An Analysis of the Biosafety System in Zambia -Regulatory framework, policies and procedures

By

Bwile Martha Musonda

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DECLARATION

I, Bwile Martha Musonda hereby declare that the work presented in this thesis is the result of my research work and that it has not previously been submitted for a degree, diploma or other qualification at this or another University.

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CERTIFICATE OF APPROVAL

This dissertation by Bwile Musonda entitled “An Analysis of the Biosafety System in Zambia: Regulatory framework, policies and procedures award of the degree of Master in Business Administration.

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ABSTRACT

In 2002, the republican President of Zambia declined a donation of Genetically Modified (GM) maize from the United States of America citing a lack of regulation and technical capacity. Consequently, in 2003 and 2007, the country passed the Biosafety Policy and Biosafety Act respectively. In 2018, government stated that Zambia is a GM food free country. However, by July 2018, the National Biosafety Authority had authorised 24 applications regarding the placements of GM food products on the market. In addition, three applications for medical research using Genetically Modified Organisms were approved. This was a departure from government's earlier precautionary stance on GM food and has led to a public outcry. The status of Biosafety in Zambia remains unclear to most members of the public. Internationally, the debate on the safety of GM food is rife, despite the World Health Organisation (WHO) and Food and Agriculture Organisation (FAO) stating that there are no known health risks posed by the consumption of GM products. Biotechnology has been identified as one of the viable solutions to improve agriculture productivity. Unfortunately, the technology is still under developed in Zambia. The objective of the study was to analyse the Biosafety System in Zambia. The study used a conceptual framework developed by International Service for National Agricultural Research (ISNR) to review the Biosafety System. The study was qualitative in nature. Secondary data was obtained from desk top reviews of relevant documents including the biotechnology and biosafety policy act. Primary data was obtained by conducting expert interviews with twelve purposely sampled experts. In addition, semi structured questionnaires were administered to thirty purposely sampled institutions. A computer assisted qualitative data analysis software, Nvivo 10, was used to aid in the data management and analysis process. The software was also used to query key words for comparison with manually coded categories and themes. The major findings of the study are that the policy is non exhaustive, and the regulatory framework takes a severe precautionary stance which does not support the development of Biotechnology. It is recommended that the policy be revised if the country is to benefit from the technology.

Key words: Biosafety, Biotechnology, Genetically Modified Organism, Precautionary

DEDICATION

This thesis is dedicated to my family, for their continued support and belief in me. May this work bring joy to you.

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ABBREVIATIONS

ABNE	African Biosafety Network of Expertise
ACTESA	Alliance for Commodity Trade in Eastern and Southern Africa
CFT	Confined Field Trials
CIRDZ	Centre for Infectious Diseases Research in Zambia
COMESA	Common Market for Eastern and Southern Africa
CPB	Cartagena Protocol on Biosafety
CUTS	Consumer Unity Trust Society
GART	Golden Valley Agricultural Research Trust
GM	Genetically Modified
IBC	Institutional biosafety committees
ICBD	International Convention on Biological Diversity
IPR	Intellectual Property Rights
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISNAR	International Service for National Agricultural Research
LMOs	Living Modified Organisms
NBA	National Biosafety Authority
NBB	National biosafety board
NBC	National Biosafety Committee
NBF	National Biosafety Framework
NBS	National Biosafety System
NEMA	National Environmental Management
NISIR	National Institute for Scientific and Industrial Research
RA	Risk Assessment
RM	Risk Management
SAC	Scientific Advisory Committee
UNEP-GEF	United Nations Environment Programmes Global Environment Facility
ZAAB	Zambia Alliance for Agroecology and Ecology
ZARI	Zambia Agriculture Research Institute
ZEMA	Zambia Environmental Management Agency
ZNFU	Zambia National Farmers Union

CHAPTER ONE – INTRODUCTION TO THE STUDY

1.1 Chapter Introduction

The chapter provides the background and problem statement of the study. The aim, objectives, research questions and hypothesis of the study are also addressed. Finally, the chapter discusses the theoretical and conceptual framework, operational definitions, methodology and the ethical considerations to be employed in the study.

1.2 Background of the Research

The history of biosafety systems can be traced back to the International Convention on Biological Diversity (ICBD) which came into force in 1992 (CBD, 2013). The ICBD recognizes the benefits of biotechnology and calls for safe management of biotechnology to ensure its safety to human health and the environment in general. Article 19.3 of ICBD (1992) raises concerns on the potential impact of biotechnology application and demands for precautions in safe handling of biotechnology products.

The ICBD article has been the basis for the international biosafety regulatory systems, supplemented by the Cartagena Protocol on Biosafety (CPB). The CPB is an international agreement which was adopted on 29th January 2000 and entered into force on 11th September 2003. It is an international mechanism to regulate trans-boundary movement of Living Modified Organisms (LMOs). It also regulates trade and use of Genetically Modified (GM) crops and derived foods. The main objective of CPB is "to contribute to ensuring an adequate level of protection in the field of safe transfer, handling and use of LMOs resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking into account also of risks to human health and especial focusing on trans-boundary trade" (Rosendal, 2002).

The main feature of CPB is the use of the "Precautionary Principle" as a policy tool of regulation of LMOs especially in risk management. The Principle states that "If an action or policy has a suspected risk of causing harm to the public or environment, in the absence of scientific consensus that harm would not arise, the burden of proof falls on those who would advocate taking the action" (Rosendal, 2002). In general terms, it requires products

to be proven safe before release to the market or into the environment. As of February 2018, the protocol had 171 parties (Publications on the Cartagena Protocol, 2017)

The CPB takes a very precautionary stance against Biotechnology because at the time it came into force in 2003, there were uncertainties regarding Biotechnology. With more information available, the follow up Supplementary Nagoya- Kuala Lumpur Protocol on Biosafety treaty of 2010 has taken a more lax approach towards biosafety regulation (FAO, 2018).

Different governments have taken different approaches to biosafety regulation. For example, the European Union (EU) places emphasis on the precautionary principle. This means that GM crops are largely absent from European fields (Bailey, 2014). On the other hand, the United States of America (USA) system weighs risk against benefit, with the result that GM acreage – in major crops such as soybean, maize, canola and cotton – is significant (ISAAA, 2017).

In Africa, biotechnology is still underdeveloped. This can be attributed to the prohibitive politics of biotechnology which are largely rooted in Europe (Parrlberg, 2002). Proposed linkages between the EU and Africa include:

- Non-Governmental Organisations (NGOs) campaigning against GM in Africa are often linked to European NGOs opposed to GM, through affiliation or funding relationships.
- European donors have promoted the development of highly precautionary biosafety regimes in Africa through bilateral and multilateral aid, and technical assistance programmes.
- The absence of a European consumer market for GM produce discourages adoption by export-oriented farmers in Africa.

Efforts to develop GM crops in Africa have increased in the last decade and are largely driven by international organisations and companies based in the USA such as Biotech, USAID, World Food Programme (WFP) and Melinda Gates foundation (Zepede & Benjamin, 2009). These groups are supported by a number of international and national scientists who argue that Africa stands to benefit more than lose from a sensible

application of regulatory mechanisms to lift the effective ban on GMOs (Broadbent, 2012).

The debate surrounding biosafety regulation in Africa has escalated, reflecting the rapid worldwide growth of GM technology as a means of obtaining perceived benefits such as greater and better quality crop yields (ABNE, 2017). As a result, there has been a gradual increase in the number of African countries that are embracing biotechnology. South Africa, Sudan, Burkina Faso and Nigeria are the four countries in Africa where GM crops are already being grown (ISAAA, 2017). The GM crop varieties being grown were originally developed from USA: Bacillus thuringiensis- *Bt* cotton and maize, and glyphosate resistant maize and soybean (Bailey, 2014). Only Nigeria is growing its own GM cowpea (Bailey, 2014). Cameroon, Egypt, Ghana, Kenya, Malawi and Uganda are some of the countries in Africa that have reached advanced stages of confined field trials, which are the penultimate step prior to commercial approval (ABNE, 2017).

For Zambia, the country passed the biotechnology and biosafety policy and act in 2003 and 2007 respectively. The policy documents acknowledged that Biotechnology and the products of biotechnology have the potential to contribute significantly to the economic development of Zambia, especially in the areas of agriculture, health and industry (GRZ, 2007). However, there has been low development of biotechnology in the country. To date, no field trials of GM crops have been conducted in Zambia (FAO, 2018).

The bottom line remains that the development of biotechnology requires a functioning biosafety regime to assess and manage risk. For poor African governments, with relatively weak institutions, low levels of regulatory capacity and enforcement, and limited scientific expertise and financial resources, this can be a significant challenge (Waithaka, et al., 2015).

1.3 Statement of the Problem

Since Zambia rejected donated GM maize from the USA in 2002, the debate on the safety of GM food is still on going. The Zambian government has on various platforms stated that GM food is not welcome in Zambia. For instance, the vice president of Zambia, reaffirmed government's position on GM food in February, 2018, stating that Zambia will

not import or allow GM food in the country (National Assembly, 2018), (Lusaka Times, 2018).

Despite the no GM food stance that the Zambian government continues to proclaim, there has been a marked degree of tolerance especially after the formation of the National Biosafety Authority (NBA) in 2015. It has been alleged that the mere passing of the Biosafety Act in 2007 was an acknowledgment of the presence and consumption of GM food in the country (Broadbent, 2012).

As of July, 2018, NBA had issued permits for the importation and/or placing on the market of products that may contain GMOs to 23 companies in Zambia (NBA, 2019). These companies include chain stores available in Zambia. This has led to a backlash from some members of the public, including the civil society and the Zambia National Farmers Union (ZNFU) that the government has rescinded its precautionary stance on GMOs. Zambia's position on Biosafety is unclear. It is for this reason that this study will endeavour to analyse the status of the current Biosafety System in Zambia.

1.4 Aim of the Study

To review the current national biosafety regulatory framework that includes policies and procedures in Zambia with the aim of identifying areas of improvement.

1.5 Research Objectives

The objectives of this research were as follows;

1. To assess the National biosafety system in Zambia
2. To understand the elements of the National biosafety system in Zambia
3. To determine how the National biosafety system operates in Zambia

1.6 Research Questions

The research questions are as follows;

1. What is the National biosafety system in Zambia?
2. What are the elements of the National biosafety system in Zambia?
3. How does the National biosafety system operate in Zambia?

1.7 Scope of the Study

The study looks at the issues surrounding the debate on Zambia's position on Biosafety as regards the Regulatory Framework, Policies and Procedures. The study is limited to biotechnology and biosafety in Food and Agriculture in Zambia.

1.8 Operational Definitions

- Biotechnology is broadly defined by the Convention on Biological Diversity as 'any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use'.
- Genetically Modified Organisms (GMOs) are organisms such as plants, animals and micro-organisms whose genetic characteristics have been modified using biotechnology in order to give them a new property (a plant's resistance to a disease or insect, increased crop productivity, a plant's tolerance of an herbicide, etc.)
- Biosafety refers to the set of measures, policies and procedures used or established for assessing, preventing, monitoring and managing any risk associated with GMOs to human health and safety and to the environment.

1.9 Research Methodology

The study was qualitative in nature and relied heavily on secondary data from the Biotechnology and Biosafety Policy and the National Biosafety Act. Primary data was also collected from purposively sampled experts from relevant institutions including the National Biosafety Authority, Zambia Agriculture Research Institute and the University Of Zambia- School Of Agriculture, using interviews. Empirical analysis of the biosafety regulatory policy process based on the accounts of scientists as practitioners and implementers of biosafety regulations informed the systemic understanding of the biotechnology system in Zambia. The researcher used thematic content analysis to analyse the data.

1.9.1 Dissertation Outline

The chapter's synthesis of the Dissertation report will adopt the following structure breakdown: Chapter One: Introduction: Introduces the research question and outlines the

path the dissertation takes to reach its conclusion. This is done by outlining the Background, research questions, aim and objectives of the study.

Chapter Two: Literature Review: Reviews the body of knowledge developed during previous researches in biosafety studies.

Chapter Three: Research Methodology: Explains the methods used in this research to collect and analyses data to achieve the aim and objectives of this study.

Chapter Four: Data analysis and findings. Comprises of the results of applying the research methods adopted in the last chapter.

Chapter Five: Discussion. Explains the findings in detail

Chapter Six: Conclusions and Recommendations. Conclusions are gathered from the data analysis and the recommendations made are based on these conclusions. Further research areas are also suggested

1.9.2 Significance of the Study

The study will increase the awareness levels of Biotechnology and biosafety in Zambia and also provide recommendations on how the development of the technology in the country can be promoted to ensure that maximal benefits are obtained.

1.9.3 Chapter Summary

The chapter provided the background and problem statement of the study. The aim, objectives, research questions, scope of the study were also addressed. Finally, the chapter discusses the research methodology, ethical considerations, operational definitions, outline and the significance of the study were discussed.

CHAPTER TWO- LITERATURE REVIEW

2.1 Introduction

This chapter will provide an overview of Biosafety Systems in the world, with special focus on South Africa and Malawi. A review of similar studies will be provided, followed by a critique of the existing literature. The chapter will conclude with the lessons learnt from the literature reviewed.

2.2 Overview of Biosafety System

The vast amount of literature on biosafety centres on the safety of GMOs, with particular emphasis on GM food. Despite renowned international organizations, including the World Health Organisation (WHO) stating that there are no known health risks posed by GM food (WHO, 2014), the debate on the safety of GM food has persisted. However, it is argued that the whole debate on the safety of GMOs is misplaced because GMOs are not derived from a single, homogenous technology. Depending on the type of GMO, there are different benefits and subsequently, risks associated (Pretty, 2001). More emphasis should be placed on case by case biosafety measures (Azadi, et al., 2017).

Extreme proponents of genetic engineering often fail to recognize that some of its products may have risks. On the other hand, extreme opponents of the technology either ignore or do not understand its potential to contribute to human development (Clark, et al., 2014). Genetic engineering, like many other technologies carries risks. These risks may cause havoc to humans and the environment. As such, biosafety concerns should be treated seriously.

One of the concerns is that introduction of GM crop varieties may lead to novel genes which might be unintentionally transferred by pollination to other plants, including weeds and also wild relatives of the crop species. Such transfers could lead to the development of resistant ‘super-weeds’, loss of biodiversity within crop species, and possibly even the destabilization of the entire ecosystems (Ecuru, 2009).

Concerns have also been expressed about the risks to human health due to consumption of food products derived from GM crops. Opponents of genetic engineering have suggested that consumption of GM food might lead to the introduction of previously unknown allergens into the food chain. However, scientists have argued that the structure

and characteristics of known allergens are well documented, and that testing for possible new allergens is therefore relatively easy (Bawa & Anilakumar, 2013).

Genetic engineering offers new possibilities of increasing food production, especially in the wake of climate change. It can be used to develop drought resistant crop varieties, improve the nutritional quality of crops such as sorghum, cassava, millet and sweet-potato, reduce post-harvest crop losses, improve livestock's resistance to disease, and enable farmers to cultivate in saline conditions (ABNE, 2017).

For example, an analysis of the impact of pathogen free banana in Kenya showed that for the larger farms; there was an average yield increase of 93 per cent to be anticipated when using the GM crop variety and this may increase to 150 per cent for smallholders (Qaim, 2003). The technology was developed through public private partnership involving the Kenya Agricultural Research Institute (KARI), the South African Institute for Tropical and Sub-Tropical Crops (ITSC), and two tissue culture companies. 'Golden' rice is another example of how genetic engineering can be used wisely to contribute to the solution of food insecurity. In this case, genetic engineering has been used to develop a variety of rice with ability to produce beta-carotene that is metabolised into Vitamin A (Parrlberg, 2002). This new variety has the potential to address the growing problem of Vitamin A deficiency that causes partial or total blindness in several million children each year on the African continent (Parrlberg, 2002).

2.3 Biosafety Systems in the world

Biosafety regulatory systems play an important role in the introduction and utilization of GMOs. The acknowledgment that modern biotechnology has the potential to contribute to sustainable development is articulated in the Convention on Biological Diversity (CBD). The CBD provided the basis for the development and adoption of the Cartagena Protocol on Biosafety, which is recognized as the international regime with reference to GMOs (Cartagena Protocol on Biosafety, 2004).

Different governments have taken different approaches to biosafety regulation. For example, the European Union places strong emphasis on the precautionary principle of the Cartagena Protocol. This means that GM crops are largely absent from European fields. On the other hand, the US system weighs risk against benefit, with the result that

GM acreage – in major crops such as soybean, maize, canola and cotton – is significant (ISAAA, 2017).

Policymakers, farmers, and consumers in many African countries, have responded to modern Biotechnology with reticence. Three main reasons have been put forward: first, the general safety of biotechnology-based crops and their impact on biodiversity have been a subject of much debate amongst farmers and regulators in many developing nations; second, GM crops have historically been subject to significant trade barriers (relative to conventionally-bred varieties) in important trading partners of many African nations; and third, many first-generation GM products were developed by companies accused of pursuing broad international intellectual property protections to the purported detriment of entities, including the seed saving farmer and agricultural research centres that rely upon the ready availability of plant seeds (Godfrey, 2011).

As a result, many African countries in the 1990s and early 2000s adopted precautionary policies governing the importation and development of biotechnology products. By end of June 2011, 48 of the 53 countries in Africa had ratified the Cartagena Biosafety Protocol (David, et al., 2012). This was followed by the establishment of National Biosafety Frameworks (NBFs) as ascension requirements of the Biosafety Protocol. NBFs encompass a package of instruments that a country should put in place to regulate safe use and deployment of modern biotechnology. The instruments are a combination of policy, legal, administrative and technical mechanisms to address safety on human health and the environment (David, et al., 2012). The formation of National Biosafety Frameworks (NBFs) in African countries was supported by the United Nations Environment Programme's Global Environment Facility of the (UNEP-GEF) and complemented by other international and regional actors in capacity building efforts (Traynor & Macharia, 2003).

Some countries, particularly those heavily influenced by European NGOs and European trade policy implemented NBFs that characterized biotechnology products as inherently hazardous, subject to quarantine, post-import milling, or outright rejection. (Parrlberg, 2002).

The perceived image of Africa as a passive actor in Biotechnology is changing rapidly with African countries taking clear positions on how to harness modern biotechnology (Waithaka, et al., 2015). Some countries have revised their NBFs to allow for regulation that supports the growth and development of modern biotechnology. South Africa, Burkina Faso and Sudan are among the African countries have been successful and are already cultivating GM crops (ABNE, 2017). Nigeria is the latest country to approve GM crops (Animasaun, 2020). In addition, Cameroon, Egypt, Ghana, Kenya, Malawi and Uganda some of the African countries at an advanced stage of confined field trials (CFTs), which is the penultimate step prior to approval of GM crop cultivation (ABNE, 2017).

South Africa is the leading GM crop producing country in Africa. Investment in agricultural development was a highly prioritized after apartheid leading to the formation the Agricultural Research Council (ARC) and investing heavily in its projects (ABNE, 2017). Due to consistently high poverty levels and other pressing needs, however, the government shifted its focus away from scientific investment and lowered financial support for the ARC and other agricultural research institutions in the early 2000s. While government support for general agricultural research has faltered, funding for domestic biotechnology projects has increased. Public research institutions, joined by a robust private sector and regional entities, conduct most of the biotechnology research performed in the country (Clark, et al., 2014).

2.4 South Africa

As an early leader in African biotechnology, South Africa was also the first African nation to establish regulatory policies on biotechnology (ABNE, 2013). Biosafety requirements for biotechnology products were first established in 1979 by the South African Committee for Genetic Engineering, focusing primarily on laboratory safety. The first formal field trials on genetically modified agricultural products were not conducted until the early 90s, however, and consisted of applications to the Department of Agriculture roughly outlining hazards potentially associated with the trials. Due to a steadily increasing volume of applications and the multidimensional concerns involved, the Departments of Health, Agriculture, and Environment collaborated to formalize the application process and collectively drafted the Genetically Modified Organisms Act 1997 which was implemented in 1999 and later updated to its current version in 2007 (Bailey, 2014). The

lead agency under the GMO Act is the Department of Science and Technology (DST) and the prescribed Scientific Advisory Committee (SAC), which advises a multidisciplinary Executive Committee. The Executive regulates the approval and supervision of the development, testing, production, and use of "genetically modified organisms," including the testing and approval of GMOs for release or importation, for which the Act suggests (but does not mandate) an environmental risk (or impact) assessment may be appropriate. The Act does not elaborate on the content of risk assessments or mandate unique analytical steps with respect to GMOs beyond imposing a general obligation on users to "ensure that appropriate measures are taken to avoid an adverse impact on the environment which may arise from the use of genetically modified organisms" (Bailey, 2014). The Environment Conservation Act 73 of 1989, provides some guidance on environmental risk assessments, requiring very generally that a proposed action (in this case, the release of a GMO) be compared to available alternatives in terms of the extent and significance of identified environmental impacts (Cloetel, et al., 2006)

The National Environmental Management: Biodiversity Act, 2004 (the NEMA), pursuant to the Protocol, requires that the release of a GMO that "may pose a threat to any indigenous species or the environment" not be permitted, unless an environmental assessment has been conducted. By their inclusion in Schedule 1 of the NEMA's prescribed categories, GMOs can be approved on the strength of merely a "basic" risk assessment (Bailey, 2014). This includes generally considering the particularities of the environment in question, the potential impact and cumulative effects of the release, measures to mitigate those effects, and information on ongoing monitoring and impact-management efforts (Bailey, 2014). Set against this framework, South Africa has the most advanced agricultural biotechnology sector on the continent (ABNE, 2017). South Africa is the eighth largest grower of biotechnological crops worldwide, with 2.1 million hectares of commercially grown transgenic crops currently under cultivation (ISAAA, 2017). Bt cotton was the first biotech crop to receive regulatory approval in 1997, and today, more than 75 percent of cotton grown in South Africa is Bacillus thuringiensis *Bt* cotton (ABNE, 2017).

Among the other *Bt* crops that have been researched is white maize, which was adapted from yellow maize varieties and is generally more consistent with South African diets

(Bailey, 2014). Furthermore, while all varieties of biotechnological crops currently under cultivation were developed off-continent, recent transformation events include the transformation of maize to tolerate the maize streak virus—the first GM plant developed entirely "by Africans, While it has thus enacted provisions corresponding to the Protocol's focus on "potential adverse effects," South Africa, via the NEMA, explicitly treats genetically modified plants as products that generally exhibit low environmental risk (ABNE, 2017).

The GMO Act and Biodiversity Act mandate unique bureaucratic processes with respect to GMOs, but those bureaucratic processes do not appear to subject the products to more stringent standards than those employed with respect to other products (Kirsten & Gouse, 2003). While some crops may be subject to rejection or quarantine due to their characteristics as revealed by environmental risk assessment, a product's transgenic or modified character does not make it inherently more hazardous than products developed by other means. By equating GMOs with traditionally bred crops and generally eschewing process-based regulation, the South African government has adopted a position on biosafety that arguably supports the biotechnology industry instead of following the "precautionary" tone of the Protocol and Model Law (Bailey, 2014).

2.5 Malawi

Key informants cited Malawi as a great example to Zambia for a country that has a clearer and more supportive biosafety framework compared to Zambia. Malawi was chosen because of its proximity in terms of culture, financial and scientific capacity with Zambia. Though the country is yet to approve the cultivation of GM crop, Malawi's National Biotechnology policy of 2007 has been appraised as being clear and supportive to biotechnology development. Malawi has been conducting Confined Field Trials of *Bt* cotton since 2013 (ABNE, 2013). In the year 2015, two CFTs of *Bt* cotton, one at Bunda College and the other in Toleza Farm in Balaka were conducted (ABNE, 2017).

Malawi has made significant progress in building workable policies and regulations. The key aspects of Malawi's Biotechnology policy are;

- An exhaustive list of all players in the Biosafety System and their respective roles
- Linkages of the biosafety policy with other relevant policies

- Review period for policy to allow for incorporation of technological advances

Overall, Malawi's biosafety policy of 2015 was cited as being responsive to biotechnology research and development by not insinuating precautionary attitudes towards biotechnology (Belay, 2019). The country has also acquired experience in testing a genetically modified crop variety, namely *Bt* cotton. Malawi is preparing to undertake a CFT on cowpea – the first GM food crop to be tested in the country (ABNE, 2017). Successful conduct of this food crop CFT and on-farm testing and commercialization of *Bt* cotton in the country requires a renewed engagement and regulatory support for the country to make economic benefit from investments made so far (Zepeda, 2006)

It is important to note that with these apparent progresses made, the usual misinformation and distortion activities of anti-GMO activists are still prevalent. To counter this imminent challenge, ABNE along with other partners has noted the importance of strengthening biosafety communication and awareness creation capacity and has shared its biosafety communication manual with the Malawian biosafety office and encouraged the office to build national biosafety communication strategy (ABNE, 2017).

2.6 Review of Similar Studies

A study titled the emerging international regulatory framework for biotechnology (Komen, 2012), outlined the main international instruments relevant to biosafety regulation, and their key provisions. It showed that while international agreements and standards provide important guidance, they leave significant room for interpretation, and flexibility for countries implementing them.

The report further showed that implementation of biosafety at the national level has proven to be a major challenge, particularly in developing countries, and consequently the actual functioning of the international regulatory framework for biotechnology is still in a state of flux.

The recommendations provided by the study is that governments need to develop and implement comprehensive national policy frameworks that guide the use of, and access to, genetic resources and biotechnology applications. International agreements such as the CPB will have to be translated into national laws and regulations and a coordinated framework for biosafety among the various national regulatory agencies. Ideally, this

development would be in line with a country's overall objectives for agricultural and rural development. National policies and strategies are instrumental in developing laws and regulations that are complementary and mutually reinforcing and responsive to international agreements.

In 2000 (Traynor, et al., 2000) presented an analysis of the status of the biosafety system in Egypt and its impact on the commercialization of GMOs. The study was supported by International Service for National Agricultural Research (ISNAR). The review of biosafety policy and procedures in this study was structured around the four elements of national biosafety systems as proposed by (Cohen, 2014). These are:

1. The *regulations or guidelines* clearly define the structure of the biosafety system, the roles and responsibilities of those involved, and how the review process is to operate;
2. The *people* involved are knowledgeable and well trained, confident in their ability to make decisions, and supported by their institutions;
3. The *review process* is based on up-to-date scientific information; focuses on specific combinations of crop, gene, and environment; promotes appropriate risk management practices; and balances risks against benefits;
4. *Feedback mechanisms* are used to incorporate new information and revise the system as needed.

The study focused on the human and mechanistic aspects of the Egyptian biosafety system. Major points of interest were: (1) the organization, membership, and operations of the National Biosafety Committee (NBC), (2) the nature and availability of information on biosafety procedures and requirements, (3) the path of regulatory review and approval leading to commercial release, (4) the extent of public involvement in biosafety matters, and (5) the personal experiences of applicants and reviewers in dealing with the biosafety system.

Recommendations following the report are summarized as follows:

- Revise or re-issue the biosafety guidelines

- Establish and Fund a Secretariat for the NBC
- Institute mechanisms to disseminate information to the biotechnology community
- Develop a pro-active plan for building public acceptance

Findings and recommendations of the report served as the basis for discussions to strengthen and adapt the biosafety system to the changing context for biotechnology products. Egypt became the second country in Africa after South Africa to allow the commercialisation of *Bt* Maize in 2010 (ABNE, 2013). However, the Egyptian government suspended the planting of GMO maize two years later citing the absence of sufficient biosafety legislation (Gakpo, 2019).

In 2003, a study was conducted in Kenya to analyse the status of the National Biosafety System in the country. The study used the conceptual framework established by ISNAR. The ISNAR conceptual framework is based on reviewing biosafety systems through five common elements that ideally function to bring about environmentally responsible decision-making regarding the use of GM products (Macharia & Traynor, 2003). These five elements are a build from the four elements identified by (Cohen, 2014). These are;

1. Strong national policies, strategies, and research agendas in biotechnology and Biosafety, including administrative systems for handling applications, monitoring and enforcement
2. A national inventory and evaluation
3. Knowledge, skills, and capacity base on which to build a biosafety system
4. Development of regulations
5. Implementation of regulations.

The country report also served to test the suitability of the framework as a tool to aid in the evaluation and analysis of existing biosafety systems.

The main findings of the report are:

- There is a need to develop the biosafety expertise of key government officials within existing regulatory agencies to help them handle increasing volumes of applications.

- There is concern about the entry of transgenic organisms into Kenya outside of regular channels, such as GM grain arriving as food aid, which could subsequently be planted by farmers.
- The National Biosafety Committee (NBC) currently takes a cautious approach to risk assessment. It needs to look at the potential benefits of GMOs and also the risks associated with *not* adopting some GM products for the future productivity and sustainability of agriculture and for the competitiveness of the economy in Kenya.
- As in most countries, public understanding of biotechnology and GM is limited.
- Kenya is well placed to take the lead in biosafety initiatives in the region.

The report's findings and recommendations served as the basis for discussions to strengthen and adapt the biosafety system in the country (Macharia & Traynor, 2003). Kenya enacted its Biosafety Act in 2009 as the legal framework necessary to regulate agricultural biotechnology. This was followed by the publication of implementing regulations in August 2011, paving the way for confined field trials of GM crops in 2005 (ABNE, 2013).

In 2005, Uganda also conducted a study to analyse the status of the National Biosafety System in the country using the conceptual framework established by ISNAR. Specific objectives of the study were to:

1. Examine the organization and operation of Uganda's national biosafety system
2. Characterize existing policies, regulations, and capacities for regulatory management and decision- making, and identify areas for further development
3. Develop a set of recommendations intended to (a) encourage a clear and supportive policy and regulatory environment, (b) increase capacities for meeting national obligations under the Cartagena Protocol for Biosafety, and (c) foster greater biosafety awareness and understanding among stakeholders and the general public.

The main findings of the report are;

- Progress in biotechnology has been relatively slow due to a lack of technocrats in the field
- The biosafety office is underfunded leading to insurmountable pressure on the staff members to produce quality work
- Food safety is the Achilles heel for the development of biotechnology in the country
- The biotechnology administration hierarchy is inconsistent
- Attempts to standardize regulation in East Africa have not materialized

The report's findings and recommendations served as the basis for discussions to strengthen and adapt the biosafety system in the country (Sengooba, et al., 2005).

In 2009, a study titled; Towards a smart biosafety regulation: The case of Kenya was conducted (Kingiri & Ayele, 2009). The main objective of the research was to develop a smart biosafety regulation for Kenya. The researchers used the innovation systems approach theory. The report found that delivery mechanisms for Kenyan biotechnology innovation to potential recipients and the analogous institutional arrangements are weak. In addition, strategies to support sustainable endeavours towards pro-poor technologies are also currently weak or non-existent. These weaknesses need to be addressed for any meaningful gain from biotechnology to be realised. In conclusion, the following recommendations were made:

- Representation of diverse and relevant voices in the biosafety policy process
- Kenya must develop home-grown biotechnology and biosafety capacity in order to instill "ownership" of thinking into the minds of scientists and policy makers, thereby enhancing public trust
- The Kenyan regulatory policy development process should take advantage of integrating the political and social "blind spots" assumed or taken for granted in the "ad-hoc" policy implementation process. A hypothetical consensus building system-oriented approach is recommended if benefits from life sciences are to become sustainable (Kinginri & Ayele, 2009).

In 2009, another study was conducted in Kenya on biosafety regulations implementation in Kenya: perspectives and roles of scientists (Kingiri, 2010). The study objectives were;

- Look at the factors that impact upon the way biosafety regulations are implemented in practice.
- to situate the role of different actors and in particular, those in the biotechnology science and biosafety arena, in policymaking and the systemic issues that determine the way these roles are articulated
- Thirdly, illuminate actors framing of issues around the first two considerations (implementation of regulations and role of scientists in regulatory policymaking) and the motivations behind the emerging discourses.
- Fourthly, by weaving these discourses together, establish how the scientific community impact upon or influence regulatory instruments in terms of context and content as this would have implications for broader innovation policies and eventual biotechnology deployment.

The Findings emanating from analysis of the data generated from this study suggest the following;

- The heterogeneous scientific community has contrasting views of regulations and regulatory process built around the prospects of biotechnology in addressing food production constraints on the one hand, and risk perception, on the other. The study empirically exposed complex technical and social factors (capacities, values, beliefs, interests, globalisation and reduced funding of public research among others) that collectively shaped the evolving perceptions of scientists of regulatory process and practice.
- Different values exhibited by the scientific community reflected cultures of different social knowledge groups and coalitions that they belong to (academic disciplines, professional and policy groups). This scenario presents a different way of interrogating knowledge use, departing from the way it has been researched by various scholars. It has also opened a new way of looking at knowledge flow and

relationships building, augmenting the interactions and cumulative learning emphasised in innovation systems and policy networks literature.

- The scientific community engages in various ways in regulatory and scientific activities which is consistent with Mode 2 integrated practice. The context under which these activities are articulated has informed better understanding of specific concepts that speak about knowledge and knowledge production dynamics. For instance, knowledge production and use in a regulatory context is complex and value laden which tends to challenge application of Mode 2 principles.
- The Mode 2 research environment impacts scientific behaviour which ultimately affect how knowledge is eventually used in regulatory decision-making processes based on the underpinning complex context. This calls for rethinking of role of knowledge and scientific practice in the regulation of biotechnology contributing conceptually to the growing scholarship around governance of the new life sciences.
- The institutional shortcomings that were revealed in the process of regulations implementation suggest a need for policy makers to reconceptualise governance approaches to regulation of biotechnology research towards regulatory models that are pro-innovation.

In 2012, (Mtui, 2012) conducted a related study on Biosafety systems in Eastern and Central Africa. The aim of the study was to review biosafety systems meant to safeguard human health, animal health and the environment against any possible risks posed by development and application of modern biotechnology.

The study gives an overview of worldwide biosafety frameworks as guided by the Cartagena protocol on biosafety. The Eastern and Central African countries covered in this study are Tanzania, Kenya, Uganda, Rwanda, Burundi, Ethiopia and the Democratic Republic of Congo (DRC). An attempt is made to assess the current status on the countries' compliance to biosafety international conventions, institutional arrangements and regulatory regimes. A critical look is given to the existing biosafety frameworks, pinpointing their weaknesses and giving suggestions on what could be done to address the shortfalls.

The report identified challenges facing the operationalization of the biosafety systems in Eastern and Central Africa to be; financial constraints, insufficient trained human resources, poor facilities, low awareness and insufficient political will by some governments. It was further argued that while biosafety frameworks stand to safeguard safe application of modern biotechnology, they should not have too stringent regulations, lest they impede the development of modern biotechnology in the Eastern and Central African region.

2.7 Critique of Existing Literature

Biotechnology is a technology which is evolving fast and there is a vast amount of literature on the topic. Despite African countries having a fair literature representation in this field, the objectivity of the journal articles and reports has often been questioned. This is because the authors or organisations behind the research are usually sponsored by either pro or anti GM food international organisations. As a result, it is difficult for the African governments or citizenry to trust the research results and findings in making informed decisions.

The ISNAR studies reviewed above did not investigate the different elements in biosafety and how they operate together. This study incorporated this aspect because the literature reviewed revealed that the lack of coordination among regulatory implementing institutions is an impediment to the development of a clear biosafety system.

Context specific literature is scanty, particularly with regards to empirical studies in developing countries. Perceptions of regulations and factors influencing these perceptions are not from empirically grounded literature. In the case of Zambia, very little research on biosafety has been conducted. Specifically, there has been no study conducted to ascertain the Biosafety status in the country. The researcher finds this topic fitting considering the food security threats posed by climate change and to add to the body of knowledge.

2.8 Chapter Summary

The Chapter provided an overview of Biosafety and Biosafety Systems in the world. A review of similar studies and a critique of existing literature was also provided.

CHAPTER THREE- METHODOLOGY

3.1 Introduction

The purpose of this chapter is to introduce the research methodology for this study on An Analysis of the Biosafety System in Zambia -Regulatory framework, policies and procedures. The research plan, including the methodology, study participants, procedures, analysis method, and ethical concerns are also primary components of this chapter.

3.2 Research Questions

The research sought to answer the following questions;

1. What is the National biosafety system in Zambia?
2. What are the elements of the National biosafety system in Zambia?
3. How does the National biosafety system operate in Zambia?

3.3 Methodology selected

The study was qualitative in nature. A qualitative study is appropriate when the goal of research is to explain a phenomenon by relying on the perception of a person's or people's experience in a given situation (Barton, 2012). In addition, a qualitative approach is appropriate when a researcher seeks to understand systems (Kumar, 2019). Because the purpose of this study was to analyse the biosafety system, a qualitative approach was used.

3.3.1 Theoretical Framework

The researcher used a Systems Approach Theory with the goal of identifying the key elements of the Biosafety system and the underlying tensions and processes that determine the system's ultimate dynamics. Systems Theory is a transdisciplinary framework for describing principles of complex systems in their structure, interaction, and behavior in relation to each other and outside actors (Ellis, 2016). Systems Theory was founded by the biologist Ludwig von Bertalanffyalyse to understand complex processes and popularised by Meadows, as a useful framework in the fields of ecology, economics, and human development theory (Peffers, 2007). These diverse schools are united by their focus on understanding how factors are connected to each other in a system: a set of things working together as a complex whole. They are also unified by the concept of emergence:

that interactions between the parts of a system can produce 'emergent' properties that cannot be understood by examining each part in isolation (Peffers, 2007).

When examined from a systems perspective, Biosafety System is defined by emergent functions or purposes. Several features of all systems apply to the development of Biosafety. The features according to (Wulczyn, 2010) include the following:

- Any system involves a collection of components or parts that are organised around a common purpose or goal—this goal provides the glue that holds the system together.
- All systems reflect a nested structure—in the case of Biosafety, elements are embedded in different ministries, which exist within a wider system.
- Given the nested nature of systems, specific attention needs to be paid to coordinating the interaction of these subsystems such that the work of each system is mutually reinforcing to the purpose, goals, and boundaries of related systems.
- All systems accomplish their work through a specific set of functions, structures, and capacities. However, the characteristics of these functions, structures, and capacities will be determined by the context in which the system operates.
- All change within a system framework is bi-directional—changes to any element, for whatever reason, will change the context and changes in the context will alter the system.
- Well-functioning systems pay attention to nurturing and sustaining acts of cooperation, coordination, and collaboration among all levels of stakeholders, including those managing key activities as well as those performing key functions.
- Systems will achieve their desired outcomes when they design, implement, and sustain an effective and efficient process of care in which stakeholders are held accountable for both their individual performance as well as the performance of the overall system.

- Effective governance structures in any system must be flexible and robust in the face of uncertainty, change, and diversity.

In this study using Systems Theory emphasis was placed on the design of the whole not only in its components, but also for its emergent system properties (Duflou, 2012). Reflecting on the different components throughout the research study was important in guiding changes in interview questions during the study to uncover more details of the themes that emerged. Examination from the perspective of systems theory provides a holistic view of Biosafety in Zambia. Understanding a system in this way illuminates the strengths and weaknesses of the system as related to the mission and goals and reveals information about the way the Biosafety system functions.

The essential elements of a systems approach to Biosafety as reflected by (Traynor, 1999) formed the basis for this study. The elements identified in this study are;

1. The policy on biotechnology
2. Laws and regulations on biosafety constituting a regulatory regime for biotechnology
3. The administrative system for handling applications and issuance of permits e.g. functional NBCs and IBCs
4. The mechanism for public participation in biosafety decision-making

The study outlined tenets such as coding, generating memos, analysing data as it is generated to build themes, selecting core categories from coding, and generating information. Together, the procedural steps used in systems theory methodology aided the researcher in continually seeing the data through a fresh lens to foster the potential for new information to emerge from the data (Barton, 2012).

3.3.2 The Conceptual Framework

The study adopted the conceptual framework from (Traynor, 1999) as shown in the figure below. In line with the systems approach theory used in this study, the conceptual framework shows how the elements in the system are related.

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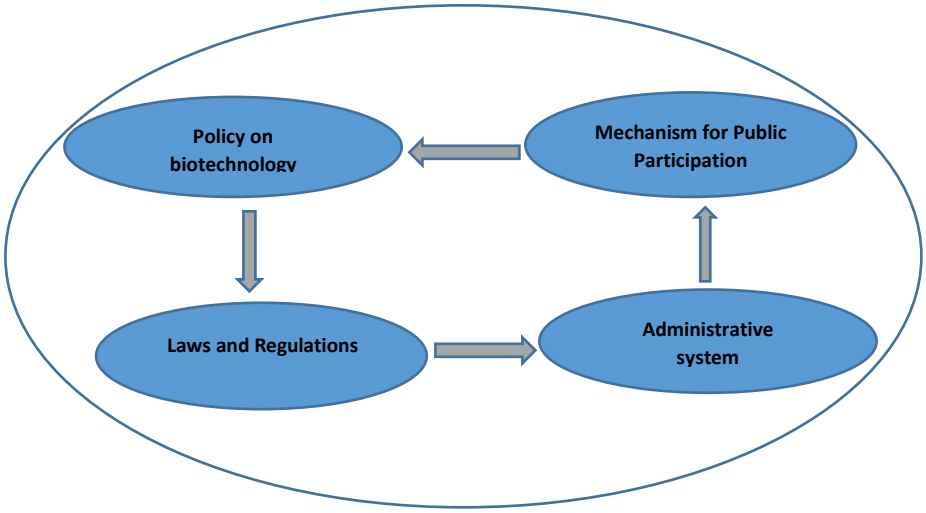


Figure 3.1 Conceptual Framework

The figure above was adapted from (Traynor & Macharia, 2003) study of biosafety management. In this study; the author proposed analysing biosafety systems in four paradigms. Namely;

1. Policy on biotechnology and the laws and regulations. Also known as the regulations or guidelines.
2. The administrative system also known as the people involved in the system.
3. the review process also part of the administrative system is based on up-to-date scientific information
4. Mechanism for public participation also known as Feedback mechanisms are used to incorporate new information and revise the system.

The researcher interrogated the separate elements of the system independently and holistically in the study.

3.4 Study Area

The study was Zambia and the data was collected from individuals and institutions based in Lusaka because that is where the most prominent institutions in the Biosafety system are located according to the Biotechnology and Biosafety policy and it was more cost effective for the student budget for this research.

3.5 Study Population

The study population was derived from the Biotechnology and Biosafety policy list of implementing players; The Ministries of: Higher Education; agriculture; health; commerce, trade and industry; legal affairs; finance; home affairs; information and broadcasting; local government and housing; transport and communications; lands, natural resources and environment protection; chiefs and traditional practices, institutions of higher learning; research institutions; civil society; industry and traditional administration authorities. Institutions such as; National Biosafety Authority, National Institute for Scientific and Industrial Research (NISIR); Tropical Diseases Research Centre (TDRC); The University of Zambia (UNZA); The University Teaching Hospital (UTH); Soil and Crop Research Branch (SCRB); Golden Valley Agricultural Research Trust (GART); The Seed Control and Certification Institute (SCCI); Cotton Development Trust (CDT); National Artificial Insemination Centre (Animal Genetic Resource (Centre) (NAIC); Central Veterinary Research Institute (Balmoral) (CVRI); National Malaria Control Centre (NMCC); the Zambia Environmental Management Agency (ZEMA); Food and Drug Laboratory; Zambia Agriculture Research Institute (ZARI); Zambia Bureau of Standards; Competition and consumer protection commission; Zambia Alliance for Agroecology and Ecology (ZAAB). In total 53 organisations were mentioned in the Biotechnology and Biosafety policy.

3.6 Study Sample

Qualitative research experts argue that there is no straightforward answer to the question of 'how many people to interview' and that the sample size is contingent on several factors relating to methodology, research design and practical issues. (Barton, 2012) recommends that qualitative sample sizes should be large enough to allow the unfolding of a 'new and richly textured understanding' of the phenomenon under study, but small enough to enable 'deep, case-oriented analysis'. It is posited that the more useable data are collected from each person, the fewer participants are needed (Kumar, 2019). Researchers need to consider parameters, such as the scope of study, the nature of topic (i.e. complexity, accessibility), the quality of data, and the study design to select the sample size (Esterberg, 2002).

In this study, primary data was collected through expert interviews from the following; two members of staff from NBA, one member of staff from ACTESA, two members of staff from ZARI, one member of staff from ZAAB, one member of staff from CUTS, one person from the ministry of Agriculture, one person from the Ministry of agriculture, one person from the ministry of higher education, one person from ZNFU and one person from CIRDZ. In total, twelve experts were interviewed. It is proposed that a sample size of twelve to fifteen is ideal when conducting expert interviews to avoid saturation (Barton, 2012).

Additionally, semi- structured questionnaires were administered to; five members of staff from NBA, three members of staff from ZARI, two members of staff and two students from UNZA, two members of staff from ACTESA, three members of staff from NISIR, two members of staff from Food and drug Laboratory, three members of staff from GART, two members of ZAAB, two members of ZNFU and two members of staff from Ministry of Higher Education. In total, thirty questionnaires were administered. The sample size of 30 was chosen because it falls within the recommended 5% to 10% of a small population (less than hundred) (Barton, 2012).

3.7 Sampling Technique

The researcher used purposive sampling. Purposive sampling is a non-probability sampling method and it occurs when elements selected for the sample are chosen by the judgment of the researcher (Kumar, 2019). Researchers often believe that they can obtain a representative sample by using a sound judgment, which will result in saving time and money (Kumar, 2019). Additionally, purposive sampling method may prove to be effective when only limited numbers of people can serve as primary data sources due to the nature of research design and aims and objectives (Barton, 2012).

Due to financial constraints, the researcher picked twelve individual experts and thirty institutions for the sample. Purposive sampling was also ideal for this study given the limited number of people who have information on biosafety systems, as revealed in the literature. Institutions that have a prominent role in the biosafety system were selected based on literature review. Individuals from these institutions were later selected based on their role in the organisation, experience and willingness to participate.

3.8 Data Collection Instruments

The researcher used the Biotechnology and Biosafety Policy and the National Biosafety Act to collect secondary data. This technique involves the use of available information that was collected by someone else for some other purpose (Kumar, 2019). The data is reused by another researcher for another purpose. The researcher in this case is the secondary user of the information. Secondary technique has advantages and disadvantages (Barton, 2012) .

Some advantages of using secondary techniques:

- Inexpensive in that the data is already in existence, therefore no need of data collection
- Permits the analysis of trends such as traffic or population growth trends;
- Less time is involved in searching secondary source than primary data.

Some disadvantages of using secondary techniques:

- Ethical issues of confidentiality for instance in the case of on-going government projects might make the information not to be availed to the researcher
- Information may be incomplete and imprecise – this relates to issues of the methods employed;
- Information from personal diaries, newspapers and magazines may have the problem of personal bias as writers are likely to exhibit less rigorousness and objectivity than one would expect in research reports.

Expert interviews and open ended questionnaires were used to collect primary data. The primary technique is used to collect the original data or information for a specific research. The researcher is the first to collect the information (Barton, 2012).

Expert interview is a kind of individual interviews carried out between an interviewer and a respondent who is a specialist in the subject in question. This type of research involves open nature of questions that allows the expert to tell their point of view on the issue under study and to assess or predict the possible options (Kumar, 2019).

Some advantages of using Expert Interviews:

- Incorporates illiterate respondents
- Permits clarification of issues
- Gives a higher response rate than written questionnaires.

Disadvantages of the method include:

- The presence of the interviewer may influence responses
- Reports of events may not be as complete as in the case of observation
- Personal interviews are costly in terms of time and money
- Danger of serious disparities is likely if more than one interviewer is used

Questionnaire - A questionnaire is a written list of questions on the research topic, the answers to which are recorded by respondents. In a questionnaire, the respondent read the questions, interpret what is expected and then write down the answers The only difference between an interview schedule and a questionnaire is that in the former it is the interviewer who asks the questions and records the respondent's replies on an interview schedule and in the latter replies is recorded by the respondents themselves (Barton, 2012)

The use of a semi structured questionnaire as the method of primary data collection had advantages and disadvantage.

The advantages are listed below;

- The most basic advantage of open-ended question is that it provides detailed responses from the audience if you think that your audience is educated enough about the questions you can ask them open-ended questions
- In open-ended questions, the investigator bias is minimized because the investigator does not propose the options and the respondents decide themselves
- The respondents can express themselves freely when they are asked open-ended questions

The disadvantages are listed below;

- The detailed answers from the open-ended questions are difficult to analyse and interpret as compared to the close-ended answers that bring uniformity in the data

- It also requires knowledge and skill to analyse these answers and take meaningful notes from the responses
- In analysing the open-ended questions the researcher bias can be introduced because he/she has to analyse these answers in his own way
- Some respondents find it difficult to give detailed answers and they leave questions unanswered especially in the questionnaire
- Respondent bias can also be introduced if the person answering the question has biases about the topic

3.8.1 Data Collection Procedure and Timeline

Secondary data was collected from the policy documents which are available online. Appointments for expert interviews were made with the experts identified from the respective institutions. Questionnaires were administered to institutions and completed according to the availability of the respondents.

3.8.2 Data validation and Analysis methods

The questionnaires used in the study were pre tested to ensure their applicability. The information generated from policy documents was triangulated with accounts of different experts in Zambian biotechnology system and from the completed questionnaires. Triangulation tests the validity and authenticity of the findings and gives the analysis rigor (Esterberg, 2002). This is critical, especially when diverse sources of knowledge are valuable in a knowledge intensive technology like biotechnology.

Coding of transcripts was completed in the order of the interviews conducted, in batches of four at a time, allowing the researcher to reflect and edit the interview questions as themes began to emerge from the data. Coding was used to aid the researcher in understanding the perspectives of the participants and in analyzing their combined experiences. Codes were created during the research process, based on the data, for the purposes of analyzing the data. Coding was conducted both manually and using computer assisted qualitative data analysis software. Coding helped to prevent the interviewer overemphasizing the importance of any one aspect early in the study and helped ensure a thorough analysis of the entire interview (Bell, 2018)

A computer assisted qualitative data analysis software, Nvivo 10, was used to aid in the data management and analysis process. The software was also used to query key words for comparison with manually coded categories and themes. Nvivo 10 was not used as a primary coding source and was only used in the context of solidifying data analysis. The research process was led by the researcher, not by supporting software (Hilal, 2013). Nvivo software is invaluable in helping the researcher index segments of text to particular themes, to link research notes to coding, to carry out complex search and retrieve operations, and to aid the researcher in examining possible relationships between the themes (Hilal, 2013).

3.8.3 Ethical Considerations

Participants were treated with respect and due consent was obtained. When requested, anonymity was granted. The researcher took time to ensure that the participants understood the study objectives and will share the findings. Clearance was obtained from the University of Zambia Ethics Committee.

3.9 Chapter Summary

The chapter looked at the research design, data collection methods and instruments, and ended with the data analysis methods and ethical considerations.

CHAPTER FOUR- DATA ANALYSIS AND FINDINGS

4.1 Introduction

This chapter presents the research findings and discussion of the study conducted. The results and discussion are devised in three parts in line with the main objectives of this research as follows:

1. To assess the National biosafety system in Zambia
2. To understand the elements of the National biosafety system in Zambia
3. To determine how the National biosafety system operates in Zambia

In this study, data presentation was done chronologically following the order of objectives set in the first chapter of the research.

4.2 Presentation of Research Results

The researcher collected primary data from 12 experts interviews, 30 semi- structured questionnaires administered to 30 institutions and triangulated the information obtained using secondary data from policy documents. The collected information was analysed using Nvivo software to give the results of the study

The first part of this section presented and analysed the preliminary data obtained from the study as presented in the questionnaire. It involves the demographic information of the respondents. The variables involved are gender of respondents, age, professional, type of organization, position held and the number of years they have worked in the organisation. These can have an influence on the perceptions, attitudes and responses of the respondents.

After the demographic questions, the researcher presents the questions that seek to address the objectives of the study. The study presents the closed ended questions from the questionnaire in graphs for easier presentation. The open ended questions where analysed and a summary of the emerging themes is presented. In addition, the researcher has also outlined comments from the expert interviews which provide more insights. These are presented in italics. The researcher also consolidated the results with references from the literature review.

4.2.1 Sex of Respondents who participate in the NBS

Sex of the respondent is significant in this study as it can have a bearing on the way males and females perceive and react to issues. It also determines power relations and access to resources between men and women. Sex plays an important role as the study looks or assesses biosafety regulatory framework, policies and procedure with respect to GM Food in Lusaka- Zambia.

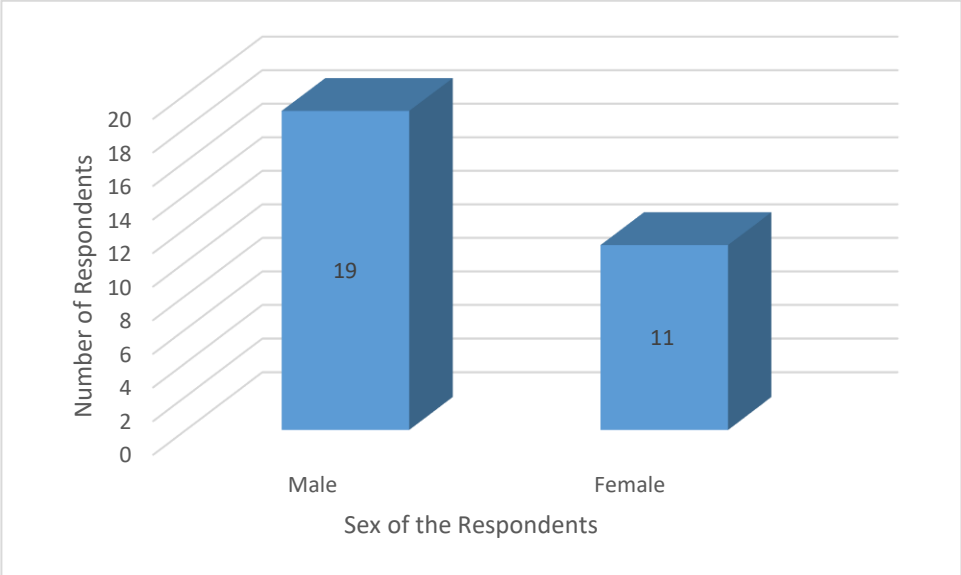


Figure 4.1. Sex of Respondents who participate in the NBS

It is important to note there were more male respondents than female respondents. The males accounted for 19 while the females accounted for 11 respondents representing 70% and 30% of the sample, respectively. This was expected because in general, there are more men than women in formal employment in Zambia.

4.2.3 Age of the Respondent who participate in the NBS

The age of respondents is critical in this study as it gives an indication of the experience and the exposure respondents have in terms of biosafety regulatory framework, policies and procedure with respect to GM food.

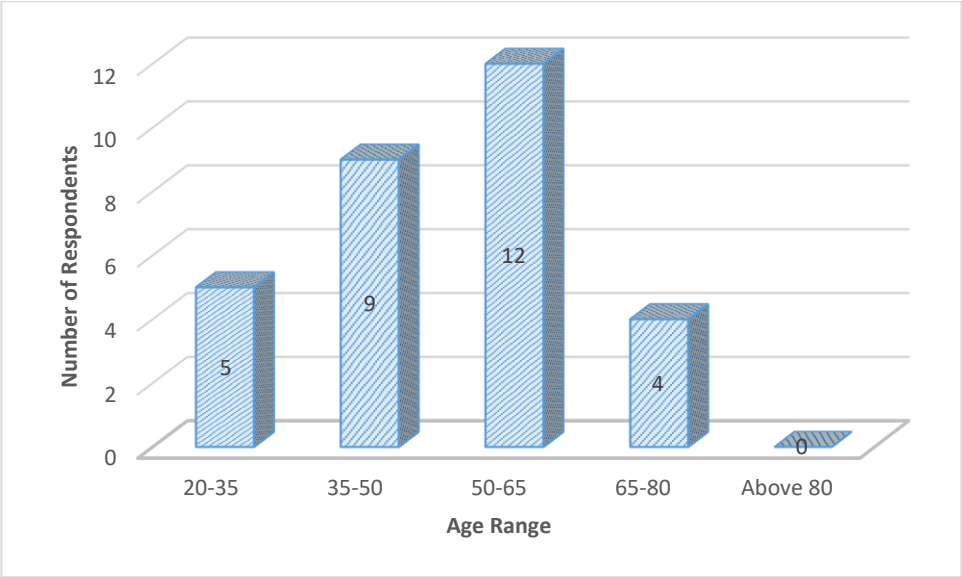


Figure 4.2 Age Range of Respondents who participate in the NBS

It was observed that majority of the respondents fell in the age group of 50-65 years. Others were between 35-50 years and few were in category of 20-35 years. This accounted for 12, 9 and 5 respondents, representing 45%, 30% and 15%, respectively. It was interesting to note that majority of respondents where in the retirement age gap. This is a good thing in the sense that it means the respondents were responding from a wealth of invaluable experience on Biosafety, both personally and professionally.

4.3 Type of Institutions that participate in the NBS

The researcher included respondents from various institutions. This is because the biosafety system in Zambia is multi institutional as informed by the biotechnology and biosafety policy. In addition, increasing the diversity of the respondents adds to the richness of the data.

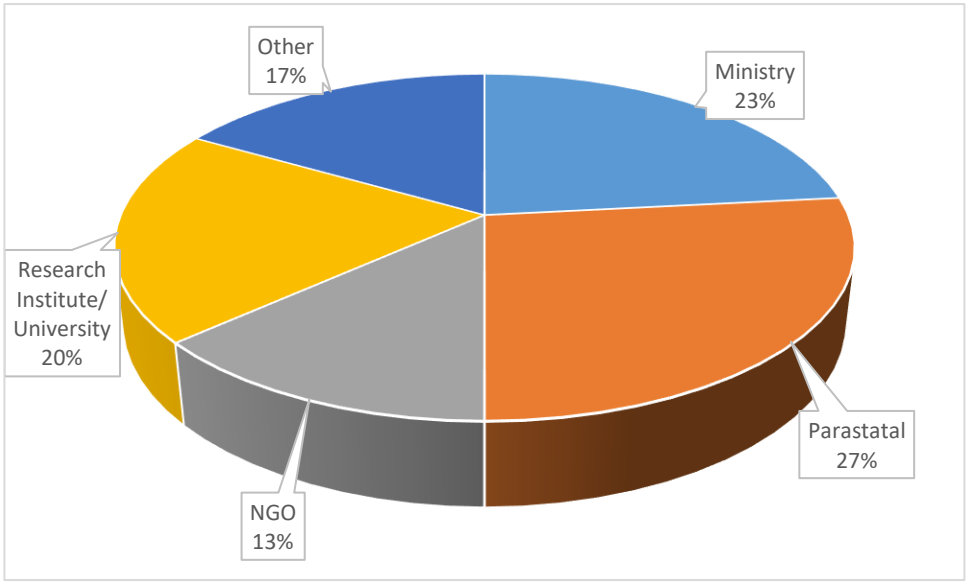


Figure 4.3. Type of Institutions that participate in the NBS

As shown in the figure above; 27% were from the parastatals representing 8 respondents, 20% were from the ministry and 13%, representing 4 respondents were from Non-governmental organisations. The diverse institutions were contacted to get a holistic view of the biosafety system in Zambia.

4.4 Number of Years of Experience in the Organisation

The number of years of experience of the respondent in the respective organisation was used to assess the knowledge levels of the individual about the issues pertaining to biosafety, and the organization's stance. It was assumed that the longer an individual had been with the organisation, the more informed they were.

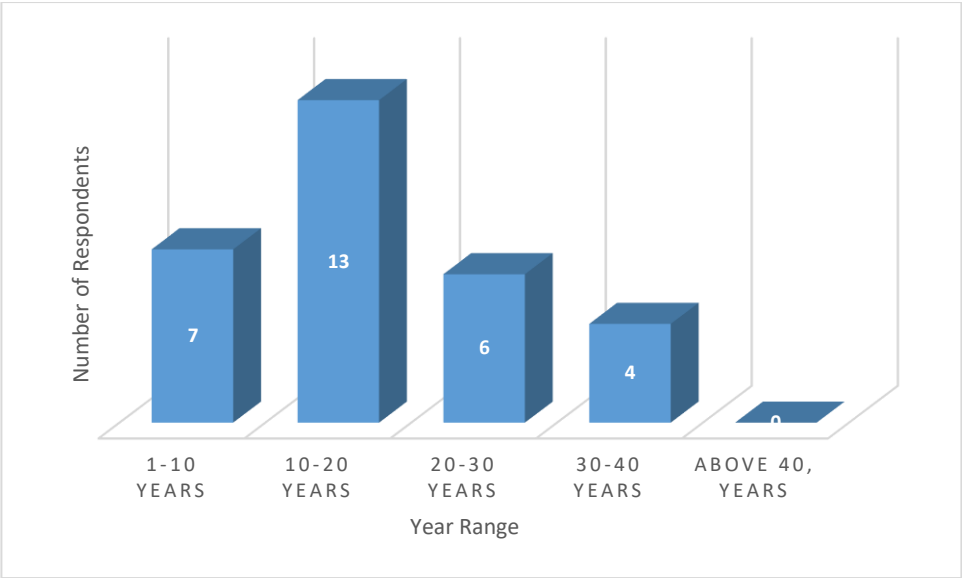


Figure 4.4. Number of years worked for an Organization by the respondent

Most of the respondents had worked for their respective organization for about 10 to 20 years (13). Others indicated that they worked for their organization for about 20 to 30 years (6); while other respondents had worked for about 1-10 years (7). This represents 45%, 20% and 25% respectively. From this experience, it can be learnt that majority of the respondents in different institutions had appropriate knowhow and experience about their institution's involvement in the biosafety systems in Zambia.

4.5 The Position Held by Respondent

The position held by the respondent also shows the diversity in terms of professional perceptions and attitudes towards biosafety in Zambia. The researcher was able to get a good mix of different professionals that are involved in the biosafety system.

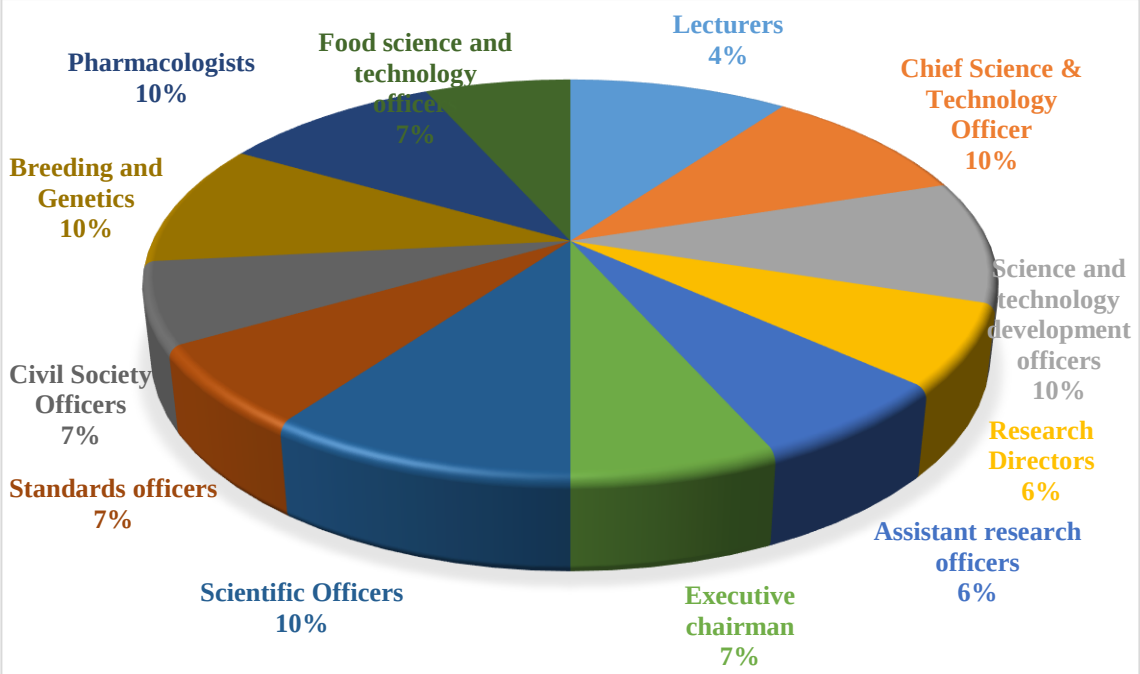


Figure 4.5. The Position of the Respondents

There is increasing recognition that biosafety issues cannot be isolated from the wider sustainable development agenda. To this end, biosafety systems in Zambia has attracted several stake holders from different institutions as stipulated in the biotechnology and biosafety policy. As observed in the figure above, respondents who took part in the research had different professional backgrounds and positions in their respective organizations. These included; food science and technology officers, lecturers, research directors and civil society program officer. The range of specialty and organisations was intended to get a holistic view of the research topic.

4.6 Are GMOs allowed in Zambia?

The question was posed to the respondents to find out the awareness levels on the topical issue. It was determined to be a fitting question to introduce the research study.

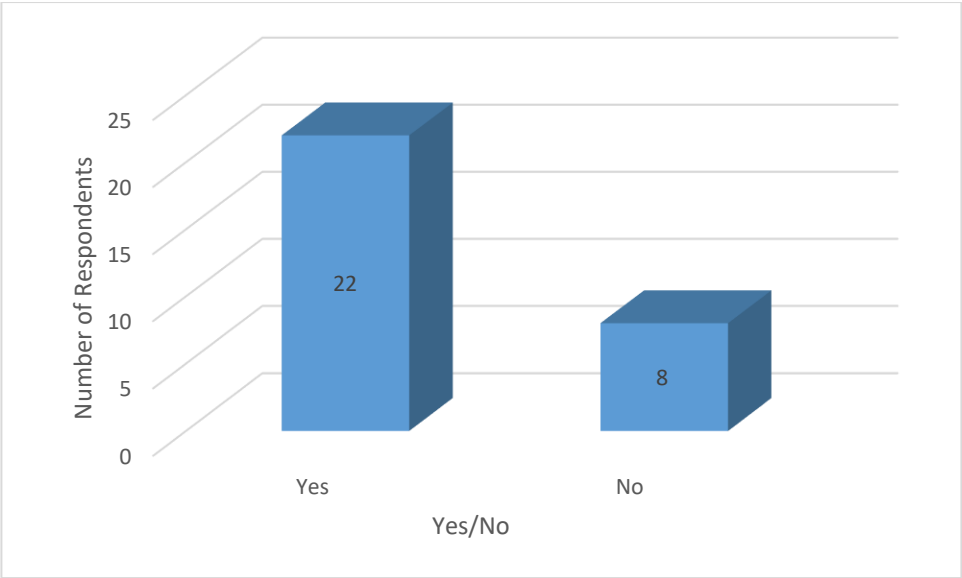


Figure 4.6. Are GMOs are allowed in Zambia?

The 22 respondents out of 30, responded in the affirmative, representing 73%. 8 respondents indicated that GMOs are not allowed in Zambia, representing 27%.

According to the National Biosafety Authority (NBA), by presence of the Biosafety Act 2010, imported food containing processed products of GM crops, is allowed into Zambia5, as long as they go through a strict application and safety testing process by the NBA, full public consultation processes are upheld, and final products are labelled (Simuntala, 2019).

Indeed, the biosafety act of 2010 allows for the importation and sell of GM food, below a threshold of 0.9% GM content, provided a license is obtained from the National Biosafety Authority. However, Live GMOS are not allowed in Zambia such as genetic modification of living organisms, and the production of GM crops remains prohibited (GRZ, 2007).

4.7 Are you familiar with the Biosafety Act of 2010?

The researcher wanted to find out if the respondents were familiar with the official government standing on biosafety. It was also a way of determining the awareness levels.

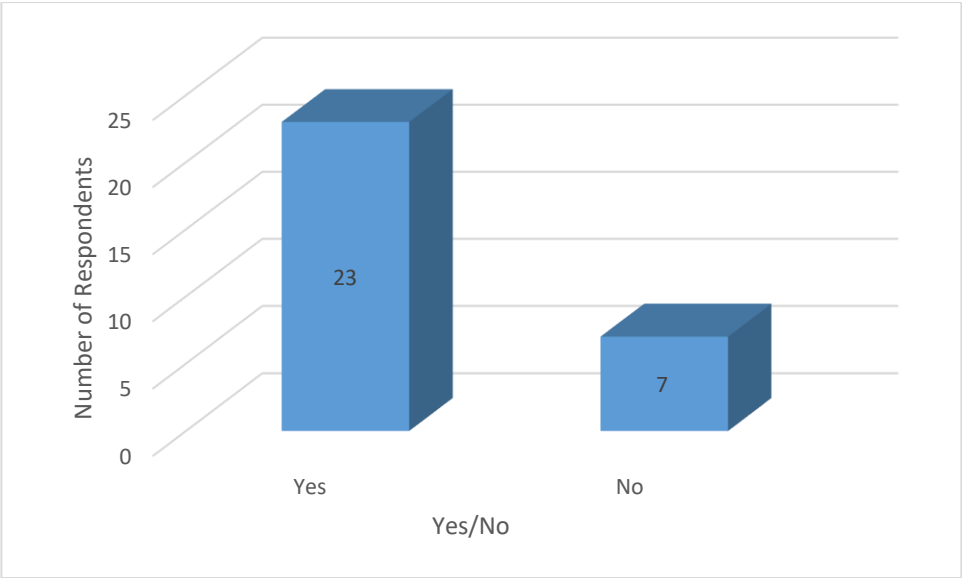


Figure 4.7 Are you familiar with the Biosafety Act of 2010?

The 23 out of the 30 respondents were familiar with the Biosafety Act of 2010, representing 73%. Only 7 out of the 30, 23%, respondents were not familiar with the Act. It was also observed that the respondents who had responded that GM food is not allowed in Zambia were not familiar with the Act.

One respondent clarified that the reason why Zambians think that GM food is not allowed in Zambia is because they have not read the Act. "GM food below 0.9% threshold is allowed in Zambia as long as one has gotten a license from the NBA."

So far, the NBA has authorised 24 applications regarding the placement of products containing GMOs on the Zambian market. One of them is for cornflakes by the US Kellogg's Company. In addition, three applications for medical research – two on HIV and one on malaria – using GMOs have been approved too (Nkandu, 2019).

The respondents in this survey were drawn from a population of people expected to have credible information on Biosafety in Zambia. However, 23% were not familiar with the act. Lack of awareness on the Biosafety act by the public has resulted in a lot of misinformation. In addition, the anti and pro GM food activists have continued riding on the public ignorance to push their respective agendas. This finding is consistent with various other researches (Broadbent, 2012) (Chambers, et al., 2008).

4.8 What do you understand by the National Biosafety System?

This question was asked in order to address the first research objective of assessing the National Biosafety System in Zambia. It was open ended and the respondents had different answers.

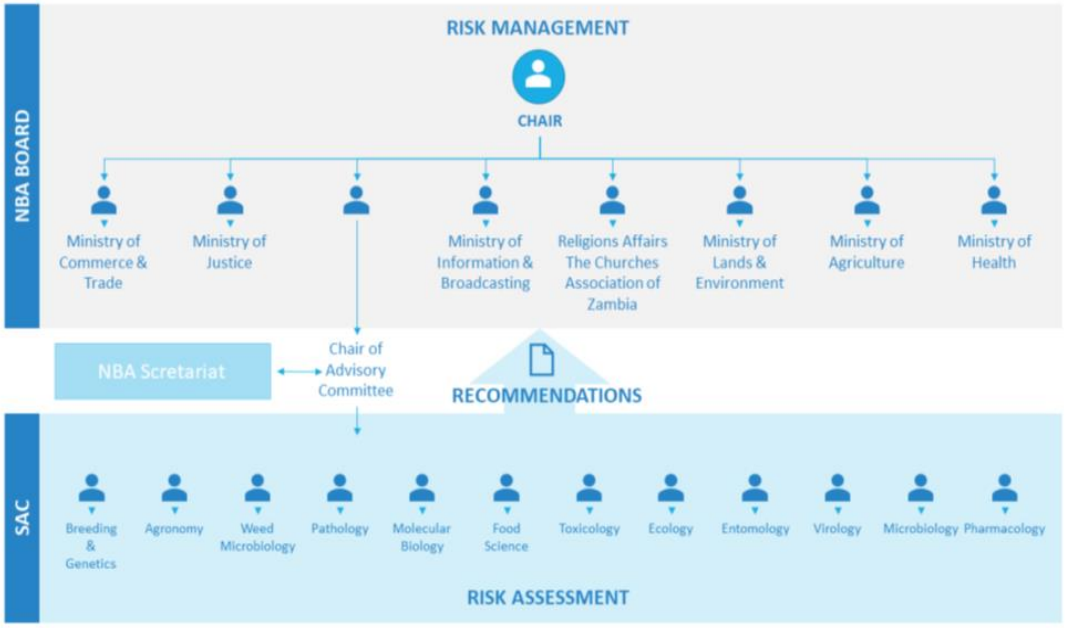


Figure 4.8. The National Biosafety System

Source (FAO, 2018)

Most respondents defined the National Biosafety System as the collection of institutions and government agencies that are responsible for enforcing the biosafety policy and the biosafety act. Thematic analysis of the open-ended responses revealed that the National Biosafety System was divided into two main components; the Risk management component conducted by the National Biosafety Board and the risk assessment component conducted by the scientific and advisory committee (SAC). The NBS is chaired by the National Biosafety Authority (NBA).

The responses were consistent with the literature as shown in the figure 4.8 above.

4.8.1 Zambia National Biosafety System Institutional Arrangement

The National Biosafety Authority (NBA) is the focal point of the biosafety system in Zambia. Its role and responsibilities include to: Review and approve biosafety applications

for research, confined release, pre-commercial release; oversee the implementation of biosafety issues including collection and distribution of biosafety information to the public; establish contact and linkages with national, regional and international agencies or institutions; establish database for the purpose of facilitating collection, storage, retrieval and distribution of information relevant to biosafety; and establish and update a register of experts in biotechnology and biosafety (GRZ, 2007). So far, the NBA has granted 24 licenses for the import and placing on the market of GM food (NBA, 2019). Additionally, the NBA is regulating clinical trials and Malaria research involving gene modification. Neither confined field trials nor national performance trials are not being conducted in Zambia (FAO, 2018).

The National Biosafety Committee (NBC) coordinated by the NBA, is a multidisciplinary team of 22 members drawn from government, non-governmental organizations and private sector, including the academia. It consists of experts from the ministries of agriculture, fisheries and livestock, health and some members are drawn from the ministry of religious affairs and information and broadcasting (GRZ, 2007).

Its functions include to review relevant applications from NBA; advice on biosafety policy, legislation and other instruments; ensure that adequate testing of GMOs developed elsewhere has been performed in the country of origin and propose mitigation measure to be undertaken in case of any accidental release; and review biosafety regulation guidelines from time to time as necessary. The NBB designates national competent Scientific Advisory Committee (SAC), which are advisory sub-committees comprising of multidisciplinary team of expert in the field of biotechnology and biosafety, to review relevant GMOs applications or proposals for development, introduction, import, export, transit, contained use, release or placing on the market. SAC is required to have all 12 positions for the different disciplines mentioned in the Biosafety Act filled; breeding and genetics, agronomy, weed microbiology, pathology, molecular biology, food science, toxicology, entomology, ecology, virology, microbiology and pharmacology (GRZ, 2007).

Institutions in Zambia that are involved in importing, exporting, handling, contained use, release or placing GMOs or GM products on the market are obliged to establish

institutional biosafety committees (IBCs) to institute and control safety mechanisms and approval procedures at the institution level. Roles and responsibilities of Zambia-IBCs are: To review the containment and confinement level required by guidelines for the proposed research; to make decision on the comparative ecological, economical, and social impacts or alternative approach to attain the objectives of the proposed GMOs; and to report to the relevant ministries and appropriate office in the concerned organization any significant GMOs activities, problems with or violation of regulation in any significant research related accidents or illness (GRZ, 2007). In Zambia, some of the functional IBCs are at Centre for Infectious Disease Research in Zambia (CIRDZ) and Macha Malaria Research Institute MMRI (Nkandu, 2019).

4.8.1 Does your institution participate in the National Biosafety System?

The researcher wanted to find out whether the institutions the respondent's belonged to were active members of the NBS, in reality. This is because literature review of similar studies had indicated that it was possible for an institution not to play an active role in biosafety regulation despite being listed in the policy framework (Broadbent, 2012).

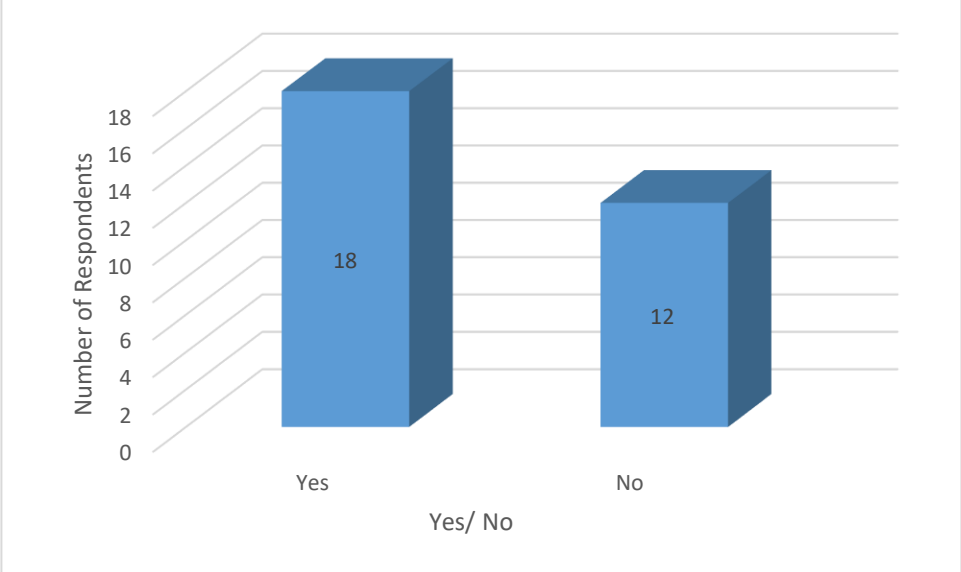


Figure 4.9 Does your institution participate in the National Biosafety System?

The 18 out of the 30 respondents stated that their organisations participated actively in the NBS. However, 12 of the respondents stated that they did not take part in the NBS

One of the respondents stated that he was on the National Biosafety Board (NBB) as a representative of his ministry. As a board member, he represented the ministry when it came to aspects of risk assessment before a GM food license would be given out (Anonymous, 2019).

Another respondent stated that their organisation was a major player in the Biosafety and Biotechnology research and development sector and had keen interest in the NBS, however, their role and responsibility under the NBS had not been clarified.

"We don't know where exactly we fit in in the NBS. Sometimes we just hear that a license was given for importation of abc or that there was a meeting to review the current legislation. We are in the dark" (Anonymous, 2019)

The responses were consistent with research carried out by (David, et al., 2012), (Godfrey, 2011) and (Belay, 2019).

The biosafety and biotechnology policy and the act in Zambia have not explicitly defined what is expected of the various players. As such, it has led to a lack of coordination and ineffective management of biosafety in the country. The result is that there are some institutions that ideally should have a big role to play in the NBS but have been seemingly left out of the process. To this effect, stakeholders have challenged Zambia to address the gaps in the policy so as to promote coordination and effective management of the national biosafety system in Zambia (ABNE, 2017).

4.8.2 Are you familiar with the National Biosafety Elements?

This question was posed in order to tackle the second objective; to understand the elements of the NBS. It was a good way of introducing the subject of the NBS structure.

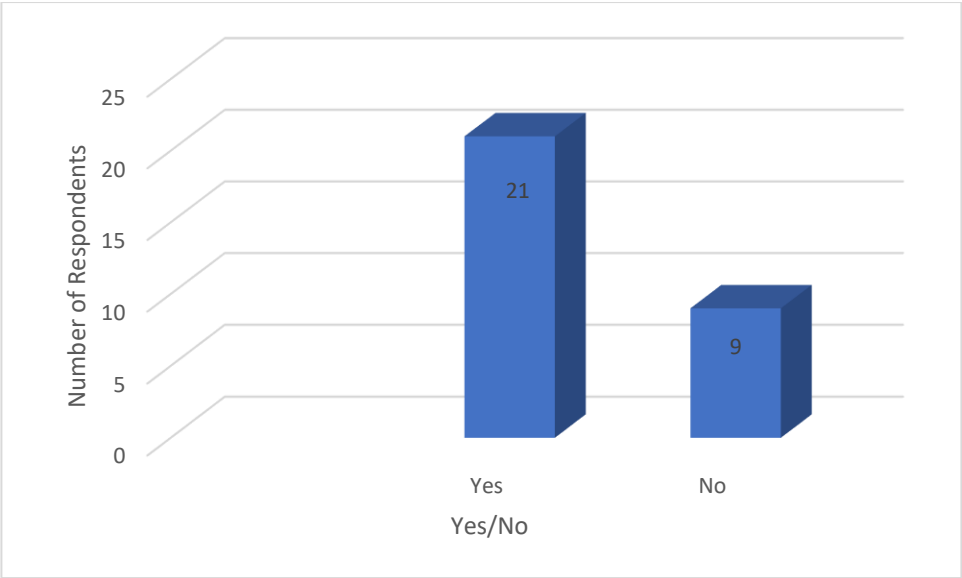


Figure 4.10 Are you familiar with the Elements of the NBS?

The 21 respondents out of 30 were familiar with the elements of the NBS while only 9 respondents stated that they were not familiar with the elements of the NBS. It was interesting to note that 70% of the respondents understood what the NBS comprises as compared to only 30% of the respondents who did not know the components of the NBS.

4.8.3 What are the Elements of the National Biosafety System

This question was a follow up question to the previous question. It was also used to address the second objective.

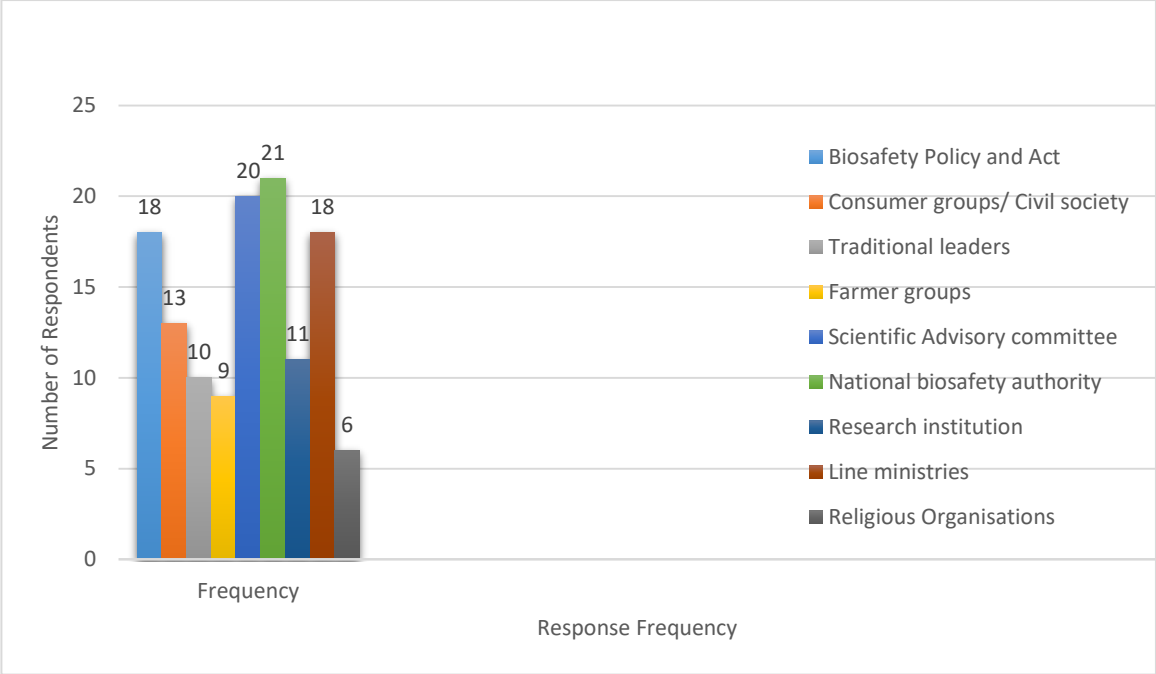


Figure 4.11 Elements of the NBS

Thematic analysis of the open-ended responses showed that the respondents had a fair understanding of the elements of the NBS. It was found that there are several elements in the NBS. The national biosafety authority received the highest frequency of responses; 21 times. Other prominent elements are research institution and line ministries, which appeared 11 and 13 times representing 13% and 15% respectively. Other important elements listed include scientific advisory committee, traditional group, farmer groups, universities, religious groups and consumer groups

Thematic analysis revealed that the responses can be categorised in four main themes as proposed by (Traynor, et al., 2000). These are the elements also captured by

the conceptual framework alluded to chapter 3. Namely;

1. The *regulations or guidelines*. The main element listed was the biosafety policy and biosafety act that is responsible for clearly defining the structure of the biosafety system, the roles and responsibilities of those involved, and how the review process is to operate;

2. The *people* where represented by consumer groups, civil society organisations and farmer groups. These people must be knowledgeable and well trained, confident in their ability to make decisions, and supported by their institutions;
3. The *review process* is based on up-to-date scientific information; focuses on specific combinations of crop, gene, and environment; promotes appropriate risk management practices; and balances risks against benefits. This was represented by the SAC and the NBA in the responses
4. *Feedback mechanisms* are used to incorporate new information and revise the system as needed.

The finding was consistent with (Sengooba, et al., 2005). In Zambia, the NBS has functional regulations and guidelines as provided in the biotechnology and biosafety policy and act, and there are knowledgeable people running the institutions under the NBS. Additionally, the review process is functional, and efforts are in place to promote efficient feedback mechanisms (Simuntala, 2019). However, there are a lot of challenges in the NBS and some of them will be addressed in chapter 5.

4.8.4 Are you familiar with the process of obtaining a license?

The question was asked to determine the awareness levels of the technical operations of the NBS. Obtaining a license for the export/ import of GMO food or for research was considered to be a basic procedure that an individual in the NBS should be aware of at the very least. This question also providing information on the third objective.

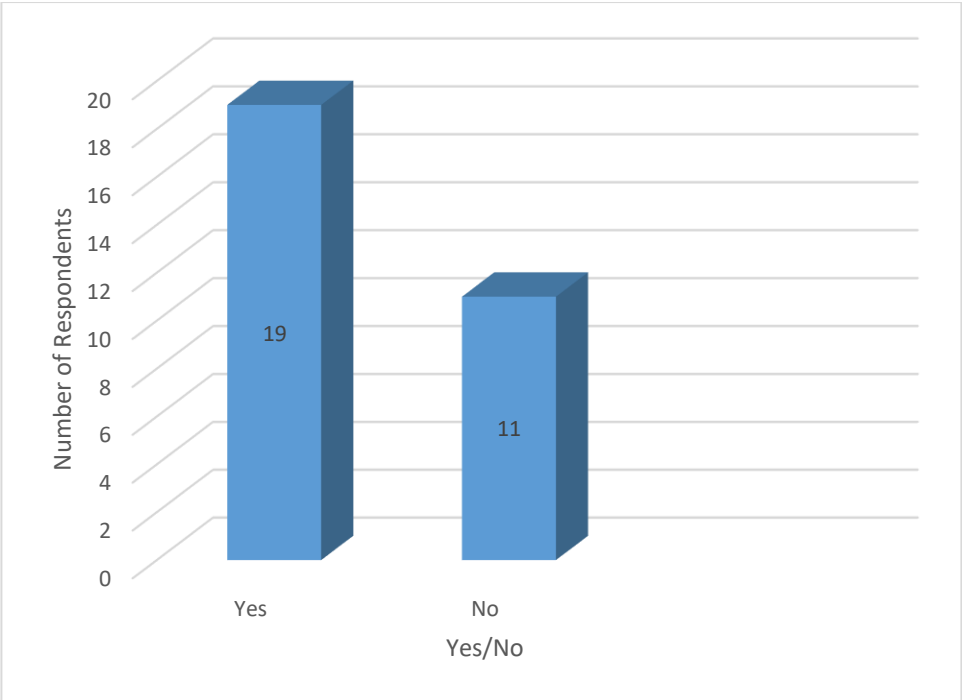


Figure 4.12. Are you familiarity with the process of obtaining a license?

Out of the 30 respondents, 19 were familiar with the process of obtaining the license representing 63%. While 11 were not familiar with the process of obtaining a license representing 37%.

Thematic analysis of the open-ended responses indicated that some responses were similar to the process highlighted in the policy.

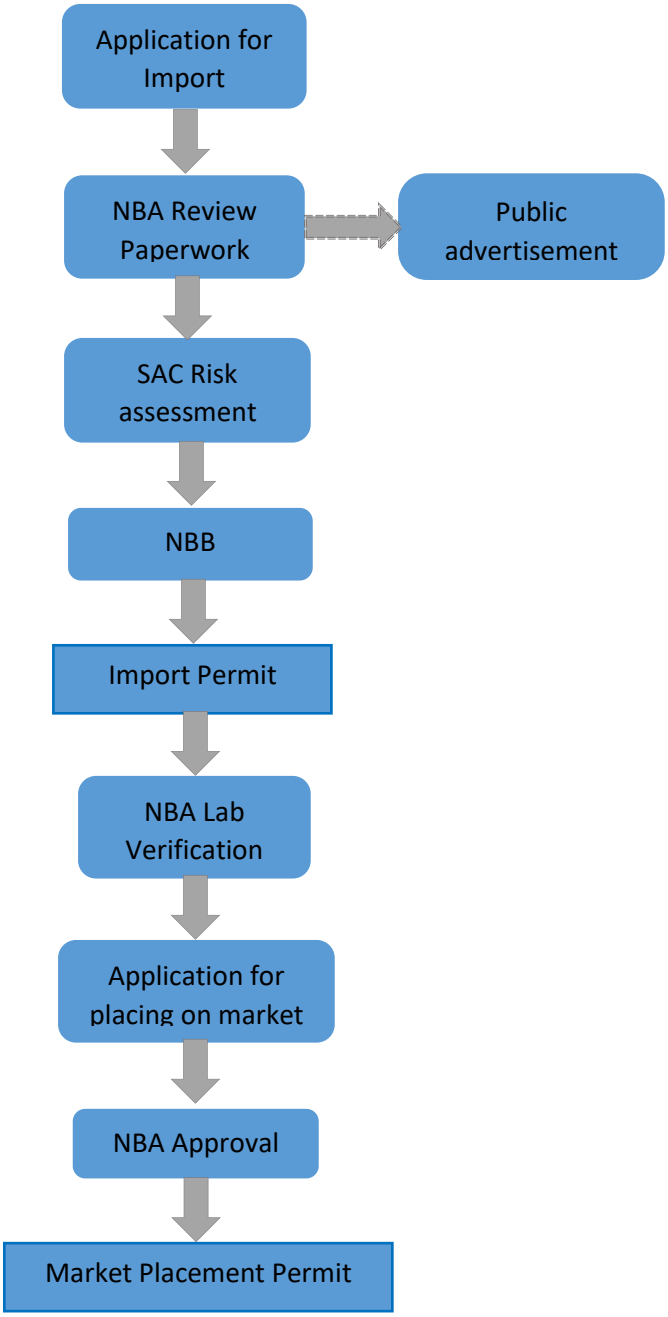
The application process for Research in GMOs is as follows (Nkandu, 2019);

1. Applications from research organizations (for example, CIRDZ) to release GMOs are submitted to the NBA through the organization's institutional biosafety committee (IBC)
2. A technical subcommittee of the NBA examines scientific details of the application. If the application is satisfactory, the NBA forwards the application to the SAC
3. The SAC conducts risk assessment and if the application is successful, it is forwarded to the board

4. The National biosafety board (NBB) deliberations must reach consensus before a decision can be made on the application. If a member disagrees that sufficient evidence has been presented to justify an approval, no ruling is made at that point. The Chair requests the applicant to provide additional information in order to satisfy the member's concern. At the same time, the Chair consults with experts on the issue so that at the board's next meeting, added information from the applicant and consulting experts allow a final ruling to be made. Recommendations for approval or denial and any conditions or requirements with which the applicant must comply are recorded in the minutes of the meeting.
5. A permit is issued if the NBB is satisfied

In the case of application for Retail/Import of GMOs;

1. The company makes an application to import GM food to the NBA (for example Choppies)
2. The NBA after reviewing the paperwork decides to either accept or reject the application
3. At the same time, the company is asked to place adverts in three different media for three times to notify the public of its intent to import GM food
4. If the NBA approves the application, it is passed on to the SAC. The SAC conducts the risk assessment and if satisfactory, the application is forwarded to the NBB
5. It is the NBB that has the final say as to whether a permit should be given or denied. If the NBB is satisfied with the application, a permit is issued.
6. The NBA takes the samples to the laboratory for verification
7. The company makes another application to the NBA for placing on the market
8. The NBA approves
9. At this point the company is free to put the GM food on the market



4.8.5 Flowchart representation of the process of obtaining a license for placement of GM food on the market

The process of obtaining a license is presented in the flowchart chart to show the steps in a simplified manner. The flow chart shows that the applicant is mandated to place an advertisement in the public media over the intention to place GM food on the market. This

notification allows members of the public who have reservations to communicate with the authority. However, the 11 people that were not familiar with the process of obtaining a licence cited irregularities in the process.

To be honest, I do not know the process because it changes every time I go there. Today I am told to fill in 8 forms, the following time its 12 forms. There is too much paperwork involved.

Additionally, there are only two officers in charge of reviewing the dossiers. Imagine if they receive 20 applications in one month and they are expected to review all the applications within 3 months. It is a difficult task (Anonymous, 2019).

The process of obtaining a license is highlighted in the policy and the standards officer from NBA explained the process as described in the figure above. However, it was discovered that the process tends to be inconsistent. In addition, the respondents cited that the process was laborious and unnecessarily prolonged due to shortage of staff. This finding was consistent with similar studies conducted in Kenya and Uganda (Traynor & Macharia, 2003), (Sengooba, et al., 2005).

4.9 Is the National Biosafety System Delivering on its Mandate

The question was posed to determine the satisfaction levels of the respondents with the operations of the NBS. It was a good way of getting the insights of the various individuals involved in the system. The information obtained was used to address the third objective in the study.

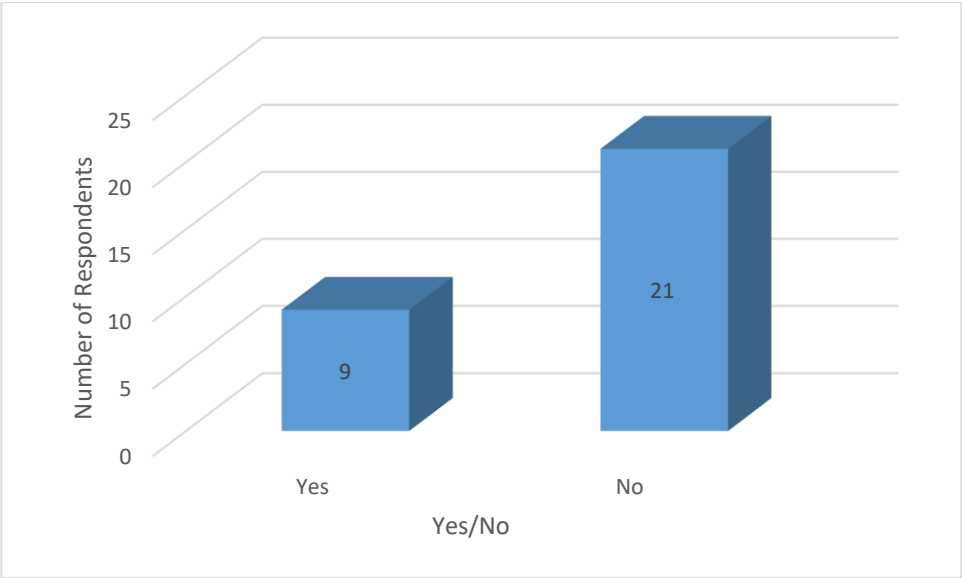


Figure 4.14 Is the NBS Delivering on its mandate?

Only 9 out of the 30 respondents (30%) said that the NBS is delivering in its role. The remaining 21 respondents stated that the NBS is not delivering on its mandate. This represented 70%.

Thematic analysis of the open-ended responses revealed that most respondents (70%) felt that the NBS was not delivering because the system was not meeting the objectives set out in the biosafety policy. The objectives in the biosafety policy of 2007 are as follows;

1. To support safe application of biotechnology techniques for the enhancement of Zambia's socio-economic and environmental wellbeing.
2. To support the development of regulatory capacity to assess, test, monitor and control for the safe research, development, application and commercialisation of Biotechnology in accordance with agreed Biosafety legislation and guidelines.
3. To ensure effective control of trans-boundary movements of Genetically Modified Organisms (GMOs) or products thereof resulting from modern biotechnology, through the exchange of information and risk assessment as well as a transparent system of advance informed agreement.

4. To ensure the safe and judicious use of biotechnology, with a view to maximising its potential benefits while avoiding to the maximum extent possible, any adverse effects on human and animal health as well as to the environment.

The 70% of the respondents were of the view that the NBS had failed to meet the objectives set out as explained below;

No, the NBS has failed. Can you imagine that even Malawi has surpassed us in conducting confined field trials of GM crops? It is quite embarrassing!

Firstly, there is a lot of negative publicity about GM food. A lot of people are ill informed and feed on negative propaganda from anti GM food activists without getting the facts. The negative publicity in turn leads to a lack of political will from the governments to support biotechnology. This results in poor funding to support research and development. Finally, the policy itself is not supportive to the system. The policy takes a very precautionary approach towards GM research and development. The liability and redress cause are too stringent (Belay, 2019).

Yes, the NBS is delivering because it is making steady steps towards meeting the objectives of the policy. As of June 2019, 23 Companies had been given the license to import and place on the market GM food. This means that the NBS is conducting the risk assessments and able to make independent decisions. Of course, there is always room for improvement but the NBS is doing the best it can, given the circumstances (Simuntala, 2019).

It was clear that most of the respondents are dissatisfied with the work of the NBS. The main reasons put forward were that the system had failed to promote the growth and development of biotechnology in the country as mandated by the policy. There was a general feeling of frustration among the experts who were of the view that by taking a severe precautionary stance towards biotechnology, Zambia was losing out on the potential benefits the technology has to offer. This finding is consistent with the reports by (Bawa & Anilakumar, 2013), (Kinginri & Ayele, 2009) and (Macharia & Traynor, 2003).

4.9.1 Zambia's Biosafety Guidelines

The Zambia biosafety guidelines apply to research, development, handling, transit, contained use, trans-boundary movement, release or placing of GMOs or their product on the market whether for release in the environment, for use as food, feed or processing. They are prepared with the view of ensuring their complementarity and mutual supportiveness with the national policies and legislations. Zambia biosafety guidelines spell out procedures on decisions making and decisions review, importation and exportation of GMOs, GMOs on transit, application procedures, GMO handling, transport, packaging and identification.

Under risk assessment (RA), the guidelines emphasize on technical and non-technical procedures of gathering diverse data to identify possible risk in research and development involving GMOs, their processes or products. Its main objective is to identify and evaluate the potential adverse effects of GMOs, considering the potential risks on human and animal health, and to the environment. The underlying principles of RA are: Scientifically sound and transparent manner of execution; lack of scientific knowledge or consensus should not necessarily be interpreted as indicating a particular level of risk, or an absence of risk, or an acceptable risk; and that RA should be carried out on a case-by-case basis. Risk management (RM) is aimed at establishing and maintaining appropriate mechanisms, measures and strategies to regulate, manage and control risk identified in the risk assessment regarding the use, handling, introduction and field release of GMOs ((GRZ, 2007), (Cohen, 2014) and (Ecuru, 2009).

Risk management is conducted in contained and confined procedures. Whereas containment refers to safe methods of managing infectious agents or hazardous compounds in the laboratory environment, growth room or greenhouse where they are being handled or maintained in order to prevent escape outside the prescribed spaces in order to reduce exposure of potential hazardous agents, confinement, on other hand, is the use of controlled areas such as isolated and fenced, limited access fields to prevent GMO spread. The procedures and levels of physical, chemical and biological containment/confinement are stated in the Zambia biosafety guidelines.

In biosafety monitoring and enforcement processes, Zambia guidelines define monitoring as a process of keeping track of activities to determine whether they meet the objectives with a purpose of gathering data on GMOs in order to assess its impact on biotic and abiotic environment. Both case-specific (short term, related to individual GMOs) and general (long-term observation) monitoring processes are adopted. It is carried out before, during and after introduction of GMOs. Monitoring, inspection, enforcement and supervision are performed by the competent authorities under the NBA (GRZ, 2007).

Under socio-economic, cultural and ethical considerations, the Zambia biosafety guidelines cover a wide range of safety and non-safety issues which are relevant for general release of GMOs and their products. Issues related to intellectual property rights (IPR) such as patenting biotechnology innovations, protection of indigenous varieties and undisclosed traditional knowledge and biodiversity; implications of crossing with local varieties (GMOs contaminations), customer choices and contradictions to religious beliefs are highlighted (GRZ, 2007). In addition, the liability and redress provision stipulates that a person who imports, arranges transit, develops, makes contained use of, releases or places on the market a genetically modified organism or product of a genetically modified organism shall be strictly liable for any harm caused by the genetically modified organism or product of the genetically modified organism and shall compensate any person to whom the harm is caused (GRZ, 2007).

Biosafety communication and public participation are key to any successful safe development and application of biotechnology. Its objective is to educate the public about biosafety processes, inform the public about the specific risks associated with the GMOs and actions taken to alleviate them; improve communicators‟ understanding of public values and concerns; develop mutual trust between the developers, regulators and the public; reduce conflicts or controversies; promote transparency in the regulatory process and collect stakeholders‟ views. The types of biosafety risk communication strategies outlined in the Zambia biosafety guidelines include public notices in-print. As a rule, all GMO products should be labelled (GRZ, 2007).

Despite the acknowledgement of the benefits that biotechnology has to offer in the policy, the guidelines take a very precautionary approach towards biosafety (Bailey, 2014). There

is poor political will and scepticism on the part of the decision makers. In addition, the public and private media are not educated enough on matters related to modern biotechnology, resulting in underreporting and sometimes distorted reporting about the technology (Clark, et al., 2014). On the other hand, strict liability clause in the Zambia biosafety regulations is scaring away not only local researchers, but also prospective foreign investors of GMO technology in the country (ABNE, 2017), (Ecuru, 2009).

4.9.2 Are there Risks Posed by GM food?

All technologies have inherent risks. However, the literature shows that some pro GM technology professionals fail to acknowledge the risks posed by GM products (Kinginri & Ayele, 2009). The researcher wanted to find out the awareness levels of the respondents.

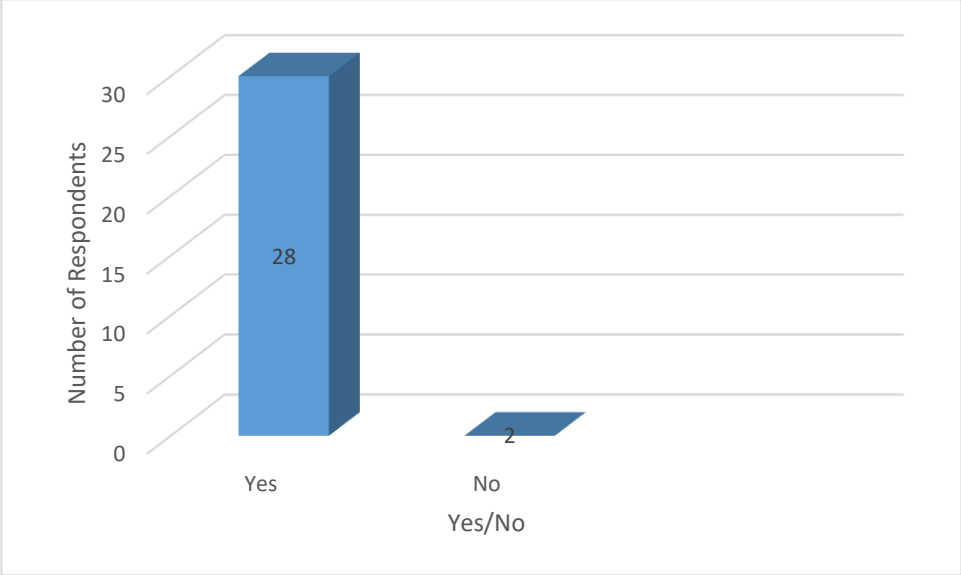


Figure 4.15 Are there Risks posed by GMOs

The 28 out of the respondents stated that there are risks posed by GM food, representing 93%. Only 2 respondents, 7% stated that there are no risks posed by food.

There is nothing that does not have risks. Even water can kill you if the source is questionable. In the same way, GM food pose serious risks if ill handled. The important thing is to have a functional NBS which can ensure that proper risk assessments are conducted, and people will have confidence in the system (Kalobwe, 2019).

There are no risks posed by GMOs. They are just food like any other food. I was in the USA for 5 years and I was eating only GMO food and I have not had any problems (Anonymous, 2019).

Most of the respondents were alive to the fact that GM food could pose serious risks to the health of humans and animals, and to the environment if mishandled. However, it was also highlighted that the risks posed by GM food can be significantly reduced if a country has an efficient NBS. This finding is consistent with several reports (Wichern, 1999), (Pretty, 2001), (Zepeda, 2006) and (WHO, 2014).

4.9.3 Do the Benefits of GM Food Outweigh the Risks they pose?

As a follow up question to the previous one, the researcher wanted to find out the perceptions held by the respondents on the risks versus the benefits of GM food.

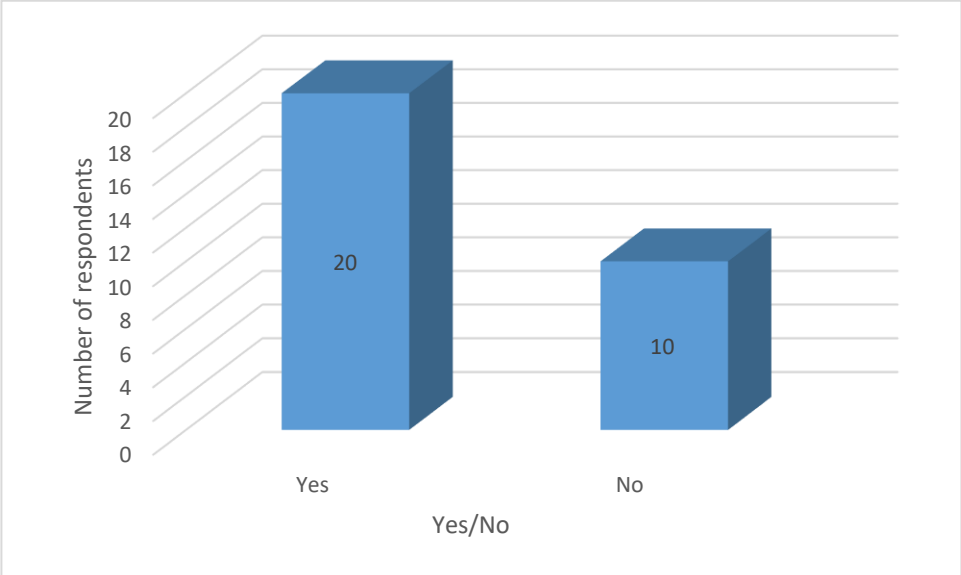


Figure 4.16 Do the Benefits of GM food outweighs the risk they pose?

The 20 out of the 30 people responded that the benefits of GM food outweigh the risks posed for Zambia, representing a 67% majority. 10 respondents did not agree with the statement.

Is it better to die of hunger or eat GM food which could have a possibility of causing health complications in the future?

I think we have a real problem of food insecurity at our hands. We cannot burry our heads in the sand and pretend things are not bad. Our brothers and sisters in rural areas are on

the brink of starvation. We must change our way of doing things in order to address this problem. Will GM technology solve all the problems? Certainly not, but it does offer some possible solutions that can be explored. The scientists have said that GM crops are safe and have the potential to increase yields through drought resistant and pest resistant varieties. These are the challenges that our agriculture sector has been battling with in the recent past. We owe the farmers and our nation at large a chance to thoroughly explore the GM technology before writing it off (Kalobwe, 2019).

Out of the 30 people, 10 responded that the benefits of GM food do not outweigh the risks posed for Zambia, representing 33%.

Our position as a nation has not changed since Mwanawasa rejected the GM maize donation- we are not guinea pigs to be eating just anything! GM foods have been linked to cancers. Let us not solve the food insecurity problem by creating more problems. There are so many other solutions we can explore as a nation, for example; creating proper infrastructure such as good roads and proper storages to increase market access and reduce on post-harvest loses. GM food is not a solution for Zambia. Moreover, we do not have the necessary facilities to conduct proper risk assessments. Currently, the NBA relies on paperwork for verification. They do not even have a proper laboratory to examine some of these GM foods they are calling "safe" (Kasope, 2019).

Despite most respondents stating that the benefits of GM food outweigh the risks for Zambia, the topic is still a contentious one. It must be noted that this debate is not unique to Zambia but is ongoing in many countries. The reasons put forward for this unending debate is that the stakeholders involved have different interests and tend to lose objectivity depending on how the technology will affect their interests (David, et al., 2012).

It has been noted that pro GM food activists are accused of receiving funding from large organisations that have invested largely in GM technology and thus looking to solicit markets for their products and services. On the other hand, anti GM food activists have been linked to large companies that produce pesticides and weed killers and therefore see GM technology as a threat to their business (Belay, 2019) and (Godfrey, 2011).

The debate in Zambia has become more heated in the recent past, with anti GM activists accusing the NBA of "chewing money from the donors" (Simuntala, 2019). This finding

is similar to what was found by (Waithaka, et al., 2015), (Godfrey, 2011) and (Qaim, 2003).

4.9.3 How can the National Biosafety System be more Relevant?

Finally, the questionnaire had an open-ended question on how the NBS can be more relevant. This question was a fitting way to end the questionnaire by providing an opportunity to the respondents to offer solutions,

The responses from the experts were generalised in the following outline;

By going back to the drawing board- why do we have a biosafety system? What exactly do we want to achieve? We cannot continue being on the fence, let us pick a side as a country and stick to it (Kalobwe, 2019).

There is need to revise the biosafety policy so that it clearly addresses some of the challenges the system is facing. In its current form, the policy takes a very precautionary approach towards GM food. As such, it does not encourage the growth and development of GM research in the country. The liability and redress clauses are outdated (Belay, 2019).

The national context for implementing biosafety is poorly defined at present. We do not know the exact roles and responsibilities of the various institutions involved in the NBS (Anonymous, 2019).

I also feel there is need to conduct a serious awareness on GM food. A lot of people have no idea what GM foods are and that is why there is a very negative perception of GM food from the public (Anonymous, 2019).

It was revealed that most of the respondents are dissatisfied with the current biosafety and biotechnology policy leading to an inefficient NBS. The reasons put forward are that it lacks clarity and consistency and as such, has contributed to the lack of growth and development of biotechnology in Zambia.

The call is for a revision of the biotechnology and biosafety policy to reflect the latest scientific findings and to be clearer in the implementation strategy. This finding is consistent with (Zainol, 2011), (Waithaka, et al., 2015) and (Kinginri & Ayele, 2009).

4.9.3 Chapter Summary

The chapter presented the results and discussion of the collected data. This was achieved by presenting the preliminary data gathered through the semi – structured questionnaire and consolidating the findings with data obtained from the expert interviews. The results obtained through semi – structured questionnaires were similar to those from the expert interview. The general findings revealed that the national biosafety system was not performing its mandate adequately as a result of inexhaustive policy framework. Furthermore, lack of public awareness on biotechnology has led to a negative perception of GM food in the country.

CHAPTER FIVE- DISCUSSION

5.1 Introduction

The previous chapter presented the findings and discussion of the field study. The results of the study were presented after an analysis of data collected using expert interviews and semi-structured questionnaires. This chapter will outline the findings of the research study, the conclusion and provide recommendations.

5.2 National Biosafety System for Zambia

Following Zambia's ratification of the CBD on 8th March 1996, the government created an enabling environment for establishment of mechanisms for safe application of modern biotechnological research and development. The National Biosafety Framework for Zambia was drafted by a multidisciplinary steering committee, coordinated by the then Ministry of Science and Technology in October 2004 under the auspices of UNEP-GEF (GRZ, 2007). It is a combination of policy, administrative, legal, and technical instruments that were developed to address safety issues with respect to human and animal's health, environmental conservation, as well as socio-economic and ethical concerns in the context of safe development and application of modern biotechnology in accordance to national needs and international legislation (GRZ, 2007).

The main underlying principles of the Zambia-NBS are strict liability, prior informed consent and precautionary approach. It aims at:

1. Establishing science based, holistic and integrated, transparent and participatory administrative and decision-making system so that Zambia can benefit from modern biotechnology, while avoiding or minimizing the environmental, health and socio-economic risk; and
2. Ensure that the research, development, handling, trans-boundary movement, transport, use, transfer, release and management of GMOs are controlled in a manner that does not cause any harm.

The National Biosafety System is a collection of institutions and government agencies that are responsible for enforcing the biosafety policy and the biosafety act. The national biosafety authority (NBA) is the focal point of the national biosafety system in Zambia.

Its role and responsibilities include to: Review and approve biosafety applications for research, confined release, pre-commercial release; oversee the implementation of biosafety issues including collection and distribution of biosafety information to the public; establish contact and linkages with national, regional and international agencies or institutions; establish database for the purpose of facilitating collection, storage, retrieval and distribution of information relevant to biosafety; and establish and update a register of experts in biotechnology and biosafety (GRZ, 2007)

The scientific advisory committee is a combination of experts from different scientific disciplines and is responsible for conducting risk assessment under the national biosafety system. Finally, there is a national biosafety authority board that is responsible for conducting the risk management. The board comprises representatives from different ministries as illustrated in chapter 4, Figure 4.8 (FAO, 2018).

5.2.1 Elements of the National Biosafety System

The national biosafety system is a combination of policy, administrative, legal, and technical instruments that were developed to address safety issues with respect to human and animal's health, environmental conservation, as well as socio-economic and ethical concerns in the context of safe development and application of modern biotechnology in accordance to national needs and international legislation (GRZ, 2007). The study attempted to break down the components of the NBS using the systems approach theory. The following elements were identified;

Guidelines/Regulations

The Zambia biosafety act (2009) is based on the biosafety policy (GRZ, 2007). The act applies to the movement, use and commercial application of GMOs and their products. The Zambian regulations cover the following areas: It gives preliminary provisions, general principles, administration and institutional arrangements, decision making procedures and approval mechanisms, risk assessment and management, GMO transportation, liability and redress, offenses and penalties, and general provisions (GRZ, 2007).

The main principles that are involved in the Zambia biosafety regulation are the precautionary principle (approval or refusal should depend on clear scientific knowledge

and lack of such knowledge shall not be used as a basis for not taking preventive measures); prevention principle (risk assessment and environmental impact assessment to be carried out so that informed decisions may be made); and the principle of strict liability (any party, individual or corporate that deals with the introduction of a GMO or its products shall be liable for any harm, injury or loss caused directly or indirectly by those GMOs and their products or any activity related).

It further states that: "In case of harm to the environment or to biological diversity, redress shall include the costs of clean up and rehabilitation whether incurred or to be incurred and costs of any preventive measures to follow, to the satisfaction of the national biosafety focal point". It is the right of individual and legal persons to seek redress in respect of breach or threatened breach of the (biosafety) regulations. Such persons shall not be expected to pay costs if their action failed, if it was out of reasonable concern. The stated penalties of offenders are monetary fines and prison terms. The provisions given in the Zambian biosafety regulations reflect the CPB provisions (Belay, 2019).

In summary, the biosafety law enacted in 2007 takes a very precautionary stance. It stipulates that approval for transfer, use and release of crops shall not be given where there is reason to believe that harm or damage may result. The law has a provision on developing mechanism for liability and redress for any harm or damage caused to human and animal health, non-genetically modified crop, socio-economic conditions, biological diversity or the environment by any GMO or a product of a GMO. The scope of socio-economic impacts is broad and means any direct or indirect effect to the economy, social or cultural practices, livelihoods, indigenous knowledge systems or indigenous technologies as a result of the import, transit, contained use, release or placing on the market of a genetically modified organism or a product of a genetically modified organism. The law further states that the competent authority "shall not grant any approval for the importation, development, production, release into the environment or placing on the market of any genetically modified organism or product of a genetically modified organism relating to any crop or livestock of strategic importance to national food security (GRZ, 2007). This implies that trials and commercialization of a GM crop of national importance such as *Bt* maize may be rejected because it is a key national food security crop.

People

There are a lot of people from different professions and in different institutions involved in the NBS. The NBS is designed to be multi institutional (GRZ, 2007). The national biosafety authority (NBA) is the focal point of the biosafety system in Zambia. Its role and responsibilities include to: Review and approve biosafety applications for research, confined release, pre-commercial release; oversee the implementation of biosafety issues including collection and distribution of biosafety information to the public; establish contact and linkages with national, regional and international agencies or institutions; establish database for the purpose of facilitating collection, storage, retrieval and distribution of information relevant to biosafety; and establish and update a register of experts in biotechnology and biosafety (GRZ, 2007).

Review Process

The review process is conducted by the National Biosafety Board and the scientific advisory committee and chaired by the NBA as illustrated in figure 4.8 in chapter 4. Once again, the policy and Act indicate that the process should be inclusive to ensure that all the individuals/institutions in the framework participate actively.

Feedback Mechanism

This element of the NBS entails that there is proper communication amongst the members of the NBS and between the NBS and the public so that new information is incorporated, and the system is revised as needed.

As illustrated in the conceptual framework in figure 3.8 of chapter 3, the elements in the system are interdependent. The elements are organized around a common purpose or goal which is to ensure safety is upheld with respect to human and animal's health, environmental conservation, as well as socio-economic and ethical concerns, in the development and use of modern biotechnology. This goal provides the glue that holds the system together.

This means that change within the biosafety system framework is bi-directional. Changes to any element, for whatever reason, will change the context and changes in the context will alter the whole system.

5.2.2 National Biosafety System Operations

The various elements come together to operationalise the system as illustrated in the conceptual framework in figure 3.8 of chapter 3. The guidelines provide the blue print of how the system functions. The roles and responsibilities of the institutions and people involved are outlined in the biosafety and biotechnology policy and act. Finally, the feedback process is also outlined in the guidelines.

An illustration of the process of obtaining a licence for placing GM food is given in chapter 4. This shows how the various elements work together in the system.

5.3 National Biosafety System Challenges

The challenges of the NBS were revealed during the study. These challenges affect the operations of the system. They are outlined below;

5.3.1 The Guidelines- Biotechnology and Biosafety Legislation are too stringent

Despite the acknowledgment of the important role that biotechnology can play in the economic development of the country in the Biotechnology and Biosafety Policy and Biosafety Act, the policy documents are overridden by the precautionary principle so much such that it is difficult for the country to benefit from the technology. The liability clauses and socio-economic considerations in the biosafety laws have discouraged and halted efforts around GM crops R&D in Zambia (ABNE, 2017). The ban of GM research on critical crops such as maize has also deterred the participation of the private sector. In general, the entire system takes a cautious, narrowly focused approach to risk assessment. Its reviews focus on risk alone and give little consideration to the benefits that the use of GMOs could bring, nor to the risks of disallowing GMOs and therefore continuing to use conventional varieties and agronomic practices (Waithaka, et al., 2015).

5.3.2 The National Context for Implementing the Biosafety Policy is Poorly Defined at Present

There is insufficient information and policy guidance on important factors such as;

- The role of institutions, civil society and general public in the process of policy and regulatory development;
- The administrative and enforcement capacity;

- The existing human, financial, and scientific infrastructure;
- The status of biotechnology research and development, including programs for the safe use and handling of GMOs;
- existing mechanisms for regional cooperation and regulatory harmonization

As a result, there is poor coordination in the system. The element's inbuilt ability to be interdependent is threatened due to the lack of clarity in the guidelines of the system. As a result, the biosafety system is unable to reach the desired level of technological development (Zainol, 2011).

5.3.3 The National Biosafety Authority in Zambia is Facing Challenges

The national biosafety authority (NBA) is the implementing authority for the biosafety and biotechnology act of 2010 in Zambia. The study revealed that the authority faces the following challenges in conducting its constitutional mandate;

- The NBA currently has only two technical staff tasked to handle applications. This is unsatisfactory as the check for completeness of information of a typically 300-1000 pages dossier with information relating to various aspects of risk assessment is likely beyond a single person's expertise. Beyond this, if several dossiers arrive within a short time of each other, the evaluation for completeness of information cannot be performed by a single or even two staff in a reasonable amount of time, given that the entire process of decision making is aimed to be completed in 90-150 days.
- There is currently no consistent approach for conducting incoming GM applications. It is not clear at which point the authority consults the line ministries and what role the respective agencies play. The roles and responsibilities for the agencies is not properly defined. A more elaborate, consistent and transparent handling of GM applications is necessary to foster public trust and acceptance.
- At the risk assessment level, experts in the following knowledge areas are currently missing, virologist, toxicologist, and pharmacologist. Though the NBA has a system to invite experts as and when required for risk assessments, it still leaves a lot of room for speculation regarding the competency of the system.

- Enforcement of regulations is generally performed through the inspection of shipment documentation, and not through GMO analysis and quantification in the laboratory. Again, this leaves a lot of room for public speculation.
- Although a formal mechanism for feedback- public participation in biosafety decision-making exists, public input into NBA reviews is limited. The authority announcements for GM products to be approved or previously approved are/were made in at least 3 different print media on three different days and comments received in a period of 30 days. However, the number of comments on the newspaper adverts or announcements is currently very low (Anonymous, 2019). This may be due to the formality of language used, lack of interest or knowledge on the subject matter in such announcements or because neither the content nor the impact may be understood by large parts of the population. There is a need to revise the public participation mechanism.
- The authority is both the regulator and promoter of GM technology. This presents a conflict of interest. On one hand the NBA is seen to push for GE technology as a developmental tool, while on the other hand the NBA is seen to be pushing for biosafety regulations to address the scepticism held by the public regarding potential dangers of life sciences to health and environment. This has left the authority in an awkward position.
- Funding crisis. Like all government agencies in the country, the authority is riddled with funding challenges. This puts the operational work of the organisation in disarray.

5.4 Chapter Summary

The chapter provided a discussion of the research results. An assessment of the NBS was outlined, with particular emphasis on the elements. Finally the national context for implementation of biosafety and the challenges observed were outlined.

CHAPTER SIX- CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The chapter presents the salient points raised in the study. This was done by critically evaluating the research questions that were formulated in first chapter of the study. The research conclusion is then presented based on the findings and recommendations are provided. Lastly, the recommendations are outlined and the future research in the field of biosafety are suggested.

Generally, there is poor political will and scepticism on the part of the decision makers. Equally, the public and private media are not educated enough on matters related to modern biotechnology, resulting to underreporting and sometimes distorted reporting about the technology. On the other hand, strict liability clause in the Zambia biosafety regulations is scaring away not only local researchers, but also prospective foreign investors of GMO technology in the country (ABNE, 2017).

6.2 Overview of Study

The research was conducted to analyse the biosafety system in Zambia. Due to the wide nature of the biosafety topic, genetic engineering in food and agriculture was considered. A total of 12 expert interviews were conducted from purposely sampled individuals. 30 semi structured questionnaires were prepared and administered purposely sampled institutions in the biosafety system. The primary data was triangulated with secondary data obtained from the policy documents to ensure validity of results.

The study proposed to assess the National Biosafety System. It also proposed to understand the elements of the NBS. Further, the study proposed to determine the operations of the NBS. The targeted population consisted of the institutions, agencies and ministries outlined in the national biotechnology and biosafety policy. Data was edited, coded, presented and analysed using Nvivo software. The resulting themes were presented in a logical manner which aided in answering the research questions.

6.3 Conclusion

The study showed that the Zambia national biosafety system is a combination of policy, administrative, legal, and technical instruments that have been put in place in order to promote safety for humans, animals and the environment at large in the development and

use of modern biotechnology. The biosafety system is comprised of many institutions, regulations and operations which can be grouped into four main elements. Namely; the guidelines, the people, the review process and the feedback mechanism. In an ideal situation, the elements in the system are interdependent and glued together by one purpose to ensure the smooth operation of a system.

It was discovered that the operations of the biosafety system have been affected by the various challenges in the elements of the system. The main one being the lack of clarity in the guidelines which has resulted in lack of coordination in the elements in the system. Furthermore, the slow development of biotechnology was shown to be attributed to the stringent and outdated policy framework which has discouraged research and development by private investors.

6.4 Limitations of the study

The field of biotechnology regulation is very broad and could not be exhaustively discussed in a single research paper of this nature due to time and financial limitations. The study was carried out during the university calendar, a situation that exerted pressure on the time and finances devoted to the study.

In addition, despite having managed to collect all the thirty questionnaires that were distributed, six of the questionnaires had the open-ended questions unanswered. As such, the researcher had to rely on expert interviews and literature reviewed for the thematic analysis.

For future research, the following recommendations are made:

- Research that includes detailed scientific investigation on the science of biotechnology
- Research to be conducted on the regulation of biotechnology in other sectors such as the health and industrial sector, as this research was limited to food and agriculture
- Research that assesses the effectiveness of the biotechnology legislation in detail

6.5 Recommendations

There is an urgent need to revise the Biosafety and Biotechnology policy.

In particular; the liability clause and redress provisions need to be revised in order to encourage investment and research and development of biotechnology in the country. It is recommended that the development of a liability and redress regime be guided and informed by the more recent Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress which was adopted by parties to the Biosafety Protocol on October 15, 2010 (David, et al., 2012). The Protocol gives the parameters of what constitutes damage and the basis for seeking redress. It has been argued that scientists have a better understanding of biotechnology and GMOs today as compared to what was known three decades ago. As such, there is need to base the policy on updated scientific evidence in order to benefit from the opportunities biotechnology offers (Azadi, et al., 2017).

There is need to clearly define the roles and responsibilities of all the stakeholders mentioned in the biosafety and biotechnology policy. Clarity in the policy documents will allow the elements within the system to operate smoothly. It will also promote efficiency and ownership of the framework. The lack of clarity in the policy documents has been highlighted as an impediment to the operation of the biosafety system in Zambia (Broadbent, 2012).

There is need to develop a strategic plan for informing and communicating with the public on modern biotechnology. The study showed that there is a big information gap on biotechnology and biosafety issues in Zambia even among the people who are better placed to have access to this information. As a result, there is widespread misinformation on the subject. There is need to be more deliberate and creative in ensuring that factual information reaches the public. Increased awareness levels is likely to change public negative perception of GM food (Zepede & Benjamin, 2009). This may in turn lead to an improved political willingness to support the growth and development of biotechnology through increased funding to the institutions in the system (Waithaka, et al., 2015).

6.6 Chapter Summary

The chapter gave an overview of the study and provided the research conclusion. It also outlined the limitations and recommendations for the study.

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APPENDIX 1: STRUCTURED QUESTIONNAIRE

INSTRUCTIONS

- Please do not indicate your name on the questionnaire.
- Circle the appropriate letter (a/b) to express your response.
- For open ended questions, briefly write your answer in the space provided.
- You are encouraged to answer all questions where applicable.

Yours faithfully,

SECTION A

BACKGROUND CHARACTERISTICS

1. Sex of the respondents
   a. Male
   b. female
2. Age of the respondents
   a. 20-35 years
   b. 35- 50 years
   c. 50-65 years
   d. 65-80 years
   e. Above 80 years
3. Number of years worked for an organization
   a. 1-5
   b. 5-20
   c. 20-30
   d. 30-40
   e. Above 40.
4. Type of institution
   a. Ministry
   b. Parastatal
   c. NGO
   d. Research Institute/ University
   e. Other; Specify

      ……
5. Position held by respondent

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SECTION B

6. Is GM food allowed in Zambia?

a. Yes

b. No

7. Are you familiar with the Biosafety Act of 2010?

a. Yes

b. No

8. What do you understand by the National Biosafety System?

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9. Does your organisation play any role in the National Biosafety system?

   a. Yes

   b. No

10. If yes, please explain this role?

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11. If no, please explain why not

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12. Are you familiar with the elements of the National Biosafety System?
    a. Yes
    b. No
13. If yes, please explain

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14. If no, please explain

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15. Are you familiar with the process of obtaining a license for Importing and Selling GM food in Zambia?
    a. Yes
    b. No
16. If yes, how is the license obtained?

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17. Do you think the National Biosafety System is delivering?
    a. Yes
    b. No
18. If yes, please explain

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19. If no, please explain

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20. Are there any risks posed by GM food?
    a. Yes
    b. No
21. If yes, please explain

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22. If no, please explain

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23. Do the benefits of embracing GM food in Zambia outweigh the risks posed by GM food for Zambia?
    a. Yes
    b. No

24. If yes, please explain

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25. If no, please explain

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26. How can the National Biosafety System be more relevant to the country?

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APPENDIX 11. EXPERT INTERVIEW QUESTIONS

Questions for National Biosafety Authority (NBA)

1. What is the role of the NBA?
2. How is Zambia's Biosafety System organised?
3. Which organisations or institutions is the NBA working with and what are their roles?
4. What are the challenges the organisation is facing?
5. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
6. What has caused the controversy surrounding GMO food?
7. How many licenses has the authority given out so far?
8. What is the process of obtaining a license?
9. Are there any laboratory tests conducted? Where?
10. From the time of submission, how long does it take to grant approval or denial of a license?
11. What monitoring is done is done after a license is granted?
12. What role does the public play in the application process?
13. How many responses do you get from the public after placing circulars in the paper, on average?
14. What steps is the authority taking to increase public awareness on GMOs?
15. What specific changes in the biosafety system would allow you to work more effectively and efficiently?

Questions for Zambia Agriculture Research Institute (ZARI)

1. How do you describe Zambia's Biosafety System?
2. What role do you play in the Biosafety system?
3. How would you describe your working relationship with the NBA?
4. Are you doing any GM related research?
5. What are some of the challenges the institute is facing in the growth and development of GM technology?
6. What, in your opinion, is the attitude of farmers towards GMOs?

7. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
8. What steps is the institute taking to increase public awareness on GMOs
9. What specific changes in the biosafety system would allow you to work more effectively and efficiently?

Questions for University of Zambia, School of Agriculture (UNZA)

1. How do you describe Zambia's Biosafety System?
2. What role do you play in the Biosafety system?
3. How would you describe your working relationship with the NBA?
4. Are you doing any GM related research?
5. What are some of the challenges the university is facing in the growth and development of GM technology?
6. What specific changes in the biosafety system would allow you to work more effectively and efficiently?
7. What, in your opinion, is the attitude of farmers towards GMOs?
8. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
9. What steps is the university taking to increase public awareness on GMOs

Questions for Alliance for Commodity Trade in Eastern and Southern Africa (ACTESA)

1. How do you describe Zambia's Biosafety System?
2. What do you think has caused the controversy surrounding GMOs?
3. How would you describe your working relationship with the NBA?
4. How is Zambia fairing in terms of the growth and development of GE in the region?
5. What specific changes in the biosafety system would allow for growth and development in GE in the country?
6. What, in your opinion, is the attitude of farmers towards GMOs?
7. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
8. What steps is the organisation taking to increase public awareness on GMOs

Questions for Food and Drug Laboratory

1. How do you describe Zambia's Biosafety System?
2. How would you describe your working relationship with the NBA?
3. How is Zambia fairing in terms of the growth and development of GE in the region?
4. What specific changes in the biosafety system would allow for growth and development in GE in the country?
5. What, in your opinion, is the attitude of farmers towards GMOs?
6. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
7. What steps is the organisation taking to increase public awareness on GMOs

Questions for the Ministry of Agriculture

1. How do you describe Zambia's Biosafety System?
2. What role do you play in the Biosafety system?
3. How would you describe your working relationship with the NBA?
4. Are you doing any GM related research?
5. What are some of the challenges the institute is facing in the growth and development of GM technology?
6. What, in your opinion, is the attitude of farmers towards GMOs?
7. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
8. What steps is the institute taking to increase public awareness on GMOs
9. What specific changes in the biosafety system would allow you to work more effectively and efficiently?

Questions for the Ministry of Higher Education

1. How do you describe Zambia's Biosafety System?
2. What role do you play in the Biosafety system?
3. How would you describe your working relationship with the NBA?
4. Are you doing any GM related research?
5. What are some of the challenges the institute is facing in the growth and development of GM technology?

6. What, in your opinion, is the attitude of farmers towards GMOs?
7. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
8. What steps is the institute taking to increase public awareness on GMOs
9. What specific changes in the biosafety system would allow you to work more effectively and efficiently?

Questions for CIRDZ

1. How do you describe Zambia's Biosafety System?
2. What role do you play in the Biosafety system?
3. How would you describe your working relationship with the NBA?
4. Are you doing any GM related research?
5. What are some of the challenges the institute is facing in the growth and development of GM technology?
6. How do you describe the process of obtaining a license from the NBA?
7. How would you describe public awareness and attitudes towards GM crops? Towards buying and eating genetically engineered food?
8. What steps is the institute taking to increase public awareness on GMOs?
9. What specific changes in the biosafety system would allow you to work more effectively and efficiently