THE IMPACT OF THE OPEN FORUM ON AGRICULTURAL BIOTECHNOLOGY KENYA CHAPTER ON STAKEHOLDERS' KNOWLEDGE, ATTITUDES AND PRACTICES TOWARDS GENETIC MODIFICATION IN KENYA

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THIS THESIS IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

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DEDICATION

I dedicate this thesis to my late parents Mr. Laban Nelson Odhong' Adoka and Joyce Lorna Odhong'. Thank you for placing me on the right path to success in life through academic acheivements! I also dedicate this thesis to my loving wife Dorsila Carolyne Ngu'ono Odhong' and my son Christian Pasaka Mor Odhong'.You are both the motivation I needed to keep pressing on to the finish line.

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ABBREVIATIONS AND ACRONYMS

AATF – African Agricultural Technology Foundation

CBD – Convention on Biological Diversity

DNA - Deoxyribonucleic acid

GM – Genetically Modified

GMOs – Genetically Modified Organisms

ISAAA – International Service for the Acquisition of Agri-biotech Applications

KARI – Kenya Agricultural Research Institute

KEBS – Kenya Bureau of Standards

KEPHIS – Kenya Plant Health Inspectorate Services

NBA – National Biosafety Authority

OFAB – Open Forum on Agricultural Biotechnology

SASHA - Sweetpotato Action for Security and Health in Africa

TAM – Technology Acceptance Model

VIRCA – Virus Resistant Cassava for Africa

WEMA – Water Efficient Maize for Africa

ABSTRACT

Kenya is moving closer to commercializing its first genetically modified product – Bt cotton in 2014/2015. It is therefore very important for stakeholders to have credible and scientifically sound knowledge and information about genetic modification. This will enable them to make informed decisions about the safe use of genetically modified products. It is this role of empowering stakeholders with sound scientific information about genetic modification that OFAB Kenya Chapter considers as its primary mandate.

In the study, we have usedthe diffusion of innovations theory and the Technology Acceptance Model in the formulation of the theoretical framework to support our analysis and interpretations. The study has primarily investigated whether there are any knowledge, attitudinal and practical differences towards genetic modification between stakeholders who attend OFAB Kenya Chapter meetings and those who don't.

Using the purposive sampling technique, we sampled a total of 95 respondents (48 OFAB attendees and 47 non-attendees) to generate our primary data through self-administered questionnaires. The collected data was cleaned, coded, input into a computer and analyzed using the Statistical Product and Service Solutions (SPSS) to generate frequencies, percentage distributions and cross tabulations used in our analysis and intepretations in our findings.

The study found that stakeholders who attend OFAB were more knowledgeable about genetic modification and therefore were generally more accomodative of using genetically modified products. Through this study, the OFAB Kenya Chapter has illustrated the merit of having knowledge sharing and awareness creation platforms when it comes to influencing stakeholder's knowledge and attitudes about new agricultural technologies like genetic modification. The government and other development agencies therefore, need to offer more support for expansion of initiatives that are already delivering like the OFAB Kenya Chapter. They can also alternatively create vibrant and complementary agencies and forums that can operate across the country to ensure that all the stakeholders and the consumers are informed of genetically modified products when they finally get to the market.

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CHAPTER ONE
THE OPEN FORUM ON AGRICULTURAL BIOTECHNOLOGY (OFAB) IN KENYA: AN OVERVIEW

1.1 Introduction

Biotechnology is defined in the UN Convention on Biological Diversity (1992: 3) as any technological applications that use biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use. Agricultural biotechnology therefore; refers to the application of biotechnology to improve specific aspects of livestock or crops production. Because of the technical nature of the science involved in agricultural biotechnology, certain specific aspects of the technology like genetic modification are usually misunderstood and regarded suspiciously by stakeholders (potential consumers of genetically modified products). There is therefore, an obvious knowledge gap when it comes to agricultural biotechnology as a whole and more specifically genetic modification. As a consequence various platforms have been established in Kenya to bridge the knowledge gap on agricultural biotechnology. One such forum is the Open Forum on Agricultural Biotechnology (OFAB) Kenya Chapter.

The Open Forum on Agricultural Biotechnology in Africa (OFAB) Kenya Chapter was initiated in 2006 as a platform for knowledge sharing on all aspects of agricultural biotechnology (Karembu et al, 2012: 22). The forum, which is open to all members of the public, attracts participation by individuals from various professions including; Government Officers, Journalists, Policymakers, Businessmen, Students and Scientists for frank discussions about the applications of agricultural biotechnology. Fundamentally, OFAB aims to enhance knowledge sharing and awareness that will raise understanding and appreciation of aspects of agricultural biotechnology like tissue culture, marker assisted selection and genetic engineering with the end goal of building an enabling environment for informed decision-making process among the participating individuals about the technology (Karembu et al, 2012: 22). The forum, which was initially started in Kenya, has now expanded to five other African countries including Egypt, Ghana, Nigeria, Tanzania and Uganda.

OFAB Kenya is the pioneer Chapter of the OFAB model in Africa. The forum is currently hosted under a collaborative agreement between the International Service for the Acquisition of Agri-biotech Applications (ISAAA), AfriCenter and the African Agricultural Technology Foundation (AATF). ISAAA coordinates the activities of the OFAB Programming Committee, manages the monthly events and packages the presentations into information briefs and reports while AATF facilitates the forum's meetings by providing the venue and refreshments as well as facilitating operations of the Programming Committee and resource persons (Karembu et al, 2012: 22).

OFAB usually has ten sessions in a year, which are held on the last Thursday of every month between 12:00 am – 2:00 pm at a designated venue – mostly the Nairobi Safari Club. Participants at the forum are usually informed via email about the venue and topics of discussion for the upcoming meetings (Karembu et al, 2010: 1). The forum usually attracts an average attendance of 60 members. Speakers at the forum are usually invited by the Programing Committee, which is composed of volunteers from the media, government and scientists with interest in agricultural biotechnology awareness creation. To promote further awareness and knowledge about aspects of agricultural biotechnology, OFAB Kenya Chapter also carries out additional activities like guided tours, visits to GM crop trial sites, biotechnology communication training workshops and seminars as well as production of agricultural biotechnology Information Education and Communication (IEC) materials.

1.2 Statement of the Problem

Genetically modified foodstuffs enterred the global food system in the mid-1990's and are now in a wide selection of raw and processed foods. Since their introduction over a decade ago, they have become a subject beset by controversy, misunderstanding and sharp differences in points of view by stakeholders (potential consumers) regarding their safety (Adenle, 2011: 176). On one hand a segment of stakeholder believe that genetically modified products are not safe for human consumption and should therefore not even be produced and on the other hand other believe that genetically modified products are as safe as their counterparts and therefore shouldn't be discriminated. Unlike other aspects of agricultural biotechnology like tissue culture and marker assisted selection which are generally easily accepted for use in agriculture, genetic modification always draws the most animated discussions. This is because the application of the technology is plagued by real or imagined fears of negative impacts arising from consumption of genetically modified products as well as a general misunderstanding and misinformation about the scientific techniques and processes it employs.

This prevailing situation therefore presents an obvious knowledge gap that translates to a general reluctance to use genetically modified products in Kenya and Africa in general. This is despite growing scientific consensus that GM products are as safe as their conventional counterparts (Karembu et al, 2011: 5). An array of literature also confirm that genetic modification can boost Kenya's dwindling agricultural productivity by providing the possibility of developing crops that are resistant to pests or diseases and can withstand various abiotic stresses like drought and salinity (Fagerström et al, 2012: 493).

Yet, despite the above mentioned potential benefits, genetic modification is still viewed apprehensively by possible consumers of the products due to widespread mis-information and strongly held myths and misconceptions. In Kenya, the concerns about safety of GM food products still prevails despite the existance of government authorities and agencies like the National Biosafety Authority and the Kenya Bureau of Standards among others to ensure all genetically modified products are safe for human consumption and the environment. The question and therefore, the problem, the fear of the unknown effects of consuming genetic modification supercedes the documented possible benefits of genetically modified products. What nature of impact does a regular communication forum like OFAB have on the knowledge, attitude and perceptions of stakeholders towards the genetically modified products? Does this forum positively influence the attitude of stakeholders towards genetic modification in Kenya? These are some of the key research questions that this study sought to investigate and interrogate further.

1.3 Objectives of the Study

The objectives of the study are:

1. To determine how the knowledge and practices of OFAB attendees towards genetic modification in Kenya compares with those of non-attendees.
2. To establish the general trends in attitude among stakeholders about specific current issues of policy debate relating to genetic modification in Kenya
3. To determine whether a demographic factor like levels of education has any influence on the attitudes of both OFAB attendees and non-attendees towards genetic modification.

1.4 Justifications of The Study

Genetically modified products have been projected to finally be commercialized in Kenya in 2014/2015. However, most potential consumers of genetically modified products are still uncertain of the safety of consuming genetically modified products. They are therefore likely to make un-informed decisions about usage when the products are finally available. More knowledge and information about genetically modified products would definitely help the stakeholders (potential consumers of genetically modified products) to make better and informed decisions about consumption. Knowedge and information would also help the stakeholders separate facts from myths about the negative effects of consuming genetically modified products. It is this role of knowledge sharing and awareness creation about genetically modified products that the OFAB Kenya Chapter has been playing over the past seven years in Nairobi, Kenya.

The forum seems to have achieved great success in providing factual, science-based input to the discourse by stakeholders on the subject of genetic modification. However, it is still not obvious what knowledge, attitudinal and practical impacts the forum has on attendees compared to non-attendees of the forum. Additionally, there is currently no documented comparative survey of this nature that has been conducted. This study is therefore one of the first attempts in generating empiracal data of this nature.

Furthermore, the choice of OFAB Kenya Chapter for this survey is informed by the fact that this chapter is one the first and oldest of the 6 OFAB chapters currently established across sub-Saharan Africa. If at all any obvious impact is to be seen from the OFAB model, then, the Kenya Chapter provides the most ideal scenario for this kind of study. This is because of the length of time it has been in existance as compared to other OFAB country chapters.

This study also contributes to a significant amount of empirical data to illustrate what works or what doesn't work in establishing long-term knowledge sharing programs about new technologies in agriculture such as OFAB. Beyond this, it also provides a significant contribution to the nascent area of science communication about agricultural biotechnology in Kenya and will therefore provide a good spring board for other scholars who wish to contribute further literature about the role of effective science communication in the diffusion of agricultural biotechnologies like genetic modification.

1.5 Theoretical Framework

The process of acceptance of any technology is usually a complex affair influenced by various factors including social, cultural, political and personal factors. Various theorists have therefore made attempts to explain this process using different theories. Genetic modification, the subject of this study, is still generally considered as a "new" and "foreign" agricultural technology by various sections of the Kenyan society who are potential consumers of genetically modified products. Furthermore, when considered in the broader context of the role of OFAB in knowledge sharing about genetic modification, it becomes difficult to have a single theory forming the basis for an effective theoretical framework for this study. In this context, therefore, the follwoing two theories are considered relevant and have the capacity to provide us with wide theoretical frameworks for analysis and interpretations. Namely, the Diffusion of Innovations Theory and the Technology Acceptance Model.

In this regard, the Diffusion of Innovations Theory according to Everett Rogers explains how innovations (new ideas) are taken up in a population by offering useful insights into qualities that make innovations to be adopted or not. The theory was first published in 1962. For Rogers, decisions to adopt or use an innovation is not a collective process but an individual process. The main questions that an individual typically asks about a new innovation (idea) includes; "What is the innovation?" ,"How does it work?", "Why does it work?", "What are the innovation's consequences?" and "What will its advantages and disadvantages be in my situation?". In this context therefore, each member of a society faces his/her own innovation decisions that follows a 5-step process starting with *knowledge* (awareness about an innovation), *persuasion* (formation of favorable or unfavorable attitude toward the innovation), *decision* (choice to adopt or reject the innovation), *implementation* (testing the innovation) and *confirmation* (evaluation of the results of an innovation-decision already made).

In the context of the diffusion of innovations theory therefore, the OFAB Kenya Chapter was already contributing to the diffusion process of genetically modified products by creating better knowledge and awareness about genetic modification. Rogers, E., (2003) defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (ibid, 2003: 5). It is therefore, not an ordinary form of communication because it involves messages concerned with new ideas or innovations such as genetic modification which is the case of this study. The Knowledge and awareness creation role played by OFAB Kenya Chapter was absolutely critical because it determines the outcomes of the subsequent four steps involved in the diffusion process – persuasion, decision, implementation and confirmation.

The diffusion of innovation theory's five characteristics that determine the rate of adoption af a new innovation is also relevant to genetic modification. These characteristics (enumerated below) canbe used in this study analysis and for comparisons in assessing the knowledge, attitudes and practices of potential consumers of genetically modified products in Kenya. For example: *relative advantage* which deals with the degree to which an innovation is perceived as better than the idea it supersedes. This may be measured in economic terms, social prestige, convenience or satisfaction. As a factor, relative advantage doesn't need to be "objective",but rather depends on how an individual perceives the innovation as advantageous. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be. This aspect is captured in the questions presented to the respondents, for example: would you buy genetically modified products if they are cheaper ?

Secondly, the *compatibility*. This explains the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. An idea that is incompatible with the values and norms of a social system will not be adopted as rapidly as an innovation that is compatible (Rogers, E. 2003: 223). The adoption of an incompatible innovation often requires the prior adoption of a new value system, which is a relatively slow process. A sample question posed to respondent in this study that assess this aspect of diffusion of innovations is: Genetic modification is against my moral values – yes or no.

Third, is the *simplicity and ease of use* (compatibility). It deals with the degree to which an innovation is perceived as being difficult to understand and use. The easier the innovation is to comprehend, the faster it will be adopted. This study assess the levels of knowledge of the respondent to determine how it influences their attitudes towards genetic modification.

Fourth is the *triability*. This covers the degree to which an innovation may be experimented with on a limited basis. According to the diffusion theory, innovations that can be tested in piecemeal will generally be adopted faster than those that are indivisible.

Last is *observability*.This is the degree to which the results of an innovation are visible to others. The easier it is to see the results of an innovation, the more likely they are to adopt. The visibility is likely to generate peer discussions of the new idea and interest as the friends and neighbors of an adopter often request innovations evaluation information about it.

The diffusion of innovation theory also has an important component about adopter categories in the diffusion process that has been deliberately left out for this study. This is because this aspect of the diffusion theory mainly deals with the actual adoption process for new innovations. However, in the case of this study, genetically modified products are yet to be commercialized and therefore actual adoption or consumption of the product can be assessed through this theoretical paradigm. However, this aspect will be absolutely important for a study of a similar nature when the first GM product (Bt cotton) is commercialized in 2014/2015. The adopter categories of the diffusion process is premised on the reality that not all individuals in a society adopt an innovation at the same time (Rogers, E. 2003: 223). He therefore goes ahead to cluster each individual adopter into five groups in terms of his or her time of adoption.

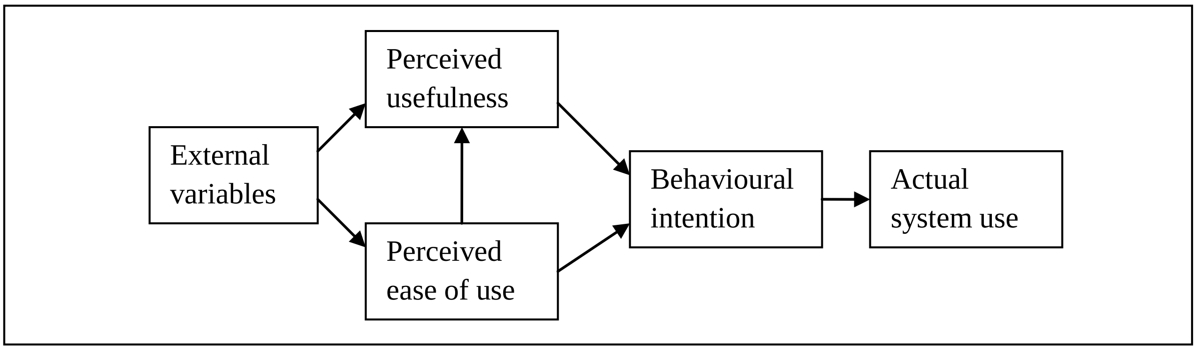
The five adopter categories are : (1) innovators, (2) early adopters, (3) early majority, (4) later majority, and (5) laggards (Rogers, E. 2003: 246). The innovators are the ones who begin the diffusion process in a social system by developing new ideasand gadgets; the early adopters are the second group of individuals to adopt new innovations mostly for strategic reasons; early majority are early pragmatists who are comfortable with moderately progressive ideas and are the third group to adopt new innovations; the late majority are the fourth group to adopt innovations and are conservative pragmatists who don't like risks and trying new ideas; finally there are the laggards who generally hold out to the bitter end before adopting new innovations.

The other relevant theory to our study is the Technology Acceptance Model (TAM). It is credited to Fred Davis and Richard Bagozzi. It provides an informative representation of the models with regards to how users come to accept and use a technology (Davis, F.D., 1989: 319). It is therefore a useful theory in applied contexts for forecasting and evaluating user acceptance of new technology. TAM is one of the most influential extensions of Ajzen and Fishbein's Theory of Reasoned Action.

Although the theory was primarily developed for use in evaluating information technology systems, in this study we apply it for purposes of evaluating and forecasting the adoption of genetic modification, which is an agricultural technology.

The Technology Acceptance Model specifies the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude towards using, and actual usage. According to the model, this relationship can be graphically illustrated as detailed in figure one below.

Figure 1: Graphical representation of the causal relationships between system design features, perceived usefulness, perceived ease of use, attitudes toward using, and actual usage behaviour



Source: Vankatesh & Davis, 1996: 453

TAM provides a basis with which one traces how external variables influence belief, attitude, and intentions to use any new technology. For example, using the TAM model to assess the utility of the digital villages, the rural inhabitants will seek answers to the following two questions:

- To what degree will the digital village centre be useful to me in enhancing my source of livelihood?
- Is the digital village centre easy to use for me or do I need to embark on some special training to use it?

Similarly, in the context of our study, before one makes a decision to use genetically modified products in Kenya, potential consumers will seek to understand the percieved usefulness of genetically modified products as well as their percieved ease of use. The relevance of the Teachnology Acceptance Model to this study is illustrated by the example of a Kenyan farmer, considering whether or not to grow a genetically modfied seed. Before making a final decision, the farmer will consider whether the genetically modified seed offers advantages like pest or weed resistance and whether by planting the seed the number of times he has to apply a pesticides or fertilizers to his farm will be reduced thereby lowering his production costs. It is such considerations and more that can either be classified under percieved usefulness and percieved ease of use according to the TAM model (Han & Harrsion, 2007: 700).

The Technology Acceptance Model is therefore, relevant to this study to the extent that it considers the important roles played by percieved usefulness and percieved ease of use in the adoption of new technologies in a social context like genetic modification. It also acknowledges the fact that external variables play a major role in influencing these two perception factors and that actual use of any new technology depends on the behavioural intentions that are formed from perceptions. Because this study was assessing the attitudes of stakesholders towards genetic modification, factors like how useful genetically modified products are will play a critical role in determining whether eventually the potential consumers will adopt genetically modified crops when they are finally commercialized in the country or not.

1.6 Definition of Terms

1. **Acceptance** – willingness by stakeholders to assent to the use of genetic modification technology and its products.

2. **Adoption** – Use of genetically engineered products either in farming or consumption as food.

3. **Agricultural biotechnology -** a collection of scientific techniques used to improve plants and animals through the purposeful manipulation of organism traits.

4. **Awareness** – the consciousness of a stakeholder about specific issues relating to genetic modification.

5. **Commercialization** – the legal introduction of genetically modified products into the local market as seed for farmers to use in planting or as food available for consumption by the public.

6. **Risk** – real or perceived negative impacts of genetically engineered crops and foods on human health or the environment.

7. **Genetic Modification (GM)** – is a modern agricultural biotechnology technique that is based on recombinant DNA manipulation that allows for precise crossing of DNA between select organisms.

8. **Genetically Modified Organisms (GMOs)** – are crops whose genetic make-up has been modified through the insertion of foreign (often bacterial genes) in order to impart certain desirable traits; for example drought tolerance, pest resistance, herbicide resistance and improved nutritive quality (Panos Institute 200: 5).

9. **OFAB Stakeholder** – an individual who has participated in an OFAB forum.

10. **Risk** – real or perceived negative outcomes that could occur as a consequence of the use of genetically engineered products.

11. **Stakeholders** – Potential consumers of genetically modified foods.

1.7 Conclusions

It is normal and valid for stakeholders (potential consumers of genetically modified products) to have concerns and fears about genetically modified products. This is because human beings tend to be very sensitive about what they consume. It is however, also a valid observation that some of the fears and concerns about genetic modification and its products are products of myths and misconceptions (Karembu et al, 2011: 19). The role of creating knowledge and awareness about genetic modification as already being done by OFAB is therefore a vital role that helps stakeholders to make the right decisions with regards to consumption or policy.

1.8 References

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CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter examines existing literature on the issues sorrounding genetic modification and why it is generally beset by sharp divergent opinions. We begin the literature review by providing a historical account of the development of agricultural biotechnology to genetic modification. This is followed by literature relating to the applications of agricultural biotechnology in Kenya. Furthermore, an overview of the global trends in the adoptions of genetic modification is also made. The section concludes with an examination of literature on the challenges of communicating about genetic modification across the world and the reasons therefrom.

2.2 The History Of Agricultural Biotechnology

Since the begining of agriculture eight to ten thousand years ago, famers have been altering the genetic makeup of the crops they grow (ISAAA, 2010: 3). They selected the best looking plants and seeds and saved them to plant for the next year. The selection for features such as faster growth, higher yields, pest and disease resistance, larger seeds, or sweeter fruits has dramatically changed domesticated plant species. Plant breeding came into being when man learned that crop plants could be artificially mated or cross-pollinated to be able to improve the characters of the plant (ISAAA, 2010: 3). The science of plant breeding was further developed in the 20th century when plant breeders understood better how to select superior plants and breed them to create new and improved varieties of different crops. Agricultural biotechnology has therefore, advanced greatly to more precise, quicker and specific techniques of plant breeding like genetic modification. This advancement has prompted the scholars in this field to categorize the techniques into groups depending on the "advanced-ness" of the technique in question. Karembu et al (2012: 2) have categorized the techniques of agricultural biotechnology into two broad groups, namely: traditional agricultural biotechnology and modern agricultural biotechnology. Traditional biotechnology refers to early methods of using living organisms to produce new commodities or to modify existing ones (Karembu, M. et al ibid: 2). They proceed to define modern biotechnology as “the techniques used in moving genetic material and the fusion of cells beyond normal breeding barriers”.

Traditional biotechnology can be traced back several centuries ago when human beings discovered how to influence natural processes that occur all the time within living cells inorder to meet certain specific goal. For example, man would collect wild plants and cultivate them. The best yielding strains were then selcted for growing the following seasons. As humans discovered more plant varieties and traits or characteristics they gradually became skillfull at breeding specific plant varieties to obtain desired traits such as disease resistance, better taste and higher yield. This was the onset of conventional breeding in agricultural biotechnology. Karembu et al (2012; 3) note that the salient characteristics of traditional agricultural biotechnology is the fact that the development and modifications geared towards improving the organisms were achieved at the organism, not cellular level. They therefore list the techniques of traditional agricultural biotechnology to include; selective breeding, fermentation and hybridization.

Modern biotechnology can be traced to the discovery of the structure of deoxyribonucleic acid (DNA) molecule in 1953 as shown in table 1 on the key milestones in the development of biotechnology by Kelemu, S. et al. (2003: 396). The discovery was made possible by earlier discovery of genes, the instructions that give organisms their characteristics. Modern science has allowed the identifications of individual genes and understanding of their specific properties. This knowledge of actual genes being transffered has significantly reduced the time it takes to obtain the same results in traditional biotechnology. ISAAA (2010; 1) lists some of these techniques of modern biotechnology to include; tissue culture and micropropagation, molecular breeding or marker assisted selection,genetic modification and GM crops as well as molecular diagnostic tools.

Table 1: Key milestones in the development of biotechnology

Year	Development	Reference
1877	Louis Pasteur and Joules F. Joubert first describe inhibition of bacterial growth	Persidis, 1999
1922	Insulin is first isolated	Banting and Best, 1922
1929	Alexander Fleming develops the first effective antibiotic (penicillin) from the fungus Penicillium sp.	McFarlane, 1984; Persidis, 1999
1944	DNA is first identified as the hereditary material in cells; this discovery was later confirmed in 1952	Avery et al., 1944; Hershey and Chase, 1952
1953	F. H. C. Crick and J. D. Watson discover DNA's double-helix structure	Watson and Crick, 1953
1960	Genetic code is deciphered	Crick et al., 1961
1970	Discovery of DNA ligase as catalyst for the ligation of DNA fragments	Sgaramella et al., 1970
1970	Specific restriction endonucleases are discovered	Smith and Wilcox, 1970
1973	The first event of genetic modification occurs: development of molecular cloning	Cohen et al., 1973
1976	First biotechnology firm is established (Genentech, USA)	Genentech, Inc.
1977	Methods of DNA sequencing are described	Maxam and Gilbert, 1977; Sanger et al., 1977

1977	Rat insulin genes are cloned	Ullrich et al., 1977
1979	cDNA, containing the entire coding of human growth hormone mRNA, is cloned	Martial et al., 1979
1980	USA Supreme Court rules that micro-organisms can be patented	Chakrabarty, 1980
1980	Agrobacterium tumefaciens is successfully used to introduce foreign DNA into plants	Hernalsteens et al., 1980
1982	First pharmaceutical substance (insulin; Eli Lilly's Humulin®) produced by a genetically engineered bacterium approved for sale in USA and UK	Eli Lilly and Company, 2003
1982	First transgenic animal is produced (growth hormone gene transferred from a rat to a mouse)	Palmiter et al., 1982
1984	First transgenic plant is produced, using an Agrobacterium transformation system	De Block et al., 1984
1985	K. B. Mullis, working for Cetus Corporation, California, invents the polymerase chain reaction (PCR)	Saiki et al., 1985
1985	U.S. Patent Office extends patent protection to genetically engineered plants	Hibberd, 1985
1985	First transgenic farm animals are produced (pig, rabbit and sheep)	Hammer et al., 1985
1988	U.S. Patent Office extends patent protection to genetically engineered animals	Leder and Stewart, 1988

1988	Thermal stable DNA polymerases are isolated from thermophylic bacteria, making PCR a very useful procedure	Innis et al., 1988
1988	Human genome mapping project starts	NRC, 1988
1990-1992	First transgenic wheat and maize plants are produced, extending genetic modification to cereals	Gordon-Kamm et al., 1990; Vasil, 1999; Vasil et al., 1992
1993	First gene for plant disease resistance (Pto) is cloned	Martin et al., 1993
1994	Genetically modified tomato is marketed in USA	Kramer and Redenbaugh, 1994
1996/97	A cloned sheep named Dolly is born at the Roslin Institute, Scotland	Campbell et al., 1996; Wilmut et al., 1997
2001	National Center for Food and Agricultural Policy quantifies, for U.S. farmers, the benefits of crop biotechnology in 30 crops	Gianessi and Silvers, 2001
2002	Draft sequences of the rice genome are published	Goff et al., 2002; Yu et al., 2002
2002	About 59 million hectares of land are planted to genetically modified crops	James, 2002
2003	The famous cloned sheep Dolly is put to sleep in February 2003, after being diagnosed with a progressive lung disease	Giles and Knight, 2003

Source: Kelemu, S. et al., 2003: 396

As illustrated in table 1, agricultural biotechnology has come a long way to reach its current levels of sophistication. Significantly, the key milestone in the advancement of the science of biotechnology as captured in this table was the identification of DNA as the hereditary material in cells. This was the first major hurdle not only in biotechnology but for science as a whole because this now enabled scientists to solely focus on the DNA when looking to modify any plant or animal traits. Other significant milestones came later with the development of the first transgenic plant in 1984. This was a significant step forward because it marked the first time a gene was transferred from one entity to another. This development also showed scientists across the world the numerous possibile uses of gene transfer to that could help address some of the challenges facing humanity. A year after the development of the first transgenic plant (1985), the first trangenic animals were developed – a pig, rabbit and a sheep. Fast forward five years later in 1990 and scientists had finally succeded in developing insect-resistant varieties of wheat and maize. This period heralded a new era in agricultural biotechnology where the science was now translating nto products of actual benefit for farmers and the society at large. It also formally began the use agricultural biotechnology in the production enhanced food crops that ensured farmers maximised profits from their farms as well as the consumers getting more nutritious foods. The first genetically modified crops to be produced for public consumption was the tomato in 1994 in the United States of America. Since then various other countries across the world have sanctioned the sale of genetically modified food crops.

2.3 What is Agricultural Biotechnology?

To define agricultural biotechnology successfully, it is imperative that we first understand what biotechnology means. This is because this understanding would give us an over-arching undertsanding of the field so that we are equipped to comprehend one of its sub-sets, agricultural biotechnology. Biotechnology is defined in the ISAAA policy document as a set of tools that uses living organisms (or parts of organisms to make or modify a product, improve plants, trees or animals or develop microorganisms for specific uses. From this definition,it is therefore clear that biotechnology and all its usbsets therefore involved using living organisms or their parts to to develop a totally new living organism or to modify an existing one for mostly improvement purposes

(ISAAA, 2010: 1). Agricultural biotechnology therefore, involves the application of these biotechnology techniques in agriculture. Biotechnology has also been applied by the industrial sector, for example in the pharmaceutical industry for the production of drugs through the fermentation technology. Another application of fermentation technology is the production of ethanol from corn starch by using yeast. Some bacteria can also decompose sludge, manure or landfill wastes to produce methane, which can be used as fuel. Biotechnology therefore, is a broad field with numerous sub-set areas of application.

However, agricultural biotechnology is the term used to refer to crop and livestock improvement through biotechnology (ISAAA, 2010: 1). Agricultural biotechnology is therefore, not limitted to genetic modifications alone as commonly assumed. Rather, it also includes; conventional plant breeding, tissue culture and micropropagation, molecular breeding or marker assisted selection and molecular diagnostic tools. It is important to note therefore that each of these sub-categories of agricultural biotechnology involves the application of different technological skills inorder to improve crops and livestock.

2.4 Ongoing Agricultural Biotechnology Applications in Kenya

There are already several ongoing applications of agricultural biotechnology in Kenya. Some of these applications include; the use of tissue culture techniques, the application of marker-assisted selection and even genetic modification (to a limitted extent). The following literature explains in detail how and where each of these agricultural biotechnology applications are being used in Kenya.

(a) Tissue Culture

Tissue culture is the cultivation of plant cells,tissues,or organs on specially formulated nutrient (ISAAA, 2010: 8).It provides an opportunity to produce large quantities of clean planting materials thus reducing the need for pesticide application and impacting positively on the environment (Karembu, Nguthi, Ogero, & Wafula, 2012: 6). For example upto 2,000 banana plantlets can be produced from a single shoot within six months using tissue culture whereas using conventional methods, only 10 suckers can be produced from one plant in the same period. Tissue culture has been around for more than 30 years and is one of the techniques of modern agricultural biotechnology which is already widely applied for farming in Kenya in the production of pyrethrum, banana, sweet potato, cassava, potato,cut flowers, tree species like eucalyptus and melia as well as sugarcane (Karembu, M. et al, 2012: p 6). The adoption and use of tissue culture by farmers in Kenya seems to have been exceptional as more tissue culture crops are in the pipeline for production due to demand.These include vanilla, coffee, oil palm, cut flowers and tea (Karembu, M. et al ibid: 6).

(b) Marker-Assisted Selection

Marker-assisted selection (molecular breeding) is a technique that allows scientists/plant breeders to identify and evaluate plants carrying useful traits for breeding purposes (Navarro, Gopikrishna, & Maslog, 2006: 8). This not only reduces the time but also the cost of identifying linked traits, besides offsetting the need for routine phenotyping under environmental conditions (that is often non-predictable and non-uniform). This is a more precise science which allows plant breeders to develop crops with specific beneficial traits (Karembu, Nguthi, Ogero, & Wafula, 2012: 7). The different traits and physical features of plants are encoded in the plant's genetic material, the deoxyribonucleic acid (DNA). For example, some traits, like the colour of a flower may be controlled by only one gene while other complex characteristsics like crop yield or starch content may be influenced by many genes. Molecular marker-assisted selection therefore helps scietists to identify these specific genes quicker and more accurately. Marker-assisted selection is currently being applied in Kenya by various research project to develop improved crops that are pest and disease resistant as well as improving the nutritional value of food crops. These ongoing projects include: strengthening the resistance of farmer-preffered sorghum varieties to Striga Weed by Biosciences east and central Africa (BecA). The production of more and better food with increased nutritional value and resistance to natural stresses, from staple cereals like sorghum, millets and legumes like groundnuts, chickpea and pigeon pea at an affordable cost by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Other programmes includes: characterization and mapping of maize streak virus and grey leaf spot resistance genes in maize by the Kenya

Agricultural Research Institute (KARI) and the development of drought-tolerant maize and wheat vaieties by KARI and the International Maize and Wheat Improvement Center (Karembu et al, 2012: 8).

(c) Genetic Modification

Genetic modification is one of the modern agricultural biotechnology tools that is based on recombinant DNA technology. Recombinant technology brings together genetic material (DNA) from multiple sources, creating sequences that would not otherwise be found in biological organisms. It therefore provides the means to make more distant "crosses" that were previously not possible opening a new realm of possibility as gene donors can now be used to donate desirable traits (characteristics) to others that are distantly-related or not related at all (Navarro, Gopikrishna, & Maslog, 2006: 15). Through genetic modification, useful genes are selected and inserted into living organisms to give them useful and desirable characteristics such as resistance to pests and diseases or resilience to harsh environmental conditions (Karembu, Nguthi, Ogero, & Wafula, 2012: 8). A genetically modified organism (GMO) is one where a single or two (rarely more) genes from closely or distantly related organisms have been introduced to provide a new trait or characteristic. Foods and products derived from GMOs are termed as genetically modified (GM) foods or transgenics.

The ability to transfer genes between species that would not readilly interbreed is what distinguishes genetic modification from the other techniques of modern agricultural biotechnology. Gentic engineering techniques is only used when all other techniques have been exhausted and when:- the trait to be introduced is not present in the germplasm of the crop; secondly, when the trait is very difficult to improve by conventional breeding methods; and when it will take a very long time to introduce and or improve such trait in the crop by conventional breeding methods. In Kenya, for example, the technique is being used to: develop cotton variety with resistance to the cotton bollworm in the Bt cotton Project by KARI; to develop a maize variety with resistance to the maize stem borer in the Water Efficient Maize for Africa (WEMA) Project; to develop a cassava variety with resistance to the cassava mosaic disease in the Virus resistant cassava for Africa (VIRCA) Project; and to develop sweet potato variety that are resistant to the feathery mottle viral disease in the Sweetpotato Action for Security and Health in Africa (SASHA) Project (Karembu, Nguthi, Ogero, & Wafula, 2012: 9). As shown in Table 2, a vast body of literature is available to explain the other benefits of genetically modified crops.

Table 2: Summary of the benefits from genetically modified crops from sampled literature

Benefit	**Rationale**	**Reference**
Increased well being and lower healthcare costs	Less frequent application of pesticides where misuse can cause severe health problems	Pray and Naseem (2007); Francisco (2007); Krishna and Qaim (2007)
Increased effective yield	Reduction of impact by pests, diseases, and other stresses	Sexton and Zilberman (2010)
Lower production costs	Less requirement for pesticides and frequent weeding	Francisco (2007); Krishna and Qaim (2007)
Reduction of greenhouse gases	Reduced fossil fuel consumption of farm machineries due to fewer agro-chemicals application in addition to probable soil carbon sequestration because of “no till” or “reduced till” systems	Brookes and Barfoot (2010)
Reduction of soil erosion	Fewer tractor passes on the field leads to reduction in soil erosion due to less stalk and ear rot	Pray and Naseem (2007); Brookes and Barfoot (2010)
Healthier product	Less mycotoxin accumulation in biotech maize kernels due to less stalk and ear rot	Ostry et al. (2010)
Higher insect	Transgenic plants are healthier later in the	Arpaia et al. (2007);

diversity	season because of their resistance to pestst allowing herbivores to feed on plants where there is less competition for the same resources.	Cattaneo et al. (2003)

Source: Navarro and Hautea, 2011: 9

(d) Improvement of livestock productivity

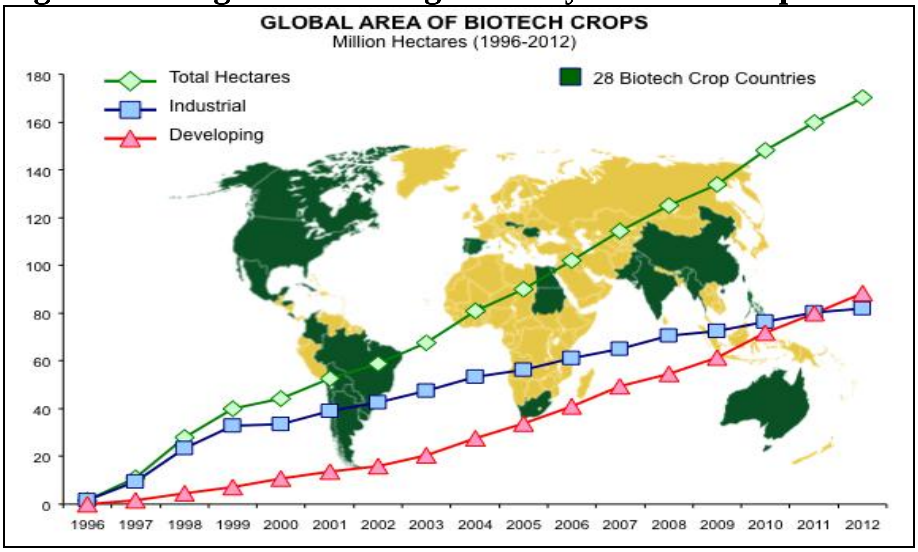
Modern agricultural biotechnology is also being applied for the improvement of livestock productivity in Kenya. These applications include; development of of novel recombinant vaccines for diseases, characterization of livestock breeds and in research into the conservation of rare species (Karembu, Nguthi, Ogero, & Wafula, 2012: 12). Some of the leading institutions involved in livestock biotechnolgy research and development include: KARI – National Vetrinary Research Centre (NVRC) and the KARI Biotechnology Centre at the National Agricultural Research Laboratories (NARL); The Institute of Primate Research at the National Museaums of Kenya; and the International Livestock Research Institute (ILRI)

A significant result so far recorded from these programmes include: the development of a recombinant vaccine for Rift Valley fever. Efforts to test the vaccine against live animals have not succeded due to lack of an appropriate biosafety testing facility for animals involving GMOs (Karembu, Nguthi, Ogero, & Wafula, 2012: p 13). However, ILRI is using modern biotechnology techniques to solve livestock problems in three areas namely: animal health – biotechnological research which seeks to develop appropriate diagnostics to help identify disease threats and develop specific vaccines; the Genetics and Genomics to develop appropriate marker technologiesto to facilitate delivery of genetic improvement into farmers' herds; and the Animal Feeds Research which is engaged in developing improved varieties of animal feeds.

2.5 Global Status and Trends in Adoption of Genetic Modification

Biotech (genetically modified) crops were first commercially grown in 1996 and since then, millions of farmers in both developing and developed countries have started growing the transgenic crops. James (2012: 5) posits that there has been a 100-fold increase in biotech crop hectarage from 1.7 million hectraes in 1996 to 170 million hectares in 2012. This meteoric rise in the hectarage of land under biotech/GM crops (as in figure 2) makes them the fastest adopted crop technology in recent history (James, 2012: 5).

Figure 2: The global area of genetically modified crops



Source: James, 2012 (cover page)

Available empirical data indicates that farmers in 28 countries worldwide, adopted biotech crops.Of the 28 countries which planted biotech crops in 2012, 20 were developing and 8 were industrial (developed) countries.And for the first time since the commercial planting of biotech crops, developing countries grew more, 52% of global biotech crops in 2012 than industrial at 48% (James, 2012: 7). This data by James indicates an emergence of developing countries in planting biotech/GM crops confirms the assertion by Paarlberg (2008: xiii) that this technology is meant for developing countries, hence the reluctance by the developed countries in commercialization of the crops because they essentially don’t really need it. James (2012: p 255) notes that since adoption, biotech crops have contributed to food,feed and fiber security as well as alleviating poverty and hunger.

However, while 28 countries planted commercialized botech crops in 2012, an additional 31 countries totalling 59 have granted regulatory approvals for biotech crops for import, food and feed use and for release into the environment since 1996 (James, 2012: 8). Progress is being made in Africa albeit slowly with South Africa increasing its biotech area by a record 0.6 million hectares to reach 2.9 million hectares. In Burkina Faso, 2012 was the fifth year for farmers to benefit significantly from Bt cotton. Biotech cotton hectarage increased by 27% in 2012 – from 247,000 hectares in 2011 to 313,781 hectares in 2012. By growing biotech cotton for the first time in 2012, Sudan became the fourth country in Africa, after South Africa, Burkina Faso and Egypt, to commercialize a biotech crop (James ibid, 2012: 165). Several developing countries are expected to plant biotech/GM crops before 2015 led by Asia, and there is cautious optimism that Africa will be well represented. There are ongoing confined field trials in Kenya, Uganda, Malawi, Nigeria and Cameroon. It is anticipated that some of these five countries will join South Africa, Burkina Faso, Egypt and Sudan in commercializing biotech/GM crops in the near future.

2.6 Hard sell? The challenges of Communicating about Genetic Modification

Communicating agricultural biotechnology in general and genetic modification in particular is a challenge for communicators and scientists working in the field for a number of reasons. For example, the polarized polemics related to genetic modification makes the task even more difficult. Similarly, separating the technology from the opinions on its applications adds to the challenge (Navarro, Gopikrishna & Maslog, 2006: 32). Furthermore, the job becomes more demanding with the exaggerations that circulate in a polarized environment. This is as a result of the heightened interests and opinions about biotech, therefore, the debate has variously been approached by different groups from scientific, political,economic, ethical, cultural, and even religious viewpoints therefore making it very contentious (Kelemu, S. et al. 2003: 394).

Navarro, Gopikrishna, & Maslog (2006: 27-33) provide an analysis of how various groups of stakeholders percieve agricultural biotechnology in the book Genes Are Gems. They note that, for scientists, agricultural biotechnology provides modern ideas and techniques to upgrade agricultural research. It transforms agriculture from a resource-based to a science-based industry. The seed industry likes the use of agri-biotechnology because it provides solutions that are not available through conventional plant breeding and overcomes the biological limitations of conventional breeding. When new traits are incorporated in crop plant hybrids, the industry can market unique products that can fetch higher profits. The civil society is one group that is divided on its perspective on agri-biotechnology. While there are those who support agri-biotechnology and see promise from the new technologies, there are others who are in fear of it and would not want to encourage it. Farmers find the GM crops useful as they are able to reduce their productivity loss to pests and thus increase yields. Further, they also save on the cost of buying pesticides. They have apprehensions about the higher cost of the GM seeds though. Finally, controversies make good stories for Journalists. Ever since the discussions and debates on GM crops started in the mid-1990s, there have been many GM crops stories in all forms of the media. However, when journalists wanted to go beyond the regular stories quoting two sides of the controversy, they found a dearth of sources to talk to about the technologies (Navarro, Gopikrishna, & Maslog, 2006: 33).

Global advancements in the Information, Communication and Technology (ICT), making the world a global village have further complicated the practise of communicating agricultural biotechnology. At the click of a button, a controversial research paper regarding crop biotechnology can become localized in any part of the world however irrelevant or inappropriate it is. This was the case in 2012 when the Kenyan Cabinet banned importation of GM maize after a French Scientist, Prof. Gilles-Eric Séralini of the University of Caen published an article linking GM maize to cancer in the Journal of Food and Chemical Toxicology. This finding that has since been found to lack scientific credibility caused many governments across the world to push the panic button without verifying the study despite having more than sufficient capacity to do so. Such a scenario has led to a polarized group of stakeholders in agricultural biotechnology thereby resulting in confusion of mixed messages from scientists, academics, activists, industry, and consumers (Navarro & Hautea, 2011: 37).

Further, lack of scientific understanding has compromised and aggravated the quality of debates in agricultural biotechnology hence blurring the lines between science, political and ideological domains (Rasco, 2008: 306). In the paper Pandora’s Box or Panacea, Laikapoulos (Navarro and Hautea 2011: 27) notes that agricultural biotechnology has now become a social phenomenon rendering it more of a social issue than a technological development. These two points of view are reinforced and supported by the United Kingdom’s Royal Society Report which asserted that public debate about genetically modified (GM) food must consider wider issues than science alone (Navarro and Hautea 2011: 34).

More often, however, policies and decisions about which technologies are appropriate and acceptable tend to be decided by society rather than just analyzed from a scientific perspective (Navarro and Hautea 2011: 15). The full benefits of agricultural biotechnology will only be realized if consumers and food manufacturers consider it safe and beneficial. This is because in the end, it is the farmer who decides what crop to grow, what seed to sow, and if he should grow certain variety in the next planting season or not. In the same vein, it is the housewife who makes the decision on what product to eat and buy from the market.

Gibbons argues that there is need for a new focus on other aspects beyond science to make decisions about new and emerging technology as science’s new social contract with society. He further notes that under the prevailing contract between science and society, science has been expected to produce ‘reliable’ knowledge, provided merely that it communicates its discoveries to society. A new contract must now ensure that scientific knowledge is ‘socially robust’, and that its production is seen by society to be both transparent and participative. This means that progress in science and technology has to develop within a societal environment and remains highly dependent on the receptiveness and appreciativeness of the society (Gibbons ,1999: c81-c82).

The society has easily acepted many products developed through biotechnology, but these have been mostly in the medical field such as recombinant vaccines for hepatitis B, antibotics, and hormones like insulin. The irony, however is that the society considers the cloning of human cells and bioremediation more acceptable than GM crops and food as revealed in a study conducted in Europe in 2008 (Gaskell, Allum & Stares, 2008: 240). The general perceptions that genectically modified products lack tangible consumer benefits and that beneficially accrue to industry (seed develpers) alone while risks are being borne by consumers and the environment forms the crux of the reasons for non-acceptance of GM food and crops.

Poortinga and Pidgeon (2007) offer a historical analysis of of how a number of successive events in Europe, more particularly UK dramatically changed public opinion about GM food and crops. Some of these events included, the consumer and non-governmental organizations succeding in pressuring the supermarkets to remove GM products from their shelves; and the creation of Dolly, the cloned sheep which sparked intensive public and media debate about the ethics of biotechnology among other examples. Public response to these issues proved that public acceptance is very important or the acceptance of new technology and that consumers are a decisive factors for a rational decision making process.

Fagerström et al argue that African governments and its people promptly follow after Europe's non-acceptance of agricultural biotechnology. This blind rejection is despite a world of difference between the circumstances the two continents find themselves in (Masood 2003: 436). For instance, while Europe on the one hand is food secure and is not faced by malnourishment, one quarter of Africans on the other hand, are undernourished and African farmers have to eke out meagre livelihoods on tiny plots of depleted soil (United Nations Development Programme 2012: p 6). Paarlberg (2008) notes that low-income, food-deficit nations are being misadvised by governments and pressure groups from privileged nations to reject agricultural biotechnology mostly because this is a technology the rich countries themselves don't happen to need because their citizens are well fed and their farmers already highly productive (Paarlberg, 2008: 16).

Indeed the position of Paarlberg offers the best historical perspective on how non-acceptance of GM food and crops in Africa gained a foothold in the continent. Africa's inclination to reject agricultural GMOs originally surfaced in the context of an international negotiations launched in 1996 under the United Nations Convention on

Biological Diversity (CBD), the negotiations of a “biosafety protocol” to ensure that international trade in living genetically engineered crops or seeds (called living GMOs, or LMOs) did nothing to compromise the safety of the biological environment.African governments were thus introduced to GMOs in the narrow context of possible environmental risks. No new risks to the environment had yet been documented, yet by the time these international negotiations concluded in 2000, with a new agreement called the Cartagena Protocol on Biosafety, most African governments had come to believe agricultural GMOs were inherently risky. Even some African governments that had been willing to sponsor research on genetically engineered crops earlier in the 1990s then began getting cold feet.

Egypt had created the Agricultural Genetic Engineering Research Institute (AGERI) in 1989, with plans to use genetic modification to improve a number of Egyptian crops, including potatoes, maize, and tomatoes.Yet despite successful field trials in 1997 with a GM potato resistant to insect damage, Egypt never approved the potato for commercial production.This is not withstanding the fact that no evidence of food safety or biosafety risk had turned up, but fears had developed that the GM potatoes might be rejected by importers in Europe. The government of Kenya also got cold feet. In 1991 Kenya’s Agricultural Research Institute (KARI) had been approached by the U.S. Agency for International Development (USAID) with an offer to develop a GM sweetpotato, and KARI agreed. But it subsequently took six years for Kenya’s National Council for Science and Technology (NCST) to issue regulations and guidelines to govern the safe handling of GMOs in the country, and it took another two years for Kenya’s National Biosafety Committee to approve an initial import of the materials for research purposes. Further delays then slowed the field trials for this disease-resistant sweet potato, and despite an absence of evidence of risk , it still hasn’t been approved for commercial planting. Kenya subsequently allowed trials of GM maize and cotton, again with no recorded evidence of biosafety harm, but no approval have been given for commercial release (Paarlberg, 2008: 13).

Paarlberg submits that European tastes regarding agricultural GMOs are not a good fit to the needs of Africa, given that two-thirds of all Africans are poor farmers in desparate need of new technologies to boost their crops' productivity. Africa stands at a great danger of missing out on the agricultural biotech revolution after missing out on the industrial revolution in the 1950's and the green revolutions in Agriculture in the 1960's.

2.7 Conclusions

Based on the literature reviewed in this chapter, it is evident therefore that genetic modification is essentially not a new discovery by humanity, rather it is a method of increasing agricultural productivity that has just been undergoing refinement for centuries to what it is now. The literature also provides an elaborate historical view of the development of agricultural biotechnology as well as providing a clear cut differentiation of the different applications of agricultural biotechnology. The fact that aspects of agricultural biotechnoology like tissue culture and marker assisted selection are already being used in agricultural production is also brought out in the literature. Finally, the body of literature brings out the reasons behind the controversial topic of genetic modification and how the anti-genetc modifcation sentiments began. This culminates into an explanation in the literature about why countries considering to use genetic modification like Kenya need to concentrate on knowledge and awareness creation initiatives like OFAB to ensure that stakeholders are in the best possible position to make proper decisions about whether or not to use genetically modified products.

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CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

Data was collected for this study through self-administered questionnaires to respondents and from secondary sources like books, journal papers and other publications. This process generated both qualitative and quantitative data which was collated and analyzed using the Statistical Product and Service Solutions (SPSS) software. This section is divided into the following sub-headings: research design, population and sample, data collection procedures, limitations of the study and the data analysis procedures.

3.2 Population and Sample

The study targeted a total of 95 respondents. The purposive sampling technique was used to obtain a sample that was one half comprised of attendees to the OFAB meetings and the other half comprised of non- attendees. Purposive sampling is a sampling technique where a sample is selected based on the researcher's knowledge of the populations and their abilities to respond to the issues (Mugenda and Mugenda, 2003: 50). The subjects are selected because of some characteristic.This technique was relevant for this study because the main focus of this study is to compare the differences in the knowledge, attitudes and practice of two groups of stakeholders – OFAB attendees and non-attendees.

The researcher therefore administered the questionnaire purposively to the respondents during an OFAB meeting in July 2013 where 48 attendees out of the estimated 60 available responded to the questionnaire. The questionnaire was also administered randomly to 70 non-attendees out of whom 47 responded to the questionnaire. Obtaining this equal representation from the two sets of respondents was important because the thrust of this study is hinged on comparison between the two groups.

3.3 Data Collection Procedures

The primary data was collected using questionnaires and additional data collected from secondary sources like books and journal papers. The questionnaires were pretested by administering them to a sample group of 10 individuals drawn from the targeted population. The questionnaires addressed specific objectives related to the study therby ensuring utmost fidelity to collecting only relevant data to this study. Both open-ended and closed ended questions were used in the questionnaire – the open-ended ones being used predominantly as follow ups to the closed-ended questions.

This combination of the qualitative and quantitative methods is called triangulation. According to Hussey and Hussey, triangulation can overcome the potential bias and sterility of a single-method/approach. Triangulation therefore leads to greater validity and reliability of data and will ensure that a study benefits from both the advantages of qualitative and quantitave research data (Hussey and Hussey,1997: 132).

3.4 Data Analysis

The data collected from the respondents was cleaned,coded,input into a computer and then finally analyzed using the Statistical Product and Service Solutions (SPSS) software. The results obtained were the presented through frequency distribution tables , percentage frequencies, bar graphs and pie charts. These methods of data presentation were used by the researcher to ensure a clear presentation of the shape of the distributions of the data.

3.5 Challenges and Limitations of The Study

The parameters of this study were limitted to comparing the knowledge, attitudes and practices of the OFAB Kenya chapter attendees about genetic modification to those of non-attendees. While OFAB has various chapters within sub-Saharan Africa in which this study could also have been conducted, this study was only limitted to the attendees of OFAB Kenya Chapter meetings which are held on the last Thursday of every month in Nairobi, Kenya. Other logistical challenges like cost, time and study duration also limitted the researcher’s ability to study the impacts of the other OFAB chapters across sub-Saharan Africa. One final limitation of the study is the fact that the sampled respondents were entirely urban and were individuals based in Kenya’s capital city of

Nairobi. Because of this limitation, potential consumers of genetically modified products from the rural areas may not feel that the findings of this study represents their views about genetic modification in Kenya.

Three major challenges faced by the researcher in the course of data collection. Firstly, some respondents didn't fully respond to all the questions contained in the questionnaires. This made it slightly difficult for the researcher to analyse some of the questions considering that the frequencies would not tally. However this challenge was limitted and was only experience in 2 questionnaires. Secondly, there was the challenge of unreturned questionnaires. For example in the case of non-attendees to the OFAB meetings, while 70 questionnaires were administered, only 47 were returned to the researcher. The 47 returned were however still adequate and statistically significant for the researcher to use in data analysis. Thirdly finances were also a major challenge, there was hardly adequate finances to enable the researcher to move around freely when distributing the questionnaires to non-attendees.

3.6 Conclusions

This chapter has discussed the methodology used in the study , how the research was carried out and how the data was collected, analysed and interpreted. Primary data was collected in this study through the self-administered questionnaires. Through the purposive sampling technique, a sample of 95 respondents took part in the study – 48 were OFAB Kenya Chapter attendees and 47 were non-attendees. The data analysis was done using the Statistical Product and Service Solutions (SPSS) software and the results obtained presented through frequency distribution tables, percentage frequencies, bar graphs and pie charts as can be seen in the next chapter.

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CHAPTER FOUR

THE FINDINGS OF THE STUDY

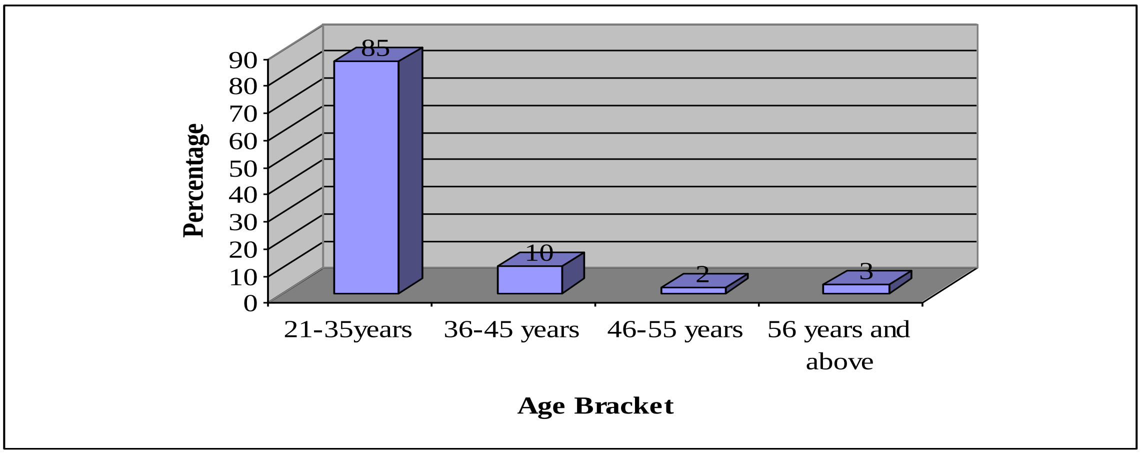
4.1 Introduction

This chapter presents the findings of the study from the field research and demonstrates how those findings address the research objectives. The findings are therefore presented through frequency distribution tables, percentage frequencies, bar graphs and pie charts followed by analysis and interpretations of the data.

4.2 The Findings

One of our key questionss was demographic information of the respondents. This is important in getting to know the age of those who take part in the OFAB forums of the Kenyan Chapter. The respondents were asked to indicate their age category. The study found that the majority of respondents interviewed (85%) were between 21-35 years. It was also found that 10% were between 36-45years. The findings of the study therefore reveals that most of the respondents interviewed were youths. The findings are as presented in Figure 3.

Figure 3: Percentage Distributions of the Respondents by Age category

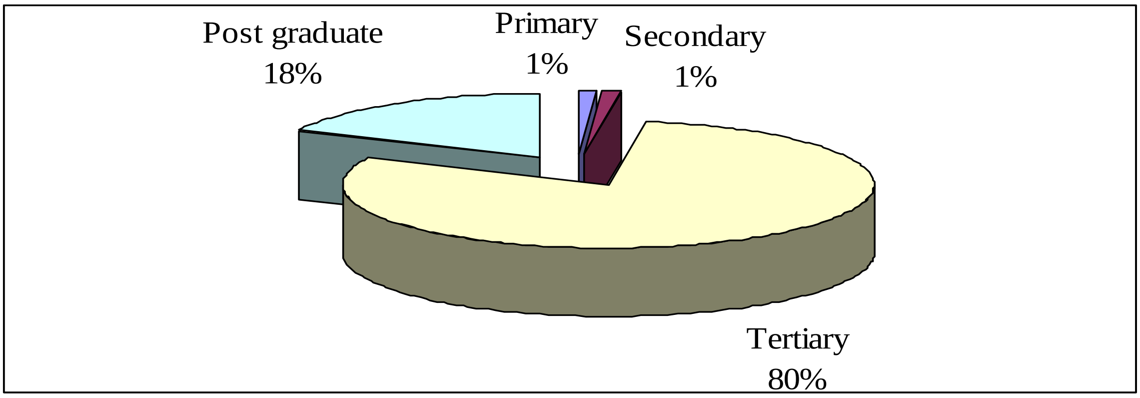


Source: Field Survey 2013

The data represented in figure 3 above indicate that most (85%) potential consumers of genetically modified products in Nairobi are youthful individuals mostly falling in between age 21-35 years old. This is a perfect reflection of the youthful nature of the demographics of Nairobi. Age group 36-45 years made up 10% of the respondents for this study.

The respondents were also asked to indicate their highest levels of education. The findings of the study revealed that 80% of the respondents had tertiary level of education. It was also found that 18% of the respondents possesed a post graduate educational level.

Figure 4: Percentage Distributions of the Respondents by Education Level



Source: Field Survey 2013

From the findings presented in Figure 4 above, it can be said that most of the respondents interviewed were well educated. This therefore means that the sample represents a highly educated and by inference an informed sample group.

The respondents were asked to mention their professions. The study revealed that 30% of the respondents indicated that they were Journalists while 17% were Research Scientists. Other categories of stakeholders sampled in the study were Students (16%), Government Officers (5%), Business Persons (11%) Communications Specialists (3%) and Religious Leaders (2%).

Table 3: Percentage Distributions of the respondents by profession

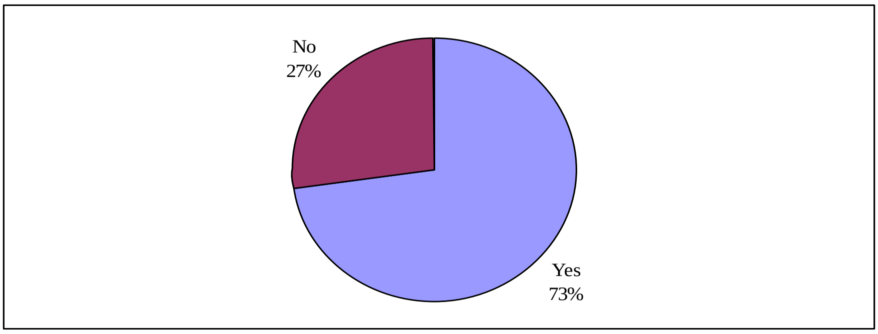
Profession	Frequency	Valid Percent
Government Officers	4	5
Researcher/Scientists	16	17
Journalists	27	30
Religious Leaders	2	2
Business Persons	10	11
Students	15	16
Communications Specialists	3	3
Others	15	16
Total	**92**	**100.0**

Source: Field Survey 2013

From the findings of the study presented in table 3 above, it can be said that OFAB brings together individuals drawn from various professions as represented by the different professions sampled in this study. This sample is therefore also valid especially considering that all the individuals sampled in the study were sampled because they were potential consumers of genetically modified products.

The respondents were asked to indicate whether they had heard about OFAB Kenya Chapter. The study found that 73% of the respondents indicated that they had indeed heard about the forum while 27% indicated that they had not heard about OFAB before. The findings were as presented in Figure 5.

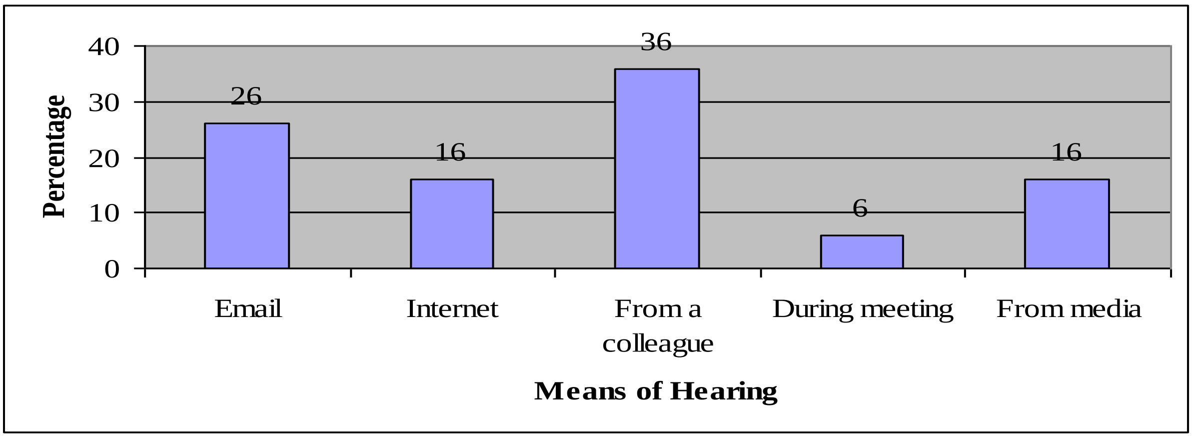
Figure 5: Percentage Distributions of the Respondents who have heard about OFAB



Source: Field Survey 2013

Those who had heard about OFAB were asked to indicate the means through which they heard about OFAB. The findings of the study revealed that 36% had heard about OFAB through their colleagues. However, 26% of the respondents said they had heard of OFAB through email. The internet and the mass media were jointly the 3rd most popular means through which the respondents became aware about OFAB and its activities.

Figure 6: Percentage Distributions of the Respondents' means of hearing about OFAB



Source: Field Survey 2013

The data presented in figure 6 indicate that interpersonal communication (from a colleague) was the most common means through which information about OFAB was being disseminated. This finding is very critical because it shows that word of mouth played a key role in convincing the other prospective participants to take part in OFAB meetings. The Email and the mass media are also very viable avenues that OFAB can exploit further to popularize the forum and thereby reach more and more stakeholders with information about agricultural biotechnology.

4.2.2 Comparison of knowledge and practices of OFAB stakeholders and Non stakeholders towards genetic modification in Kenya

This section interprets the knowledge levels of the respondents on GMOs. For example, the respondents were first asked to indicate their self evaluations of their knowledge about GMOs. The findings on table 4 show that 37.5% of the attendees to OFAB had confidence that they were very knowledgeable about GMOs. While at the same time 62.5% of the attendees felt that they had some reasonable level of knowledge about genetic modification. There was no OFAB attendee who considered him/herself as not knowledgeable. On the other hand, 23.4% of respondents who didn't attend OFAB meetings indicated that they were not knowledgeable about genetic modification, but a significant majority of them (76.6%) felt that they had a reasonable level of knowledge about the same.

Table 4: Respondents self-evaluations of their levels of knowledge about GMOs

	Rate of knowledge on GMOs							
Attendance	**Very knowledgeble**		**Somewhat knowlegeble**		**Not knowlegeble**		**Total**	
OFAB Attendees	**18**	**37.5**	**30**	**62.5**	**0**	**0**	**48**	**100**
Non-Attendees	**0**	**0**	**36**	**76.6**	**11**	**23.4**	**47**	**100**

Source: Field Survey 2013

Not a single non-attending responded or evaluated him/herself to be very knowledgeable about genetic modification. This is an indication of the important role OFAB plays in creating awareness and confidence about the level of knowledge regarding genetic modification. It is therefore expected that this disparity in knowledge levels therefore plays a significant role in determining the usage decisions attendees make about genetically modified products as compared to non-attendees.

To further evaluate the knowledge of the respondents regarding genetic modification, they were asked four questions regarding the fundamental aspects and issues pertaining to genetic modification in general and in Kenya. The aim of seeking responses to these questions was to generally evaluate and compare if there was any significant difference between the correctness of the knowledge OFAB attendees had in comparison to the non-attendees regarding genetic modification. The questions which were phrased as statements and the respondents either had to agree or disagree were as follows: *In reality, all crops have been "genetically modified" from their original state through domestication, selection, and controlled breeding over long periods; In genetic modification, genes of interest are transferred from one organism to another; and By eating genetically modified (GM) food, a person's genes could also be modified.*

When asked to indicate whether they agreed with the statement: *In reality, all crops have been "genetically modified" from their original state through domestication, selection, and controlled breeding over long periods*. More OFAB attendees (39%) agreed with this statement compared to 31% of non-attendees. On the other hand, fewer attendees (12%) disagreed with the statement in comparison to 18% of non-attendants who disagreed.

Table 5: All crops have been "genetically modified" from their original state

Attendance	**In reality, all crops have been "genetically modified" from their original state through domestication, selection, and controlled breeding over long periods.**					
	Agree		**Dont Agree**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**
OFAB Attendees	**35**	**39**	**11**	**12**	**46**	**51**
Non - Attendees	**28**	**31**	**16**	**18**	**44**	**49**
	63	**70**	**27**	**30**	**90**	**100**

Source: Field Survey 2013

This statement is a fact of the science of genetic modification. From the data presented in table 5, it is clear that OFAB attendees understood this fact probably owing to their attendance to OFAB meetings.

The respondents were further asked a question regarding the general concept behind modern practise of genetic modidfication. They were asked whether they agreed or disagreed with the following statement: *In genetic modification, genes of interest are transferred from one organism to another*. As shown in table 6, more OFAB attendees (49%) than non-attendees (42%) agreed with this general fact about the process of genetic modification.

Table 6: In genetic modification, genes of interest are transferred from one organism to another

Attendance	**In genetic modification, genes of interest are transferred from one organism to another.**					
	Agree		**Dont Agree**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**
OFAB Attendees	**45**	**49**	**3**	**3**	**48**	**52**
Non -attendees	**39**	**42**	**5**	**6**	**44**	**48**
Total	**84**	**91**	**8**	**9**	**92**	**100**

Source: Field Survey 2013

This means that generally, OFAB attendees are more informed about the fundamental process of genetic modification than non-attendees. This capacity of being more informed about the fundamentals of genetci modification by OFAB attendees can be attributed to attendance to OFAB meetings.

To further assess the respondents knowledge about the possible effects of consuming genetically modified products. They were asked to indicate whether they agreed with the following staement: *By eating genetically modified (GM) food, a person's genes could also be modified*. Scientifically this is not a possible occurance, but a myth that prevails about genetic modification. More Non-attendees (12%) seemed to agree with this statement in comparison to OFAB attendees of whom only 3% seemed to agree with this statement out of the 46 who responded to this question.

Table 7: By eating genetically modified (GM) food, a person's genes could also be modified

Attendance	By eating genetically modified (GM) food, a person's genes could also be modified.					
	Agree		Dont Agree		Total	
	f	%	f	%	f	%
OFAB Attendees	**3**	**3**	**43**	**48**	**46**	**51**
Non -Attendees	**11**	**12**	**32**	**37**	**43**	**49**
Total	**14**	**15**	**75**	**85**	**89**	**100**

Source: Field Survey 2013

The data presented in table 7 above is a further indication that OFAB attendees are generally more knowledgeable about the scientifically verifiable facts about genetic modification. The findings also further indicate that more non-OFAB attendees were likely to accept and believe in myths about genetic modification in comparison to OFAB attendees.

Finally, to assess the respondents knowledge about specific aspects of how genetic modification is being used in Kenya; they were asked two questions about the sale of genetically modified products in Kenya and the commercial growing of genetically modified crops in Kenya.

As depicted in table 8 below, majority of both the OFAB attendees and Non-attendees seemed to concur that products from genetically modified crops were on sale in the country. More Non-attendees (38%) held this position in comparison to OFAB attendees (32%).

Table 8: Products from genetically modified crops are now being sold in Kenya

Attendance	Products from genetically modified crops are now being sold in Kenya.					
	Agree		Dont Agree		Total	
	f	%	f	%	f	%
OFAB Attendees	**30**	**32**	**18**	**19**	**48**	**51**
Non -Attendees	**36**	**38**	**10**	**11**	**46**	**49**
Total	**66**	**70**	**28**	**30**	**94**	**100**

Source: Field Survey 2013

It is instructive to note that more OFAB attendees (19%) than the non-attendees (11%) had knowledge of the correct scenario – that there were no products from genetically modified crops being sold in Kenya at the moment. As a matter of fact, there are currently no genetically modified products being sold in Kenya and the government put in place a ban on the import of genetically modified products in November 2012. Neither are there currently any genetically modified crops that have been licensed by the National Biosafety Authority (NBA) for growing by farmers in Kenya. What this data illustrates is the fact that attending OFAB seems to not only add value to the level of knowledge of participants about genetic modification, but also equip them with information about current issues regarding genetic modification in the country.

The respondents were further asked whether farmers in Kenya are growing genetically modified crops. The findings presented in table 9 indicate that more Non-attendees (34%) wrongly believe that genetically modified crops are already being grown commercially by farmers in Kenya. This is in stark contrast to only 18% of OFAB attendees who believe so too. A majority of the OFAB attendees (33%) possess the correct knowledge that genetically modified crops are not yet grown by farmer in the country. Only 15% of non-attendees have the correct information.

Table 9: Genetically modified (GM) crops are being grown by farmers in Kenya

Attendance	Genetically modified (GM) crops are being grown by farmers in Kenya					
	Agree		Dont Agree		Total	
	f	%	f	%	f	%
OFAB Attendees	**16**	**18**	**28**	**33**	**44**	**51**
Non -Attendees	**29**	**34**	**13**	**15**	**42**	**49**
Total	**45**	**53**	**41**	**48**	**86**	**100**

Source: Field Survey 2013

The findings of table 9 are yet a further confirmation that attending OFAB meetings improves the knowledge levels of a participant about genetic modification in the country. Genetically modified crops are not yet approved by the National Biosafety Authority for growing by farmers in Kenya.

To assess the practices of knowledge gathering practices of both OFAB attendees and non-attendees, the respondents were asked to indicate through which medium they mostly obtained information about genetic modification in Kenya. As presented in table 10, The internet (63%), followed by newspapers (55%), then friends and colleagues (42%) were overally the three most utilized mediums to obtain information about genetic modification for both sets of respondents.

Amongst OFAB attendees only, the internet (35%) was still the most popular source of information closely followed by OFAB meetings (34%). Amongst Non-attendees, the newspapers (31%) were the most popular source of information, follwed by the internet (28%).

Table 10: Sources of Information about genetic modification

Media	Attendance to OFAB					
	Attendees		Non attendees		Total	
	f	%	f	%	f	%
Newspapers	23	24	29	31	**52**	**55**
Online / Internet	33	35	27	28	**60**	**63**
OFAB	32	34	5	5	**37**	**39**
Friends/ Colleagues	19	20	21	22	**40**	**42**
Pamphlets/Brochures	19	20	8	8	**27**	**28**
University Scientists	23	24	6	7	**29**	**31**
National Biosafety Authority	23	24	6	7	**29**	**31**
Science Magazines	23	24	10	11	**33**	**35**
Seminars	24	25	8	9	**32**	**34**
Government officials	12	13	7	7	**19**	**20**

Source: Field Survey 2013

The data presented in table 10 above indicates that any knowledge sharing or awareness creation about genetic modification needs to use the Internet, newspapers and interpersonal channels like friend and colleagues to make impact. For targeted outreach to non-attendees the best medium to use is the newspaper. However for the OFAB attendees, the internet and the OFAB forum are the two joint most recommendable mediums to use. There was also generally limitted use of government officials as sources of information. Only 20% of the respondents use them as sources of information about genetic modification. This could be an indicator of a lack of effort from the government to sensitize stakeholders about genetic modification.

4.2.3 general trends in attitude among stakeholders about specific current issues of policy debate relating to genetic modification in Kenya

The respondents were further asked questions that would clarrify their attitudes about specific issues of policy discourse relating GMOs in Kenya. The respondents were first asked to indicate whether genetic modification in animals or plants was more acceptable to them. As presented in Table 11, majority of the respondents (54%) – both attendants and non-attendants, were more accomodative of both genetic modification in plants and in animals. However, considered separately, more respondents (42%) were receptive of genetic modification in plants compared to only 4% who have a favourable attitude towards genetic modification in animals.

Table 11: More acceptable practice with regards to genetic modification

Attendance	Which is more acceptable to you?							
	Genetic modification in animals		Genetic modification in plants		both		Total	
	f	%	f	%	f	%	f	%
OFAB Attendees	2	2	14	16	30	35	46	53
Non - Attendees	2	2	22	26	16	19	40	47
Total	4	4	36	42	46	54	86	100

Source: Field Survey 2013

The respondents who indicated that it was more acceptable to modify plants explained that plants heavily rely on climate for survival and therefore their modification is easier compared to animals. They also explained that modification of plants is safer way of solving the problem of food shortage. Modification of animals was explained to be inhuman and abuse of animals rights.

Regarding labeling of genetically modified foods, trespondents were asked to indicate whether or not they prefered the existance of a labeling regime for GM foods. As presented in table 12, majority of the respondents (55%) expressed strongly felt that GM foods should be labeled while another 37% agreed that some form of labeling would be necessary. Only 3% of the respondents strongly disagreed that labeling of GM foods was necessary. Therefore an aggregated 92% of respondents were generally in favor of labeling compared to only 8% of the respondents who were not in favor of it.

Table 12: Foods that have been genetically modified should be labeled

Attendance	**Foods that have been genetically modified should be labeled.**									
	Strongly agree		**Agree**		**Disagree**		**Strongly disagree**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Attendees	**22**	**24**	**19**	**20**	**4**	**4**	**2**	**2**	**47**	**51**
Non -Attendees	**29**	**31**	**15**	**16**	**1**	**1**	**1**	**1**	**46**	**49**
Total	**51**	**55**	**34**	**37**	**5**	**5**	**3**	**3**	**93**	**100**

Source: Field Survey 2013

The issue of whether or not to label genetically modified foods is currently one of the areas of current policy discourse. The results in table 12 above therefore confirm that an overwhelming majority of stakeholders regardless of whether they attend or don’t attend OFAB would prefer to have a labeling regime for genetically modified food products in place. The point of contention however for those who feel that labeling is not necessary has been the fact that if GM foods are considered to be as safe as other non-GM food products, why then do they need to be labeled? According to those opposed to labeling, they express the fear that labeling will lead to discrimination of genetically modified foods. Further to this, they expressed reservations about how practical a labeling regime would be enforced in Kenya especially considering that majority of the food products were sold in open markets where foods come directly from the farm to the market and to the table. On the contrary, respondents who were in support of labeling explained that it gives room to make choices, allow for easy identification and to ensure safety among consumers.

To test how resolute the respondents were on the issue of labeling. They were asked if they are willing to pay an extra-cost of goods as a result of labeling them as being either genetically modified or not. As presented in table 13, majority of the respondents (55%) indicated that they were willing to pay for the extra cost of goods as a result of labeling while another 45% said they were unwilling to pay the extra-cost that could come as a result of labeling.

Table 13: Willingness to pay for the extra cost of goods as a result of labeling

Attendance	**I am willing to pay for the extra cost of goods as a result of labeling genetically modified foods**					
	Yes		**No**			
	f	**%**	**f**	**%**	**f**	**%**
OFAB Attendees	31	34	15	16	**46**	**50**
Non -Attendees	19	21	27	29	**46**	**50**
Total	50	55	42	45	**92**	**100**

Source: Field Survey 2013

The findings in table 13 above indicate that much as labeling of genetically modified foods is the preferred scenario for majority of the respondents, economic considerations still surpasses their desire for labeling. As a result, they are not so much in favor of labeling GM food products if it will increase the amount of money they have to spend in buying the products. This finding is useful for the policymakers in Kenya to rethink on ways of implementing the already existent labeling regimes in the country. It is therefore recommended that in whichever way labeling is implemented, the consumers should still be cushioned from any price increases that may result from it.

Asked whether they would buy genetically modified food in the event that they were cheaper in comparison to non-GM foods, majority of the respondents (65%) as shown in table 14 responded in the affirmative. Only 35% of the respondents indicated that they would not buy genetically modified food even if they were cheaper.

Table 14: Buying genetically modified foods if cheap

Attendance	**Would you buy genetically modified foods if they were cheaper than non-genetically modified foods?**					
	Yes		**No**		**Total**	
	f	**%**	**f**	**%**	**f**	**%**
OFAB Attendees	34	38	11	12	**45**	**50**
Non -Attendees	24	27	21	23	**45**	**50**
Total	58	65	32	35	**90**	**100**

Source: Field Survey 2013

The findings in table 14 above indicate that for majority of the respondents, economic considerations formed and integral aspect of their decision whether to consume genetically modified products or not. This finding further confirm the data in table 13 that indicates economic considerations as the biggest factor when it comes to decisions regarding whether or not to consume genetically modified products.

Asked to explain their answers, those who indicated that they would buy GMOs explained that if it is economical then they would buy because the foods would have already been proved to be safe for consumption anyway. Those who inidcated that they would not buy GMOs even if the prices were lower noted that cheap is expensive in the long run. By this they meant that even though GMOs may be cheap, they may have negative effects on health in the long run and thus they were cautious not to consume them.

To test on the views of the respondents on the ban on GMOs, they were asked to indicate their level of agreement with the GM imports ban that was currently in place in the country. The findings on Table 15 shows that 23% of the respondents strongly agreed that GMO imports should stay banned untill they are proved safe for human consumption. A further 34% subtly agreed with this sentiment. On the converse, 16% strongly disagreed that the GMO imports should be banned and a further 26% also disagreed with this position.

Table 15: Stopping GMO imports untill they are approved safe for human consumption

Attendance	**All GMO imports into Kenya should be stopped until there is sufficient evidence that GMOs are safe for human consumption.**									
	Strongly agree		Agree		Disagree		Strongly disagree		**Total**	
	f	%	f	%	f	%	f	%	f	%
Attendants	6	7	16	19	14	16	6	7	42	49
Non -attendants	14	16	13	15	9	10	8	9	44	51
Total	**20**	**23**	**29**	**34**	**23**	**26**	**14**	**16**	**86**	**100**

Source: Field Survey 2013

The findings in table 15 is an indication that most of the respondents were cautious about GMOs. The findings therefore suggests that more research work and knowledge sharing and awareness creation should be conducted to ease stakeholder uncertainities with regards to the safety genetic modification and its products.

Asked to explain their answers, the respondents in favour of banning GM imports mentioned that GMOs have great potential to harm consumers' health and thus there should be enough/sufficient evidence that GMOs are safe for consumption and will not have negative effects on consumers before they are imported into the country. They also explained that there is no conclusive and universal agreement on the safety of GMOs.

Those who were of the opinion that the ban shouldn't even be in place explained that GMOs should only be labeled to allow for choice among consumers as opposed to blaket ban. They also mentioned that the research done globally by reputable institutions have shown that GMOs are safe for consumption. They also pointed out further that GM products were already being consumed in other countries and that it is not logical to stop GMO imports using the guise of the safety of Kenyan consumers while the same consumers travel abroad and generally consume the GM products withour any negative effects on their health.

The respondents were also asked whether in their opinion they felt that the risks of GMOs had been exaggerated. As presented in table 16, majority of the respondents (81%) also expressed their concern that majority of the popularly held risks of genetically modified foods and crops were greatly exaggerated. This opinion was held by both the OFAB attendees (43%) and Non-attendees (38%). Only 19% felt that the risks of GM foods were not exaggerated.

Table 16: The risks of genetically modified foods and crops have been greatly exaggerated.

Attendance	The risks of genetically modified foods and crops have been greatly exaggerated.					
	Yes		No			
	f	%	f	%	f	%
OFAB Attendees	**38**	**43**	**6**	**7**	**44**	**49**
Non -Attendees	**34**	**38**	**11**	**12**	**45**	**51**
Total	**72**	**81**	**17**	**19**	**89**	**100**

Source: Field Survey 2013

The findings represented in table 16 above generally indicate that most stakeholders understand that most of the popularly held information about the negative efects of consuming GMOs are largely exaggerated. This findings therefore outline the amount of knowldge sharing and awareness creation work that forums like OFAB still needs to be do with regards to GMOs so that the stakeholders can have factual and scientifically based information.

Asked on whether the government were effective in ensuring that GMOs are safe for human consumption. The findings of the study are as presented in Table 17 below. Majority of the respondents (58%) agreed that the government agencies in charge of overseeing the safety of genetically modified food were competent in doing so. Another significant number of respondents (29%) were however not sure that these government agencies were able to effectively ensure safety of genetically modified foods. Only 13% of the respondent felt that the government agencies were not up to the task of ensuring the safety of GM products.

Table 17: Capability of government agencies to ensure safety of genetically modified organisms

Attendance	Government agencies are capable of effectively ensuring that genetically modified organisms (GMOs) are safe for human consumption.							
	Yes		No		Not sure		Total	
	f	%	f	%	f	%	f	%
OFAB Attendees	29	32	4	4	11	12	44	49
Non - Attendees	23	26	8	9	15	17	46	51
Total	52	58	12	13	26	29	90	100

Source: Field Survey 2013

The findings above indicate that a good majority of stakeholders have confidence in the ability of the government agencies capability to effectively regulate genetic modification. However, the significant percentage that either remain unconvinced (13%) or uncertain (29%) about the ability of the government agencies' ability is however worrying. This either indicated that the agencies haven't explained clearly to the stakeholders their capacity to effectively regulate genetically modified products or the stakeholders plainly don't believe that they are capable and therefore more capacity should be created.

Those who stated that government agencies were effective explained that the government officers are trained to conduct the neccesary tests to ensure safety of GMOs and government agencies such as KEPHIS and Kenya Bureau of Standards are in place to ensure that GM plants and food products are safe to the environment and for human consumption. Other govenment agencies like NBA also regulate the use of GM products in the county.However, those who stated that the government agencies are not effective explained that there is inadequate technology to effectively research on GMOs, inadequate trained human resource on GMOs combined with corruption may compromise their effectiveness.

4.2.4 Influence of demographic factors on attitudes of both OFAB and non-OFAB stakeholders towards genetic modification

To interrogate whether an individual's level of education influenced attitudes about genetic modification. The respondents were asked whether they thought genetic modification was harzadous, somewhat harzadous or not harzadous at all. Their responses are summarized in table 18.

Table 18: Are genetically modified foods harzadous

	I think genetically modified foods (GM foods) are						
Level of education	**Attendance**	**Not Hazadous**		**Somewhat Hazadous**		**Very Hazadous**	
		f	%	f	%	f	%
Primary	Yes	1	1	0	0	0	0
Secondary	Yes	1	1	0	0	0	0
	No	1	1	0	0	0	0
Tertiary	Yes	21	24	15	17	3	4
	No	11	12	21	24	0	0
Post graduate	Yes	6	7	0	0	0	0
	No	2	2	6	7	0	0
Total		**42**	**48**	**42**	**48**	**3**	**4**

Source: Field Survey 2013

The findings on Table 18 shows that 17% the respondents who had been educated upto a tertiary level felt that genetically modified foods were somewhat harzadous while another (4%) felt that they were not harzadous at all. Perhaps instrutive of how the level of education influences attitudes towards genetic modification, not a single respondent educated up to post-graduate level indicated that GM foods are harzadous. This is probably because through education they had gotten to understand and read a variety of literature that shows GM products can not be condemned through blanket statements, but rather on a case by case basis.

Those who indicated that GMOs were not hazadous explained that GMOs undergo rigorous scientific testing and cannot be outrightly considered hazardous. They also explained that commendable measures such as testing and monitoring by government agencies were being done to ensure the safety of GMOs for human consumption and the fact that they have been used in other countries for long without any known serious negative effects make them be considred non hazardous. But a total 48% who indicated that GMOs were somewhat hazardous explained that they were not sure of the long term effects of GMOs and that scientifc reports indicate the possibility of negative effects of GMOs.

4.3 Conclusions

Overall, our findings indicate a strong influence by the OFAB Kenya Chapter on the attendees knowledge, attitude and practices regarding the subject of genetic modification. The OFAB attendees generally exhibited more awareness and knowledge when it comes to the issue of genetic modification. As illustrated in table 4, a total of 37% of OFAB attendees felt confident that they were very knowledgeable about genetic modification while none of the non-attendees had this kind of confidence in their knowledge about GMOs. The attitudes of attendees toward genetic modidfication was also more accomodative, probably because they had gotten a chance to obtain knowledge about this controversial subject. As represented in table 18, more OFAB attendees (33%) indicated that genetic modification was not harzadous compared to only 31% of non-attendees who felt it is somewhat harzadous.Regarding contemporary issues of policy debate with regards to genetic modification, for example labeling, it didn’t matter, whether the respondents were OFAB attendees or non-attendees, all of them were almost unanimous that labeling of products that have genetically modified content was their ideal scenario inorder to facilitate choice. Interestingly however, it emerged from the findings that financial consideration played a major part in the decisions about whether or not to consume GM products. As shown in table 14, majority of the respondents (65%) indicated that they would buy genetically modified foods in the event that they were cheaper in comparison to non-GM foods. Only 35% of the respondents indicated that they would not buy genetically modified food even if they were cheaper. This findings offer an insight about how the respondent evaluate genetically modified product based on high ideals which they subsequently lower as soon as reality strikes and there is need for practicality.

CHAPTER FIVE

SUMMARY, POLICY IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 Introduction

This study set out to investigate whether attendance to the OFAB meeting had impact on the knowledge, atitudes and practices of OFAB attendees compared to non-attendees. As captured in hapter one, OFAB is a regular weekly forum that is open for attendance to all interested individuals and organizations with the aim of sharing knowledge and creating awareness about agricultural biotechnology. Chapter two provided an indepth review of literature about agricultural biotechnology in general and genetic modifiction in particular and why communicating about genetic modification like OFAB does is not a straight forward affair. Chapter three of this study highlited the methodology used in conducting this study and how the researcher collected and analyzed the data that was presented exhaustively in chapter four of this research report. In this chapter, we are now presenting the recommendations and specific issues for policy action arising from this study. Drawing from the empirical data gathered through this study, we hope that the already illustrated benefits of OFAB Kenya from chapter will make a strong case for the expansion of the OFAB forum beyond Nairobi into the new county administratives units so that the rural populations can also be exposed to more knowledge about genetic modification.

This study has justified the important role played by the OFAB Kenya Chapter in sharing knowledge and creating awareness amongst stakeholders about a controversial agricultural technological subject like genetic modification. As shown in the findings presented in table 4, OFAB attendees are more knowledgeable and aware about genetic modifcation thah the non-attendees. More however needs to be done by expanding the forum into the counties and further to ensure that the whole country has the benefit of this knowledge that will help in making informed decisions about whether or not to to use genetically modified products.

5.2 Policy Implications

Kenya's first genetically modified product (Bt cotton) is expected to come into the market in 2014/2015. Stakeholders like farmers and the public therefore need to be sufficiently knowlegeable in order to make the correct choices about genetically modified products like Bt cotton. Additionally, the first genetically modified food product - the Water Efficient Maize for Africa (WEMA) is expected to be commercialized in 2017. Will the consumers expected to use it for food be able to separate the myths from the facts about the alleged negative effect of consuming genetically modified foods?

There is therefore, a lacuna of knowledge that needs to be filled sonner rather than later as Kenya moves towards commercializing genetically modified products. The OFAB Kenya Chapter through this study has illustrated that, forums such as these make an impact interms of knowledge sharing and awareness creation about a technology like genetic modifiction. Once the potential consumers of these genetically modified products acquire a crtical mass of knowledge, then decision making about whether or not to use products developed from the technology becomes easier. To fill this existing knowledge void on genetic modification, both the government and other development agencies (both local and international) need to come in and either offer support for expansion of initiatives that are already delivering on this like the OFAB Kenya Chapter or to alternatively create vibrant and complementary agencies and forums that can operate across the country.

5.3 Recommendations

Few knowledge sharing and awareness creation forums on agricultural biotechnology and genetic modification exist within the country. As already shown by the findings of this study, OFAB has been confirmed as a forum that has helped the stakeholders to better understand the subject and therefore be able to make informed decisions about the use of genetic modification. For this reason and from the findings laid out in chapter four of this study, the researcher wishes to make the following recommendations:-

- The OFAB forum needs to be expanded beyond the capital city of Nairobi. This is because as has been illustrated by our study findings, the OFAB attendees are much more confident and consider themselves more knowledgeable about genetic modification. They are therefore, empowered to make informed decisions and choices about whether or not to use genetically modified products in the next few years when they eventually get commercialized.

- To rope in more participants during OFAB meetings given that the findings of our study indicate that organizers should focus more on using interpersonal channels of communication. This is because most of the respondents (36%) sampled noted that they had become aware about the OFAB Kenya Chapter through friends and colleagues. This medium was followed by Email forwards (26%) and thirdly by both the mass media channels (16%) as well as the Internet (16%). These four channels are clearly OFAB Kenya Chapter's best mediums for getting more people to participate in the forum.

- The three most popular mediums for sharing knowledge about genetic modification are the internet, newspapers and finally friends and colleagues in that order. These are therefore, the channels that OFAB Kenya Chapter should structure its communication and knwoledge dissemination strategy around. Other mediums would also be recommended, but as a matter of priority, these three should be utilized ahead of the others.

- Genetic modification in plants is more acceptable to stakeholders in Kenya than in genetic modification in animals. This therefore, calls for massive knowledge sharing/ awareness initiatives before the commencement of any genetic modification activities on animals.

- The issues of labeling genetically modified products is a strongly held opinion that most stakeholders are willing to pay an extra cost to guarantee that this is done as indicated by our field results. This issue is a current policy subject of discussion and should therefore, be considered on the basis of the findings of this study.

- Economic considerations are a major factor for stakeholders considering to use genetically modified products. It will therefore be critical for the manufacturers and producers of products with genetically modified contents to ensure that the prices of their products are cheaper to ensure that they are bought once they finally are commercialized.
- Although a slight majority of stakeholders who participated in this study expressed confidence in the ability of the government agencies to ensure the safety of use of genetically modified products in Kenya. The government in general still needs to do more in this regard in order to provide leadership when it comes to the subject of genetic modification. From the findings it was clear that the government was the least utilized source of information when it comes to genetic modification as only 20% indicated it as a source of information.

5.4 Conclusions

As postualted in the diffusion of innovations theory, this study has confirmed that knowledge sharing forums like OFAB play an important part in the diffusion process of any new innovations. It is therefore, imperative that pro-active measures be made to kick-start a country-wide initiative to promote awareness about genetic modification. Kenya is expected to commercialize its first genetically modifed product in under 12 months from the publication of this research. Urgent action is therefore needed to ensure that citizens understand what genetic modification is all about and to address the numerous myths and misconceptions about its negative effects.

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APPENDIX I

QUESTIONNAIRE

Dear Respondent,

Thank you for accepting to respond to this questionnaire. The questions herein are for the purposes of generating data for an academic research project as part of the requirements for the award of a Master of Arts Degree in Communication Studies at the School of Journalism, University of Nairobi.

Your assistance in answering the questions truthfully and accurately will be highly appreciated. Please also note that the information you provide here will be treated with utmost confidentiality.

Thank you once again!

Kind regards,

Jonathan Odhong',
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SECTION A: Respondent Demographic Characteristics

Date:	**Response options**	**Mark { X } as appropriate**

Name		
Age Category	**21 – 35 years**	
	36 - 45 years	
	46 - 55 years	
	56 years and above	
Educational Level Attained	**No formal education**	
	Primary	
	Secondary	
	Tertiary (College/University)	
	Post-Graduate (Masters/PhD)	
Professional Categorization	**Government Officer**	
	Researcher/ Scientist	
	Journalist	
	Religious Leader	
	Business Person	
	Student	
	Communications Specialist	
	Elected Leader	
	Other	

SECTION B: Sources of information, knowledge and understanding of genetic modification

	Question	Response options	Mark { X } as appropriate

1.	(a)	**Have you heard of the Open Forum on Agricultural Biotechnology (OFAB)?**	Yes	
			No	
	(b)	**If Yes, how did you hear about the Open Forum on Agricultural Biotechnology (OFAB)?**	Email	
			Internet	
			From a colleague	
			During another meeting	
			From the media	
2.	(a)	**Have you attended an OFAB meeting before?**	Yes	
			No	
	(b)	**If Yes, how many times?**	Once	
			Twice	
			Thrice	
			More than thrice	
3.		**How do you rate your knowledge about genetically modified organisms (GMOs)?**	Very Knowledgeable	
			Somewhat Knowledgeable	
			Not Knowledgeable	
4.		**Please explain in a short sentence what a genetically modified organism (GMO) is?**		
5.		**In reality, all crops have been "genetically modified" from their original state through domestication, selection, and controlled breeding over long periods.**	Agree	
			Don't agree	
6.		**In genetic modification, genes of interest are transferred from one organism to another.**	Agree	
			Don't agree	
7.		**By eating genetically modified (GM) food, a person's genes could also be modified.**	Agree	
			Don't agree	
8.	(a)	**Products from genetically modified crops are now being sold in Kenya.**	Agree	
			Don't agree	
	(b)	**Please explain your answer in 8 (a) above?**		
9.	(a)	**Genetically modified (GM) crops are now being grown by farmers in Kenya**	Yes	
			No	

		Question	Response options	Mark { X } as
10	(a)	**Where do you obtain most**	Newspapers	
			Online / Internet	
			OFAB	
			Friends/ Colleagues	
			Pamphlets/Brochures	
			University Scientists	
			National Biosafety Authority	
			Science Magazines	
			Seminars	
			Government officials	
	(b)	**How much trust do you have on the sources of information selected in question 10 (a)?**	Total Trust	
			Some Trust	
			No Trust at all	
			Not Sure	
	(c)	**How would you rate the clarity of the information?**	Very Clear	
			Somewhat Clear	
			Not Clear	
	(d)	**How do you rate the usefulness of the information?**	Very Useful	
			Somewhat Useful	
			Not Useful	
	(e)	**How scientific is the information?**	Very Scientific	
			Somewhat Scientific	
			Not Scientific	

SECTION C: Worldviews and values about genetic modification

				appropriate
11.	(a)	**The use of genetic modification is against my moral values.**	Yes	
			No	
	(b)	**Please explain your answer in 11 (a) above?**		
12.	(a)	**Genetic modification takes mankind into realms that belongs to God alone.**	Yes	
			No	
	(b)	**Please explain your answer in 12 (a) above?**		
13.	(a)	**Which is more acceptable to you?**	**G**enetic modification in animals	
			Genetic modification in plants	
			Both	
	(b)	**Please explain your answer in 13 (a) above?**		
14.	(a)	**Foods that have been genetically modified should be labeled.**	Strongly Agree	
			Agree	
			Disagree	
			Strongly Disagree	
	(b)	**Please explain your answer in 14 (a) above?**		
15.		**I am willing to pay for the extra cost of goods as a result of labeling genetically modified foods.**	Yes	
			No	

SECTION D: Attitude and perceptions towards genetic modification

		Question	Response options	Mark { X } as appropriate
16.	(a)	**All GMO research currently going on in Kenya should be stopped until there is sufficient evidence that GMOs are safe.**	Strongly Agree	
			Agree	
			Disagree	
			Strongly Disagree	
	(b)	**Please explain your answer in 16 (a) above?**		
17.	(a)	**All GMO imports into Kenya should be stopped until there is sufficient evidence that GMOs are safe for human consumption.**	Strongly Agree	
			Agree	
			Disagree	
			Strongly Disagree	
	(b)	**Please explain your answer in 17 (a) above?**		
18.	(a)	**Would you buy genetically modified foods if they were cheaper than non-genetically modified foods?**	Yes	
			No	
	(b)	**Please explain your answer in 18 (a) above?**		
19.	(a)	**I think genetically modified foods (GM foods) are**	Not Hazardous	
			Somewhat Hazardous	
			Very Hazardous	
	(b)	**Please explain your answer in 19 (a) above?**		
20.	(a)	**Government agencies are capable of effectively ensuring that genetically modified organisms (GMOs) are safe for human consumption.**	Yes	
			No	
			Not sure	
	(b)	**Please explain your answer in 20 (a) above?**		
21.		**The risks of genetically modified foods and crops have been greatly exaggerated.**	Yes	
			No	
22.	(a)	**Vital information about the health effects of GM foods is being held back.**	Yes	
			No	
	(b)	**Please explain your answer in 22 (a) above?**		
23.	(a)	**Current regulations for genetically modified organisms (GMOs) in Kenya are sufficient to protect people from any risks linked to GMOs.**	Yes	
			No	

	(b)	**Please explain your answer in 23 (a) above?**	