-wide framework for improving water resource management. Through its environmental management systems, the company has implanted a wide range of sustainability measures into its core operations, has made reduction of water use across its construction project sites a priority, and beginning in 2008, HCC adopted a rigorous, company-wide framework for improving water resource management. The Company is applying innovations in water treatment and rainwater harvesting to large-scale infrastructure projects in India that contribute to the company's goal of water neutrality by taking the "4R" approach to water interventions (reduce, reuse, recycle and recharge). This prompts the need for business enterprises to be innovative to counter climate change and its negative effects which presents both risks and opportunities. Of course it is worth noting that, each company addresses adaptation from a unique perspective. According to a report by the United Nations Global Compact and United Nations Environment Programme in cooperation with the CEO Water mandate published in 2012, companies pointed to the essential leadership role that government policymakers must play in catalysing, facilitating, and supporting business engagement in climate change adaptation that benefits vulnerable communities. Climate volatility may force companies to deal with uncertainty in the price of resources for production, energy transport and insurance. And some products could become obsolete or lose their market.

2.4 Policy framework on Climate Change in Zambia

Policies and programmes on climate change are largely in place together with relevant governance and institutional structures, but the challenges of integration of climate change across all sectors, as well as implementation of policies remain (GRZ, 2016). In addition, an important requirement for informed decision making on adaptation is that it should be based upon the best available information on the implications of both the current and the future climate in the country. This entails employment of quality climate information and improvement of available information. This will encompass several processes including; improving the coverage and quality of climate monitoring data, commissioning assessments of climate change impact, vulnerability and

adaptation if they are not already available, and using multi-model ensembles with a clear articulation of associated uncertainties (OECD, 2009). The 2016 Zambia Climate Action report also documents that Zambia has put in place climate relevant policies and strategies which include:

i. National Adaptation Plan of Action (NAPA) 2007

ii. Intended Nationally Determined Contribution (INDC) 2015

iii. National Climate Change Response Strategy 2010, and

iv. National Policy on Climate Change 2016.

There are other policies and sectoral strategies that contribute to environment, climate change adaptation and mitigation, including

i. National Policy on Environment (NPE, 2007)

ii. National Forestry Policy of 2014

iii. National Energy Policy of 2008

iv. National Agriculture Policy of 2014

v. Transport Policy of 2002

vi. National Strategy for Reducing Emissions from Deforestation and Forest Degradation (REDD+, 2015)

vii. Second National Biodiversity Strategy and Action Plan (NBSAP2)

viii. Technology Needs Assessment (TNA, 2013)

ix. Nationally Appropriate Mitigation Actions (NAMAs, 2014)

x. Second National Communication (SNC, 2015).

National Climate Change Policy (NCCP) of 2016 was born from realisation that adverse effects and the threats posed by climate change would have an impact on the development process including attainment of the Vision 2030 (GRZ, 2016). Hence, steps were taken to reduce some of these effects and minimize the potential for further damage. In spite of these efforts, the steps and actions undertaken so far on mitigating

climate change and adaptation to the adverse impacts of climate change have been fragmented and done in an ad-hoc manner (GRZ, 2016).

The government of Zambia has developed the National Policy on Climate Change to provide a framework for coordinated response to climate change (GRZ, 2016). It provides guidance on how the Zambian economy can develop in a sustainable way and thus allow for implementation of Development Plan and subsequent visions such as the vision 2030 (GRZ, 2016).

In spite of the above policy documents in place, there are still policy gaps at sectoral level to enable integration of climate change adaptation as an important issue.

2.5 Manufacturing Business enterprises in Zambia and Climate Change

There is a vast number of manufacturing enterprises in Zambia, the bigger number of these business enterprises consists of small to medium scale business entities. The Zambia Association of Manufacturers-ZAM has registered over 1500 enterprises. 14% of these are specialised in the manufacturing of construction related materials, those that largely comprise of cement and steel inputs. These are essential elements of the global economy and industrial development, as they deliver key materials for buildings, infrastructure, industry and almost all structures (GDSS, 2019). Further, these sectors are significant and growing emitters of CO2. Iron & steel represents 6-8% and cement & concrete 6% of global energy system combustion and industrial process CO2 emissions. This aggravates the quest to fight the challenges brought about by climate change. It is on this premise that this research sought to investigate the adoption of mitigative and adaptive strategies to climate change by business enterprises particularly those that manufacture construction materials.

According to an issue paper done by the GDSS forum which is an initiative of OECD, demand for concrete and other construction materials is on the rise due to the need for infrastructure development. Onkangi, et al (2018) adds that infrastructure, which is a product of construction, is very vulnerable structurally and financially to extreme weather conditions and events and as such calls for a paradigm shift in conducting business in the construction industry in developing countries. It goes without saying that the main material in the Zambia construction process is steel and concrete, which comes from cement. These contribute a great deal of greenhouse gas emissions both

during production and as a finished product during its life span as part of existing infrastructure like buildings. Engineering design decisions can produce more sustainable civil infrastructure systems, but cognitive barriers to innovative thinking often inhibit such outcomes (Ruth, et al., 2018). It is therefore important to establish how business enterprises that deal with such are doing to reduce their ecological footprint and also to adapt to the new normal which is characterised by regulations and adverse weather patterns that affect supply chains, work pattern and production. Having a deeper understanding of what is prevalent on the ground regarding these business enterprise will enable policy makers, investors and other stakeholders to re-strategize their approaches towards bracing themselves for climate change challenges and formulating more workable solutions. Several authors have written about climate change but emphasis has been on industries such as mining, agriculture, tourism and others. This creates a knowledge gap that needs to be filled to establish facts from a manufacturing business enterprise angle from the construction industry, which is also one of the major contributors to Zambia's Gross Domestic Product-GDP. According to the Zambia Manufacturing Sector Profile of June 2013, the Manufacturing sector accounts for 11% of Zambia's GDP. 25% of the country's exports come from the manufacturing sector which absorbs outputs from other sectors and ultimately supplies inputs to other sectors such as mining and construction (Zambia Development Agency, 2013).

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Overview

This chapter presents the research methods that this dissertation used to accomplish the aim of this research. It provides details of how the data was processed using selected instruments such as questionnaires and also shows how the respondents were selected and how the data collected was finally analysed to establish findings.

3.1 Research design

Bryman (2008) asserts that a research design provides a framework for the collection and analysis of data. Research design is defined as, "the plan and structure of investigation so conceived as to obtain answers to research questions" (Kerlinger, 1986). The type of research will ultimately dictate the research design suitable for the same. The choice of a research design is closely linked to the type of study being conducted. This means that the type of research will dictate the research design suitable for the same. To this effect, there are different types of research designs. This decision on which type to use will affect reliability, validity and replicability of the research (O'Connor & Gibson, 2003).

This study adopted a descriptive research design using a mixed method approach that uses both qualitative and quantitative methods of data analysis. These methods of data analysis have their own strengths and weaknesses. However, the use of either methods does not always completely eliminate certain components of the other (Bless, et al., 2013). A researcher can use both methods to leverage on their advantages.

3.2 Target population

An entire set of objects or people that is the focus of a research project is called a population (Bless, et al., 2013). The target population consisted of approximately 1,500 registered Manufacturing enterprises by the Zambia Association of Manufacturers-ZAM, with special attention on approximately 135 enterprises that manufacture major construction materials such as steel and cement/concrete. In addition, as mandated by government to spearhead issues bearing on climate change specific institutions hold that responsibility. These included institutions such as the Climate Change Secretariat, Disaster Mitigation and Management Unit-DMMU, Ministry of National Development Planning and Ministry of Lands, Natural Resources and Environmental Protection-

through Zambia Environmental Management Agency (ZEMA). Upon close consultation it with these institutions, guidance was given to obtain information from ZEMA which was the sole authority in environmental protection and regulation.

3.3 Sample size and sampling procedure

The researcher was guided by the sample size that they chose for their research. The sample was selected using step by step procedures in a chronological order as shown below under the sampling procedure. This process ensured that the sample derived was representative and without bias.

3.3.1 Sample size

A sample is a subset of population whose characteristics will be generalised to the entire population (Bless, et al., 2013). A sample is needs to be representative in order to reflect the true nature of a population. The sample size was derived from a comprehensive updated list obtained from the Manufacturers Association of Zambia-ZAM, which revealed the number of manufacturing enterprises located in Lusaka Province that specifically deal in production of construction materials.

3.3.2 Sampling procedure

Simple random sampling was used to derive the sample size for this research. It is a sampling procedure that provides equal opportunity of selection of each element in a population (Bless, et al., 2013). Using a list compiled by Zambia Association of Manufacturers-ZAM, the researcher segregated the list into clusters in order to identify the subpopulation of interest. ZAM has registered over 1500 registered manufacturing enterprises. Using cluster sampling, from the population of over 1500, three groups were identified, the biggest category of approximately 1365 consisted of business enterprises that manufacture various products that are not construction related. This group was not of interest to this research but the rest of the population consisted of two categories; one group of 43 enterprises manufactures cement, concrete and steel while another group of 92 enterprises manufacture any other construction material. The last 2 categories were the subpopulations of interest to this research from which samples were drawn. Using simple random sampling, a 50% sample of 92 and

43 of the enterprises was drawn, giving 46 and 22 respondents respectively. This gave a more representative sample to reduce bias. Non-probability sampling was used to select respondents of particular interest. The researcher also employed purposeful sampling regarding an interview that was be conducted ZEMA. The representative sample is one that is able to account for a significant number of elements in a population, therefore 50% is a representative number. Although for descriptive research 10% of the sample is considered representative according to an author cited in the Advanced Business Research Methods Module MBAZ 521 (Zimbabwe Open University, 2019).

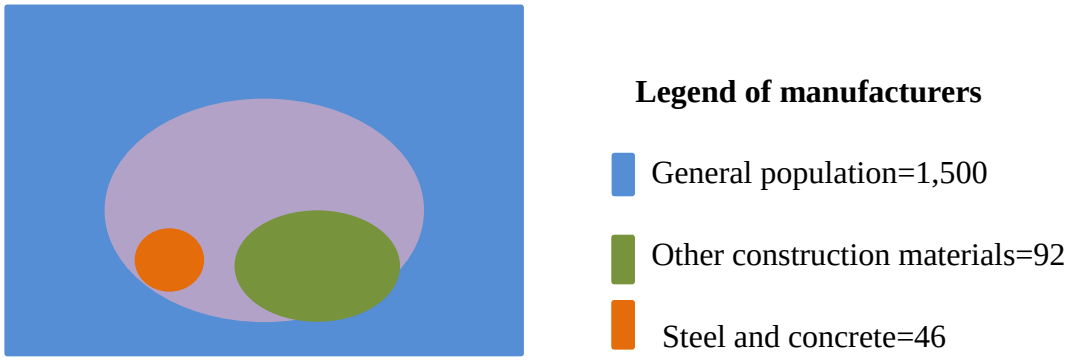

***Figure 3**: Cluster sampling illustration*

Source: Self-composed illustration

Method for simple random sampling

1. A list of all the business enterprises for each of the two clusters was made. (as shown above there are 135 business enterprises in the main population of over 1500 consisting of 43 Manufacturers of steel and concrete and 92 Manufacturers of other construction materials.
2. A sequential number was then assigned to each business enterprise. This became the sampling frame for each category (the list from which the simple random sample is drawn)
3. The sample size was aimed at half of the cluster populations. (In this case, the sample size was 50% of 92 and 43 which translates to 46 and 22 respectively). Using the formula below, where **N** is the population size and **n** is the sample size. According to (Bryman, 2008) the formula below can be used to get the sample size.

$$P=1- N-1/N. N-2/N-1\ldots. N-n/N-(n-1)$$

$$\text{Cancelling}=1-N-n/N$$

$$=n/N$$

$$=46/92$$

$$=50\%$$

From the above, the sample is chosen due to a number of issues such as cost, time and response rate. Hence, for this research the deciding factor was to ensure that cost and time were within the time frame of the research.

4. Using a random number generator, a list was then generated which came to a combined sample of 65 respondents.

3.4 Data collection methods

Primary data and Secondary data

According to Bless, et al (2013), data consist of measurements collected as a result of scientific observations which can be classified according to the way it is collected. That collected anew by the researcher by way of questionnaires or interviews is called primary data, While, that acquired from concept papers, books, journals, reports, publications, and annual reports is considered as Secondary data. This research used both types of data collection methods.

3.4.1 Data collection instruments

Questionnaires had a mix of questions to include Yes or No questions, multiple choice questions, open ended and closed ended questions to allow the respondents to provide information on the topic of research. Questionnaires were used to collect data from Business enterprises while a list of questions was used during interviews with relevant respondents within bodies and institutions identified as key stakeholders in the implementation of climate change in Zambia, such as ZEMA.

3.4.2 Data collection procedures

Data was collected from mid of March, 2021 to end of April, 2021. Interviews were conducted in person to all respondents who were requested to answer the questions. Further, key informants in the in relevant institutions responsible for climate change issues were also interviewed. These interviews were done face to face with careful precautions to avoid the risk of exposure to Covid 19 which at the time of research was a matter of concern.

3.5 Data analysis

Data analysis is said to take different forms depending on the type of research being undertaken (Creswell & Creswell, 2018). Most qualitative research will use a lot of narratives and other graphical or pictorial representation to show this. However, quantitative studies use more of statistical methods to analyse data. This study used a mixed method approach and as such both methods of data analysis were conducted as will be seen. The data was collected using questionnaires and interview. These were checked for completeness, consistency and accuracy. Further, the unprocessed data that was collected from the field was subjected to a coding process. Data was then exported to Statistical Package for Social Sciences version 20 for data modification and analysis. Data analysis involved descriptive statistics of the variables including frequencies and percentages, and charts and tables using Excel which has the ability to generate meaningful graphical representations of the findings.

CHAPTER 4: DATA PRESENTATION, INTERPRETATION & ANALYSIS.

4.0 Overview

With reference to the preceding chapter, the collection of this data was done through the application of qualitative and quantitative methods. The qualitative part of data collection was done via collection of data from open ended questions from the questionnaire. The responses from the respondents had to undergo further qualitative restructuring to enable responses to be grouped or coded. This required what is known as 'Thematic analysis' which looks at patterns of meaning in a data set. These themes aid in making sense of the content and deriving meaning from it (Warren, 2020).

This chapter focuses on research methodology that was employed to collect data on the investigation of adoption of mitigative and adaptive measures for business enterprises to climate change in Lusaka Province particularly those that manufacture construction related materials. If further gives a description of the research that was conducted, the research instruments which were mainly questionnaires, the criteria for sampling and the data analysis tools. It also shows means used to represent findings through charts and tables.

4.1 Data Analysis Method

The data collected was analysed using the methods cited in the first Chapter of this research, such as the Statistical Package Storage System-SPSS and Microsoft Excel Package. This data was derived from the answers given to the questions in the questionnaires that were administered. The questionnaires were designed to accommodate both open and closed ended questions in order to allow for both qualitative and quantitative analysis of data. The questions were structured in line with the research objectives and research questions whose essence was to reveal:

a) Climate change awareness
b) Risk exposure awareness
c) Understanding of adaption and mitigation
d) Proposed solutions
e) Knowledge of climate change policy
f) Adoption of adaption and mitigation measures
g) Challenges in Adoption of adaption and mitigation measures

h) Institutions working closely with Business Enterprises
i) Use of Change Management theory in adoption process

The researcher planned to obtain data from the respondents below with regards to the above information that was planned to be collected.

Table 1: *Target group of response rate(Planned)*

Source: Generated by SPSS version 20.0 software

Category of respondents	**Number of questionnaires administered**	**Number of responses obtained**	**Response rate**
Manufacturing enterprise (steel and concrete products only)	22	22	100%
Manufacturing enterprise (other products)	43	43	100%
Policy Implementers	7	1	14%

Note: It was however established that, the organisation that was able to give valid information on policy implementation was ZEMA as it was the principle regulator of the environment, hence the 6 other policy implementers fell off the list of planned respondents.

Table 2: *Target group of response rate(Actual)*

Source: Generated by SPSS version 20.0 software

Category of respondents	**Number of questionnaires administered**	**Number of responses obtained**	**Response rate**
Manufacturing enterprise (steel and concrete products only)	22	22	100%
Manufacturing enterprise (other products)	43	43	100%
Policy Implementers	1	1	100%

As stated above only ZEMA was interviewed with regards to how they were interacting with business enterprises and the challenges they were facing in executing their mandate. ZEMA submitted the following:

ZEMA monitors greenhouse gas emissions country wide, it has two departments that work closely with business enterprises, that is the operations department and the corporate affairs. The former works in the field to check compliance of business enterprises while the latter deals with providing awareness on environmental issues. To ensure that mitigation is done ZEMA conducts Environmental Impact Assessments for all manufacturing enterprises to ensure that they are within the authorised pollution ratings, they also provide public hearings and encourage participation by awarding compliant enterprises with best practice recognition awards. Further, ZEMA has now enhanced its communication platforms by having an online platform that can provide more prompt and easy to access information, this will help increase awareness as it has been difficult to have full physical contact with all the enterprises due to Covid 19 restrictions and financial limitations. Latest technology envisaged to be adopted by ZEMA is monitoring via the use of drones so as to reach all areas of the industry that have been hard to reach as a result of limited financial capacity.

In summary, ZEMA submitted that it has financial limitations that hindered its ability to fully implement its mandate to provide awareness and monitor compliance of

business enterprises. This validated that indeed there was a lack of comprehensive implementation of policy and from the findings below, there was evidence of lack of awareness and low levels of adoption of adaptive and mitigative strategies to Climate Change.

4.2 Data Analysis and Representation (Part 1-Quantitative)

In order to evaluate the quality of the research, it is necessary to test the data for reliability and validity. This means that reliability checks the data for consistency while validity checks the data for accuracy. The Cronbach's alpha is used to verify reliability and validity of research. Using SPSS version 20.0, the following information was generated;

***Table 3**:Reliability statistics*

Source: Generated by SPSS version 20.0 software

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.584	.602	9

***Table 4**:Item-Total statistics*

Source: Generated by SPSS version 20.0 software

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Knowledge of climate change policy	3.32	4.472	-.162	.	.669
Adoption of adaption and mitigation measures	3.74	4.571	-.209	.	.650
Risk exposure awareness	3.17	2.987	.763	.	.416
Understanding of adaptation	3.75	3.626	.477	.	.518
Understanding of mitigation	3.75	3.626	.477	.	.518
Proposed solutions	2.74	2.696	.361	.	.546
Challenges in Adoption of adaptation and mitigation measures	3.62	3.272	.554	.	.479
Institutions working closely with Business Enterprises	3.74	4.040	.141	.	.585
Use of Change Management theory in adoption process	3.31	3.466	.360	.	.531

The requirement is that the Cronbach alpha must be within a certain number to show if the data is reliable. The value of the alpha will change depending on the number of variables included in the analysis. When the variables are less than 10, the value of the alpha must be greater than 0.5. In the data set above, there were 9 items used and the alpha was 0.58, which verified the reliability of the data set. However, for items more than 10, the Cronbach alpha can be greater than 0.75.

The researcher then proceeded to analyse the data accordingly, through frequency tables, cross-tabulations and correlations.

Using SPSS software version 20.0 as the tool to facilitate quantitative analysis, several analyses were conducted in order to obtain frequencies, cross-tabulations and correlations. The two variables that were considered in order to ascertain if there was an association between the variables, to ascertain whether this association was significant and the nature of relationship between the variables, and finally the strength of this relationship between variables were climate change policy implementation and adoption of adaptive and mitigative strategies.

Frequency Tables

The number of cases in each categorical variable can be depicted by frequencies, however frequencies cannot further categorise respondents in each variable category. Below is a number frequencies of selected variables.

Table 5*: Knowledge of Climate Change Policy*

Source: Generated by SPSS version 20.0 software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	28	43.1	43.1	43.1
	NO	37	56.9	56.9	100.0
	Total	65	100.0	100.0	

The table above shows that there is a higher frequency of Business enterprises that are unaware of climate change policy.

Table 6: *Institutions working with Business Enterprises*

Source: Generated by SPSS version 20.0 software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ZEMA	36	55.4	55.4	55.4
	ZEMA & NCCN	10	15.4	15.4	70.8
	NONE	19	29.2	29.2	100.0
	Total	65	100.0	100.0	

There is significant number of enterprises that submitted that they did not work closely with any policy implementers with a percentage of close to 30%. However, a good number did submit that they worked with ZEMA and NCCN.

***Table 7**: Adoption of Adaptation and Mitigation measures*

Source: Generated by SPSS version 20.0 software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	55	84.6	84.6	84.6
	NO	10	15.4	15.4	100.0
	Total	65	100.0	100.0	

The adoption levels of business enterprises have a very high frequency showing that over 80% of the enterprises have adopted some kind of climate change strategy. However, among these a good number only adopted a strategy toward having an alternative power supply.

***Table 8:** Use of Change theory in adoption process*

Source: Generated by SPSS version 20.0 software

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	YES	27	41.5	41.5	41.5
	NO	38	58.5	58.5	100.0
	Total	65	100.0	100.0	

From the table above less than 50% of the respondents were using strategies from the Change Management theory. Only the component on creating awareness and supply chain management was prominent. This shows that there is need for business enterprise to also work on their internal processes to help then facilitate for adoption of climate change strategies.

Table 9: *Knowledge of Climate Change Policy*Adoption of adaptation and Mitigation measures(Cross tabulation)*

Source: Generated by SPSS version 20.0 software

			Adoption of adaption and mitigation measures		Total
			YES	NO	
Knowledge of climate change policy	YES	Count	27	1	28
		Expected Count	23.7	4.3	28.0
		% within Knowledge of climate change policy	96.4%	3.6%	100.0%
		% within Adoption of adaptation and mitigation measures	49.1%	10.0%	43.1%
		% of Total	41.5%	1.5%	43.1%
	NO	Count	28	9	37
		Expected Count	31.3	5.7	37.0
		% within Knowledge of climate change policy	75.7%	24.3%	100.0%
		% within Adoption of adaptation and mitigation measures	50.9%	90.0%	56.9%
		% of Total	43.1%	13.8%	56.9%
Total		Count	55	10	65
		Expected Count	55.0	10.0	65.0
		% within Knowledge of climate change policy	84.6%	15.4%	100.0%
		% within Adoption of adaptation and mitigation measures	100.0%	100.0%	100.0%
		% of Total	84.6%	15.4%	100.0%

The above table shows a cross-tabulation analysis performed using SPSS. The cross-tabulation statistics provide several remarkable observations about the data collected

from business enterprises. In the table above, there appears to be an association between Knowledge of climate change policy and adoption of adaptation and mitigation measures category, as the expected values, which are the values expected by chance, and the actual counts are different from each other. However, in order to ascertain how significant this difference between the expected counts and observed, a Chi-square test was conducted.

The Chi-square statistic uses the difference between observed and expected values. It assesses the probability that the differences between the observed and expected values would happen under the null hypothesis that there is no difference between these values. Below is the table for the said analysis

***Table 10**:Chi-Square test*

Source: Generated by SPSS version 20.0 software

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.273[a]	1	.022		
Continuity Correction[b]	3.799	1	.051		
Likelihood Ratio	6.129	1	.013		
Fisher's Exact Test				.034	.021
Linear-by-Linear Association	5.192	1	.023		
N of Valid Cases	65				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.31.

b. Computed only for a 2x2 table

From the table above, the large Chi-Square statistic (5.273) and its small significance level ($p > .000$) indicates that it is very likely that these variables are independent on each other. Thus, you can conclude that there is no relationship between Knowledge on climate change policy and the adoption levels of business enterprises to climate change strategies via adoption of mitigative and adaptive strategies but it is possible that the levels of adoption can still increase even with limited policy knowledge.

To verify the kind of relationship that exists between the two variables a correlation analysis was done as shown below.

***Table 11**:Correlation table*

Source: Generated by SPSS version 20.0 software

		Adoption of adaptation and mitigation measures	Knowledge of climate change policy
Adoption of adaptation and mitigation measures	Pearson Correlation	1	.285*
	Sig. (1-tailed)		.011
	N	65	65
Knowledge of climate change policy	Pearson Correlation	.285*	1
	Sig. (1-tailed)	.011	
	N	65	65

*. Correlation is significant at the 0.05 level (1-tailed).

Correlations are a measure of the linear relationship between two variables. A correlation coefficient has a value ranging from -1 to 1. Values that are closer to the absolute value of 1 indicate that there is a strong relationship between the variables being correlated whereas values closer to 0 indicate that there is little or no linear relationship. Pearson's is appropriate for continuous data and since the hypothesis being tested is to make a prediction about the direction of effect between the two variables that positive relationship between the variables exists then the one-tailed test is appropriate.

1. The sign of a correlation coefficient describes the type of relationship between the variables being correlated. A positive correlation coefficient indicates that there is a positive linear relationship between the variables meaning that an increment in one variable also causes an increment in another.
2. From the correlation table above the output shows the positive correlation coefficient (.285) indicates that there is a statistically significant ($p < .001$) linear relationship between these two variables such that the more knowledge a

business enterprise has on climate change policy, the more likely that it is able to also adopt climate change measures of adaption and mitigation.

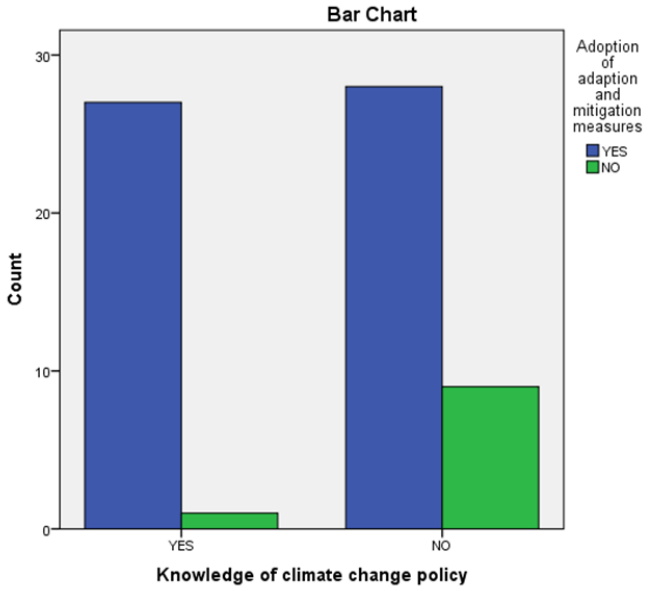

Figure 4: *Bar Chart showing Knowledge of climate change policy vs adoption of adaptation and mitigation measures*

Source: Generated by SPSS version 20.0 software

The bar chart above shows that proportions of business enterprises that were aware of climate change policy was also showing a high level of adoption of adaptation and mitigation measures.

4.2 Data Analysis and Representation (Part 2-Qualitative)

a) Climate change awareness

All the enterprises that were issued questionnaires had a clear understanding of what climate change is, what causes it and its effects on the global weather patterns. 100% of the respondents were climate change aware.

b) Risk exposure awareness

A significant number of respondents were not aware of the implications that climate change had on their business. 72% of the business enterprises were of the view that climate change had no effect on their production or business while 28% noted that climate change affected their business by way of lower production as shown in the pie chart.

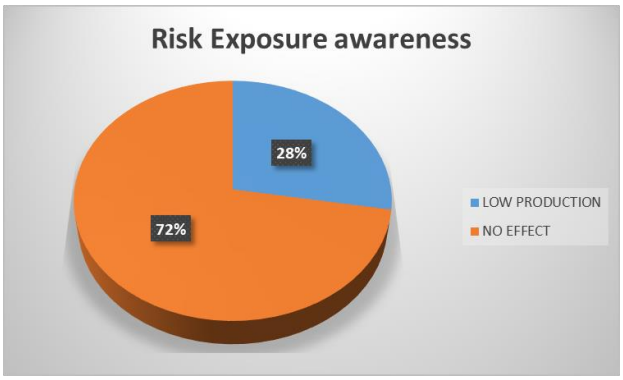

***Figure 5**: Risk exposure awareness*

Source: Generated by Microsoft excel

c) Understanding of adaption and mitigation

It was established that a significant number 86% of business enterprises did have a good understanding of what the terms, adaptation and mitigation mean. They were able to give a good illustration of examples of what the terms meant. This means that the ability to adopt adaptation or mitigation strategies have little to do with limited Climate Change awareness.

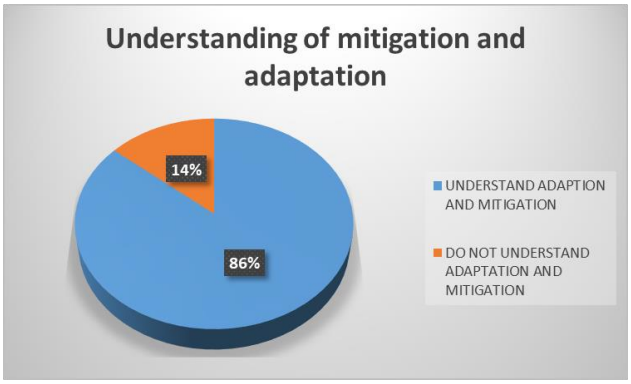

***Figure 6**:Understanding of mitigation and adaptation*

Source: Generated by Microsoft excel

d) **Proposed solutions**

Having knowledge on the meaning of the terms adaptation and mitigation mean is not sufficient without implementing the strategies aligned to these terms. Hence, it was important to also establish what challenges could hinder the adoption of strategies to climate change adverse effects and proposed solutions. It was established that funding was inadequate to help business enterprises to easily adopt strategies especially those that depended on advance technological equipment. A small number of enterprises submitted that lack of awareness also contributed to low levels of adoption of strategies, while a 43% number also submitted that there was need to have better stakeholder inclusion as most enterprises felt they are side-lined. A combined percentage of 71% established that funding would be a good way to help enterprises to adopt strategies.

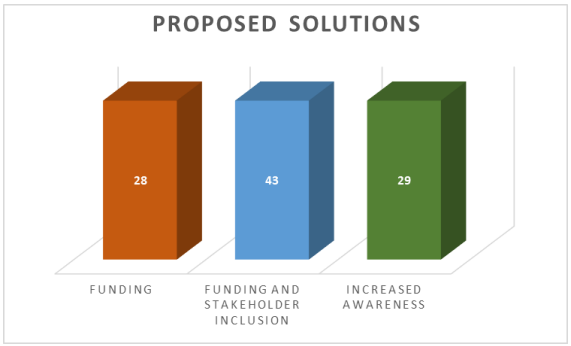

***Figure 7**: Proposed solutions*

Source: Generated by Microsoft excel

e) Knowledge of climate change policy

The National Climate Change Policy of 2016, is the main document that provides policy guidelines with regards to Climate Change. However, it was noticed that even though business enterprises were knowledgeable on what Climate Change is and what adaptation and mitigation strategies meant, there were not fully aware of what this policy is all about and its essence. Close to 60 % did not have any knowledge of the policy document. The remaining 40% was only knowledgeable on its existence but did not know much about the contents.

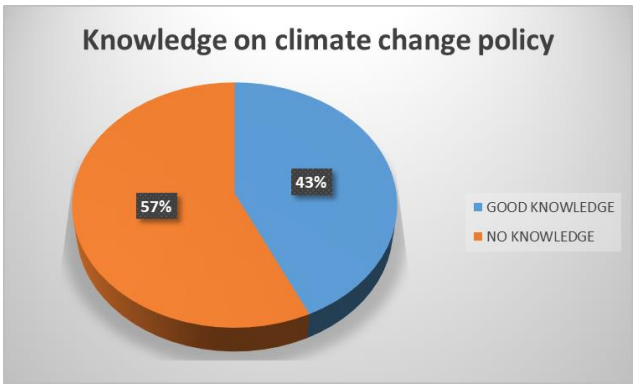

***Figure 8**: Knowledge on climate change policy*

Source: Generated by Microsoft excel

f) Adoption of adaption and mitigation measures

Business enterprises showed a good level of adoption but were however limited to only two strategies, that being management of resources inputted into the production process such as water and electricity/power. 72% of these enterprises were found to also employ alternative power supply such as solar power for their basic operations, 14% had revised their supply chain management systems to ensure that they are able to get their production inputs on time. Only 14% had done nothing at all to adopt any strategies to counter the effects of climate change.

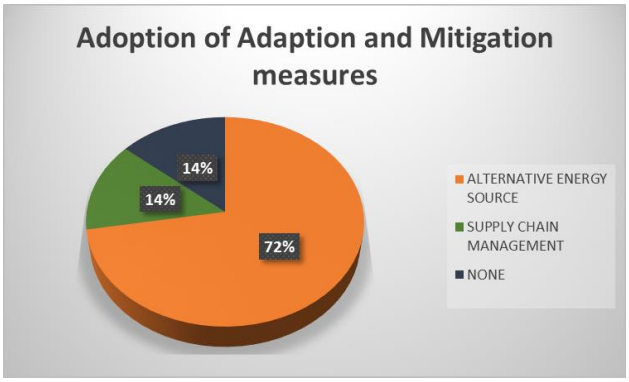

***Figure 9**: Adoption of Adaptation and Mitigation measures*

Source: Generated by Microsoft excel

g) Challenges in Adoption of adaption and mitigation measures

As noticed from the adoption levels above, it was established that so of the business enterprises had not adopted any strategies due to challenges as noted in the figure below which shows that 72% claimed that limited funds and lack of awareness was the biggest challenge, 28% submitted that alternative methods and equipment that help counter climate change adverse effects were too costly as compared to the conventional ones that have previously been employed.

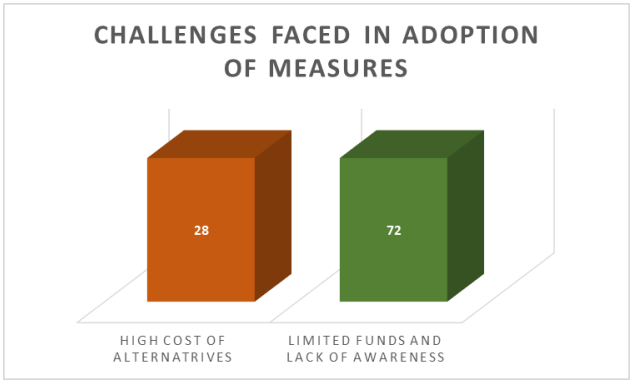

***Figure 10**: Challenges faced in adoption of measures*

Source: Generated by Microsoft excel

h) Institutions working closely with Business Enterprises

As mandated by the NCCP of 2016, a number of organisations have been tasked to spearhead all matters concerned with Climate Change. Among which, the Zambia environmental Management Agency has been tasked to oversee environmental concerns. Close to 30% submitted that they have not interacted

with any policy implementers such as ZEMA. This shows that there is need for more awareness and inclusion of business enterprises through comprehensive policy implementation.

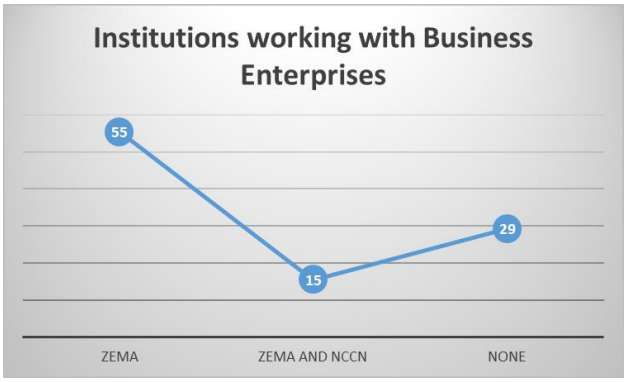

***Figure 11**: Institutions working with Business Enterprises*

Source: Generated by Microsoft excel

i) Use of Change Management theory in adoption process

Having noted that Change is hard to implement, it is important to adopt certain management strategies to ensure that there is a smooth transitioning. Change Management strategies can be employed to help in this regard. Close to 60% of the business enterprises did not employ any change management strategies. The remaining number had only employed one component of creating more awareness on the need to employ change but the rest of the measures were not adopted hence compromising the efficiency of implementing change. This shows that there is need to ensure that Change Management strategies are employed in the change adoption process for adoption of adaptation and mitigation to climate change adverse effects.

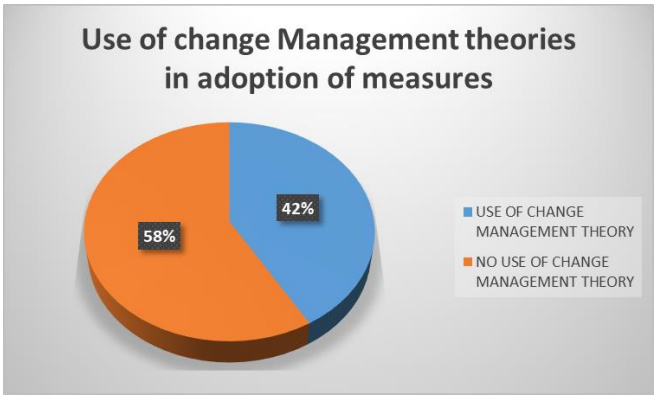

***Figure 12**: Use of Change Management theories in adoption of measures*

Source: Generated by Microsoft excel

4.3 Summary of Findings

i. Although all the respondents were aware of what climate change was and its effects, 43% did not have any knowledge of the existence of climate change policy.

ii. Even though good number claimed to have not been in contact with the policy implementers (80%), some of these did not also adopt any strategies to climate change.

iii. A significant number of enterprises 60% were not aware of climate change policy and only 21% acknowledge being directly affected by climate change.

iv. Only a small number of enterprises used components of change management theories (only one of the steps in Proci's ADKAR model was employed).

v. All the enterprises used both electricity and water in their production processes but only a selected few used alternatives as these were said to be expensive.

vi. Only 14 % did not adopt any form of strategy but the rest were limited to use of alternative power like solar and supply chain management review.

vii. Limited funding and lack of awareness were some of the challenges that these enterprises cited.

CHAPTER 5 –SUMMARY, DISCUSSION, CONCLUSION & RECOMENDATIONS

5.0 Overview

This chapter starts by giving a summary and then gives a discussion on the research and finally gives a conclusion followed by recommendations.

5.1 Summary

The study set out to investigate the adoption of adaptive and mitigative measures to climate change; A case of construction materials manufacturing business enterprises in Lusaka Province. A sample of 65 respondents was investigated using a descriptive case study methodology. The study was prompted by submission of several authors on the challenge of policy implementation which was alleged to be inadequate despite the existence of climate change policy guidelines. Seeing that business enterprises in question are producers of inputs that feed the construction industry which is one of the largest contributors to Zambia's Gross Domestic Product, it is imperative to ensure that their current means of coping in this era of climate change challenges are reinforced so as to foster economic development, whose backbone rests on sustainable infrastructure development.

Based on the data analysis in chapter 5 above, there was a strong affirmation that indeed 'A lack of comprehensive implementation of climate change policy through provision of climate change policy knowledge has contributed to poor adoption of mitigation and adaptation measures to climate change in 'construction materials' manufacturing business enterprises'. This was evident in that a significant number of respondents who were not very knowledgeable on climate change policy also had low adoption levels, another issue was that a bulk of these enterprises had limited financial capacity to adopt measures that required the use of smart technologies in their production processes. A lack of funding was cited as being the major deterrent for business enterprises. Another aspect was on lack of awareness on part of some enterprises that seemed to not have good knowledge of the implications of climate change for their business. A significant number of business enterprises were found to closely work with policy implementers through the Zambia Environmental Management Agency but needed more awareness and monitoring.

There is need for government to invest more resources into the manufacturing business industry to provide both funding and proper awareness of Climate Change adverse effects and how they inhibit economic growth at national level and globally. As business enterprises, there is need to embrace change management theories to help in the adoption of new processes and procedures which also include strategies aimed at combating and countering the effects of climate change on business enterprise.

6.2 Discussion

An Investigation into Adoption of Mitigative and Adaptive Strategies to Climate Change: A case of construction materials manufacturing business enterprises in Lusaka Province, was the research topic whose problem statement was that a lack of comprehensive implementation of climate change policy will influence adoption of mitigation and adaptation measures to climate change in 'construction materials' manufacturing business enterprises. To establish this assertion, the research had the general objective to emphasise the role of business enterprises in climate change adaptation and mitigation while examining the policy guidelines that exist in Zambia.

This objective entailed examination of policy guidelines, establishing the strategies that business enterprises where adopting in the adaptation and mitigation to climate change. The research thus adopted a mixed approach descriptive design by considering a case study of business enterprises that were specific in their manufacturing business. Questionnaires with both closed and open ended questions were the main tool used to collect data and these instruments had to be physically delivered to the respondents who were located in the industrial area of Lusaka Province, however due to busy working nature of the businesses and restrictions of Covid 19, a number of return visits had to be done in order to collect the full number of respondents planned.

The data collected was then analysed using Coding to obtain some form of uniformity in the qualitative responses, and SPSS was also used to obtain quantitative analysis of the data in order to arrive at the findings.

Grounded on change management theories, it was expected that if these theories where used extensively by the enterprises in the adoption processes of adaption and mitigation, it would ensure a smooth transitioning to change that was brought about by climate change and thus encourage the levels of adoption of strategies. This would thus lead to a more successful business outcome for the enterprises thereby enhancing production

and building revenue which would lead to economic development of the country at large. However, with reference to the findings, only 42% of business enterprises were using Change management theories in their adoption process of change that emerged as a consequence of climate change adverse implications through adaptation and mitigation. The remaining 58% was also only employing one aspect of the change management process hence this coupled with a lack of comprehensive implementation of climate change policy which was established by a lack of proper awareness of climate change policy and poor interactions with business enterprises on part of policy implementers, could possibly be the reason behind the poor adoption of change in these enterprises.

5.3 Conclusion

The research revealed that Climate change has affected business enterprises adversely and that there is need for policy implementers to ensure that they provide more awareness for these business enterprises alongside adequate funding to facilitate procurement of latest methods and equipment that are climate smart. Business enterprises also need to implement strategies to help them be able to have a smooth adoption of Climate Change strategies through the use of Change Management theories. It is only then that the business enterprises will thrive and contribute to the country's economic development by providing climate smart inputs that do not affect their revenue or the environment negatively while at the same time enhance the longevity of infrastructure which plays an important role in economic development.

From the findings of this research as revealed in Chapter 4, the objective of this research were met; The research findings in view of the three (3) research questions revealed the following:

a) The current adoption of adaption and mitigation of climate change measures revealed that business enterprises are adopting measures mostly bordered on use of other forms of power specifically use of solar power, but this was only for operations within the enterprise and not for manufacturing. The other measure was restructuring their internal processes such as supply chain management.
b) Policy documents that provide guidelines on climate change are in place. The National Climate Change Policy of 2016. However, there is poor knowledge of

its existence and business enterprises do not understand its significance. This lack of knowledge coupled with a lack of comprehensive implementation of the policy has affected the adoption levels of business enterprises.

c) Due to poor funding, there are currently no support mechanisms for business enterprises to ensure that they are able to adapt climate change measures that will enable them to become competitive and be able to make profits in spite of climate change challenges.

5.4 Recommendations

i. There is need for government to review climate change policy in order to cater for business enterprises more comprehensively by use of evidence led policy reviews that consider the current challenges brought forth by business enterprises

ii. More funding has to be reserved for business enterprises to help them mobilise smart equipment that can enable these enterprises to adopt climate friendly technologies.

iii. There is need for more awareness on climate change to equip business enterprises on the urgency of adopting adaptation and mitigation strategies.

iv. Further studies need to be conducted to establish the nature of industrial processes that are being employed by business enterprises that manufacture construction materials to ascertain their real effect on the environment and to investigate the latest technologies on the market that can be used to counter or reduce the effects of climate change.

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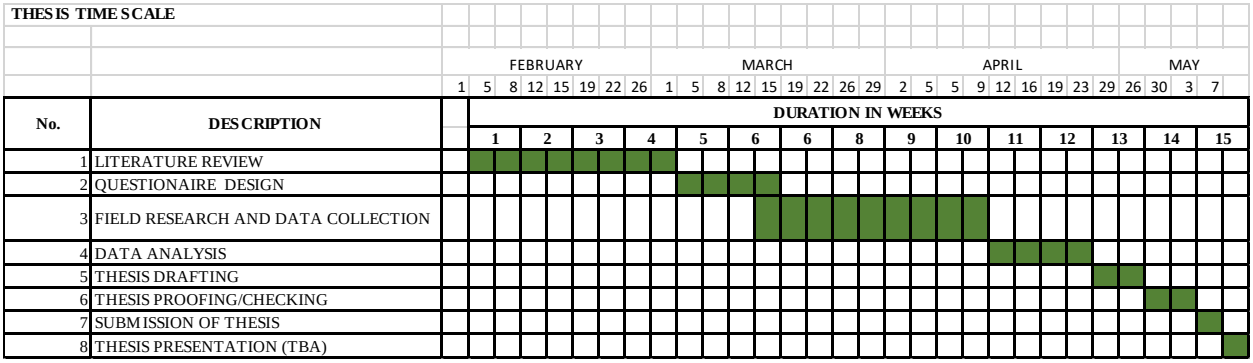
APPENDICES

1. Gantt Chart (Time table)
2. Study Budget
3. Maps (only if I wish to show proximity of manufacturing enterprises to each other's location)
4. Instruments for Data collection –Questionnaires
5. Paris Agreement
6. The CERES Principles
7. BOP ISO 14001_1600_10 (extract)
8. Ethical clearance letter

APPENDIX-1: Gantt Chart (Time table)



APPENDIX- 2: Study Budget

ITEM	DESCRIPTION OF EXPENSE	COST
1	Printing of Proposal And Dissertation	200.00
2	Binding of Dissertation	600.00
3	Transport Costs	1,500.00
4	Internet Cost	500.00
5	Miscellaneous Cost	300.00
	TOTAL BUDGET	**3,100.00**

APPENDIX-3: Maps (showing proximity of manufacturing enterprises to each other's location)

NOTE: A good number of manufacturing enterprises are located in the Industrial area.

APPENDIX-4: Instruments for Data collection -Questionnaires

QUESTIONNAIRE FOR BUSINESS ENTERPRISES/POLICY IMPLEMENTERS

-Are you registered with Zambia Association of Manufacturers-ZAM? a) Yes b) No

-What is your line of manufacturing?.....

-What resources do you use in the manufacturing process? a) Water b) Electricity c) Both

-Are there any sustainable practices you employ to use these resources well?

1. What do you understand by climate change? (list of possible answers)

a) Normal Weather changes

b) Climatic changes caused by human activity alone

c) Climatic changes caused by the earths' natural activity alone

d) Climatic changes caused by a combination of human activities and earth's natural processes

e) Other definitions

……

……

…….

2. What do you think causes it? (list of possible answers)

a) Not aware of causes

b) Human activities

c) Earths natural processes

d) A combination of human activities and earth's natural processes

e) other……

3. Do Business Enterprises contribute to climate change as a result of manufacturing processes? (Closed Ended-Yes or No)

a) Yes

b) No

4. Are Business Enterprises such as yours exposed to any form of risks as a result of climate change?

a) Yes

b) No

If Yes in above question, what risks are Business Enterprises such as yours exposed to as a result of Climate change?

……
……
……

5. What do you understand by adaptation (adjusting) to climate change? (list of possible answers)

a) Adjusting to the new environment that climate change has brought about

b) Changing business strategies to maximize profits

c) No knowledge of such

d) Company rules and regulations

e) other …….

6. What do you understand by mitigation (reducing effects) to climate change? (list of possible answers)

a) Business operations that focus on making profit through climate change

b) No knowledge of the meaning

c) Limiting the speed and scale of climate change by use of alternative methods/operations

d) Working with government to improve work conditions affected by climate change

7. What should government do to help Business Enterprises such as yourselves develop resilience to climate change negative effects?

……
……
……

8. What do you understand by climate change policy? (list of possible answers)

a) Procedures for internal management of operations

b) Any formal documents that guide stakeholders on how to behave or act with regards to climate change

c) No knowledge of such

d) Climate change

e) other

……....

9. The National Climate Change Policy is a policy document on climate change. Do you know how it applies to Business Enterprise? (Open Ended)

a) Yes

b) No

Briefly explain

……
……
……

10. Does National Climate Change Policy lack in adequately addressing climate change challenges? (Open ended or list of possible answers)

a) Yes

b) No

If Yes, briefly explain how and suggest possible solutions……
……...……
……
……...

11. What are you doing as an enterprise to Adapt (adjust) and Mitigate (reduce effects) to Climate Change? (Open ended or list of possible answers)

a) Resorting to alternative energy sources e.g. solar

b) Nothing is being done

c) Strategizing on how to implement supply chain and manufacturing processes

d) Weather proofing premises against extreme weather

e) Others……...

12. What challenges are Business Enterprises facing in adjusting and reducing the effects of climate change? (Open ended or list of possible answers)

a) Lack of funding from government to support initiatives

b) Lack of adequate knowledge on climate change

c) Expensive alternatives available

d) Others
……
……...

13. What organizations are working closely with Business Enterprises to support and guide Adaptation and Mitigation Strategies? (Open ended or list of possible answers)

……
……

……
……

14. What would be helpful for Business Enterprises with regards to policy framework? (Open ended)

……
……
……

15. What is the role of policy implementers such as Climate Change Secretariat, Disaster Mitigation and Management Unit-DMMU, Ministry of National Development Planning and Ministry of Lands, Natural Resources and Environmental Protection, with regards to Business Enterprises and their approach to climate change? (Open Ended)

……
……
……

16. What challenges are policy implementers facing in executing their mandate? (Open Ended)

……
……
……

17. Do you agree that Business Enterprises are contributors to national economic growth? (closed Ended-Yes or No)

a) Yes

b) No

18. If Yes, briefly explain how or in what way?

……
……

……
……

19. Change is difficult to implement, what steps did you follow to ensure that the strategies you put in place as a business enterprise would support your efforts to implement adaptation and/or mitigation successfully? (refer to Question 11)

a) Created awareness of the need to change

b) Weighed the desire to support change

c) Acquired Knowledge of how to change

d) Gained ability to demonstrate skills and behavior

e) Made reinforcement to make the change stick

f) None of the above

g) others

……
……
……...

20. Climate change is an issue that affects the world. It has brought changes that need to be managed in order for a business to become resilient to its effects. Do you agree that Change Management strategies can help Business Enterprises in their efforts to adapt and mitigate climate change?

a) Yes

b) No

APPENDIX-5: List of manufacturing enterprises(ZAM)-steel and concrete products

No.	Project name	Country o	Street	Year
1	Happy Metal Resources Company Limited	Chinese	Nampundwe	2015
2	African Needs Limited - Manufacture of Corrugated Iron Sheets & Iron N	Burundese	Mumbwa Rd	2008
3	Oriental Steel Manufacturing Ltd - Various Steel Products	Chinese	Mungwi Road	2005
4	Chilanga Cement Plc	French	Kafue Rd	2001
5	Nasla Cement Limited - Manufacturing of Cement	Lebanese	Bombay Rd	2008
6	Technical Engineering Co. Ltd - Manufacture Of Steel Products	Lebanese	Chinika Area	2010
7	Laiwu Iron & Steel Group (Z)Mining Company Ltd	Chinese	Impala	2007
8	Shonga Steel Limited	Zambian	Mukwa	1995
9	New Century Steel Zambia Limited	Chinese	Mukwa	2000
10	Bright Vast Concrete Pole Factory Ltd - Manfacture of Concrete Poles	Chinese	Great North	2011
11	Generation Steel Ltd - Manufacture of Steel Products	Zambian		2010
12	Saltech Investments Ltd - Steel Fabrication	Indian	Mukwa Rd	2008
13	Eon Metal Almacs Steel Company Ltd - Steel Products	Zambian	Luanshya Rd	2008
14	Good Time Steel Company (Z) Ltd - Various Steel Products	Chinese	Mungwi Rd	2005
15	Star Steel And Wire Product (Z) Limited	Ugandan	Off Lumumba Rd	1998
16	Steel Tech Investment Limited	Indian	Off Chandwe Mus	2014
17	Steelworx Zambia Limited	British	Nkachibaya Road,	2014
18	Chisteel Zambia Limited-Steel Products	Chinese	Lumumba Road	2011
19	Amalgamated Steel Engineering Company Limited - Expansion for Steel &	Indian	Mwembeshi Rd	2008
20	Dangote Industries Zambia Ltd - Establishment of a Cement Plant and Pac	Nigerian	Katemo Rd	2008
21	Scirocco Enterprises Ltd - Cement Production, Mining, Quarring and Concr	Zambian	Makeni	2007
22	Good Time Steel Company Zambia Limited	Chinese	MUNGWI ROAD	2012
23	Afil Engineering Limited - Manufacture of Steel Products	British/Lel	Katanga Rd	2008
24	Universal Mining & Chemical Industries - Manufacture of Steel Products	Zambian	Nampundwe Rd, Ir	2007
25	Zenith Investments Ltd - Wood Processing	Indian	Mumbwa	2008
26	Sonar Steel Ltd - Fabrication of Roofing Sheets & Other Steel Products	Indian	Mukatasha Rd	2008
27	Steel World Zambia Limited	Zimbabwe	Lumumba Rd	1994
28	Kitchenware Industries Ltd - Manufacturing of Alluminium and Kitchen ute	Indian	Kalambo	2007
29	Global Products Ltd - Manufacture of Packaging Products	Indian	Chinika Area	2011
30	Steel Tubes & Hardware Manufacturing Ltd	Indian	Lumumba Rd	1994
31	Office Spectrum (Z) Ltd	Zambian	Malasha	2001
32	Infraset Zambia Limited	South Afri	Off Great North R	2009
33	Master Timber Joinery and Alluminium Ltd	Tswana/Z	Olympia	2014
34	Sikale Wood Manufacturers Ltd - Wood Processing	Chinese	Middleway Rd	2007
35	Safintra Zambia Limited - Manufacture of Steel Roofing Sheets	Indian/Mauritian		2009
36	Planet Home Innovations Limited - Wood Processing	Zambian/Z	Tina Road, Ibex Hi	2012
37	Ductshop Limited - Manufacture of Cables	Zambian	Kachidza Rd	2010
38	Asbestors Roofing Ltd - Manufacturing of galvanised iron sheets and Lipch	British	Lumumba Road	2007
39	Malata Roofing Limited	British/Zar	Lumumba Road	2013
40	Wonderful Industry (Z) Company Ltd	Chinese	Mulalika Rd, Off M	2012
41	Amalgamated Steel Engineering Company	American/	Mwembeshi Road	2012
42	cx	British	-	2010
43	Hai -Tian Investments Limited-Manufacturing of steel products	Chinese	Off Mumba Road	2011

building products(49)

No.	Project name	Country of	Plot numl	Street
1	Adnan Blocks Factory Limited	Turkish	396A	Makeni Road
2	Africa Builders Merchants Ltd - Timber Processing	Zambian/Zin	Stand 168	Nangwenya Rd
3	Akaal Engineering Limited	Indian	200a	Villa Park
4	Alloy Metal Products Limited	Zambian	8582	Njanshinshi Rd
5	Architectural Aluminium and Woodtech Ltd - Manufacture of wood and alu	Kenyan/Zam	287	Mutobe
6	Asbestos Roofing Limited	Zambian	8481	Lumumba Road
7	Belgium Echo Investments Ltd - Manufacture of Building products	Lebanese	8074	Off Mumbwa Rd
8	Bestcol Investments Ltd - Manufacturing of Steel Mill Balls, Casting and C	Canadian	32	Enos Chomba Avenue
9	Beta Bricks (Pvt) Limited	Zimbabwean	397/2	Kafue Road
10	Breza Engineering Ltd - Provision of mechanical structural electrical and cu	Slovak/Zamb	5260B	Mukwa
11	Brunelli Construction Company (Z) Ltd - Manufacture of Building Products	American	5267	Mukwa Rd
12	Chaka Builders and Manufacturing Company Ltd - Manufacturing of Furnit	Zambian	2802	Livingstone Rd
13	Decomore Investments Ltd - Manufacture of Wood Products	Lebanese	6726	Chainama Rd, Olympia Extension
14	Decotex Paints Limited	Indian/Zamb	13955	Chandwe Musonda Road
15	Decotex Paints Limited	Indian/Zamb	13955	Chandwe Musonda Road
16	Decotex Paints Zambia Ltd	Zambian		Off Chandwe Musonda Rd
17	Diab Block Investment Limited	Lebanese/ M	9487	Makeni
18	DSS Block Manufacturing Company Limited	Turkish	C34	Chakeluka Road, Olympia
19	Dwinchi Woodtech Limited	Zambian	9526	Off Katanga Rd
20	Elroi Engineering Limited	South Africa	724	off Kabulonga Road Ibex Hill
21	Elsewedy Electric (Z) Engineering - Manufacture and Distribution of Trans	Egyptian/Za	Stnd No. (	Great East Rd
22	Fangzheng Construction (Zambia) Limited	Chinese	Plot No. 8	Enock Kavu Road
23	Glass Touch Investments Limited	Kenyan	Mar-58	Chikwa Road
24	Global Wheel Ltd - Manufacture of Engineering Products	American/Bi	2	Oxford Rd
25	Granite Terrazzo & Decorators - Others (Manufacturing)	Cypriot/Italian		Lumumba Rd
26	Handyman's Lime Quarries Limited	British/Zamb	5159/60	Foundation House, Washama Road
27	Handyman's Paradise Lime Manufacturing	Zambian	627, Allian	Cairo Road
28	Ideal Property Builders Limited	Cypriot/Zam	203	Provident Street
29	Inland Engineering Co. Limited	British	10566	Off Chandwe Mus
30	Inter-Africa Cement (Lusaka) Ltd - crushing aggregates and produce cem	Zambian	9003	Chifinga Rd
31	Kafubu Limestone Ltd - Manufacture of Building Products	Chinese		
32	Kalulushi Clay Bricks Limited		7477	Off Kalulushi/Chingola Road, Kalu
33	Kenol (Z) Ltd - Manufacture of Engineering Products	Nigerian		
34	Kudu Engineering Services Limited	Zambian	8513	Chinika Industrial Area
35	Lamasat International Ltd - Expansion of Existing Manufacturing Plant	Lebanese	397/0/1	Chipwenupwenu Rd
36	Leading Century Building Materials Ltd - Manufacture of Building Product	Chinese	52 Maken	Kafue Rd
37	Lions Group Quarries Ltd - Quarrying and Crushing	Lebanese	6294/6283	Lusaka West
38	Longgan Investments Ltd - Manufacture of Building Products	Chinese		
39	Lubuto Const. & Cater.Ind.Ltd	Zambian	6681	Olympia Extension
40	Luhang Building Materials Limited	Chinese	2440	chipwenupwenu road
41	Lusaka Aluminium Ltd - Manufacture of Aluminium Pots and Pans	Indian	10866	Lumumba Rd
42	M.D.M Engineering Company Ltd	Zambian	1566	Miseshi Rd
43	Mashate Wire Manufacturing Co.	Zambian	287	Mumbwa Rd
44	Meem Engineering Company	Indian	8580	Chamapepe
45	Metalco Industries Ltd - Engineering Products	Lebanese/Za	5110	Lumumba Rd
46	Micro Engineering Works	British	1443/13	Luanshya Rd
47	MM Integrated Steel Mills Limited	Indian/Tanza	8643	Chinika Industrial Area
48	MM Integrated Steel Mills Limited	Indian/Tanza	8643	Chinika Industrial Area
49	MM Integrated Steel Mills Ltd - Manufacture of Roofing Sheets	Indian/Tanza	8463	Lunzua Rd
50	Modern Engineering Company Ltd	Zimbabwean	1573	Freedom Way
51	Mornab Construction and Repairs Limited	Greek	397a	Makeni Rd
53	Nova Engineering & Construction Ltd - Manufacture of Engineering Produ	Indian	10953	Mumbwa
54	Omar's Investments Ltd - Manufacture of Building Products	Zambian	1	Buyantashi
55	Phoenicia International Ltd - Manufacture of building products	Lebanese	396A	Kafue Rd
56	Pilatus Engineering Limited	Swiss/Zamb	2319	Leopards Hill Rd
57	Pipe Master Zambia Limited	Chinese	7313	Kachidza
58	Powerhold Hardware and Construction Materials Company Limited	Taiwanese	8474	Chimpepe Road
59	Prime Marble Products Limited	Zambian	12592/3	Off Mumbwa Rd
60	Puzzolana Zambia Ltd - Metal Products and Others	Indian	11058	Haile Selassie Avenue, Longacres
61	Quick Space (Z) Ltd - Fabrication Of Steel Structures	Zambian	22	Chipwenupwenu
62	Rankin Engineering Consultant	Canadian	Rankin Ho	Chozi Rd, Northmead
63	Reunited Engineering Limited	Zambian	9530	Katanga Rd, Heavy Industrial Area
64	Roof Rite Limited	British	7039	Chibengele Rd
65	Royal Brick Ltd - Manufacture of Tiles and Paving Bricks	Chinese	4898	Los Angeles Boulevard
66	S. A Lime and Gypsum (Z) Ltd - Manufacture of Lime and gypsum Produc	South Africa	6964	Mungwi
67	Safintra Zambia Limited - Manufacture of Steel Roofing Sheets	Indian/Mauritian		
68	Saltech Investments Ltd - Steel Fabrication	Indian	5256	Mukwa Rd
69	Sapphire Electrical Limited	Zambian	151/52	Kalundwe Rd
70	Saro Agro Industrial Ltd - Manufacture of engineering products	Zambian	5284	Buyantanshi
71	Sav Steel Mills Limited	Kenyan	27367	Iubambe Road
72	Scirocco Enterprises Ltd - Cement Production, Mining, Quarring and Concr	Zambian	288a	Makeni
73	Scirocco Enterprises Ltd - Manufacture of Building Materials	Zambian	288a	Makeni
74	Shameem Investments Ltd - Manufacture of Engineering Products	Australian/Z	Sub 14, Fa	Makeni Rd
75	Skyline Quarry Limited	Chinese/Zan	Zone 10	Nkomeshya Chiefdom
76	Sun Share Investments Limited	Chinese	N3267 Chilanga	
77	Tap Building Products Limited	British	2097	Cairo Rd
78	Technical Engineering Co. Ltd - Manufacture Of Steel Products	Lebanese	Stand 127	Chinika Area
79	Thermopack Zambia Ltd - Manufacturing of plastic & metal products	American	11889	Chandwe Musonda
80	Thinkcheng Engineering Ltd - Manufacture of Building Products	Chinese	Farm 283a	Kariba
81	Tianjian Zambia Ltd - Manufacture of Street Lighting Bulbs, Electric Cable	Chinese	10865	Kafue Rd
82	Trulong Timber Merchants Ltd - Manfacturing of timber products	Zambian	609/V	Zambezi
83	Turtle Blinds Manufacturing Limited	Zambian	9216	Off Lumumba Road
84	Turtle Tile and Memorial Limited	Zambian	12913	Mumbwa Rd
85	Uniturtle Industries (Z) Limited	Indian/Zamb	9216	Lumumba Rd
86	Univide Hi-Tech Engineering Limited	Filipino	1277	Freetown
87	Wah Kong Enterprises Ltd - Manufacturing of building Products	Chinese	379A	Great East Rd
88	Wonderful Industry (Z) Company Ltd	Chinese	Plot No. 7	Mulalika Rd, Off Mumbwa Rd
89	Woodclass Ltd	Pakistani	S/D 32 of	Makeni Rd
90	Yo Limba Bricks and Blocks Limited		297A	Leopards Hill Road
91	Zambezi Metal Recycling Limited	South Africa	10960	Off Chandwe Mus
92	Zambia Aluminium Limited	Bermudan/B	1633	Malambo Rd
93	Zambian White Rhino Ltd - Manufacture of Roof Tiles and Paints	Chinese	11839	Lubumbashi Rd
94	Zaminliny Investments Limited - Wood Processing	Chinese	5/737	Industrial Area
95	Zenith Investments Ltd - Wood Processing	Indian	11931	Mumbwa
96	Zhong Energy (Z) Ltd - Manufacture of electrical products	Chinese	2440	Chipwenupwenu
97	Zhong Mei Engineering Group Limited	Chinese	9654	Central Street

APPENDIX-6: Paris Agreement

UNITED NATIONS NATIONS UNIES

POSTAL ADDRESS—ADRESSE POSTALE: UNITED NATIONS, N.Y. 10017
CABLE ADDRESS—ADRESSE TELEGRAPHIQUE: UNATIONS NEWYORK

Reference: C.N.735.2016.TREATIES-XXVII.7.d (Depositary Notification)

PARIS AGREEMENT
PARIS, 12 DECEMBER 2015

ENTRY INTO FORCE

The Secretary-General of the United Nations, acting in his capacity as depositary, communicates the following:

On 5 October 2016, the conditions for the entry into force of the above-mentioned Agreement were met. Accordingly, the Agreement shall enter into force on 4 November 2016, in accordance with its article 21, paragraph 1, which reads as follows:

"This Agreement shall enter into force on the thirtieth day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 per cent of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession."

5 October 2016

Attention: Treaty Services of Ministries of Foreign Affairs and of international organizations concerned. Depositary notifications are issued in electronic format only. Depositary notifications are made available to the Permanent Missions to the United Nations in the United Nations Treaty Collection at https://treaties.un.org, under "Depositary Notifications (CNs)". In addition, the Permanent Missions, as well as other interested individuals, can subscribe to receive depositary notifications by e-mail through the Treaty Section's "Automated Subscription Services", which is also available at https://treaties.un.org/Pages/Login.aspx?lang=_en.

APPENDIX-7: The CERES Principles

CERES PRINCIPLES

First published in the fall of 1989, the Ceres Principles are a 10-point code of corporate environmental ideals to be publicly endorsed by companies as an environmental mission statement or ethic. The Ceres Principles are;

1) Protection of the Biosphere

We will reduce and make continual progress toward eliminating the release of any substance that may cause environmental damage to the air, water, or the earth or its inhabitants. We will safeguard all habitats affected by our operations and will protect open spaces and wilderness, while preserving biodiversity.

2) Sustainable Use of Natural Resources

We will make sustainable use of renewable natural resources, such as water, soils and forests. We will conserve non-renewable natural resources through efficient use and careful planning.

3) Reduction and Disposal of Wastes

We will reduce and where possible eliminate waste through source reduction and recycling. All waste will be handled and disposed of through safe and responsible methods.

4) Energy Conservation

We will conserve energy and improve the energy efficiency of our internal operations and of the goods and services we sell. We will make every effort to use environmentally safe and sustainable energy sources.

5) Risk Reduction

We will strive to minimize the environmental, health and safety risks to our employees and the communities in which we operate through safe technologies, facilities and operating procedures, and by being prepared for emergencies.

6) Safe Products and Services

We will reduce and where possible eliminate the use, manufacture or sale of products and services that cause environmental damage or health or safety hazards. We will inform our customers of the environmental impacts of our products or services and try to correct unsafe use.

7) Environmental Restoration

We will promptly and responsibly correct conditions we have caused that endanger health, safety or the environment. To the extent feasible, we will redress injuries we have caused to persons or damage we have caused to the environment and will restore the environment.

8) Informing the Public

We will inform in a timely manner everyone who may be affected by conditions caused by our company that might endanger health, safety or the environment. We will regularly seek advice and counsel through dialogue with persons in communities near our facilities. We will not take any action against employees for reporting dangerous incidents or conditions to management or to appropriate authorities.

9) Management Commitment

We will implement these Principles and sustain a process that ensures that the Board of Directors and Chief Executive Officer are fully informed about pertinent environmental issues and are fully responsible for environmental policy. In selecting our Board of Directors, we will consider demonstrated environmental commitment as a factor.

10) Audits and Reports

We will conduct an annual self-evaluation of our progress in implementing these Principles. We will support the timely creation of generally accepted environmental audit procedures. We will annually complete the Ceres Report, which will be made available to the public

APPENDIX-8: BOP ISO 14001_1600_10 (Extract)

7. **ENVIRONMENTAL MANAGEMENT SYSTEM (EMS) DEVELOPMENT AND PROCEDURES**.

This section explains the steps involved in establishing an ISO 14001-based EMS and developing procedures to establish, operate, and maintain an EMS at each Bureau institution.

A. Background. ISO 14001 is an environmental management system based on a methodology known as Plan-Do-Check-Act (PDCA). PDCA is briefly described in ISO 14001, **Environmental management systems - Requirements with guidance for use**, as follows:

Plan: establish objectives and processes necessary to deliver results per the organization's environmental policy.

Do: implement the processes.

Check: monitor processes against environmental policy, objectives, and legal and other requirements and report results.

Act: continually improve performance of the EMS. ISO 14001 follows the PDCA model by setting requirements within each subsection (Plan, Do, Check, Act):

1. **Plan**

Establish and implement a procedure to identify aspects of an organization's activities, services, or products that affect the environment; determine which aspects have a significant affect on the environment; and take into account these significant aspects when establishing and implementing an EMS.

Establish and implement a procedure to identify legal and other requirements related to environmental aspects; determine how the requirements apply to the environmental aspects.

Establish and implement objectives to improve environmental performance.

Establish and implement environmental programs for achieving objectives.

2. **Do**

Ensure availability of resources and define roles, responsibilities, and authority.

Identify training needs.

Develop internal and external communication procedures related to the EMS.

Maintain and control EMS documentation.

Prevent deviations from environmental policy and objectives.

Prepare for and respond to emergencies.

3. **Check**

Monitor and measure controls established to prevent deviation from policy and objectives.

Evaluate compliance with legal and other requirements related to the EMS.

Identify and correct EMS nonconformance.

Identify and protect records related to the EMS.

Perform EMS audits.

4. **Act**

Review the EMS to ensure its continued suitability, adequacy, and effectiveness.

Initiate actions to maintain the institution's commitment to continual environmental improvement.

B. Establishing EMS Procedures. Procedures play a vital role in an ISO 14001-based EMS. They provide instructions to develop the system and information to manage it.

The Occupational Safety and Environmental Health Branch, Health Services Division (HSD/Safety), will help institutions develop their EMS by providing the following sample documents**:**

Identifying Significant Environmental Aspects.

Identifying Legal and Other Requirements.

Determining Objectives and Targets.

Determining Environmental Management Programs.

Environmental Training for Employees.

Emergency Preparedness and Response.

Document Control.

Records Control.

Identifying and Implementing Operational Controls.

Providing Internal Communication. Responding to External Interested Parties.

Internal Auditing.

External Audits.

Management Review.

Monitoring and Measuring EMS Performance.

Compliance with Legal and Other Requirements.

EMS Nonconformity, Corrective Action, and Preventive Action.

HSD/Safety provides training on ISO 14001 requirements and procedure development to institution EMS Committee members.

After training is complete, the EMS Committee reviews each sample provided by HSD/Safety and may make modifications (conforming to ISO 14001) to meet institution needs. EMS procedures are used by the EMS Committee to develop, implement, and maintain the institution's EMS.

C. EMS Development Steps. An ISO 14001 EMS has numerous interdependent elements; it is necessary to follow sequential steps when developing the system. The EMS Committee uses the following steps:

Develop EMS procedures.

Identify significant environmental aspects.

Determine objectives, including numerical targets.

Develop environmental programs, including controls for significant environmental aspects.

Identify and provide staff training.

Establish the EMS audit program.

Establish the management review process.

Self-declare concurrence with ISO 14001.

APPENDIX-9: Ethical clearance letter