GMO regulation in Tanzania: Stakeholder analysis on awareness, understanding, accessibility and compliance of GMO regulations.

Msc. thesis in Food Safety

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List of abbreviation

CBD   Convention for Biological Diversity

GMO   Genetic Modified Organism

IBC   Institutional Biosafety Committee

NBC   National Biosafety Committee

NBF   National Biosafety Framework

NBFP   National Biosafety Focal Point

UNEP   United Nation Environment Programme

URT   United Republic of Tanzania

GM   Genetic Modification

CPB   Cartagena protocol on Biosafety

TFDA   Tanzania Foods and Drugs Authority

TBS   Tanzania Bureau of Standard

VPO   Vice President Office

EMA   Environmental Management Act

LMO   Living Modified Organisms

US   United States

WEMA   Water Efficient Maize

AAFT   African Agriculture Technology Foundation

VPO-DoE   Vice President's Office – Division of Environment

TZ-NBFP   Tanzania National Biosafety Focal Point

TPRI   Tanzania   Pesticides Research Institute

MARI   Mikocheni Agricultural Research Institute

NIMRI   National Medical Research Institute

DMBB   Department of Molecular Biology and Biotechnology

UDSM   University of Dar es Salaam

SUA   Sokoine University of Agriculture

MUHAS   Muhimbili University of Health and Allied Sciences

ADRI   Animal Diseases Research Institute

TGCLA   Tanzania Government Chemist Laboratories Agency

URT   United Republic of Tanzania

GMO regulation in Tanzania: Stakeholder analysis on awareness, understanding, accessibility and compliance of GMO regulations

Case of Dar es salaam, Tanzania

This thesis submitted to the Wageningen University and Research Centre in Partial fulfilment of the Requirements for the Award of Masters of Science Degree in Food safety (Law)

By

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Abstract

Background: Bio-technological improvements which include genetic modification technology are said to provide many significant opportunities for the agriculture sector and the farmers especially in sub Saharan Africa where food insecurity and nutritional problems are the common issues. The technology being new in these developing countries the awareness and understanding of the stakeholders which includes farmers and consumers is still a big problem. The quantitative study was developed to assess the awareness, understanding, accessibility and compliance to the GMO rules and regulation from all of the stakeholders in GMO sector.

Methods: Eighty (80) individual interviews (i.e. 30 consumers, 25 business operators which included farmers and 25 government officials) were conducted in Dar es Salaam region in Tanzania. The oral interview included asking respondents questions from the list which have been prepared to capture the objective of the study. Also secondary data was gathered from studying different literatures and written down.

Results: Awareness, understanding and accessibility was found to be very poor among stakeholders especially to the consumer and business operator groups. Non-compliance to the rules and regulation was also found to be there as well as there were GM products found in the market while the government is claiming that has never commercialized any GM product to in the market, they all still in their confined trials. Other findings included that the government has no working monitoring and control system in the GMO sector as they believe themselves that there is no any GM product in the market. Also the receptivity to the use of GM crops was high. Respondents were willing to use GM products if they were made available to the market without focusing on their longer term risks.

Conclusion: This study focused on the awareness, understanding and accessibility and on the level of compliance to the GMO rules and regulation by different stakeholders which in general was found to be very low. Further research work can be done to continue assessing opinions and attitudes of farmers and consumers in sub Saharan Africa towards potential use of GM technologies and also their opinion on the regulations that manage their use. This will allow people to make accurate, informed decisions in use of GM biotechnology and also their regulation.

Key words: GMO, Biosafety regulations, stakeholders, Tanzania

CHAPTER ONE: INTRODUCTION

1.1   Research background

Like many other developing nations, Tanzania, embraced Green revolutionary agricultural techniques from the 1970s as a solution for eradicating hunger and poverty (Katunzi, Tibamanya et al.). Such revolution agricultural techniques include bio-technological improvements which include genetic modification technology which are said to provide many significant opportunities for the agriculture sector and the farmers (Toenniessen, O'Toole et al. 2003, Eicher, Maredia et al. 2006, Lewis, Newell et al. 2010). Some of the seeming benefits of the GM technology in agriculture is the production of genetically modified (GM) crops such as weed and insect controlled crops, higher productivity and drought resistance crops (Zarrilli 2005, Azadi and Ho 2010). These benefits lead to sustainable agriculture and better food security. For instance, breeding for drought tolerance crops, will help to minimize food insecurity by increasing yield stability, as different crops will be able to be grown in different stress conditions hence ensuring food production for future (Cattivelli, Rizza et al. 2008). High productivity means introducing higher yielding varieties of different crops which will lead to increased amount of food produced per hectare that will help to feed the more growing population especially in developing countries without the degradation of more land from other drivers such as forestry, animal grazing or conservation (Wisniewski, Frangne et al. 2002). One of the apparent benefits that have been brought through GM technology in developing world is that scientists have managed to produce a genetically altered rice called golden rice to combat vitamin A deficiency, which is pronounced to be the world's leading cause of blindness and a malaise that affects millions of children many being in developing countries mainly Asia (Potrykus 2001). There are also a number of food products that have been developed through bio-technological improvement to act as edible vaccines and have given hopes to solve many problems associated with the delivery of safe, effective vaccines in developing countries and those includes vitamin A rice and also vitamin A sweet potatoes (Zarrilli 2005).

In addition, genetically modified organisms are used for different purposes such as research, agriculture, gene-therapy and in the medical industry. In agriculture, crops have been modified for different characteristics including resistance to commercial herbicides such as roundup or to produce pesticidal proteins internally and also for drought resistance. In medical industry genetic engineering has produced some positive results. Example of one GM application in

medical sector is the sequencing of the human DNA which have been transplanted into mice, causing the mice to produce components for human blood needed in medicine (Phillips 2008).

In spite of the many explained benefits of GM technology, scientists warn that GMOs could pose a threat to human health and the environment. Tanzania like any other developing country has seen the importance of protecting human health and the environment from the new technology. As a matter of fact new technologies need to be controlled by guidelines or regulations so as to maximise benefits and minimise risks to humans, animals and the environment (Mugwagwa and Rutivi 2009).

Many of the developing countries specifically in Africa use biosafety systems to regulate the use of GM technology and products. The foundation of biosafety systems is the Cartagena protocol on Biosafety (CPB) which began in 2000. The major objectives of biosafety systems in Africa include establishment of a science-based, common and integrated, efficient, transparent participatory administrative and decision making system so that member countries can benefit from modern biotechnology while avoiding or minimizing the possible environmental, health, and socio-economic risks; and to ensure that research, development, handling, trans-boundary movement, transit, use, release and management of GMOs and products are undertaken in a manner that prevents or reduces risks to human and animal health, biological diversity and the environment in general (Jaffe 2006, Sengooba, Grumet et al. 2009). Tanzania ratified the Cartagena protocol on Biosafety in April 2003 and came into effect from September 2003. The protocol recognizes the benefits of biotechnology and advocates for safe management of biotechnology to ensure its safety to human health and the environment in general. Article 19.3 of CBD talks about handling of biotechnology and distribution of its benefit states that "The Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity". This Article raises concerns on the possible impact of biotechnology application and it demands precautions concerning safe handling of biotechnological products (Mtui 2012).

However, the existence of the regulatory system, biosafety guidelines and compliance of the regulation of GMO and GM technology in Tanzania among stakeholders is questionable. In Tanzania, legislations regarding GM technology and products as well as monitoring and control of their residues are not adequately enforced. The inadequacy has probably led to the

reported cases of GM products to be found in the market where by the Government has not yet commercialized GM crops. To attest to this inadequacy, there is a study by (Lewis, Newell et al. 2010) conducted in one of the regions in Tanzania whereby the results showed very poor knowledge, understanding and awareness of the potential risks and benefits of the technology among farmers. However, the study found a high potential for demand and use of GM products in Tanzania.

Therefore, it is the intention of this thesis to analyse the stakeholders on awareness, their understanding, accessibility and compliance of GMO regulation in Tanzania.

1.2   Problem statement

According to many studies which have been conducted in Tanzania it has been shown that there awareness concerning GM technology is relatively low while the demand for the technology is high. There exist rules and regulations that address GMO and GM technology in Tanzania. However, most of these regulations are seemingly not known to all stakeholders, neither their implication on the National Biotechnology policy nor their impact on agriculture and food industry in the future.

1.3   The research objectives and questions

The research has following objectives and research questions as explained below:-

1.3.1   The research objectives

This research has two objectives namely:
 i. To assess the awareness, understanding and access of stakeholders to GMO laws and regulations
 ii. To evaluate the compliance to the existing policies, rules and legislation by the stakeholders

1.3.2   The research questions

To achieve the objectives of this research, the following questions will be answered:
 i. What are the rules and regulations governing GMO in Tanzania?
 ii. Do stakeholders understand and have access to the rules and regulations (asses stakeholder understanding of GMO rules and regulation and their accessibility)
 iii. Do stakeholders comply with the rules and regulations? (Assessment of the compliance of stakeholders on GMO rules and regulation)
 iv. What are the policy implications of and measures needed with respect to a discerned:
     a. Lack of understanding of the rules

b. Lack of accessibility of the rules

c. Lack of compliance? (Evaluation of policy implication (expected output and impact of the policy) and measures that need to be taken)

1.4 Significance of the research

Lack of knowledge, understanding and accessibility of the Tanzanian GMO-regulation to the public seems to affect level of compliance to these regulations. It is the intention of this research to clearly assess all the rules and regulations governing GMO and GM technology in Tanzania, and evaluate their accessibility and understanding of stakeholders. Another aspect that this research will focus on is compliance of stakeholders on the rules and regulations. The research will fill the knowledge gap through tracing the understanding of laws, policy and regulations and will establish what has been done so far and what needs to be done if GMOs are to be successful in Tanzania. In addition, the research will provide a basis in what should be done to create awareness, understanding, access and compliance to GM policy and regulation practices in Tanzania

1.5 Research design and methodology

The research design and methodology includes data collection strategy, primary and secondary data collection methods and a brief explanation about the theoretical framework

1.5.1 Study area

This study was conducted in Dar es Salaam city, the largest city in Tanzania and the commercial hub of the country. According to Population and Housing census of Tanzania conducted in 2012, the population of Dar es Salaam was established to be 4,364,541. The city was chosen as the study area mainly because it hosts most of the food business/industries whereby food products which are packed are then distributed to different regions in the country. Dar es Salaam has a sea port and the international airport which make it vulnerable as many of the food products are imported through such gateways.

1.5.2 Study design

A research survey was conducted in the study area in May 2014. The study involved both quantitative and qualitative methods of data collection.

1.5.3   Data collection methods

1.5.3.1   Secondary data

Secondary data for this study were obtained from various sources which included Vice president Office Division of Environment, Tanzania Foods and Drugs Agency (TFDA) headquarters, Tanzania Bureau of Standard and Local authorities (Municipal Authorities). The information obtained included documents concerning regulation of GMO in Tanzania, Tanzania food law and other documents in Tanzania food legislation.

1.5.3.2   Primary data

Primary data was collected from different GM technology stakeholders who included government officials, farmers, business operators and consumers. The list of questions which was prepared before was administered to the respondents. The questions were in English but during administering them they were translated into Swahili which is national language in Tanzania, in order to be understood by all respondents and the answers were retranslated into English for reporting purposes. The interview was a face-to face interview and was administered by a researcher.

1.5.4   Selection of stakeholders

A total of 80 respondents participated in the study survey. The respondents included 30 consumers, 25 business operators and 25 government officials.

The selection and identification of the relevant stakeholders was done during desk study. The identification and selection of the key stakeholders was based on their knowledge in GM technology, as the study was intending to assess the knowledge on regulation. According to this a respondent must have at least heard and have a knowledge on GMO. The stakeholders were classified based on social networks (i.e. Business network, Policy network and societal network) stakeholders. Food business operators included owners of supermarkets and food manufactures/processing industries. Farmers whom included were those who have at least general knowledge on GMO and they are living in Da es salaam. Government officials included all whom were working in governmental institutions especially in Vice President Office where GMO are regulated under Environmental Management Act (EMA) 2004. Consumer group were selected from members of Consumer organisation in Tanzania and at least they had a little knowledge in GMO. These stakeholders were first communicated to know if they have a slightly general knowledge on GMO and then later they did face to face interview with a researcher using the questions list.

1.6 Data analysis

1.6.1 Quantitative data

Quantitative data from the survey were coded, entered and analysed using SPSS software version 20.0 for Windows. The sample for the survey was 80 respondents where 25 respondents were government officials, 30 respondents were consumers and the other 25 were food business operators which also included the farmers.

1.6.2 Qualitative data

Qualitative data were analysed manually by the researcher by taking notes during discussion and later arranging the points according to topics outlined in the list of questions. During the face to face interview the researcher wrote down all important points and opinion from respondents and put them into comprehensive account after the discussion whereby they were analysed.

1.7 Conceptual Framework

Compliance with any rule and regulation is subject to existence of the rules and regulations and the monitoring and control by the Government. In Tanzania GMO rules and regulations do exist and they are imposed on business operators who deal with GMO's and GM products in the country. In this study, the understanding and accessibility to the GMO rules and regulations is assessed in conjunction with the understanding and the willingness to buy by the buyers/consumers of GM products. The Figure 1 is a conceptual framework that depicts the GM stakeholders and how they influence one another.
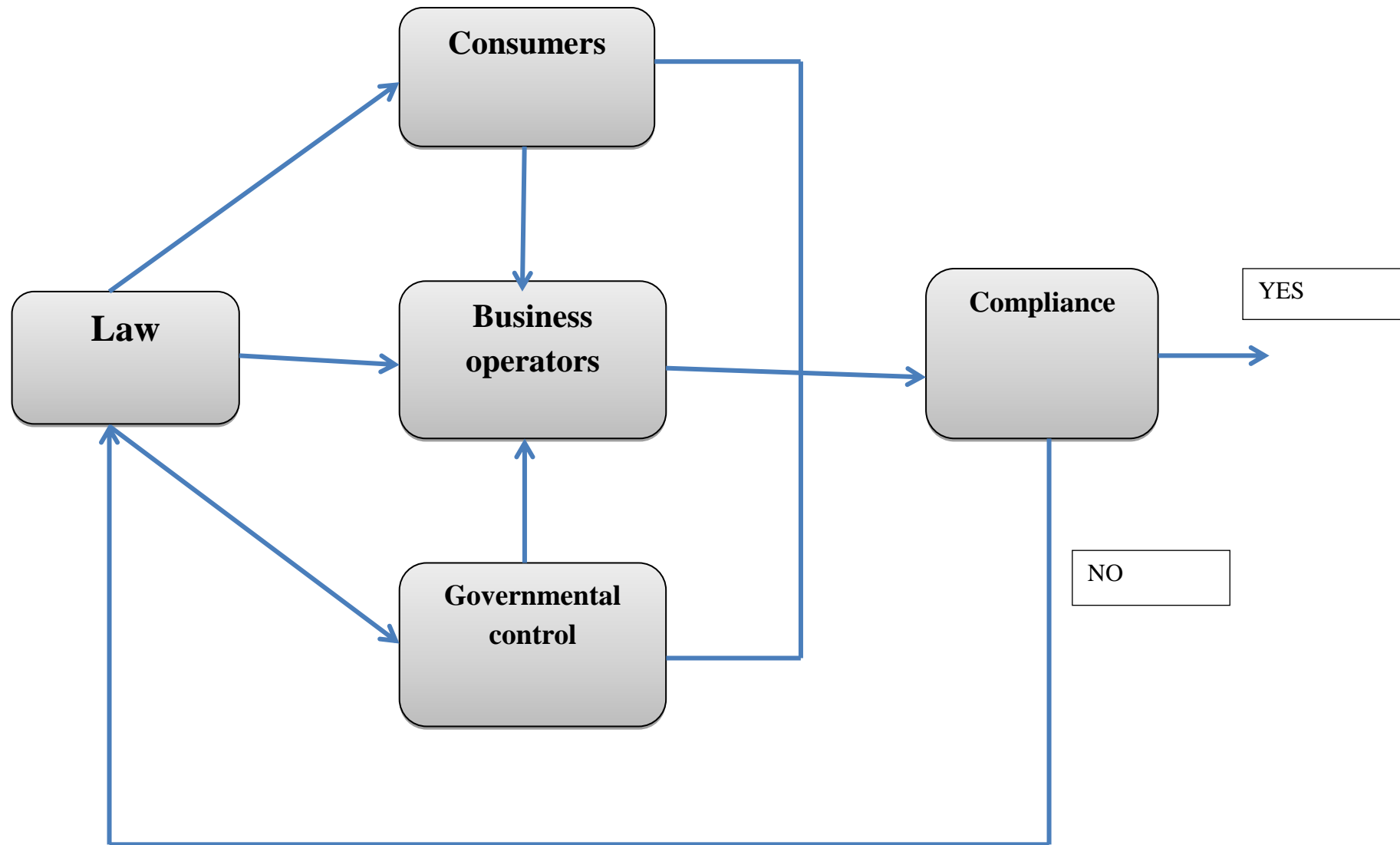
Figure 1: Conceptual framework

Using the theoretical framework (Figure 1) and the research design and methodology this study seeks to get answers on what are the rules and regulations governing GMO in Tanzania and analyse whether stakeholders understand, have access, do comply and what the policy implications are is this is not enough understanding and accessibility to the rules and regulations governing GMO in Tanzania.

As the figure explains itself, at the very first side of the hierarchy there is existence of rules and regulation that governs GMO in Tanzania. These laws and regulations are imposed to both consumers, business operators and also to the different governmental institutions for the enforcement and control.

It is the role of the government actors to control the production and market of the GMO production by enforcing the laws and regulation on how the production and handling should be through the controlling processes. Government have to make sure that consumer healthy are being protected so it's their responsibility to strongly enforce the law to the business operators and make them comply for the assurance of the safety of food product in the market.

The business operators of GMO products are influenced by the government enforcement processes, the cost of production, consumers and also by the regulations. Business operators have to meet the legal requirements for their business such as they are supposed to apply for the permit to bring the GMO to the market; also they have to label the GMO products for the consumers to know and to make the informed choice on buying these GMO products. Together with the legal requirements also the business operators are influenced by the consumers to the compliance of the GMO rules and regulation. The consumers influence the operators in a way that if they know what they want and if they know and understand the requirements such as labelling of those products.

As it has been explained to the business operators' point the consumers influence the compliance of the business operators in a way that, do they really need GM products, do they have information and are they aware on the products and the regulations associated with these GM products. These information are very influential to the business operators to comply with the regulations. If the consumers have the knowledge and are very aware on the products then it's easier for them to make the business operators comply with the legal requirements.

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With these interrelation from all of the stakeholders (government institutions, business operators and consumers), it is the intention of this study to analyse all the rules and regulations covers GMO in Tanzania and how the government enforce/operationalize these laws and regulations. In addition the study will assess on the stakeholders awareness, understand and accessibility to the rules and regulations covering GMO in Tanzania. The compliance level of the business operators regarding GMO regulations will also be assessed. From the result of the level of compliance then the study will suggest some of the ways of either influence the compliance with regards of the fallouts of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1   The international environment of GM technology

This chapter briefly introduces the concept of GMO, what is GMO, the history of GMO, GMOs acceptance in the world focusing on developed and developing countries, potential GMO applications, risks and controversies surrounding the use of GMOs, and GMOs and Biosafety in Africa. In the end, this chapter is going to explain the Tanzania involvement in the GMO technology, the policy and the Biosafety system in Tanzania.

2.2   Definition of key concepts

This section provides the general definitions of a number of terms which are used in this thesis. These terms include Genetically Modified Organisms, Genetically Modification Technology and, Living Modified Organisms, Cartagena Protocol on Biosafety, Biosafety and National Biosafety Framework (NBF).

2.2.1   Genetically Modified Organism (GMO)

Genetically modified organisms (GMO) are organisms whose genetic makeup has been directly altered by humans. An organism's biochemical, anatomical, physiological and, to some extent, behavioural traits are determined by genetic information encoded in deoxyribonucleic acid (DNA). DNA forms a hereditary code that is carried in each cell of each organism (O'Toole 2010).

2.2.2   Genetic Modification (GM) Technology

Genetic Modification technology or sometimes known as Modern biotechnology is defined as one of many developed techniques that makes use of manipulation of genetic material further than the normal breeding. It makes use of the application of invitro nucleic acid techniques, including recombinant (DNA) and direct injection of nucleic acid into cells or organs, that overcome natural physiological reproductive or recombination barriers and that are not techniques used in traditional breeding and selection (Eggers and Mackenzie 2000). One example of the modern biotechnology is genetic engineering to form GMOs.

2.2.3   Living Modified Organism (LMO)

Living Modified Organism (LMO) is a term that captures a wide range of genetically modified organisms. These are any living organisms that possess a novel combination of genetic material obtained using modern biotechnology. In turn a living organism is defined as any

biological entity capable of transferring or replicating genetic material including sterile organisms, viruses and viroid (Eggers and Mackenzie 2000).

2.2.4 Cartagena Protocol on Biosafety

Cartagena Protocol on Biosafety (CPB) is an international agreement on biosafety dealing with modern biotechnology. It is an addition to the Convention on Biological Diversity. The CPB is for protection of biological diversity from the potential risks that are likely to be posed by genetically modified organisms resulting from modern biotechnology. It is specifically dedicated on trans boundary movement of GMOs (Living Modified Organism under protocol) (Kinderlerer 2008).

The CPB regulates trade and use of GM crops and foods derived from it. The CPB uses the precautionary principle to regulate the trans boundary movement of GM crops and foods (Mtui 2012). The Precautionary Principle in the protocol 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 (Cullet 2006, Kinderlerer 2008). Generally, the protocol gives the direction to prove safety of genetically engineered organisms before releasing it to the public or environment.

2.2.5 Biosafety system

These are systems that are used by different countries for regulating the handling of GMO and GM technology. Biosafety means the avoidance of risk to the environment and to human and animal health, as a result from the use of research and commercial activities of GMOs (Mugurusi and Mwinjaka 2006).

2.2.6 National Biosafety Framework

The National Biosafety Framework (NBF) is a combination of policy, legal, administrative and technical instruments that is set in place to regulate safety for the environment and human and animal health from the uses of modern biotechnology in different countries (Mugurusi and Mwinjaka 2006).

2.3   GMOs in the World

Plant genetic engineering started in early 1980s, and in the mid-1990s GM crops started to be available in the market. From there, GM crop implementation has been improved quickly. Until 2008, GM crops were being grown on 9% of the global arable land (James 2008, Qaim 2009). Global implementation of GM crops has increased over recent years. To date, these crops have primarily been used for animal feed, processed products and fibre. By the year 2008 twenty-five (25) countries had already approved planting of biotech crops and another thirty (30) countries had already approved import of biotech products for food and feed use. That makes a total of 55 countries with approval to use biotech crop (James 2008).

In the year 2012, 17.3 million farmers in the 28 countries were recorded to grow biotechnological crops on 170 million hectares, which accounts of more than 12% of the World's arable land. Out of the 28 countries that planted biotech crops in 2012, 20 were developing and 8 were developed countries Sudan which grew Bt cotton and Cuba which grew Bt maize adopted planted genetically modified (GM) crops for the first time in 2012. The 90% of the farmers who adopted GM crops were small scale farmers mostly in developing countries (Aerni 2013). Table 1 shows the 28 countries growing GM crops, the area grown and the type of Biotechnological crop.

Table 1: Countries growing GM crops

Rank	Country	Area (million ha.)	Biotech Crops
1	U.S.A	69.5	Maize, Soybean, cotton, canola, sugar beet, alfalfa, papaya squash
2	Brazil*	36.6	Soybean, maize, cotton
3	Argentina*	23.9	Soybean, maize, cotton
4	Canada*	11.6	Soybean, cotton, canola, sugar beet, maize
5	India*	10.8	Cotton
6	China	4.0	Cotton, Papaya, poplar, tomato, sweet pepper
7	Pakistan	2.8	Cotton
8	Paraguay	3.4	Maize, Soybean, Cotton
9	South Africa	2.9	Maize, Soybean, Cotton
10	Uruguay	1.4	Soybean. Maize

11	Bolivia	1.0	Soybean
12	Philippines	0.8	Maize
13	Australia	0.7	Cotton, Canola
14	Burkina Faso	0.3	Cotton
15	Myanmar	0.3	Cotton
16	Mexico	0.2	Cotton, Soybean
17	Spain	0.1	Maize
18	Chile	<0.1	Maize, Soybean, Canola
19	Colombia	<0.1	Cotton,
20	Honduras	<0.1	Maize
21	Sudan	<0.1	Maize
22	Portugal	<0.1	Maize
23	Czech Republic	<0.1	Maize
24	Cuba	<0.1	Maize
25	Egypt	<0.1	Maize
26	Costa Rica	<0.1	Cotton, Soybean
27	Romania	<0.1	Maize
28	Slovakia	<0.1	Maize

Source: James (2012)

2.3.1   GMOs acceptance in the world: developed countries

Consumer acceptance of GM foods differs significantly around the world. Different studies have been conducted in different countries and the results showed to differ from country to country. In the United States, high number of consumers showed to accept GM products and the their willingness to pay for non-GM products was too low (Ganiere, Chern et al. 2004). A study which was done to compare U.S. and Chinese consumers found that their attitudes generally support new technology means that the acceptance to GMO products was high (Zhang and Prybutok 2004). On the other hand consumers in European countries showed to have strong objections on GM crops. A small number of consumers in the United Kingdom showed the acceptance on consuming GM food. The study from (Moon and Balasubramanian

2004) explains that U.K. consumers were willing to pay much higher for non-GM food than U.S. consumers. From different studies it was shown that on average, 73% of consumers in 15 European countries rejected GM food (Springer, Mattas et al. 2002). Also the current study from (Rollin, Kennedy et al. 2011) shows that consumers in European countries tend to take more negative than positive attribute of the agro biotechnology lead to low acceptance of GM technology. Another study by (Hoban 2004) showed that Swedish consumers did not accept GM food, and were willing to pay higher for the ban on GM feed for their livestock. According to the Food and Agriculture Organization (FAO) of the United Nations, public acceptance trends in Europe and Asia are mixed depending on the country and current mood at the time of the survey.

2.3.2 GMOs acceptance in the world: Developing countries

From the study of (Herrera-Estrella and Alvarez-Morales 2001) it shows that farmers in developing countries stand generally not in favour nor against GM crops. It shows that they are willing to adopt any promising technologies that will help them in production at lower costs, increased productivity and producing products of higher value. On the other hand the study of (Lieberman and Gray 2008) explains on some of the African countries such as Zimbabwe to refuse shipments of food aid which were said to contain GMO. The use of GMO in developing countries is mainly influenced by developed countries in the EU and US. Many African countries appear closer to the EU position in terms of the GM regulatory system, some rejecting GM food in aid form, and some choosing not to introduce agricultural biotechnology into their farming system (Lieberman and Gray 2008). Many of the countries in Africa believe that capitalizing in GM crops will lead them to lose the trade with Europe and that means their economic situation will be compromised. And this continue to in vain decisions about the adaptation of biotechnology (Cooke and Downie 2010).

2.4 GMO Applications in the World

There are many potential GMO applications, the most known example being its application in agricultural sector. Many of the said benefits of genetic engineering in agriculture include increased crop harvests, costs reduction for food products, reduction in the need for pesticides, improved nutrient composition of food materials and general food quality, plant resistance to pests and disease, improved food security, and medical benefits (Phillips 2008).

The study of (Takeda and Matsuoka 2008) explains more biotechnological improvement where it shows the successful ways of mapping different genes from different crops to develop crops which matured faster and also they are tolerant to different kind of soil stress such as boron, salt, drought, frost, and other environmental stressors. This allows crops to grow in different soils where previous crops would not be able to grow.

The pharmaceutical industry is another edge that benefits with the uses of GMOs. From the review of (Ma, Drake et al. 2003) it shows that there some of the plants that have been used to produce several types of proteins with direct or indirect medical applications such as milk proteins β-casein and lysozyme, which could be used to improve child health. In addition, it explains through genetic engineering plants have been able to produce several types of antibodies and made it to clinical trials.

Salmon is one example of animals which have been genetically engineered to grow larger till four times its normal size and mature faster. This can be achieved without stressing about their disappearance as many people in the US were worried that salmon have been overfished, and their numbers in the wild have been declining rapidly (Stiers 2013).

2.5   Risks and Controversies Surrounding the Use of Genetically Modified Organisms

On one hand, there are many uses and benefits from using GMOs and GM technology, on the other hand there are also some controversies around it. The study of (Phillips 2008), argues that regardless of the fact that during the DNA engineering process the genes are transferred naturally into other species, there might be unknown consequences to the altering of the natural state of an organism through foreign gene expression. The alterations may bring the changes to the organism's metabolic activities such as growth rate, or their response to external environmental factors. These consequences are said to influence the GMOs and also the environment in which that organism is allowed to multiply. This is said to pose potential health risks to humans such as allergens as well as the transmission of antibiotic-resistant genes to the bacteria in the human intestine.

(Phillips 2008) also explains that another concern associated with GMOs is that private companies will claim ownership of the organisms they create and not share them at a reasonable cost with the public. But the author also says that if these claims are correct, it may be argued that use of GM crops will hurt the economy and environment, because monoculture

practices by large-scale farm production centres will dominate over the diversity contributed by small farmers who cannot afford the technology.

The attitudes towards modern biotechnology and genetically modified products differ among people and depend upon people's level of education and interpretations of terms. For example, there are people who would not want GMOs, not for safety reasons, but because of personal or religious beliefs. Some people believe that through genetic engineering some people want to play God's role and also the transfer of foreign material can lead to the mixture of foods which is allowed and not allowed in their belief. Some people believe that tampering with nature is intrinsically wrong, and others maintain that inserting plant genes in animals, or vice versa is immoral (Macer 1998).

2.6   Genetically Modified Organisms and Biosafety in Africa:

Since the implementation of genetically modified (GM) crops in the mid-90s, these crops have spread at a very low rate in African countries. (James 2008) explains that until 2008 only three African countries were engaged in biotechnology crops, which are South Africa, Burkina Faso and Egypt. South Africa grows them in significant quantities and the other two grow GM crops only for food. The safety concerns and regulatory issues have brought the slow progress of GM developments in Africa.

A total of 40 countries from Africa signed and became parties to the Cartagena protocol on biosafety (CPB) in 2008 (Mtui 2012). Signing and becoming the member of the protocol means they have to comply with the requirements of the protocol of which the principal one is to develop national biosafety systems as well as set out appropriate procedures in the field of safe transfer, handling and use of living modified organisms resulting from biotechnology that may have adverse effect on conservation and sustainable use of biological diversity and taking into account risks to human health. Practically these binders stimulate the development of functioning National Biosafety Frameworks. As signatories of the CPB many of the countries are currently engaged in the implementation of the Protocol's biosafety framework. However, biosafety regulations and legislations are still developed in few countries.

2.7   Tanzania involvement on GM technology

Currently, there are at least four crops for which there are or have been trials or experimentation involving GM crops in Tanzania. For instance, Water Efficient Maize (WEM) is being tested in Tanzania, and is expected to be released for public farming as soon

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as 2015 if the research will be successful with the approval from relevant authorities. The objective of the project is to develop and make drought tolerant maize available free to small-scale farmers in Sub-Saharan Africa. The project to test WEM in Tanzania began in 2003 by the African Agriculture Technology Foundation (AAFT). AAFT gained support from Tanzania, Kenya, Mozambique, South Africa and Uganda to begin testing the WEM immediately. The project is said to be in accordance with the Cartagena Protocol and all rules and regulations governing GMO and GM technology within these five African countries and is fully funded through the Bill & Melinda Gates Foundation. Another GM crop under trial is banana. The trials of GM virus resistance in bananas has been undergoing at Maruku, HORTI-Tengeru Arusha region, and Sokoine University of Agriculture in Morogoro. The project aimed to boost production through the introduction, multiplication and diffusion of one to two million samples of planting material to the region of Tanzania. To achieve the aim several partners, from universities to community-based organizations, were involved in each stage of the production, quarantine, growing, testing, multiplication, demonstration and diffusion of plant material (Smale and Tushemereirw 2007). The third crop being on trial is tobacco. From 2003, Tanzania has been conducting field trials of GM tobacco near Moshi region. The trial of tobacco that has been genetically modified to be nicotine-free and has been conducted to target future market of tobacco that is free of nicotine. Cotton is the another GM crop which Tanzania is under trial and there have been field trials of Bt cotton in Tanzania since 2005 (Omamo and Von Grebmer 2005).

2.8   The GMOs policy: Policy and legal context of GMOs in Tanzania

In Tanzania, the introduction of genetically modified crops raises new challenging questions on the possible ecological, economic, and social impacts of GMO agriculture on smallholder farmers and environment. The main concern on the introduction of GMO lies in human and animal health and the environment. Under human health, there are concerns that genetically modified foods may contain protein toxins arising from introduction of foreign gene and also contain proteins that may cause harmful immunological responses such as allergies. Therefore, as biotechnology develops rapidly, more and more GMOs and their products will be released into the environment and may thus pose potential risks to the environment, and on human and animal health.

In a bid to ensure the safety of GM technology, Tanzania took some essential measures and established some initiatives. These measures and initiatives include ratifying the Cartagena protocol and establishment of a biosafety regulatory system.

Tanzania is a member to the Convention on Biological Diversity (CBD) and has ratified the Cartagena Protocol on Biosafety (CPB). The protocol is widely supported in Africa to the extent that some countries have rejected food aid where there have been concerns that the aid included genetically engineered food. The CPB was ratified by Tanzania in April 2003 and it came into effect from September 2003.

A biosafety regulatory system was established in Tanzania and independently reviews and approves each product for safety before it is released into the environment or ingested by humans. Tanzania 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.

2.8.1   National Biosafety framework for Tanzania

Following Tanzania's ratification of the CBD in 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 Tanzania was drafted by a multidisciplinary steering committee, coordinated by the Vice President's Office in October 2004 under the sponsorships of UNEP-GEF. The National Biosafety Framework is a combination of policy, administrative, legal, and technical instruments that was 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 (Mugurusi and Mwinjaka 2006). The key elements of Tanzania-National Biosafety Framework includes: National policies related to biosafety, regulatory system , Administrative and decision mechanisms , Monitoring mechanisms, and lastly the Mechanisms for public awareness, education and participation. (URT 2009). The National Biosafety framework mainly aims at:

1) Establishing a science based, holistic and integrated, transparent and participatory administrative and decision making system so that Tanzania can benefit from modern

biotechnology, while avoiding or minimizing the environmental, health and socio-economic risk; and

2) Ensuring 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.

2.8.1.1   National policies and legislation related to biosafety

The biosafety framework for Tanzania included a lot of different existing National policies and legislation in Tanzania which recognised the importance of biosafety. These different legislations have not shown that they full cover the issue of biosafety in the country. From these legislation there are various pieces which addresses the biosafety issues which includes plant protections, animal and human health. This piece from the legislation which has states these concerns on biosafety has been collected and included in the biosafety framework of Tanzania. These policies and legislation have been reviewed and have been shown to have gaps in the management of GMOs issues but they are in the process of being reviewed so that they cover all the aspects in regulating GMOs in the country.

The different National policies and legislation which have been included in biosafety framework for Tanzania includes:

- The Plant Protection Act No. 3 of 1997

This Act in different sections speaks on the prevention and control of attacks by, or spread of harmful organisms or diseases in Tanzania. It states on the right of entry and destruction of infectious articles (Section 5); It also states the possibility measures for control of outbreaks of pests (Section 6); The Act also states of the power which the responsible Minister have been granted to make special regulations (Section 7);The National quarantine measures and plant import and export control (Section 8), The importation for research (Section 9), The Conveyance and goods in transit (Sections 10 and 12) and the regulations on plant protection substances and plant resistance improvers for the protection of human and animal health or averting dangers, particularly to the natural environment (Section 16) have been explained in the Act.(URT 1997).

The Act with these explained subsections is being used in regulating on the planting of GMOs; however the Act does not provide for biosafety the particulars with regards on the risk assessment and management, breaches, liability and compensation issues.

- The Tropical Pesticides Research Institute Act No. 18 of 1979

The Tropical Pesticides Research Institute (TPRI) Act No. 18 of 1979 explains on the technical part of biosafety framework. It explains that the TPRI should provide the following: registering and controlling of all of the pesticides, it should be responsible for the National plant quarantine and herbarium and also it should serves as the National Centre for Plant Genetic Resources(URT 1979) .With these explained function of TPRI, it makes it as a key and potential institution in the implementation of National Biosafety Framework.

- The Veterinary Act No. 16 of 2003

The Veterinary Act, 2003 has got nothing to do with biosafety but the only reason that make it to be included in National Biosafety Framework is, it manages the registration and enrolment of veterinarians who plays big role on the implementation of the NBF such as care for the health of pets, livestock, and animals.(URT 2003).

- The Animal Diseases Act No. 17 of 2003

The Animal Diseases Act has been included in NBF as it provides the provisions on the monitoring of the animal production and the disposal of animal carcasses also has been explained in this act. The act explains on the importation of animals. It denies the importation of any animals to the country without permission of the Director responsible for animal diseases (URT 2003).

- Grazing-land and Animal Feed Resources Act, 2010

Grazing-land and Animal Feed Resources Act, 2010, manages the importation, manufacture and sale of animal feedstuffs to Tanzania Mainland. But it also includes different issues in different sections which are related to the sanitary of animal feeds. The legislation explain also on the declaration if any GMO materials has been added to the any animal feeds it has been included in the biosafety as it includes animal feeds which are also important aspects in the NBF (URT 2010).

- The Tanzania Food, Drugs and Cosmetics Act No. 1 of 2003

The Tanzania Food, Drugs and Cosmetics Act No. 1 of 2003 Act repealed the Food (Control of Quality) Act of 1978. The Act establishes the Tanzania Food and Drugs Authority (TFDA), which is responsible for controlling the quality, safety and effectiveness of food, drugs, herbal drugs, cosmetics and medical devices. It also regulates the importation, manufacturing, labelling, distribution, storage, promotion and sale of food, drugs, herbal drugs, cosmetics and medical devices in Tanzania(URT 2003).

Although the Act has not mention anything on biosafety but it has been included in NBF as it regulates and control food safety in the country and the Authority (TFDA) has different food and medical inspectors whom are important on the enforcement of biosafety issues(URT 2003).

- The Merchant Shipping Act No of 2003

The Merchant Shipping Act No of 2003 provides on protections of marine environment against pollution emanating from ships and other sea-transport vessels, it provides regulations on goods, articles or materials carried by ships which include any dangerous things which have to be packed and identified in such a way that they don't cause any harm to marine environment. This act also gives the right to the director of Marine environment to inspect any ship to ensure that it complies with the laid down regulations.The Act has been included in NBF as it is fulfils the section 18 of the Cartagena Protocol on Biodiversity regarding the handling, transport, packaging and identification of Engineered product (URT 2003).

- The Tanzania Civil Aviation Authority Act No. 10 of 2003

The Tanzania Civil Aviation Act of 2003 establishes the Tanzania Civil Aviation Authority (TCAA), which is responsible on protecting the interest of consumer by enhancing public knowledge, awareness and understanding of the regulated sectors. This Act has been included in the NBF as it gives a focus and emphasis on environmental and consumer protection which are important aspects in NBF(URT 2003).

- The Fisheries Act No 22 of 2003

The Fisheries Act No 22 of 2003 repealed the Fisheries Act No. 6 of 1970. The act provides the management of the fishing industry through licensing. It gives the Minister responsible for

fisheries to make regulations for the purpose of protecting, conserving, developing, controlling the capture, collection, gathering, manufacture, storage and marketing of fish and fish products

The Act does not explain anything on biosafety concern but for it has the provision on the restriction of import, export and introduction of new species in Tanzania which this might be explained roles NBF(URT 2003).

- Forest Act No. 14 of 2002

This Act repealed the Forest Ordinance Cap. 389 enacted in 1959. The Act provides on the regulation of the harvesting of forest resources through licensing. The law did not include anything on the biosafety but as it speaks on the protections, conserving, developing, regulating or controlling forest resources which includes the conservation of flora and fauna then it was included in NBF (URT 2002).

- Beekeeping Act No. 14 of 2002

The Beekeeping Act provides for the procedures in the conduct of beekeeping, which includes the improvement of the products gained from the beekeeping and also the prevention and suppression of diseases and pests among bees.This piece of legislation does not have provisions on biosafety or biotechnology but as the other Acts and legislation it speaks on the matters which are important to be covered in the NBF(URT 2002).

- Wildlife Conservation Act No. 12 of 1974

Wildlife Conservation Act No. 12 of 1974 provides for the control and regulation of the hunting of wildlife resources through licensing. The Act denies the entry of any foreign wild animals without the permission from the Director of Wildlife in Tanzania. And this includes any genetic modified animals (URT 1974).

- The Tanzania Commission for Science and Technology Act No. 7 of 1986

This Act establishes the Tanzania Commission for Science and Technology (COSTECH) which is principal advisory organ of Government on all matters related to scientific research and development. COSTECH is responsible to acquire, store and disseminate scientific and technology information. It also has a role of mobilising the funds for scientific research and technology (URT 1986).

- The Tanzania Bureau of Standards Act No.2 of 2009

The Tanzania Bureau of Standards Act No.2 of 2009 repealed the Standards Act No. 33 of 1975 established the Tanzania Bureau of Standards which is responsible on providing for inspection, sampling and testing of locally manufactured and imported commodities (including foods) with a view to determine whether the commodities (foods) comply with the provisions of the Act or any other law dealing with standards relevant to those commodities (food) (URT 2009). The Act does not say anything about biosafety the availability of its inspectorate services serves as a major ingredient in NBF as it adds on human resource to enhance the enforcement of the NBF.

- The Industrial and Consumer Chemicals (Management and Control) Act No 3 of 2003

This Act provides for the management and control of production, importation, transportation, exportation, storage, dealing and disposal of chemicals. The Act does not say much on biosafety but the useful provisions on risk assessment and risk management brought it in the NBF (URT 2003).

- The National Environment Management Act 2004

The Environmental Management Act 2004 was enacted in February 2005. The Act provides for the legal and institutional framework for sustainable management of the environment. The Act further provides for the regulation of development, handling and use of genetically modified organisms (GMOs) and products thereof. It empowers the minister responsible for environment, in consultation with sector ministries to make regulations, issue guidelines and prescribe measures for the regulation of the development, handling, and use and the importation and exportation of GMOs and their products (URT 2004).

2.8.2 Tanzania biosafety regulatory system (Institutional structure and administrative mechanisms)

The biosafety regulatory has four institutions for the managing of GMOs in the country. These Institutions includes: National Biosafety Focal Point (NBFP); competent authorities/relevant ministries, National Biosafety Committee (NBC) and Institutional Biosafety Committees

(IBCs). These institutions in general have the role of communicating and manage all the issues concerning the use of modern biotechnology particularly on biosafety issues in Tanzania. Figure 1 shows the biosafety institutional structure for GMOs in Tanzania
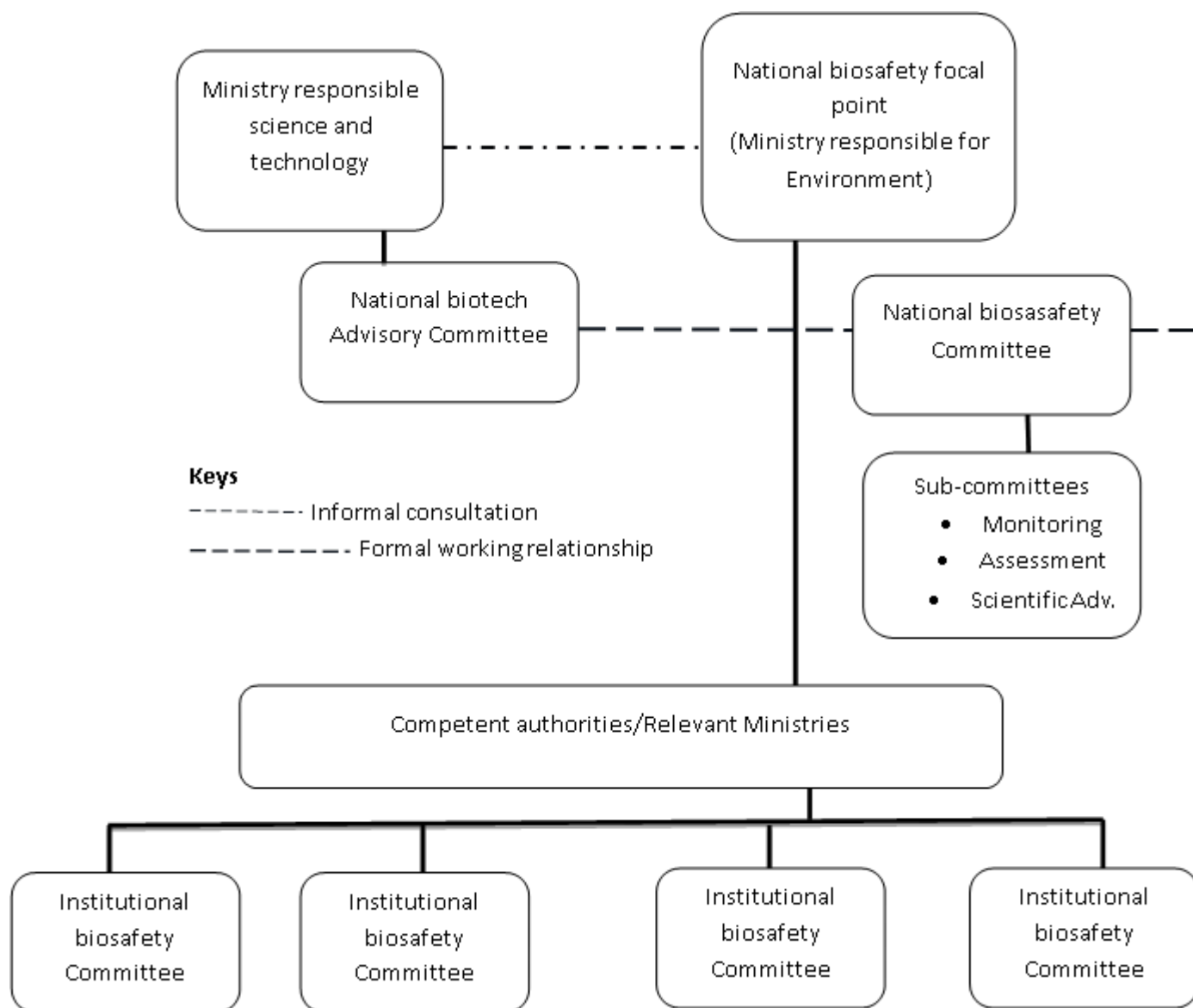
Figure 2: Biosafety institutional structure (Mugurusi and Mwinjaka 2006)

Below are the explanations on each institutions and the role played for the advancement of capabilities for the effectively regulation of the GM technology and its products in Tanzania.

- National Biosafety Focal Point (NBFP)

The National Biosafety Focal Point (NBFP) is Vice President's Office – Division of Environment (VPO-DoE). The NBFP is responsible for reviewing and approving biosafety applications for research, confined release and pre-commercial release. The NBFP is also responsible managing the implementation of biosafety issues including collection and distribution of biosafety information to the public; establishing contact and linkages with national, regional and international agencies or institutions; establishing of the 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. It is also responsible on deciding whether to accept or reject an application based on the advice of the competent authority and NBC and to notify the applicant about the results of the review. (URT 2009).

- National Biosafety Committee (NBC)

The NBC comprises of the representatives from governmental and non-governmental institutions and the private sectors that are related to the biotechnology and biosafety concerns. It includes the experts from the ministries of agriculture and food security, livestock development and fisheries, health and social welfare, industries trade, and also some members are from the commission of science and technology (COSTECH), University of Dar es Salaam (UDSM), Muhimbili University of Health and Allied Sciences (MUHAS), Sokoine University of Agriculture (SUA) and other related research and development institutions (Mtui 2012).

The NBC is responsible on reviewing relevant applications, advising on policies, legislation and other policy instruments, carrying different study and evaluation of biotechnology research and control to minimise risks and hazards associated with the deliberate release of GMOs in the environment and advise the NBFP and competent authorities. Also they have to ensure that adequate testing of GMOs developed elsewhere has been performed in the country of origin before it is introduced in a local trial programme in Tanzania. The NBC have to review and facilitate the biosafety regulations and guidelines from time to time as necessary (URT 2009).

- Relevant ministries/competent authorities

The relevant ministries/ competent Authority includes ministries responsible for environment; agriculture; livestock; health; wildlife; fisheries; forestry; transport and communication;

industry and trade; and science and technology, It also includes non-governmental organizations and agencies with areas of relevant expertise on agriculture, GMO and GM technology. Some of the competent Authority/ institutions includes Mikocheni Agricultural Research Institute (MARI), National Medical Research Institute (NIMRI), the Department of Molecular Biology and Biotechnology (DMBB) at UDSM, SUA, MUHAS, Ifakara Health Institute (IHI), Tanzania Food and Drug Authority (TFDA), Tanzania Bureau of Standards (TBS), Tanzania Pesticide Research Institute (TPRI), Animal Diseases Research Institute (ADRI), Kizimbani Research Station, Zanzibar, and Tanzania Government Chemist Laboratories Agency (TGCLA)(Mtui 2012).

These relevant ministries and competent Authority are responsible for follow up, supervision and controlling the application of the biosafety regulations. They make the review of different relevant applications or proposals for development, introduction, import, export, transit, contained use, release or placing on the market. They are supposed to do the risk assessments of GMOs or its products and advise the NBFP. They carry out inspections and other control measures to ensure compliance with the Biosafety Regulations (URT 2009). The competent authorities and relevant ministries work closely with the Institutional Biosafety Committee (IBC) on performing biosafety functions by way of providing review and consultation as well as advice on biosafety matters

- Institutional Biosafety Committee (IBCs)

The Institutional Biosafety Committees (IBC) includes institutions that are involved in the import, export, handling, contained use, release or placing on the market GMOs or GM products. The NBC has multidisciplinary teams whose roles and responsibilities include: Reviewing of the containment and confinement levels required by the Guidelines for the proposed GMO research, discussing of the ecological, economic and social impacts of the approaches to attain the purpose/objectives of the proposed GMO and other services and also to report to the relevant ministries/competent authorities for any significant GMO activities, problems with or violations of the regulations and any significant research related accidents and illness. Some of the functional IBCs are at MARI, NIMRI and DMBB-UDSM (Mtui 2012). The decision making structure of the NBFP is illustrated in Figure 2.
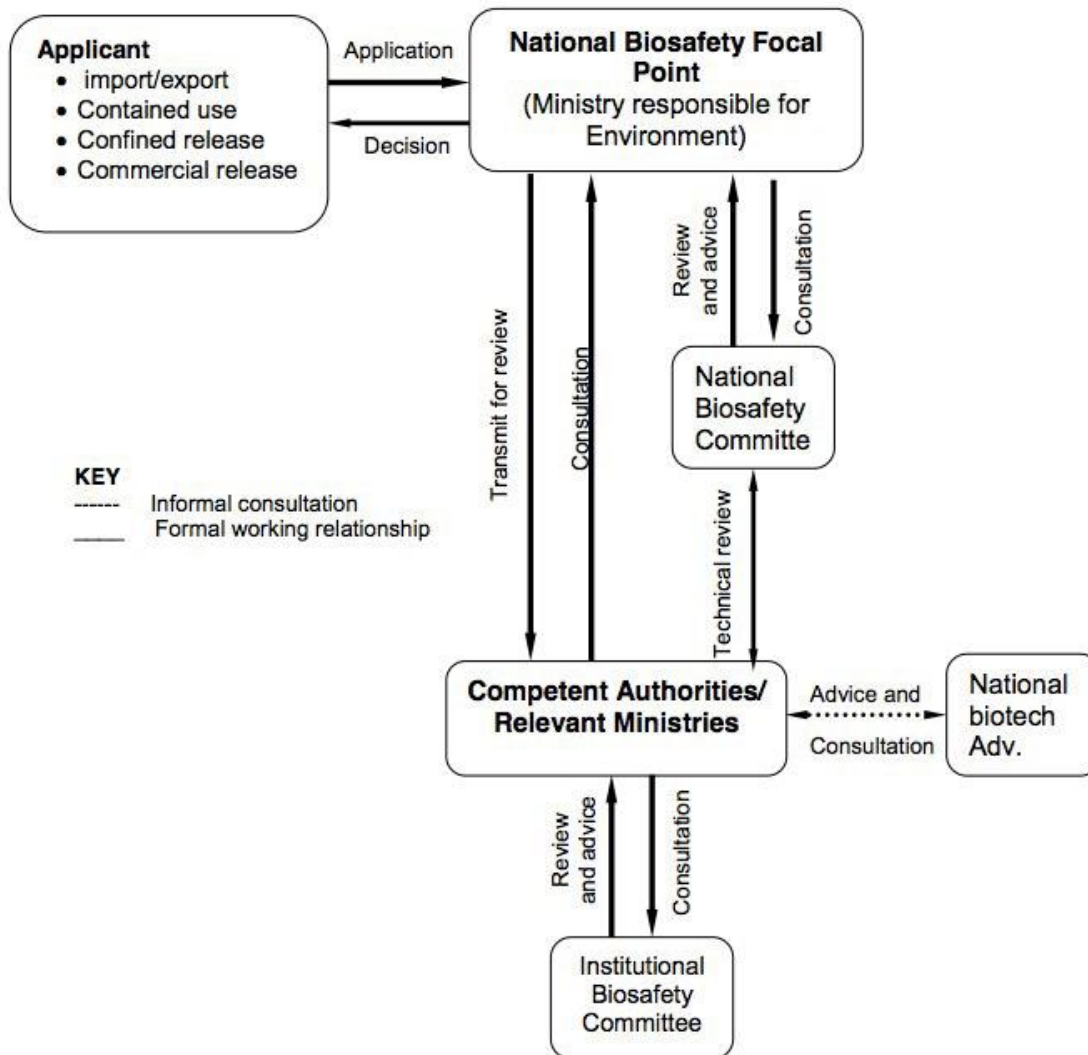
Figure 3: Decision making structure for GMO in Tanzania (Mugurusi and Mwinjaka 2006)

2.8.3   Biosafety regulatory regime

2.8.3.1   Environmental Management Act (2004)

The regulations that establish Tanzania's biosafety system are stipulated in the Tanzanian Environmental Management Act of 2004 (EMA 2004). This Act gives the legal and institutional framework for maintaining and also managing of the environment. The act outlines the principles for management, impact and risk assessments, prevention and control of pollution, waste management, environmental quality standards, public participation, compliance and enforcement; to provide basis for implementation of international instruments on environment; to provide for implementation of the National Environment Policy; to repeal the National Environment Management Act, 1983 and provide for continued existence of the National Environment Management Council; to provide for establishment of the National Environmental Trust Fund and to provide for other related matters (Pallangyo 2007). The Act further provides for the regulation of development, handling and use of genetically modified organisms and products thereof. It empowers the minister responsible for environment, in consultation with relevant ministries to make regulations, issue guidelines and prescribe measures for the regulation of the development, handling, and use and the importation and exportation of GMOs and their products. It is on the basis of EMA 2004 that the Biosafety guidelines should be established and made operational by the Minister for Environment (Mugurusi and Mwinjaka 2006).

2.8.3.2   Biosafety regulations (2009)

The biosafety regulations highlights the government's goal of promoting biotechnology in the country as highlighted by the Tanzania Biotechnology Policy of 2010, as well as the need to enhance biosafety as much as possible for the benefit of the present and future generations.

Tanzania biosafety regulation are operated under three main principle which are: Precautionary principle whereby the approval or refusal of the application to the use of GM product will depend on clear scientific knowledge and if there is no such knowledge then it is not the reason for not taking preventive measures. The second is the prevention principle, which involves risk assessment and environmental impact assessment, which are to be carried out so that decisions will be made under the informed choice. The third is the principle of strict liability whereby any party, dealing with the introduction of a GMO or GM products is

pronounced to be liable for any harm, injury or loss which will be caused by those GMOs and their products directly or indirectly (Mtui 2012).

The Biosafety Regulations 2009 are prescribed in ten parts as follows:

a) Part one explains on the preliminary provisions which includes citations of the regulation, its application, and interpretation of different terms which has been used in the regulations.

b) Part two explains on the general principles for the implementation of the regulations. The principles include precautionary principle, the principle of prevention and strict liability.

c) Part three explains for the administration and institutional arrangements which includes the establishment of the National Biosafety Focal Point, the NBC and IBC.

d) Part four explains on the approval of an activity. This part gives the provisions for notification and approval procedure for any dealings in GMOs and their products. It prohibits carrying out any activities on GMO without the prior written approval of the NBFP. It provides for the public awareness and participation and a duty to disclose certain information to the public.

e) Part five provides the provisions on risk assessment and decision making. It explains on the procedures of risk assessment by applicant, attributes of the risk assessment and decision making, evaluation of risk assessment report, risk assessment parameters, risk management schemes and the consideration of sustainable and safer alternatives

f) Part six provides for the with decision making procedure. It explains the decision making procedures , approval steps for the application, monitoring and evaluation process, the insurance against liability, the review of decision made, the process of the applicant to notify of new information, appeals to the Minister and appeals to the Committee.

g) Part seven provides for the risk management and this includes measures that may be imposed to prevent effects of GMOs and their products on human and animal health, biological diversity or the environment. It provides the measures on the unintentional release of GMOs and emergency measures, the procedures for notification of accident,

Identification and labelling of the GMOs, Documentation and identification of GMOs, confidential business information, adventitious activity, capacity building, export of GMOs and their products, export of banned GMOs or their product, and GMO food and feed assistance

h) Part eight provides for the aspects of liability and redress. It provides the explanations on operation the principle of strict liability, extent of liability for environmental damage, the liability of officer of corporation, the liability for socio-economic harm or damage, It also explains on the right of individual and legal persons to sue.

i) Part nine is provides on offences and penalties. It provides for the actions committed and their penalties. It includes loss assessed upon conviction, enforceability of judgment, liability of the employer, liability of the manager and community right for GMO free zone.

j) Part ten is on general provisions. It includes the provisions on Environmental Impact Assessment, Reporting procedures, Duty to keep records, Register of permits and licences, Register of permits and licences, Cancellation of permits or licences, general Fees, Operation of regulations, Guidelines, Amendment of schedules and transitional of provision.

2.9   Tanzania biosafety guidelines

The biosafety guidelines apply to the movement, use and commercial application of GMOs and their products. The guidelines gives preliminary provisions, general principles, administration and institutional arrangements, decision-making procedures and approval mechanisms, risk assessment and management, GMO transportation, liability and compensation, offenses and penalties, and general provisions (URT 2009). The biosafety guidelines also state that it is the right of individual and legal persons to seek compensation 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. Most of the provisions given in the Tanzania biosafety regulations are a reflection of the CPB provisions (URT 2009) The following are short explanations for the different guidelines from the Biosafety regulations (2009):

- In the risk assessment the guidelines explains all the procedures technical and non-technical for different data collections in identification of the possible risk all of the applications involving GMOs, their processes or products. The main objective of the risk assessment is to identify the potential adverse effects of GMOs which will lead to the potential risks on human and animal health, and to the environment.

- Under risk management, the guidelines provides all the procedures for regulation, management and controlling of the risk which has been identified in the risk assessment regarding the use, handling, introduction and field release of GMOs. Risk management is conducted in contained and confined procedures. The guidelines also provides the procedures and levels of physical, chemical and biological control for the 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 the monitoring and implementation processes, the guidelines define monitoring as a process of keeping track of activities to determine whether they meet the objectives. Monitoring is an on-going process meaning it is carried out before, during and after introduction of GMOs. Monitoring, inspection, enforcement and supervision are performed by the competent authorities under the NBFP. Monitoring is used to gather additional scientific data to assist the assessment of risk and decision-making

- Under socio-economic, cultural and ethical considerations, the biosafety guidelines also covers safety and non-safety issues which are related to the general release of GMOs and their products. Different issues such as intellectual property rights (IPR) like patenting of the biotechnology innovations, protection of indigenous varieties and traditional knowledge and biodiversity; implications of crossing with local varieties (GMOs contaminations), customer choices and contradictions to religious beliefs are all stipulated under this section.

- The biosafety also stipulates the procedures for the communication and public participation. These are regarded as the key to any successful safe development and application of biotechnology. The objective here is to educate and inform the public about biosafety processes and the risks, associated with the GMOs. Some of the

biosafety risk communication approaches explained in the guidelines include public notices in print and electronic media, scientific publications from expert groups and decision documents. Also as a rule, all GMO products should be labelled (URT, 2005a, b, c) (Mtui 2012).

Besides Tanzania having a very well explained and practical biosafety regulatory framework in place compared to the other East African Countries (Kenya and Uganda) it is shown to be lagging behind those two countries in processing the permits for GMOs research, import and applications. The speed in accommodating GMOs research, importation and applications is not clearly recognizable. These may be due to the lack of political will and doubts on the safety of GM technology. In addition, the strict liability section in the Tanzania biosafety regulations is frightening away the investors of GMO technology in the country except for the few which are on-going at present (Mtui 2012, Wafula 2013).

Being well explained also we want to know if all of the stakeholders understand and are aware with this explained biosafety regulatory framework. Stakeholders groups are being identified and explained in the next chapter.

CHAPTER THREE: STAKEHOLDER PERSPECTIVES ON GM TECHNOLOGY

3.1   Introduction

In this chapter, an introduction of what is stakeholder's analysis, definition of stakeholders; importance of stakeholders' involvement will be briefly described and concluded by the different stakeholders in Tanzania relevant for this research.

3.2   Definition of stakeholder

From different scholars the term stakeholders means many different things (Phillips, Freeman et al. 2003). But in the 80's according to Freeman (1984) stakeholders are any group or individuals who can affect or is affected by the achievement of the firm's objectives and may be either primary with direct impact or secondary (i.e. not directly involved but may indirectly influence the firm via primary stakeholders).

3.3   Stakeholders identification

Stakeholders' identification for any venture generally is founded on the impact and interest of those stakeholders from the project. (Polonsky 1995) explains that when determining the relevant stakeholder groups, it is important to consider both internal and external groups and the relationship they have with the firm. (Donaldson and Preston 1995) informed that, identification of stakeholder is based on definition "anything influencing or influenced by the firm". Identification of stakeholders is always followed by the differentiation and categorization of those stakeholders. Primary and secondary stakeholder groups have been distinguished by referring to the level of importance of the different groups for corporate goal attainment (Clarkson 1995). (Mitchell, Agle et al. 1997) in their article identified stakeholders by their possession or attributed possession of one, two, or all three of the following attributes: (1) Stakeholder's power to influence; (2) Legitimacy of the stakeholder's relationship, and; (3) Urgency of the stakeholder's claim. Other scientific literatures pointed out other several criteria which include the level of interest of a stakeholder in an issue, Attitudes of stakeholder towards a project, power of influence and the degree of impact of an issue on a stakeholder.

In the context of this research, potential stakeholders were defined as the actors who can influence and benefit from the GM technology and GM products. These GMO stakeholders includes Government which is responsible for making the regulations regarding GMO production and GM products and farmers and business operators who are responsible in

producing and bringing GM products to the market. Another group of stakeholders is the consumer's base as they are the buyers of the GM product. Following the interrelationship between stakeholders then it is important for all stakeholders to have enough and right information regarding GMO and GM technology.

3.4 Stakeholders analysis

Stakeholder analysis is an approach that can be used to understand and acquire knowledge about the different characteristics of the stakeholders in terms of their interest and influence and their interrelationships. It is a process that, first defines aspects of a social situation that can be affected by a decision or action. The situation may either be human, non-human or living objects. Second, it identifies individuals, groups and organisations that are affected by or can affect that part of the situation. Third, it explains priorities of these individuals and their involvement in the process of decision-making. Stakeholder analysis approach has been found to be important after the recognition of importance of stakeholder interaction and participation in the policy making, and project development (Reed, Graves et al. 2009). After identification of individual stakeholders it is also important to analyse the relationship between the stakeholders. (Reed, Graves et al. 2009) has defined the conflicts and coalitions between stakeholders and their objectives. Also the social network analysis have been described in (Prell, Hubacek et al. 2009) on how information which have been generated can be used to select stakeholders for participation. The social analysis can be used to identify the role and influence of stakeholders in the network.

From the study of (Hall and Martin 2005), they discussed about stakeholder ambiguity where they explain it as a situation where various stakeholders with different goals, demands and opinions understand the same situation differently. They argued that ambiguity can emerge when for example a technology is based on a new science that has yet to be fully accepted (e.g. biotechnology), or simply because stakeholders have irreconcilable differences based on ethical, religious, cultural or social issues.

For this study, stakeholders were identified and categorized based on institution networks that are Business, Policy and Societal Networks in which relevant stakeholders with different role, interests and influence are located to their respective network.

3.5 Stakeholders' interest and influence

In every single venture, there are categories of stakeholders which have different interests and influence which all these have to be explored. These influence and interests were determined during the empirical study. In this study for example the different stakeholders identified have different influence in GMO regulations compliance. This means that, each stakeholder groups around the industry have specific issues to deal with (Polonsky 1995).

The study of (Lewis, Newell et al. 2010), showed that farmers and business operators in Tanzania find GM crops attractive as it offers crops with higher yield and disease resistance crops that means lower cost-to-output ratio while for the government, genetically modified products should have been seen as a challenge for them in the protection of the environment and consumer safety, and for consumers they have to put up with the buying cost and quality products while their safety also it is a priority.

This chapter on stakeholder analysis was trying to explain about the analysis of the GM technology stakeholders. It was necessary to define and point out who are the stakeholders and what are their roles in the GM technology venture in Tanzania. In any business there are different stakeholders with different interests and influence.

The stakeholders in GM technology in Tanzania included government officials who were the key player as they were the once who makes the rules and regulation to govern GMO industry in Tanzania. The second stakeholders were business operators which included also the farmers, these were also important as they were the ones who are responsible on bringing the GM products in the market. The last group of stakeholders were the consumers, the consumers were very important as they are final in the chain. Their demand can trigger the business operators to or not bring the GM products in the market and also to or not to comply with the rule and regulation.

The next chapter will explain the results obtained after these stakeholders being interviewed on different aspects which included their awareness, understanding, accessibility and compliance to the GMO regulation

CHAPTER FOUR: RESULTS

This chapter presents analysis and findings of the study as set out in the research methodology. Descriptive analysis results regarding stakeholder's analysis on awareness, understanding, accessibility and compliance of GMO regulation in Tanzania are presented.

4.1   Awareness of stakeholders to GMO laws and regulations

4.1.1   Results on awareness of stakeholders

The results on awareness and understanding of stakeholders to the rules and regulation were explained by different questions, which include asking of stakeholders on their knowledge as well as judgement of the researcher according to the conversation made with the respondents during interviews. In addition, their perception on long-term effect of growing and consumption of GMO products was also used to test the awareness of respondents. Furthermore, awareness and understanding of the respondents was tested by asking the respondents whether they were aware of any unclear parts of the current GMO regulation that need much explanation as well as whether there was a much demand of GM food in the market.

4.1.1.1 The awareness of stakeholders to GMO laws and regulations

The study sought to establish the stakeholder's awareness on GMO laws and regulation. Indicators used to measure awareness include, knowledge of the stakeholder of existence of the laws and regulations and simple understanding of the content of the laws as well as its enforcement and compliance. The results are as shown in **Table 2**. On overall, majority of stakeholders (52.5%) showed a moderate level of awareness on GMO laws and regulations whereas 39% showed weak level of awareness. Also, more than 70% of consumers were seen to possess weak knowledge on GMO and its regulation whereas 30% of consumers had moderate awareness. Furthermore, most of Government officials (68%) were shown to have moderate awareness on GMO and its regulation. Regardless of showing moderate awareness on GMO its regulations among Government officials, a small proportion (16%) of them possessed both low and high awareness on GMO regulation. Similarly, most of business operators (64%) were shown to have moderate knowledge and small proportion (12%) possessed high knowledge and awareness on GMO as presented in **Table 2**.

Table 2: Level of awareness among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	n	%	n	%	n	%
Weak	21	70	6	24	4	16	**31**	**38.75**
Moderate	9	30	16	64	17	68	**42**	**52.5**
High	0	0	3	12	4	16	**7**	**8.75**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.1.1.2 Perception of risk and effect of GMO products among stakeholders

The stakeholders were asked to give out their opinion and the perception on the risks associated with long term effect of growing and consumption of GMO products as stipulated in the **Table 3**. The response tabulated below show that, majority of the stakeholders (80%) believed that GMO products might have long negative effects to human beings and the environment whereas 12.5% believed that there is no any risk associated with long term effect of GMO to human health and small proportion (1 %) of the respondents seems not to have any opinion about the risk and effect of long term effect of GMO products, they didn't show any knowing if there is or no risks associated with GMO. The results showed that, most of Government officials (88%) and consumers (86.7%) seemed to be much worried on the long term effect of growing and consumption of GMO products as compared to business operators (64%) **Table 3**.

Table 3: Awareness on long term effect of growing and consuming GMO products

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	n	%	n	%	**n**	**%**
yes	26	86.7	16	64	22	88	**64**	**80**
No	0	0	7	28	3	12	**10**	**12.5**
I don't know	4	13.3	2	8	0	0	**6**	**7.5**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.1.1.3 Existence of unclear parts of the regulation

The study also sought to find whether the stakeholders were able to mention the sections in the GM regulation that seemed to be unclear. The parts that were asked included, liability in case of committing a fault, regulation of crops in the field, consumers protection on GMO products, controlling trans boundary movement of GMO products, handling of GM seeds. The findings from this study revealed that 33.7% of the stakeholders do not understand the liability in case of committing a fault and what the regulation says on this act. Furthermore, 18.8% of the stakeholders particularly the consumers found that the regulation was unclear in the aspect of

consumer's protection on GMO products. Notably, no consumer mentioned that all the parts of the regulations are clear but the remaining stakeholders (13.8%) said the regulations were clearly stated as summarized in **Figure 4**.
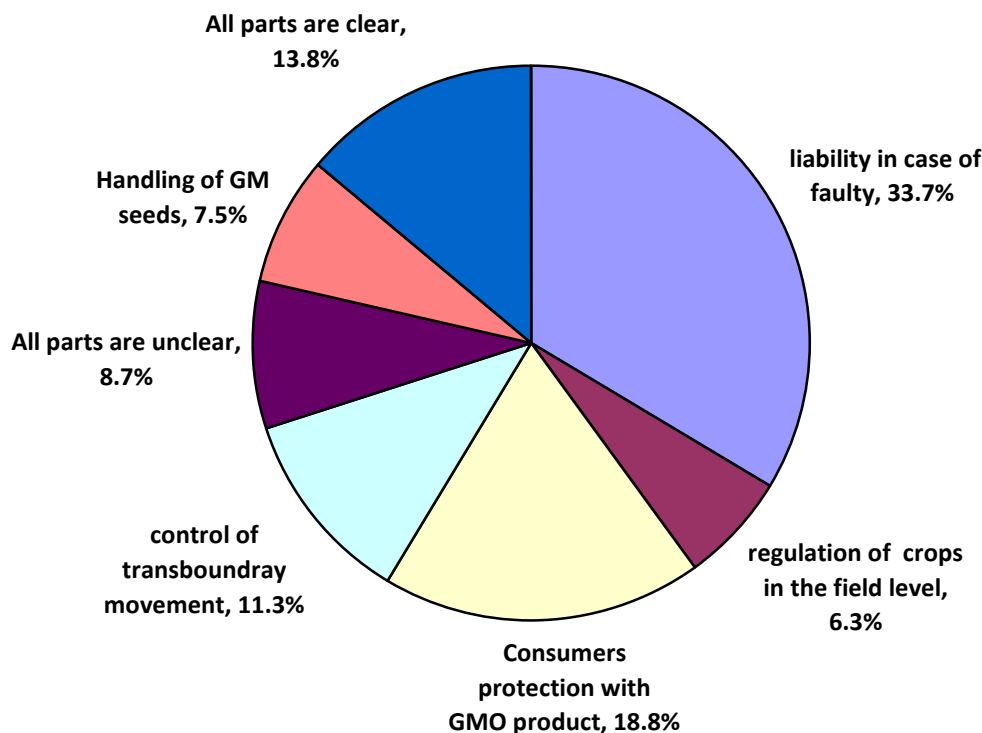
Figure 4: Stakeholders response to clarity of the regulations

4.1.1.4 Perception on the consumption of GM products

The stakeholders were asked to state whether they would consume GM food products when they were made available to the market. From the study findings, majority of stakeholders (55%) were ready to consume the GM food product when available in the market whereas 45% were not ready to consume the products. Furthermore, most of consumers (53.3%) and business operators (64%) were ready to consume GM products when were made available on the market while for government official more than half of them (52%) replied that they would not consume those GM products as summarized in **Table 4**.

Table 4: Perception on consuming of GMO products among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	**%**	**N**	**%**	**n**	**%**	**n**	**%**
Yes	16	53.3	16	64	12	48	**44**	**55**
No	14	46.7	9	36	13	52	**36**	**45**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.1.2   Discussion on awareness of stakeholders

Generally the study showed that majority of the stakeholders particularly consumers are unaware of genetic modified food technology and their considerable risks to human health. Similar to the present findings, previous study conducted in three regions in Tanzania also found lack of awareness and knowledge of GM crop technology and knowledge on its potential risks and benefits were very poor in all regions (Lewis, Newell et al. 2010). During this study it was revealed that lack of public awareness on GM technology have been attributed to negative attitude towards GM technology. This fact is also attested in a study conducted in Turkey that aimed to assess the attitudes of consumers toward the effects of genetically modified organisms (Oguz 2009).

Based on this study, it was shown that people were ready to consume GM products if they were made available to the market. As presented in the results, most of participants (55%) were ready to consume GMOs when available to the market. These results contradicts some observations form other literatures such as the study from Frewer et al. (2004) which explains that in a democratic society where people have the right of choices, people will not at least consume foods that they feel it in with some negative attribute. In this study, respondents had that opinion of the risks and long-term effect of GM products but they are still willing to consume if they were made available to them.

The contradiction of response among stakeholders between consumption of GMO food and long-term effect of GMO food is not clearly explained as many of the respondents they had the opinion that these GMO might have risks and long-term effects. However, from the study of Lewis, Newell et al. (2010) it was shown that the famers in Tanzania were willing to adapt the use of GM crops in farming believing that the technology will help on improving crop resistance to pests, disease, improving yields, taste and quality or nutritional value of food. The food insecurity observed in the country for recent years could be the possible reason that influences the stakeholders be willing to consume the GMO products when available in the market even if they might have the feeling that it has some risks. They would not worry much about the future rather than having enough food to feed them.

4.2   Accessibility of GMO rules and regulation to the stakeholders

4.2.1   Results on accessibility of GMO rules and regulation

The accessibility of rules and regulation were tested in different questions that included asking the respondents themselves if they think there is accessibility of the rules to the public, also the

sources where they get this information were asked to be mentioned. The results are explained in the subsequent subsections.

4.2.1.1 Accessibility of GMO rules and regulation to the stakeholders

The study required the respondents to state whether GMO regulation was easily accessible to the public. Data presented in **Table 5** shows that about 73.8% replied that the regulation were not accessible by the public. Also, the data showed that almost all stakeholders in the current study including consumers (96.7%), business operators (68%) and government officials (52%) showed inaccessibility of GMO regulation to the public. For the government official they also showed to have the impression that the regulations are accessible by the public as 42% of them they said it is accessible.

Table 5: Accessibility of GMO rules and regulations among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	n	%	n	%	n	%
Yes	1	3.3	7	28	12	48	**20**	**25**
No	29	96.7	17	68	13	52	**59**	**73.75**
I don't know	0	0	1	4	0	0	**1**	**1.25**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.2.1.2   Main sources of GMO information among stakeholders

The study also required the stakeholders to indicate the main sources where GMO information was obtained. As presented in **Table 6**, the mentioned sources of GMO information were Non-Government Organization (NGO), Public Medias, Government publications and Extension officers. Among all sources, government publication was mentioned to be the main source by more than 36% of stakeholders. Other sources were Public media (25%), NGO (33.7%) and Extension officers (5%). Conclusively, the main sources of GMO information were government publications and NGOs.

Table 6: Sources of information on GMO products among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	n	%	n	%	n	%
Public media	7	23.3	7	28	6	24	**20**	**25**
Extension officers	2	6.7	1	4	1	4	**4**	**5**
NGO	12	40	11	44	4	16	**27**	**33.75**
Government publications	9	30	6	24	14	56	**29**	**36.25**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.2.2 Discussion on accessibility of GMO rules and regulation

In the context of GMO regulation, the current study found that the regulation was not easily available and accessible to the public as admitted by most of the consumers, business operators and government officials. Alternatively, Non-Governmental Organization was found to be the most important source of GMO information. This sources might not be very liable than the government itself as the people might be getting wrong information according to interest of different groups (Frewer, Lassen et al. 2004). In addition, information from the government institution is more likely to suggest positive benefit of GM technology as compared to private sectors as they are more speaking on negative situations of GMO. The accessibility to the GMO regulation has been stated in the NBF of Tanzania as the main aspects to increase awareness of the modern biotechnology to the public.

4.3 The compliance of stakeholders to the existing policies, rules and legislation

4.3.1 Results on compliance of stakeholders to the existing policies, rules and legislation

The research sought to find out the compliance of stakeholders to the existing policies, rules and legislation. The compliance of stakeholders to the rules and regulation was explained by different questions, which includes asking of government officials whether the business operators were complying with regulation, also asking the stakeholders if they ever come across with the GM products in the market and how did they recognized it. The other questions that were used to explain the compliance in the current study was on the strictness of the rules and their implementation that includes monitoring and control practice. The findings are presented in the subsequent subsections.

4.3.1.1 Compliance of GMO rules and regulation according to the government officials

In the current study, majority of Government officials whom were asked if they think that there is compliance to the GMO regulations in the country (96%) testified that there is high compliance while small proportion (4%) said that the compliance was low.

4.3.1.2 Availability of GMO products in the market

The study asked the stakeholders if they ever come across with the GM product in the market. From the study findings, majority of stakeholders 42.5% have never come across GM products in the market, (28.8%) found GM products in the market and (28.8 %) were not sure whether the product were in the market or not as shown in **table 7**. The respondents who said they came across with the GM products was later asked on how they recognized the products they all replied by reading the labels from the product.

Table 7: Availability of GMO products in the market among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	n	%	n	%	n	%
Yes	12	40	5	20	6	24	**23**	**28.75**
No	4	13.3	16	64	14	56	**34**	**42.5**
I don't know	14	46.7	4	16	5	20	**23**	**28.75**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.3.1.3 Strictness of the GMO rules and regulation

The study also asked the stakeholders to give their opinion on the GMO regulation implementation in the country. Majority of stakeholders (78.8%) were satisfied with implementation of GMO regulation, while 21.3% were not satisfied and small proportion (6.9%) knew nothing. Notably 40% of consumers and 20% of business operators said the regulations were not strict enough. All the government officials had a feeling those GMO regulations strict enough and well implemented.

Table 8: response on implementation of GMO rules and regulations among stakeholders

	Consumers		Business operators/Farmers		Government officials		Total	
	n	%	N	%	n	%	n	%
Yes	18	60	20	80	25	100	**63**	**78.75**
No	12	40	5	20	0	0	**17**	**21.25**
Total	**30**	**100**	**25**	**100**	**25**	**100**	**80**	**100**

4.3.1.4 Monitoring and control practice

The government officials from VPO were asked if they do any monitoring and control practice to check for the GMO products in the market and most of them (96 %) said that for the time being there is no monitoring and control done in regards of GMO products. They explain more that they are not doing the monitoring and inspection for the GMO products in the market as they are other institutions such as TFDA, TBS and others that are doing inspections for the food and medical products, in which if they encounter with any GMO products they will report to them which there is no any case have been reported to them until that time. For the other government officials from other institutions such as TFDA and TBS they said they do inspections for all of the food products in the market and for the GMO products they have to get the permit from the VPO-DoE. They are not concentrating much on GM products, as they are not mandated to do that. It is the responsibility of the VPO and their associated department to monitor and inspect these GMO products.

4.3.2 Discussion on compliance of stakeholders to the existing policies, rules and legislation

In regard to the government officials the compliance of business operators to the GMO regulation was shown to be high. The government officials explained that until now there were no any GMO products introduced in the market. They believe that the regulations concerning GMO activities in the country are strictly enough and well implemented except with few setbacks such as lack of expertise and equipment's for better enforcement of the law. From the consumer group and business operators the findings showed that most of them were satisfied with the implementations of the GMO regulations especially the implementation of the strict liability part of the biosafety regulations. In contrast to some of the consumers and business operators whom said that the regulations are not strict enough and not well implemented. They discussed this in a context of the seen GMO products in the market. In the study where we saw that there was no monitoring and control practices done with regards to the GMO products in the country might be the reason of belief from the government officials that the GMO products

are currently not in the market. In regard to this, the Government might be trying to create an image to the people believed that, the existing GM laws and regulation are very strict which prevent the business operators to introduce the GM product in the market without being aware that the GM product is still in the market. The result of this study failed to provide clear explanation on the availability of GM product in the market and compliance among business operators as some of consumers reported to find GM product in the market. The reason could be due to lack of monitoring and inspections from the responsible office.

4.4   Summary

This chapter has presented the results and discussion of the study in line with research questions and made a comparison with the findings of other studies in order to find the consistency or controversy between the studies. The research questions that were answered in this were stakeholder's analysis on awareness, understanding, accessibility and compliance of GMO regulation in Tanzania. According to the results as presented in this study, most stakeholders were found to be unaware of GM technology and the regulations covering it. The results further showed difficulty in availability and accessibility of GM regulation to the public. The study finds that the compliance to the GMO regulations seems to be uncertain. The present of the GMO products in the market and the absence of the monitoring system from the respective office does not guarantee the compliance of the regulations in the country while the strict liability part in the biosafety regulations explain for the strength of the management of the GMOs in Tanzania.

CHAPTER FIVE: RECOMMENDATIONS AND MEASURES NEEDED WITH RESPECT TO A DISCERNED RESULTS OF AWARENESS, ACCESSIBILITY AND COMPLIANCE TO THE STAKEHOLDERS

5.1 Lack of awareness and understanding of the rules

Results from this study have revealed that there is low awareness and understanding to people on the rules of GMO and GM technology thus responsible organs such as the government and its stakeholders should devise some of strategies to ensure that information on these rules is made public and available to the general population and government officials. It is very crucial to involve a wide range of stakeholders through a consultative process in order to promote and facilitate public awareness and public participation. The following are the recommended strategies from the study:

- The government should collaborate with other key stakeholders such as NGOs and media as well as conducting regular stakeholder consultative workshop and meetings in order to create awareness to the public in GMO issues including the technology and regulation covering it.

- In a bid to improve the current situation where there is low awareness and understanding of the regulations, it is recommended that the regulations and guidelines should be translated into simple language specifically in Swahili(National language) as for now the regulation are only written in English.

- The government should utilize agriculture extension officers to raise awareness and understanding regarding GM technology and the regulation managing it by provision of accurate and objective information. However, these extension officers should be trained on GMOs and GM technology. This would then enable these officers to provide accurate information to people concerning the risks and benefits of the GM technology and also the regulations, which will allow them to make informed decisions about the use of GM crops.

5.2 Lack of accessibility of the rules

This study has revealed that the accessibility to the GMO regulations in Tanzania is very low and for the few who can access it they get it mostly through NGOs and media. Therefore there is a need to expand the accessibility by implementing the following recommendations:

- Increase the cooperation of the responsible institutions, and government agencies, NGOs and media in order to reach many people with the information on GMO and work hand in hand to provide education and awareness to the people.

- The government and relevant institutions should also ensure the availability of all documents such the Tanzania Biosafety regulation 2009, guidelines, application forms, and others to improve efficiency in the delivery of services and enhance compliance to legal requirements. Furthermore, accessibility should also be increased by preparing fliers and posters also post in different websites details in GMOs, GM technology and their regulations.

5.3   The compliance with the GMO regulations

The results from the study have shown that there is uncertainties in the compliance with GMO regulation in the country, as there are some GMO products which have been found in the market and also the monitoring and inspections is not done by the respective office which is VPO-DoE. With these results then the study recommends the government to implement the following measures to enhance the compliance:

- The VPO-DoE which is responsible for the management of GMOs in Tanzania have to set an effective working monitoring and control system for the GMO products. They have to ensure that they work hand in hand with the other institutions which are responsible for the control of the food products in the market.

- The government should build capacity through the Vice President's Office – division of Environment (VPO-DoE) who are responsible in regulating GMO. Currently, this division has no enough expertise and equipment to test GMO. It has to train more expertise and add more advanced equipment's to add on GM technology field. This will help the division to undertake all the important activities for the better enforcement of Biosafety regulations

- There is a great chance that GM product might be imported in Tanzania from different countries as the borders are porous, the government has to make sure that the borders are well protected. The strong system of monitoring and control should be kept in place along borders.

- The strict liability part in the regulation is the important part as it makes the business operator to be afraid on bringing these GM products on fear of being liable in case anything happens. The government should not think of removing that part for the time being as they still have no enough capacity for the enforcement of biosafety regulation in terms of experts and equipment's.

CHAPTER SIX: CONCLUSION

6.1 Rules and regulations governing GMO in Tanzania

The rules and regulations that govern GMO is the Environmental Management (Biosafety) Regulations 2009. The biosafety regulation includes all the measures for dealing with the GMOs and procedures that cover applications for the testing, risk assessment, release and commercialization of GMOs and also include the liability for any damage which can be caused by GMOs. Biosafety regulation have implemented a strict liability approach where by whoever introduces the GMO will be inevitably liable for any damage caused to human and environment. From the literatures the strict liability part in the biosafety regulation is said to be the hindrance factor for the development of GM technology in the country as the GMO dealers are not willing to sign that part of being liable for any damage cause which is also bring questions why are they not ready to take that liability part, is there anything wrong with these GM technology.

For the time being, this strict liability part is seen to be very important as we have seen the country has very low capability for policing and enforcing regulations relating to GMOs, which might because of its large area (945,087 sq.km including 61,000 sq. km of inland water), porous borders, lack of GMO testing equipment and also shortage of expertise. Therefore the strict liability approach is believed to be more easy to enforce and also feasible to implement.

6.2 The awareness and understanding of stakeholders to GMO laws and regulations

The genetic engineering technology is a relatively new technology in developing countries of which there is little public awareness on the technology in general and the rules and regulation covering it. The results and findings obtained from this study have shown that there is very low knowledge and awareness in GM technology and its regulation. Public is not aware on what GMO really is, they just heard as an advanced technology to solve different problems in crop production to produce high quality foods.

The study also found that people were ready to use GMOs as they seem to be interested in crop that might grow better and have more food for their families or for their business. For the farmers they are interested in crops that will be resistant to disease and pests, which mean that there will be an increase in crop yield. Some stakeholders had the feeling that there might be risky and long-term effects on GM products but they still say they will consume the products

if they were made available to the market, as they want to make sure they have enough food and they never care about the future.

6.3   The accessibility of stakeholders to the GMO regulations

The study concludes that the accessibility of people to the GMO rules and regulation is very low. The public have no access to this information as there are no enough efforts done to avail the information to the public.

People who have this information mostly get it through NGOs; this might be due to lack of adequate transparency of government on the issues concerning GMO. The government does not publish much information on GMO. The government maintains a position that GM technology is not yet in the country. The only organisations that provide information on GMO in a transparent way are those private sector which sometimes oppose the use of GMO, so they have to speak out to make people say no to the GM technology

The media are another source where people get information concerning GMO issues. However, information provided by the media depends on the time the issue happened after that that there is no continuing of the information.

6.4   The compliance of stakeholders to the existing policies, rules and legislation

The study has shown that there might be chances of non-compliance to the GMO regulations as there is enforcement of regulations is still not strong enough, which includes monitoring and control systems. The non-compliance to the regulations has been seen in a way that there are some found GM products in the market and have been recognized by labels. These products might be introduced in the country through the various borders that Tanzania have.

6.5   Policy option

As explained in the previous section, following the growing of GMO products in Tanzania, the government through the Vice President's Office – division of Environment (VPO-DoE) developed the biosafety regulations to manage their application. The regulations are still at the infant stages, as GMOs issues in the country are not yet commercialized. Currently the biosafety regulation shows to cover all of important parts for the regulation of GMO however there is a lack of implementation and enforcement. This might be due to lack of expertise and equipment on the GMO area. Also the regulatory framework might be a little weak and insufficient in a way that there are so many different institution which are in charge of regulating the GMO such as Vice President office division of Environment which is

responsible for the application then there it gives the mandate to other institutions such as TFDA, TPRA and other many more to continue for the risk assessment and other measures. This is seen as a big challenge because there are so many institutions to be involved whereby there were could be only one institution which will be dealing with only GMOs in the country.

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APPENDICES

Appendix: 1

a) INTRODUCTION AND RESPONDENTS' PROFILE

  i.   Respondents Name:
 ii.   Organisation:

iii.   Occupation:

iv.   Location:

 v.   Source of food products

Supermarket	
Open market	
Other sources; please specify	

These types of question will be asked to get the general overview from the respondents, means what kind of the respondents you are having for an interview. You want to know the organisation where the respondent come from will help to have the picture on what kind of organisation are dealing with GMO, also you want to know if the respondent is a farmer or is only the business operator for GM crops. For the government officials you want to know which department is working on and also to which position, which will help the study to get the details on how much these government with different positions are aware and to what extent they do understand the rules. With the consumers, we want to get general overview on the respondents. We want to know the organisation and occupation that will help to know the knowledge capacity and the general perception on the use of GMO. In addition, we want to know the location where the respondent come from, if it is in town or in rural areas where the chance to encounter with the GM products differ strongly. Also the shopping places of respondents will give the difference as many of GM products will be in large shops and also in supermarkets while few of them in open market.

A.   Respondent's awareness and knowledge of GM technology

i.   Have you heard of Genetically Modified organisms? …………….

By asking this question you get to know if the respondents have knowledge on GM crops or they might not having an idea of what it is, and through this they might be practising GM technology without knowing or knowingly. To start with the research study the respondent must be aware on the subject (GMO).

If yes, how did you hear about them? ………………………………..

This kind of question want to know where exactly the respondents got their information and through this we can establish the ground that which source are more easily to be accessible for the GMO information and if also checking on the liability of the source.

ii.   What is your understanding of the term Genetically Modified technology or Genetically Modified crops?
    ....

With question, we want to get the general overview of the stakeholders on understanding the real meaning of GM technology. This will help the study to the context of the consumer understanding of GMO.

iii.   Do you know whether GM crops are used in farming practice in Tanzania?
    ....

This question will be asked to get details on whether the stakeholders are aware on the GM technology practices so that we know if the respondents are aware or they might be practising GM without even knowing taking into account that GM technology is still new in Tanzania

Also the question was asked to know if the stakeholders were aware on the on-going GM practice in Tanzania (confined trials). This will help the study to establish the relationship on the awareness of the stakeholders to GM practice in Tanzania.

iv.   Where did you get the information about the GMO? (Public media; Agriculture extension officers; NGOs; workshop, OTHERS)………………………………….

To this question, we want to know where most of the people get information and if they get correct information. Do they get information from government officials, private organisations or from just anybody? This will help in the research study to establish the context on where the information is more accessible to the people.

v.   Would you consume GM products if they were available in the market? YES/NO

The question was asked to see the perception of different stakeholders on GM products. We wanted to see on the point of business operators if they feel that they will benefit more from the technology or not. This is because the farmers and business people always look to benefit from their product.

And also to gain insight on how the government perceive its people attitude towards the consumptions of GM products. This will help to know the government strategies to ensure the

availability of the information concerning GMO to its people and the effort of the government authority to make people aware on the technology.

Also we wanted to get the general perception of the consumers on GM products. If the consumers understand GMO and how the practices are taking place then what would they decide on purchasing of the products

    vi.   Do you think it's risky to consume GM foods or use GM products? ....

    vii.   Do you know the impacts or effects (negative and/or positive) of using GM products in the country? YES/NO

With these two questions the study wanted to get the details if the stakeholders have doubts on the safety of GM products, and what are their doubts and also how do they perceive the risk. To know if the consumers have second thought that there might be long-term effect on GM products

And also the study wanted to know if the government have some safety doubts concerning GMO. This will help to understand the extent of the enforcement of the regulation by the government.

    viii.   Do you think there might be GM products in the market? ....

    ix.   Have you ever found any GM products in the market? YES/NO

With the first question, we wanted to know if consumers are suspicious about GM products being in the market already. And for the second question the study wants to get the assurance from the respondents if they have ever come across with GM product. This will add to the knowledge of compliance of the stakeholders

      If yes, how did you recognize them? ....

To this question, we want to know if the consumers have already found GM products in the market and how did they know that it is a GM product. This will be the results of incompliance to the regulations.

    x.   Are you aware of existence of GMO regulations in the country? ....

To this question, we want to know if the respondents besides of being aware on the GM technology are they aware also on regulations guiding their use. This may come to the point that sometimes people might be aware on GM crops and may be also practising it or would like to practice it but they are not aware on the regulations that govern their applications which lead to their incompliance.

B.   Respondents accessibility to the rules and regulations governing GMO

i. Do you think it is important to regulate GMO? ....

To this question, the research study wanted get an overview of opinion from stakeholders on how they perceive the issue of GMO and if they think it's necessary for them to be regulated. This will add to the awareness on the GMO issues.

ii. Are the GMO regulations clearly explained and easy to understand by common people?............

With this question, we want to know if the stakeholders understand the regulations governing GMO in a country.

iii. Are there any particular aspects of the regulations you consider to be confusing or unclear?................. If so, what are they?...

To this question, we want to get the general aspects if regulations seem to be clear or confusing to people. This might be interfering with their compliance and also will help us to know their understanding to the regulations.

Also to this question we wanted to get insight if they understand the regulations and they have specific parts that they think they are confusing, this will help the government to reconsider the parts that have been seen more confusing to the stakeholders

iv. Do you think it's possible for farmers and business operators to get the regulations at any time they need?...

v. Do you think GMO regulations are available to public?..

With these two questions the study wanted to get insight from the stakeholders if they feel that the regulations are easily accessible when there is a need of it. This will help in terms of knowing the extent of accessibility of regulation to the stakeholders (public)

C.   compliance of stakeholders to the rules and regulation governing GMO in the country

i. Is there any case recorded of offender to the regulations of GMO in Tanzania? ....

With this question the study wanted to establish the ground of the compliance to the GMO regulations. We wanted to know the number of the cases and establish the context of compliance in the country. If there were high number of cases then the non-compliance could be high and the same applies to the low number of case where the non-compliance could be low.

ii. Is it easy to comply with the GMO regulations? ....

iii. Do you think the GM business operators do comply with the GMO regulations?

With these two questions we wanted to know if the stakeholders have different opinion on the compliance of the regulation. If they feel the regulations are easily to be complied with or it's difficult. And this is especially to the business operators on GM technology. And also we wanted to know their opinion if they have that confidence that the business operators are complying with the regulations.

    iv. Do you think the government is capable for controlling, monitoring and inspecting GM food, food and business operators?

    v. Is there any monitoring or inspection conducted on GM business operators?

With these two questions we want to get an idea of the enforcements for the compliance by the government by controlling the market on GM product.

    vi. Do you think the GM regulations are effectively enforced and implemented to ensure human health and environmental protection?.........

To this question, we want to have an overview of the government on the regulations governing GMO. Are they strict enough for the protection of the environmental safety and human healthy, or there is a need to change some parts of the regulation for better control. This will help to the study on establishing to what the government is doing to make people comply with the regulations.

    vii. Do you think that the GMO regulations are in favour of the consumer? ....

This is to know if the consumers are confidently enough to the regulations, believing that the government authorities work enough to protect for their safety

Appendix 2

QUESTIONS LIST FOR CONSUMERS/BUYERS, GOVERNMENT OFFICIALS DEALING WITH GMO, AND FARMERS/BUSINESS OPERATORS OF GM PRODUCTS

b) INTRODUCTION AND RESPONDENTS' PROFILE

vi.   Respondents Name:

vii.   Organisation:

viii.   Occupation:

ix.   Location:

x.   Source of food products

Supermarket	
Open market	
Other sources; please specify	

A. *Respondent's awareness and knowledge of GM technology*	1	2	3	4	5
Have you heard of Genetically Modified organisms? ……………. If yes, How did you hear about them?………………………………..					
What is your understanding of the term Genetically Modified technology or Genetically Modified crops?..					
Do you know whether GM crops are used in farming practice in Tanzania?..					
Where did you get the information about the GMO? (Public media; Agriculture extension officers; NGOs; workshop, OTHERS)……………………………….					
Would you consume GM products if they were available in the market? YES/NO					
Do you think it's risky to consume GM foods or use GM products?..					
Do you know the impacts or effects (negative and/or positive) of using GM products in the country? YES/NO					
Do you think there might be GM products in the market?..					
Have you ever found any GM products in the market? YES/NO If yes, how did you recognize them?..					
Are you aware of existence of GMO regulations in the country?...					

B. *Respondents accessibility to the rules and regulations governing GMO*	1	2	3	4	5
Do you think it is important to regulate GMO?...					
Are the GMO regulations clearly explained and easy to understand by common people?............					
Are there any particular aspects of the regulations you consider to be confusing or unclear?................ If so, what are they?...					
Do you think it is possible for operators (farmers and business) to comply with the regulations?.....					
Do you think it's possible for farmers and business operators to get the regulations at any time they need?..					
Do you think GMO regulations are available to public?...					

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	1	2	3	4	5
C. *compliance of stakeholders to the rules and regulation governing GMO in the country*					
	1	2	3	4	5
Is there any case recorded of offender to the regulations of GMO in Tanzania?............................					
Is it easy to comply with the GMO regulations?...					
Do you think the government is capable for controlling, monitoring and inspecting GM food, food and business operators?					
Is there any monitoring or inspection conducted on GM business operators?					
Do you think the GM business operators do comply with the GMO regulations?					
Do you think the GM regulations are effectively enforced and implemented to ensure human health and environmental protection?.........					
Do you think that the GMO regulations are in favour of the consumer?...................................					

Appendix 3

Names and addresses of the respondent

	Consumers
	Tanzania Consumer Advocacy Society E-mail; bernard@tcas-tz.org www.tcas-tz.org
1	Salum Bakari Mgwende
2	Hemedi Selemani Mzurumbi
3	Salehe Salum Kiwato
4	Salum Hassan Mbonde
5	Mzee Sefu Mperi
6	Mussa Omari Mzurumbi
7	Yusuf Saidi Mavue
8	Hamidu Yusuf Jongo
9	Juma Saidi Mzome
10	Selemani Saidi Mwela
11	Athumani Bakari Maramoja
12	Leyla(lydia) Salehe
13	Paulina Mbelwa
14	Abdulrahman Ally Katundu
15	Juma Hassan Kazenga
16	Saidi Mohammed Mavue
17	Salum Saidi Mavue
18	Maulidi Nasoro Ambali
19	Ally Sefu Mzome
20	Ramadhani Juma Korosheni
21	Omari Abdallah Katundu
22	Amina Ally Ulingano
23	Juma Juma Mkenge
24	Hamida Mohammed Kalota
25	Shabani Sefu Mzome
26	Ramadhani Mohammed Chawaka
27	Ngarambe Ally Ngarambe
28	Selemani Ramadhani Jongo
29	Mohammed Saidi Mavue
30	Abdallah Saidi Mavue

Business operators/farmers

P.o Box 70089, Dar es salaam
Old Post Office Building, Sokoine Drive,
First floor, Room 07.
Telephax: +255 22 2124441
E-mail:TanCert@TanCert.org
website: www.tancert.org

1.Ally Sultani K
2.Saidi Mohamed
3.Athumani Ally
4.Ibrahim Omari
5.Mohamed Kassim
6.Miraji Hija
7.Kassim Ally
8.Mzee Athumani T
9.Rashidi Sultani Mkinga
10.Ally Hatibu
11.Mtaala Katundu
12.Mohamed Raja
13.Selemani Sultani
14.Shabani Kondo
15.Rajabu Hija
16.Omari Saidi
17.Mussa Ambali
18.Shaha Saidi
19.Omari Selemani
20.Halima Shabani
21.Zeituni Muhua
22.Saidi Aley
23.Abdallah Juma B
24.Hamisi Saidi
25.SelemaniNyambi

Government officials

1.Rwelengera Mugyabuso Environmental officer VPO.doe
2. Gaudens Masebe Extension officer Ilala municipal council Dar es Salaam
3. Abdul Ruta Tanpro Investment Ltd Temeke Municipal council Dar es Salaam
4.Frank Msigwa Horticulturist Ilala Municipal council Dar es Salaam
5.Jacob Maisel Vicfish Ltd… Quality Assurance Manager Dar es salaam
6.Natujwa Mellau Kinondoni Municipal council Extension officer Dar es Salaam
7. Omar Mussa Othman Agronomist Temeke Municipal council
8. S.Axmann Kimango Farm E Agronomist Da es Salaam
9. Richard James Bliault. Local Area Sustainability Manager Dar es Salaam
10. Lusajo Ambakalile Agronomist Temeke Municipal council
11. Neema Mwifunyi Extension officer Ilala municipal council Dar es salaam

12. Ramadhani Mohamed Kinondoni Municipal council Extension officer Dar es Salaam
13. Ally Ally Njechele Environmental officer VPO.doe
14. Rajabu Athumani Mussu Environment officer VPO
15. Haruna Rashidi Luhombo Enviroment officer Ilala municipal council Dar es Salaam
16. Yusuf Hassan Seif Agronomist Temeke Municipal council
17. Jihadhari Mohamed Extension officer Ilala municipal council Dar es salaam
18. Nasoro Iddi Puga Environment officer VPO
19. Ramadhani Mohamed Horticulturist Temeke Municipal council Dar es Salaam
20. Hasan Mohamed Mikocheni Agricultural Research Institute Dar es Salaam
21.Ramadhani Abdallah Mikocheni Agricultural Research Institute Dar es Salaam
22.Abdallah Juma Puga Environment officer VPO
23.Jumbe Jumbe TFDA Dar es Salaam
24.Rhoda Kidolezi

TFDA
Dar es Salaam

25.Abdallah Mkanza
TFDA
Dar es SAlaam