An analysis of the socio-economic consequences of biosafety regulation: The case of maize trade between Zimbabwe and South Africa

by

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DECLARATION

I, **Cleopatra Sikhangezile Siphiweni Ngulube**, declare that this thesis, which I hereby submit for the degree of **MSc (Agric) Agricultural Economics** at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other institution.

Signature: _____

Date: _____

DEDICATION

To my daughter Kukudzwa and my son Nkanyiso, I love you more than you know. Although this thesis took some of my time away from you, I hope you are inspired by this achievement and all the work that went into it.

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AN ANALYSIS OF THE SOCIO-ECONOMIC CONSEQUENCES OF BIOSAFETY REGULATION: THE CASE OF MAIZE TRADE BETWEEN ZIMBABWE AND SOUTH AFRICA

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ABSTRACT

The levying of strict biosafety regulations for GM imports intended for food, feed and processing by importing countries is expected to have socio-economic consequences. For countries like Zimbabwe the significance of the impact of the regulations lies in the context of the role of regional agricultural trade in enhancing national food security. Accordingly, this study analyses the effects of complying with the regulatory requirements on Zimbabwe's maize grain-to-maize meal import supply chain from South Africa. The study uses a combination of quantitative and qualitative measures to determine the costs and benefits of the regulation. Focusing principally on the Zimbabwean consumers at the end of the supply chain, the price effect of the added costs of complying with the regulation are considered to represent the costs of the regulation; while the concerns of the consumers regarding GMOs based on the government's concerns as implied by the regulation, are assumed to be indicative of the benefits realised as a result of the regulation. The Total Landed Cost analysis is used to estimate price effect while the Consumer Risk and Benefit Perception analysis is used to determine the consumer perception.

The study reveals that Zimbabwe's strict domestic GM policy influences the regulation of trade in commodities with GM equivalents such as maize. The regulation has resulted in a dual maize grain import channel by stipulating import requirements that differentiate between GM and non-GM maize grain imports. As the only commercial producer of GM crops in

southern Africa, South Africa supplies both channels. However, in the non-GM channel South Africa competes with Zambia, who only produces non-GM crops and has managed to produce substantial surpluses in recent years. Taking this into consideration, the study conducts the cost analysis by comparing the GM and the non-GM channels and, the cost of maize sourced from South Africa and Zambia.

The evidence from the study suggests that the GM grain import channel is only known to be functional during times of severe food shortages, as in line with their strict GM policy the government of Zimbabwe tends to have a primary preference for non-GM maize. Nonetheless, the GM channel is characterised by a precise and elaborate compliance process aimed at preventing the grain from being used as seed. As such, the results of the cost analysis show that despite the purchase price of GM grain being significantly lower than non-GM grain the compliance procedures in the GM maize grain-to-maize meal channel makes it the most costly channel and consequently the market price of the maize meal is comparatively high.

The non-GM channel features as the customary channel with the comparison between South Africa and Zambia being highly emphasized. The most important finding is that despite the premium added on non-GM maize in the South African market, the price of the grain remains comparatively competitive. However, the relatively higher transport and logistics costs in the South African channel seem to be the major contributor of higher total landed cost of non-GM maize. In addition the study finds that while the price effect of the regulation on maize meal is unclear, the cost effects have acted as a protectionist measure for local producers who sell at government gazetted prices that are well above prices in the regional market. From these findings the study concludes that although the cost effect of the regulation has a distortionary effect on trade between South Africa and Zimbabwe, it cannot be considered in isolation of other economic factors such as transport costs as well as domestic distorted markets. Therefore the recommendation is that for the regional market to realise the potential of GM grain imports in providing affordable food imports, countries do not only have to accept GM imports but they have to address other challenges to regional trade such as high transport costs.

The analysis of the risk and benefit perceptions of the Zimbabwean consumers reveals that consumers are undecided about GMOs, as they perceive both high benefits and high risks.

The most perceived benefit is that GM crops increase food production and supply while the major perceived risk is the negative effect on human health and the development of allergic reactions. To this end the study concludes that the concerns of governments as outlined in the National Biotechnology Act (the primary law governing GMOs) and pronounced by the Minister of Agriculture are aligned with the concerns of the consumers. However, in contradiction, the occasional exceptional acceptance of GM grain or food in times of severe food shortages has resulted in the confusion among consumers. A further examination of the perceptions shows a limited knowledge about GM technologies. The recommendation is that perhaps increased public knowledge and awareness on GMOs may demystify GMOs thus reduce the confusion among consumers.

Overall, the study finds that the costs and benefits of the regulation are indistinct, as there are other socio- political and economic factors that come into play; with the findings suggesting that the perceived benefits for the consumers roughly outweigh the cost of the regulation.

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LIST OF ACRONYMS

AMA	Agricultural Marketing Authority
BFAP	Bureau for Food and Agricultural Policy
Bt	Bacillus Thuringiensis
CBA	Cost Benefit Analysis
CCAPS	Climate Change and African Political Stability
CCZ	Consumer Council of Zimbabwe
CIA	Central Intelligence Agency
COMESA	Common Market for Eastern and Southern Africa
CPB	Cartagena Protocol on Bio-safety
CPI	Consumer Price Index
DAFF	Department of Agriculture, Forestry and Fisheries
EU	European Union
FANRPAN	Food Agriculture and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Organisation
FAOSTAT	Statistics Division of the Food and Agriculture Organisation
FDA	Food and Drug Administration
FEWSNET	Famine Early Warning System Network
FISP	Farm Input Subsidy Program
FRA	Food Reserve Agency
FTLR	Fast Trek Land Resettlement
GATT	General Agreement on Trade and Tariffs
GM	Genetically Modified
GMAZ	Grain Millers Association of Zimbabwe
GMB	Grain Marketing Board
GMO	Genetically Modified Organisms
HT	Herbicide Tolerance
IAC	Inter Academy Council
IP	Identity Preservation
IPPC	International Plant Protection Convention
IPR	Intellectual Property Rights
IR	Insect Resistance

ISAAA	International Service for the Acquisition of Agri-biotech Applications
ITC	International Trade Centre
JADAFA	Joint Agribusiness Department of Agriculture, Forestry, and Fisheries Forum for Africa
MFN	Most Favoured Nation
MoAMID	Ministry of Agriculture, Mechanization and Irrigation Development
NAPRECA- ZIM	Natural Products Research for Eastern and Central Africa Zimbabwe
NBA	National Biotechnology Authority
OIE	World Organisation for Animal Health (formerly Office International des Epizooties)
PCR	Polymerase Chain Reaction
PQS	Plant Quarantine Services
RSA	Republic of South Africa
RoO	Rules of Origin
SA	South Africa
SADC	Southern African Development Community
SAFEX	South African Futures Exchange
SAGIS	South African Grain Information Services
SAZ	Standards Association of Zimbabwe
SCM	Supply Chain Management
SI	Statutory Instrument
SOP	Standard Operating Procedure
SPS	Sanitary and Phyto-Sanitary
TBT	Technical Barriers to Trade
TCE	Transaction Cost Economics
TLC	Total Landed Cost
TRIPS	Trade Related Intellectual Property Rights
UN	United Nations
UNCOMTRADE	United Nations Commodity Trade Statistics Database
US	United States
USA	United States of America
VCA	Value Chain Analysis
WEMA	Water-Efficient Maize for Africa

WFP	World Food Programme
WHO	World Health Organisation
WTO	World Trade Organisation
ZIMRA	Zimbabwe Revenue Authority

CHAPTER 1

INTRODUCTION

1.1 Background

The commercial use of genetically modified organisms (GMOs) in agriculture has had an effect on global trade in predominantly bulk, unprocessed agricultural products; both in business-related dealings and food aid deliveries (FAO 2003). The uncertainty surrounding the safety of GM products in the food chain and their possible impact on local biodiversity presents countries, not producing GM crops, with a trade-off between benefitting from relatively less expensive GM imports and, what some countries perceive to be, a compromise on human health and the environment. As such countries have had to develop bio-safety regulations that would permit them to appraise GM products for environmental and food safety before entering their borders.

While there are various international regulatory instruments that govern the different aspects of GMOs, the Cartagena Protocol on Biosafety (CPB) has generally been adopted as the principal guide for setting up regulatory frameworks on GMO import control by developing countries (Kimani & Gruère 2010). The Protocol, a supplement to the Convention on Biological Diversity was designed essentially for the protection of national biological diversity from the movement of GMOs across borders. Instituted on the basis of the precautionary principle it makes provision *inter alia* for importing countries to limit the importation of GMOs for feed, food and processing. The precautionary principle, at its most basic, is a concept that provides for regulatory action even in the absence of absolute scientific evidence of risk based on the reasoning that lack of proof does not mean absence of risk. Compliance with the provision involves importing nations putting in place pre-market approval processes and procedures requiring exporters to document and disclose information on any shipments that may contain GMOs (Articles 1, 2, 3, 4, 7 & 11 of the Protocol). Economically the regulation of GMO imports in trade can be justified by the need to protect the public and the environment from possible market failures resulting from externalities and information asymmetries. However, the benefits of reduced possible risks are not without costs and consequences on trade markets.

Managing potential risks related to importation of GM crops or products is knowledge intensive and requires a certain level of technical equipment and expertise. Henceforth the act of putting in place approval procedures involves the setting up of appropriate infrastructure and personnel for sampling, testing and verification of disclosed information; perceptibly this entails high initial investment costs. In addition, compliance with the pre-market approval procedures represents fixed costs for actors in the potential GM cross-border agricultural supply chains thus implying higher transactions costs. While several studies have focussed on the effect of GM regulation, there are relatively few studies on the consequent trade market effect on developing countries (Anderson & Jackson 2005; Bernauer 2005; Bouët, Gruère & Leroy 2011; Gruère & Sengupta 2008; Kimani & Gruère 2010). These studies generally argue that developing countries are technically and financially challenged in their capacity to implement the regulations, thus meaning limited effectiveness in ensuring import control. However, they do indicate that the regulation is generally expected to act like a tariff and have a distortionary effect on agricultural trade. On the basis of the assertions on the limited capacity of developing countries, researchers in fact seem to suggest that for developing countries the regulation is more of a cost to society than a benefit.

Although most developing countries have signed and ratified the Protocol they are yet to meet the basic obligations of the Protocol. Zimbabwe is reportedly one of the few countries in sub-Saharan Africa that signed, ratified and managed to meet the obligations of the Protocol (Nang'ayo 2006). Gruère and Sengupta (2008) identified Zimbabwe as the only country in Africa that has over a long period of time consistently implemented its regulatory ban on GM food products. However, Zimbabwe neighbours South Africa, a significant longstanding GM producer and exporter of agricultural produce. South Africa and Zimbabwe have strong trade relations dating back to the colonial times, by way of both informal and formal cross border movement of commodities and products between the two countries. Therefore it is necessary to understand the extent to which society has been affected by the regulations – in particular the society in Zimbabwe, where the restrictive regulation has impacted on the importation of the food commodity consumed as staple by the major share of the Zimbabwean population.

1.2 Problem statement

African countries have increasingly become net food importers (Rakotoarisoa, Lafrate & Paschali 2011), relying on the world food markets to meet domestic food requirements (Paarlberg 2008). However, the 2008 global food price spikes and shortages made again apparent the susceptibility of the African countries to the unpredictability of the world markets. Increased productivity and intra-regional trade are possible solutions to the crisis. Intra-regional trade has the potential to ensure access to cheaper regional products and to stabilise prices and supply. To experience the benefits of intra-regional trade, countries need to practise free trade with minimum barriers to trade. However, trade regulatory requirements have been identified as a growing and significant barrier to effective intra-regional trade (Keane, Calì & Kennan 2010; Kapuya *et al*. 2010).

Zimbabwe has been South Africa's main export market for maize since 2000, accounting for more than two-thirds of the exports. South Africa has also been enjoying a zero-rate import duty on its maize exports and subsequently supplying its product at a cheaper cost. But, since South Africa is a major GM maize producer, Zimbabwe's strict GMO import requirements have become the single important threat to the trade between these two countries (BFAP 2010). This situation raises two main questions:

- What is the cost for Zimbabweans to regulate or keep GM products from South Africa out of the country?, and
- What are the benefits of avoiding GMOs?

1.3 Importance of the study

The study uncovers information regarding the implied socio-economic welfare impacts of the current precautionary GM regulatory policy position in the Zimbabwe maize market. Taking a non-traditional approach to determine costs and benefits of the regulation, the study focuses on the regulation related additional costs in the Zimbabwe maize-to-maize meal import channel from South Africa and compare these to Zimbabwean consumers' perceptions on GM crops and / or food. The findings of the study are particularly important to regional policy makers as they can utilise the information to understand how biosafety policy can affect local and regional food security. The study also presents the first Zimbabwean

consumer GM perception study, a substantial contribution to the small but growing body of literature on African consumers' position on GM crops.

1.4 Objectives of the study

The overall objective of this study is to assess the social and economic effects of the implementation of the GM product focussed biosafety regulatory policy import requirements of Zimbabwe. Focusing on the Zimbabwe maize grain-to-maize meal supply chain from South Africa, the specific objectives of the study are:

- To outline the processes and procedures for approval and control of GM products exported from South Africa into Zimbabwe; this includes inspection, tests, and information and document requirements.
- To identify the cost of complying with the regulatory procedural requirements and the distribution of these costs in the maize supply chain.
- To establish the extent of the effect of the added costs on the maize grain and maize meal prices in Zimbabwe.
- To determine the risk and benefit perceptions about GM crops and food amongst Zimbabweans living in Zimbabwe and South Africa.

1.5 Research questions

- What are the effects of complying with the strict GM import regulatory requirements on a) the costs of activities in the maize value chain and b) on the prices of maize meal at the end of the chain?
- What are the benefit and risk perceptions on GM food of Zimbabwean consumers, and what is shaping these perceptions?
- Are the concerns emerging from consumer perceptions in alignment with the Zimbabwean Government's motivations for implementing the GM import regulations?

1.6 Research hypotheses

- The actions of complying with the GM import regulation add to the costs in the maize value chain. Consequently the additional costs are factored into the price of maize meal for Zimbabwean consumers.
- Consumers perceive low benefits and high risks in GM food crops that are shaped by a) attitude to science and technology, b) awareness and knowledge on GMOs, c) trust in information sources, food chain actors and regulators, and d) ethical, equity and moral concerns.
- The consumer concerns are in alignment with the desired policy outcome of the Zimbabwean Government's GM policy and regulations.

1.7 Overview of research methodology and data

To achieve the objectives and test the hypotheses of the study, a simplistic, non- traditional approach to cost benefit analysis that combines two distinctly different types of methodological approaches for cost and benefits valuations, was used.

The cost valuation method employed is the Total Landed Cost (TLC) model, which is rooted in the Supply Chain Management (SCM) branch of the field of Value Chain Analysis (VCA). On one hand it involved identifying and quantifying the direct costs of complying with the GM commodity importation regulation along the supply chain from a source where GM produce exist in the market (i.e. South Africa). On the other hand it involved determining a comparative non-GM counterfactual scenario by tracing the alternative supply chain from a source that has guaranteed GM-free products i.e. Zambia. All the costs were added to calculate the total cost of getting the product to the point of destination in Zimbabwe. A combination of primary and secondary data was used in the TLC model. The primary data used was collected using unstructured personal interviews with key informants while the secondary data was collected from generalised industry data, documented by various sources.

The benefit valuation method used relies on the psychometric paradigm of risk analysis where benefit is indirectly determined by inferring from the consumers' non-expert value judgements about the benefits and risks of GM foods. To this end, a consumer GMO perception survey was undertaken on a total of 260 Zimbabweans living in Zimbabwe and

South Africa. Data was collected from respondents across a range of demographic characteristics. The analysis of the survey data was mostly descriptive in order to provide a generalised view of GMOs by the Zimbabwean society. The study focuses on the consumers as the point of benefit valuation because ultimately the added costs of the regulation are expected to end up with the consumer through increased prices of maize meal. Respectively, the study establishes the consumer concerns around GMOs and compares them to the government motivations behind the policy, as implied in the interpretation of the written policy document.

1.8 Outline of the study

This dissertation is organised as follows, following this introductory chapter, chapter two presents a literature review on the introduction of GMOs in food and agriculture, and the culmination of the regulations to govern its presence and movement within the global, developing country and southern Africa contexts. Chapter three provides a detailed description and discussion of the overall research design, the entire research process and method of analysis of the data. Chapter four provides details of the actual regulation, indicating where it is applied in the supply chain and also discusses the findings of the cost valuation. Chapter five presents the consumer perceptions findings, provides a demographic profile of surveyed Zimbabwean consumers and discusses the possible explanations on factors that influence perceptions. Chapter six concludes with a summary discussion of the collective findings, concluding remarks on the implication of the results and recommendations for the future.

CHAPTER 2

LITERATURE REVIEW

GENETICALLY MODIFIED ORGANISMS IN FOOD AND AGRICULTURE

2.1 Introduction

The modern global food and agricultural system has evolved to operate under an entirely new economic model that relies substantially on science and sophisticated technologies (Kinsey 2003). It has become what Kinsey (2003) terms, "a brave new world of production and consumption;" where backward linkages of the food supply chains extend well beyond the traditional farm input suppliers as we know, to scientists who now remodel the food itself using emerging and novel technologies such as genetic modification to create new traits and products. Most commonly, scientific research is being used to create novelties that assist farmers to produce more produce while using less resources and less effort (Douthwaite 2001). The science is often not well-understood and is often subject to various judgments and interpretations by biased and unbiased parties resulting in uncertainty and generally, division in consumer views and reactions to this new agro-food industry. While some have readily embraced this new food economy there are others who either dread or abhor it.

Arising from this mix of sentiments is a new and diverse set of ideological and physical threats perceived by the different sections of the society regarding the human, environmental and societal impact of the novelties (Kinsey 2003). Depending on the influences of the different sections of the society, countries have adopted varying levels of tolerance for the new technologies in their food systems; consequently transforming the paradigm on which the international food and agricultural trading system is built. In the past, the trading system was founded on the design of international trade agreements and policies that largely depended upon the assumption that commodities traded across national borders are homogenous. However, the introduction of the new technologies has created a parallel demand for trade policy that governs products of the new science separately from the 'usual' product in order to minimise the perceived potential threats.

In the context of food security, and for the reason that food and agriculture are at the heart of many countries' economic wellbeing, policy makers are faced with the trade-off between harnessing the asserted benefits of accessing an adequate supply of affordable food and guarding against any perceived threats to society that are presented by the science. Addressing this trade-off has extensively been emphasised by some scholars to be of greater importance for developing countries (especially those in southern Africa) that have not fully embraced the new scientific advancements and, yet continue to face challenges in meeting the food quantity requirements of their populations and rely on the unstable world trade markets for the supply of their food (Paarlberg 2008; Bourlag & Carter 2008). As such, the main issue of concern is how developing countries can guard against any threats while meeting their populations' food needs at minimal cost.

In this regard this chapter focuses on the review of literature on the specific application of the science of genetic modification in crop production and its significance and impact on food and agricultural trade systems. The chapter provides an overview and synthesis of previous research on the use of GM in food and agriculture by providing a background to the establishment of the GM trade regulatory policy. Starting with the definition of GM crops, the literature review explores the overall theme of the research study: the impact of GM crop introduction on trade in the food and agriculture industry and consequently in the wider context of food security for countries in the southern African region.

2.2 Defining genetically modified crops/ food

Bearing a variety of names (often used interchangeably in many literature sources) that include genetically modified organisms (GMOs), biotech crops, transgenic crops, bioengineered crops, genetically engineered (GE) etc.; genetically modified (GM) crops are products of modern plant breeding techniques based on the science of genetic engineering – a branch of agricultural biotechnology. The crops are created using a precise and advanced process of genetic manipulation, which involves altering the genetic make-up of crop varieties by taking certain desirable genetic traits from another organism and introducing it into the cells of the targeted crops. The difference between conventional breeding and genetic engineering is that the in some cases genes are transferred between organisms that are totally unrelated. The precision and selectiveness of adding specific genes from one organism to

another, not only speeds up the breeding process but has enabled certain traits that were previously difficult or impossible to obtain through conventional breeding to be added to crop varieties (Brookes 2014; Paarlberg 2008).

There are three categories of GM crops namely first, second and third generation GM crops. First generation GM crops are mainly focused on improving agronomic traits while the second generation involves quality enhancement traits such as improved nutritional content in food products. The third generation of crops is mostly designed to produce specific substances for pharmaceutical or industrial purposes (Qaim 2009). To date the category of the first generation of GM crops is the most prevalent as it is most long-established, widely adopted and commercially produced globally. For this reason the literature review and ultimately the study are respectively written and conducted with particular reference to the first category. The two common traits of the first generation GM crops are herbicide tolerance (HT) and insect resistance (IR). Sometimes these traits exist separately and in some cases they are stacked together (i.e. added simultaneously) in one crop. Insect resistance is generally developed through the transfer of genes from the soil bacterium *Bacillus thuringiensis* (B*t*), which produces a certain type of protein not digested by many insects while herbicide tolerance ensures crop survival from the spraying of a broad spectrum herbicide like glyphosate or 2.4 D.

The HT and IR crops were first developed and approved for commercial use in the mid 1990s (Paarlberg 2008). Since then the production of crops with these traits has increased exponentially such that by 2010 the area under production of single and stacked traits was one hundred times more accounting for almost 100% of the area under GM crop production (James 2010). In addition substantial yield increases, lower production cost and income gains resulting from the HT and IR crops have been recorded (Brookes & Barfoot 2014). However in spite of the extensive production, the positive yield and income benefits as well as the cost effective weed and pest management the genetic modification of food crops has been received with considerable suspicion by some sections of the society. Respectively, the global sentiments about the GM products have largely been split into two distinct and strongly conflicting views i.e. the pro-GM view and the anti-GM view. Although according to international scientific commissions such as the United Kingdom Royal Society of Medicine, the US National Academy of Science, the French Academy of Science etc. the science of genetic modification is secure, there are various aspects that are contested by the antagonists.

The contested aspects have thus become points of conflicts and debate between the protagonist and the antagonists as both sides have undertaken and are well funded to support their point of view.

2.3 The main points of conflict on genetic modification in food and agriculture

This section discusses the key points of conflict on GM foods based on the main arguments of the pro-and anti-GM viewpoints. The main points of conflict are centred on the potential direct and side-effect impacts of the GM crops on production, the environment, humans and the markets. The section specifically reviews the issues of concern from perspectives on agricultural production challenges and food security needs of the African continent, and also considers the effect on the actors relating to the identified aspects.

2.3.1 Farmer level impacts

The first and foremost point of conflict is on the farm level benefits of HT and IR crops. Pro-GM views argue that the reduction in losses due to insect damage (IR crops) and the reduction of cost of purchasing chemicals (both IR and HR crops) are strong points for the positive role GM crops play at farm level. This point has been strongly emphasized as a solution to Africa's much documented low agricultural productivity challenges.

Agriculture is the principal source of food, income and livelihoods for the majority of the population in Africa. However, despite its important role agriculture in the continent continues to perform poorly with the production levels attained in most regions of the continent frequently falling short of sustaining the populations' food needs. Low productivity, particularly in the cultivation of food crops is the major impediment. Productivity is constrained by a myriad of complex factors and according to a number of research studies weeds and pests singularly represent significant limitations by causing serious damage to food crops and loss in yields. For example, the Inter Academy Council (IAC) found that *Striga* weed caused yield losses between 65% and 72% while Gouse (2013) indicated that in southern Africa the maize stalk borer resulted in maize losses of about 5% – 75%. Managing and controlling the weeds and pests is generally a challenge particularly for the majority of the farmers in Africa, the smallholder farmers. Not only is it costly but in the case of weeding, Konde (2006) notes that the activity is labour intensive with fields often

requiring to be weeded 2 to 3 times per season; yet in most cases smallholder farmers have limited labour available for effective weeding. In view of the productivity constraints, many of the development efforts aimed at improving the food security situation in Africa have in one way or another concentrated on promoting the use of productivity raising technologies that address the specific productivity constraints. For this reason the supporting view on GM crops is that the HT and IR traits would address the pest and weed crop losses thereby increasing yields attained. Sages such as Paarlberg (2008) and Jackson and Anderson (2005) have used to this viewpoint to suggest that GM crops would be ideal for addressing Africa's food insecurity problem. Empirical evidence from a study by Gouse *et al.* (2006) revealed that while the yield increases observed by small maize farmers were marginal, offering limited advantage in income terms, the yield advantage (as a result of less damage due to the stalk borers) were important in improving food security, by reducing the need to purchase grain or maize meal.

On the other end of the scale the opposing view of the GM crops is premised on the grounds that the causes of the food security problem in Africa are complex and extend beyond productivity to include many other issues that include weak institutions, poor governance, high post- harvest losses and lack of effective market systems (Clover 2002; Africa Centre for Biosafety 2010). The major counteractions however will appear to be closely linked to the overall characteristics of the smallholder farmers, who constitute the majority of the farmers. Firstly, the subsistence nature of most of the smallholder farmers limits their interest in investing in productivity enhancing technologies like GM seeds (CCAPS 2014). Secondly, the typical minimal use of agro-chemicals by smallholder farmers especially in the production of grain and legume food crops, tend to render the benefit of reduced chemicals meaningless for Africa. Finally, studies conducted on the economic impact of GM crops have also shown the cost of GM seed to be relatively more expensive than conventional seed thereby presenting a challenge for the lowly resourced smallholder farmers who already cannot afford conventional seed. Case-in-point are findings in Bukina Faso and South Africa by Dowd-Uribe and Bingen (2011) and Gouse (2013) respectively. While Dowd-Uribe and Bingen noted that a 10kg bag of B*t* cotton seed in Burkina Faso was US$2 more costly, Gouse reported a 27 – 30% additional cost of B*t* maize seed compared to the conventional isoline. Furthermore in seasons when insect pressure is low, especially under dryland production conditions, increased seed expenditure can increase financial risk for farmers (Gouse 2013).

2.3.2 Environmental impacts

Generally agricultural production impacts on the surrounding plant and animal populations by altering the biodiversity and ecosystem of the environment through the management of pests, weeds and diseases in order to attain high yields (Wolfenberger, Carrière & Owen 2014). In the GM debate environmental impacts have been emphasized with anti-GM views alleging that GM crops will lead to the permanent loss of natural local plants (biodiversity) through cross-pollination, and possibly the development of super weeds (due to HT crops) as well as the death of natural insects (due to IR crops) (Clover 2002; Whitman 2000). The protagonists refute these claims citing lack of adequate evidence. However, according to the pro-GM view, by reducing insecticide and pesticide use, GM crops in fact benefit the environment (Brookes & Barfoot 2013). Additionally because of conservation tillage practises that to a large degree is made possible through the use of herbicide tolerant commodities, there is a beneficial impact on soil health and management (Qaim 2010) which in turn reduces soil erosion, carbon sequestration and greenhouse gas emissions. Consequently GM crops contribute positively to the reduction of climate change (Brookes & Barfoot 2013).

2.3.3 Consumer level impacts

Consumer impact is concerned with the effects on the consumer as the ultimate user of the products at the end of the food supply chain. Aligned to the farmer level impact, the pro-GM viewpoint is that the first generation GM crops contribute to national food security by making food affordable. The reasoning behind this belief is that by increasing production efficiencies GM crops ultimately lead to lower food prices for consumers (Bruinsma 2003). This viewpoint is further emphasised by the proponents to be particularly important for Africa where the majority of the population are in need of access to cheaper food especially in the face of declining agricultural food crop production and increasing food prices. In addition, the GM protagonists are of the view that since the production of HT and IR crops results in the reduced usage of agro-chemicals, the chemical residues on fresh produce are subsequently reduced (Qaim 2010).

The opposing view is largely based on the producer –focus of the current generation of GM crops where the main issues called to question are; who benefits from GM crops and what are

the health effects on consumers? In terms of the benefits there are reportedly no visible benefits for the general public as much as there are benefits for scientist and the GM producing companies (Serageldin 2000; Bodiguel & Cardwell 2010). Supporting this opinion Paarlberg (2010) makes note that the lower price advantage for consumers, of GM crops is not noticeable. The possible health risks to consumers are the most contentious issues relating to the consumer impact. On account of the changes in the genetic make-up of the crops, there are concerns that this may bring about the possibility of new toxins and allergens in the food derived from GM crops (Clover 2002). The health risk argument however, has been dismissed by the proponents citing the lack of documented evidence about health risk and pointing that given the vigorous testing and approval processes that GMOs have to go through GM crops are probably less risky than conventional and organic food. To this end, the opposition response suggests that just because at present there is no documented risk, it does not mean that there are no possible risks that may become apparent in the future (Paarlberg 2013a; Paarlberg 2014). On the grounds of potential future risk the emerging recommendation from this viewpoint is that when dealing with GM crops precautionary (rather safe than sorry) measures have to be taken up to safeguard against any unknown threats. This recommendation would appear to be the most significant one for the development of the regulatory frameworks in food and agricultural trade.

Going beyond the benefit and health risks, consumer impact is also strongly linked to the indefinite issues of ethical and moral values of the public. The main issue is that for some people, altering organisms by the process of moving genes from one organism to another is tampering with the work of the Creator and therefore cause uneasiness in their belief system (Paarlberg 2010).

Important to note about the conflict on the consumer impact are the varied consumer perceptions and opinions in the different regions of the world and their subsequent contribution to GM food debate. Consumer perceptions and opinions in developed countries in particular the European Union (EU) have been comprehensively researched with results indicating that consumers in these countries generally view GM to be more risky than beneficial (Lusk *et al*. 2005; Costa-Font *et al*. 2008). However, in some developed countries like the US, consumers have been more positive with their viewpoints being more aligned with the pro-GM viewpoint. On the other hand, studies of consumers perception and opinions in developing countries have been few and mostly been focused in Asia, specifically China

and India (Smale *et al*. 2009). In Africa there are even fewer studies, largely concentrated in East and West Africa (Kimenju and De Groote 2008; Kimenju et al. 2011; Kushwaha *et al*. 2008; Kikulwe, Wesseler & Falck-Zepeda 2011). The results of these studies have generally yielded mixed results with consumers being positive, non-committal as well as negative. Nonetheless, the negative anti-GM views have been the most influential globally. The very strong and vociferous consumer groups in the EU have been especially instrumental in publicising the risk potentials and consequently in the formation of the overall negative global views on GMOs. What's more, is that regardless of findings of the 2005 Eurobarometer[1] surveys on biotechnology that showed the perception in Europe to be evolving and becoming more accepting of GM there still remains a strong resistance towards GMOs in Africa particularly in southern Africa where the lawmakers often cite the unknown potential health impacts on consumers as one of their major concerns. However, because the regulation of GMOs is more than the technical scientific management of risk but extends to include the broader socio-economic issues such as consumer perception in making choices (Lee 2009), the minimal inquiry into Africa's consumer perceptions and attitudes represents a limitation in the participation of consumers in the formulation of regulations and the ability of the regulation to address consumers concerns.

2.3.4 Industry level impacts

Because there are limited publicly funded developments of GM crops, as most of the developments are done by independent, large multinational companies, the concerns at industry level mainly surround the issue of market power. For GM opponents, the domination of these companies is seen as a form of the privatisation of science and consequently the creation of monopolies in breeding and seed production (Serageldin 2000; Qaim 2010). The global agri-biotechnology industry is highly concentrated with a few United States (US)-based conglomerates dominating the seed industry (Clover 2002). For Africa, the main concern is the effect a highly concentrated seed industry can have on national food sovereignty (Chambers *et al*. 2014). The reliance on a few large private entities for seed and thus food is viewed as a massive threat to food security (Clover 2002).

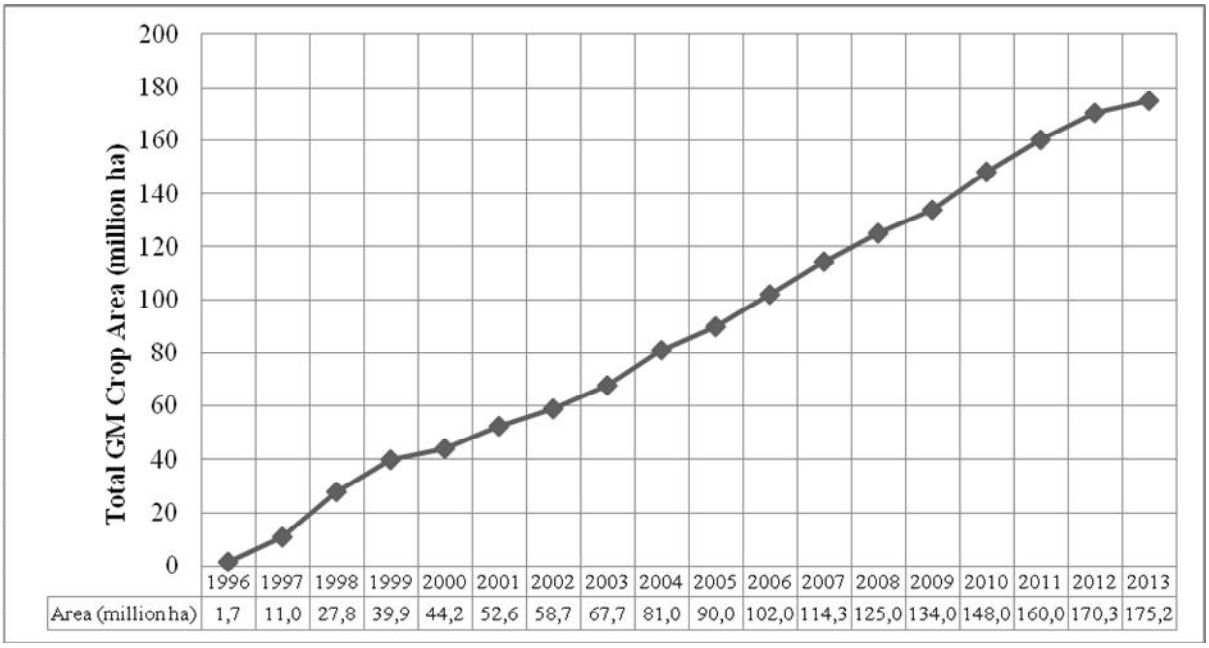
[1] The Eurobarometer is a series of surveys conducted on behalf of the European Commission, to get public opinion on various matters of interest in the European Union

2.4 Global responses to genetic modification in food and agriculture

The endless contests between the pro-GM views and the anti-GM views have governments, consumers and market actors divided on whom to believe. As a result, varied global acceptance levels have been observed and accordingly, depending on the political, social and economic conditions within a region or a country, regions and countries have responded differently to GM crops. This section explores the responses with regard to the three main relevant matters of production, marketing and trade and, finally policy and regulation.

2.4.1 Production

Despite being the most contested technology in the history of agriculture development and, the unrelenting difference of opinions, GM crop technology is reportedly the most rapidly adopted crop technology (Morin 2008; Raney 2006). Since the commercial cultivation of GM crops began in the mid-1990s, the global production of GM crops has increased unabatedly every year (Kalaitzanonkaes 2003; Qaim 2009; James 2013). These statements are supported by the 2013 annual report on the status of the global commercial spread of GM crops compiled by the International Service for the Acquisition of Agri-biotech Application (ISAAA – a not-for-profit industry trade group). In the 2013 report it is pointed out that from the year of the first commercial production, the total area planted to GM crops has increased by more than a hundred times, at a growth rate of 3% p.a. from 1.7million ha to about 175 million hectares (ha) in 2013. Figure 2.1 below, illustrates the annual increases in the area under GM crops. The ISAAA report asserts that these increases are owed to farmers and countries realising the positive yield and income benefits of GM crops that were alluded to in an earlier section in this chapter. Furthermore, the ISAAA notes that more countries have, as a result conducted trials and subsequently approved new GM varieties every year and, accordingly more farmers are adopting the technology. While the USA continues to be the lead global producer of GM crops with 70.1 million ha (approximately 40% of the global area of GM crop), Brazil continued in its 5th successive year, to be the major driver of GM crop growth globally with a 10% year-on-year increase in area under GM crop cultivation. The increases do not only make Brazil the second biggest producer of GM crops after the US but also, the leading developing country producer.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Area (million ha)	1,7	11,0	27,8	39,9	44,2	52,6	58,7	67,7	81,0	90,0	102,0	114,3	125,0	134,0	148,0	160,0	170,3	175,2

Figure 2.1: Total Area under GM crop cultivation from 1996 - 2013
Source: Compiled from ISAAA 2011, 2012, 2013 and 2014 reports

Over the years, the production of GM crops in the developing countries has increased progressively to a point that the developing countries planted more GM crops than the developed countries in 2012 and 2013, consecutively. In 2013 the area under GM crops in developing countries gained an additional 2% on its share of the total global area under GM crop cultivation from 52% in 2012 (81 million ha) to 54% in 2013 (94 million ha). Incidentally GM cultivation is still largely concentrated to a few developing countries from South America and Asia with the top four producers (Brazil, Argentina, India and China) producing almost half of the global production area (45.5%). Africa still lags behind in its adoption of GM crops. Nevertheless, according to James (2013) there has been a gradual and steady acceptance. In the 2011 report James indicated that South Africa was the only country in Africa that commercialised GM crops until 2008, when Burkina Faso and Egypt began the commercial production of Bt cotton and Bt maize, respectively. Since then Egypt has put production on hold pending Government review, Sudan has commercialised Bt cotton production and Cameroon, Egypt, Ghana, Kenya, Malawi, Nigeria and Uganda have conducted field trials to include new traits (e.g. drought resistant crops) and new crops (e.g. sweet potatoes) (James 2013; James 2012).

Although a number of GM crops have been developed, only a few have been widely produced. Commercialisation has been most widespread for soybeans, maize, cotton and

canola. The four crops take up almost the entire GM crop production area (Grueré & Sengupta 2008). Other crops with GM applications include papaya, sugar beet, tomato and sweet pepper. Stacked varieties appear to becoming increasingly important covering 27% of total GM crop area in 2013. Research into new crops and new traits is continuously being conducted to develop new varieties.

While anti-GM organisations such as the Canadian Biotechnology Action Network (CBAN) and GM Freeze are dismissive of the seemingly unstoppable increase in global GM production, claiming that the ISAAA would like the public to believe that the GM crops are already saturating the market and hence they should have no choice but accept GMOs; the presence of GM crops in national and trade market systems cannot be denied. Hence the trade and marketing systems have evolved to cater for their presence.

2.4.2 Marketing and trade

With the increasing share of GM products in the global trade markets (Omamo & Grebmer 2005), the polarised views on GM crops have prompted the development of strong preferences for non-GM food among some market segments at both individual consumer and national levels. As a result, demand in markets where GM products exist has also become divided. On the supply side, to meet the demand for non-GM products, some producers/traders are segregating and preserving the non-GM identity of their products, thereby giving rise to dual national and international marketing systems that distinguish between a mixed GM and non-GM market channel, and a pure non-GM market channel (Grueré & Sengupta 2008). So as to provide markets with assured non-GM foods, segregation and identity preservation (IP) are conducted throughout the supply chain from production through handling, storage and processing (Nielson & Anderson 2011; Buckwell *et al*. n.d.). The products of GM and non-GM crops are basically impossible to differentiate unless if they are tested and labelled (FUTURELIFE 2013; Hallman 2009). To this end the products from GM are labelled to provide consumers with an informed choice (Buckwell *et al*. n.d.). In most of the countries that are producing GM crops labelling is voluntary and those supplying non-GM products are offered premium prices (Desquilbet & Bullock 2009). Owing to this rigorous process, compared to the GM suppliers, the suppliers of IP products pay additional costs for keeping their products separate from GM crops (Huffman 2004). The additional costs are expected to be transferred to consumer prices and have been hypothesised

to result in higher product prices (Buckwell *et al*. n.d.). Identity preservation depends on levels of GM content that may be tolerated (Huffman 2004). According to Knutson, Penn & Boehm (1983) zero tolerance in food safety is difficult and costly to achieve prompting countries to specify their tolerance levels. This has also been found to be the case with regard to GM product whereby countries have adopted thresholds of GM content that are in line with the specific tolerances for the products in the respective markets. Consequently the IP requirements are developed to meet the thresholds (Huffman 2004).

In the international trade market the major suppliers of world commercial and food aid markets are also the main GM producing countries (USA, Brazil and Argentina). In contrast the major food importing countries (e.g. southern African countries) are essentially on the other end of the spectrum and are anti-GM in their positions, as they restrict the production and/ or importation of GM crops or products (Gruère & Sengupta 2009). Consequently the anti-GM countries have put in place policies and regulations that either limit or prevent the production and consumption of GM products.

2.4.3 Policy and regulation

The policy and regulation of GM food crops are applied to a range of themes that include Intellectual Property Rights (IPR), biosafety, trade, food safety and consumer choice and public research investments. In addressing the different themes, regulations governing GMOs are developed and applied to different stages; firstly in research and development then in seeking approval for commercialisation, commercial release and the importation of GM material. The aspects governed at each stage are indicated in Figure 2.2 below. This study is interested on the fourth stage that governs import control. As such, this subsection is discussed with particular reference to the importation of GM products for food.

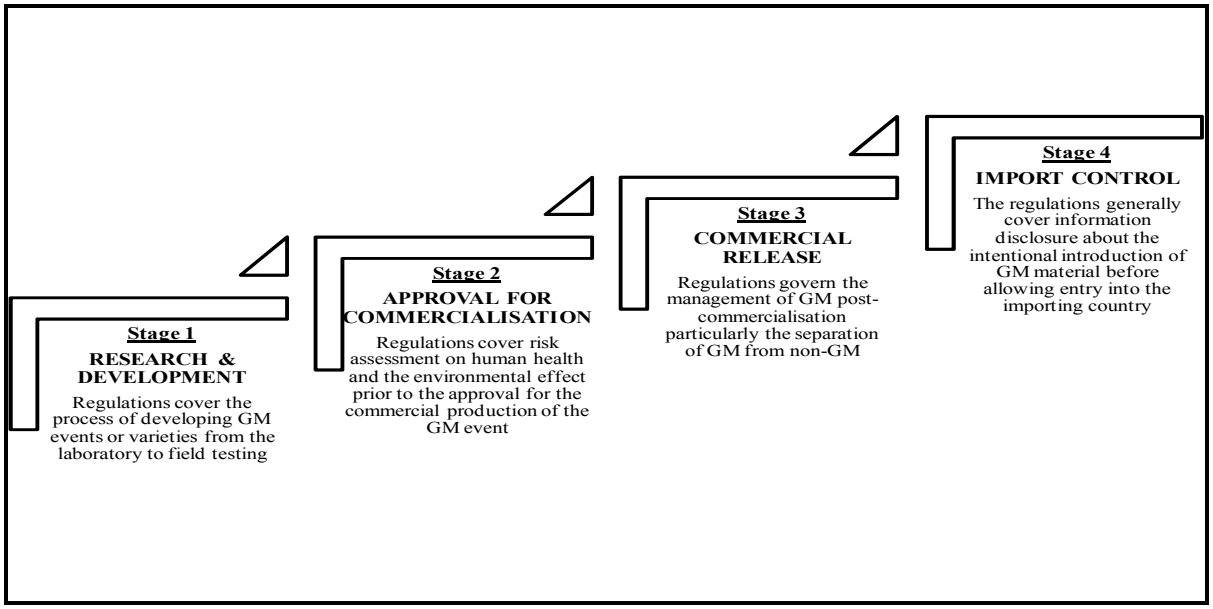


Figure 2.2: The Four Stages of GM Regulation

Source: FAO (2003)

There are various international regulatory mechanisms that can be applied to the control of GM imports. These include the World Trade Organisation (WTO) agreements and the Cartagena Protocol on Biosafety (CPB). Within the WTO there are four agreements that are of relevance to GMOs; that is to say, the General Agreement on Trade and Tariffs (GATT), the Sanitary and Phytosanitary (SPS) Agreement, the Technical Barriers to Trade (TBT) Agreement and the Agreement on Trade Related Intellectual Property Rights (TRIPS). Table 2.1 provides details on the applicability of these regulatory instruments to the importation of GM products, in terms of their scope and regulatory process. Given the extensive publicity of the perceived risks of GM crops, the policy problem relating to GM food has been viewed almost entirely as a risk issue. As a result, it can be noted that the policy and regulatory responses to trade have been aimed at putting to rest public fears about GM crops. Hence, generally all the applications of the different regulatory mechanisms appear to be in agreement about ensuring the safety for all living organisms. However, the agreements under the WTO do not adequately address the aspects related to GMOs (Sheldon 2002; Stewart 2009). Specifically, the lack of international standards around GMOs limits the applicability of the SPS and the TBT agreements to GM trade while TRIPS falls short of providing applicable definitions of the innovations (Mupotola 2005). The Cartagena Protocol on Bio-safety (CPB) was therefore developed to provide an extensive coverage of concerns for countries, in the regulation of GMOs (Stewart 2009). Thus it became the main instrument governing trade in GMOs even though it is mainly a biosafety protocol.

The Cartagena Protocol on Biosafety only applies to the countries that have signed and ratified the protocol (Baumüeller 2003; Clapp 2013). By signing and ratifying the Protocol countries have agreed to establish regulatory frameworks to manage the movement of genetically modified organisms, among other things (Nyang'ayo 2006). The Protocol is based on the precautionary principle that allows countries to prohibit the importation of GMOs even in the absence of scientific evidence of risk. It is interesting to note that major GM crop producers like the US, Brazil, Canada and Argentina are not signatories to the Protocol.

Influenced mainly by the binary division in opinions about GM food crops, countries have applied the precautionary principle to varying degrees, and subsequently have adopted different policy positions, which may be defined based on the degree of restriction towards GM products. According to Paarlberg (2001) four main policy positions that have been observed globally:

1. Promotional – there are no restrictions on the importation of GM, particularly with reference to plant material for propagation.
2. Permissive – neutral approach that subjects GM imports to the same regulatory processes as the non-GM imports in accordance with the standard World Trade Organisation (WTO) rules and regulations.
3. Precautionary – imports of GM products are limited by using regulatory mechanisms that have been developed specifically for GM product and are administered separately and, more strictly than non-GM products.
4. Preventive – the import of GM products are strictly prohibited.

Table 2.1: International regulatory mechanisms that are applicable to GM import control

Regulatory Mechanism	Scope and relevance	Key principles guiding the regulatory process
GATT	Provides for countries the right to set their own environmental and food safety regulations (article XX).	Upholds the non-discrimination national treatment and Most Favoured Nation (MFN) principles in the treatment of traded goods.
SPS	Protection of human, animal and plant life from imports without necessarily discriminating against trade (Article 5.6). Uses as reference standards set by the following institutions: 1. Codex Alimentarius Commission – sets food labelling and food safety standards. 2. World Organisation for Animal Health (OIE)[2] – defines the infectious animal diseases. 3. International Plant Protection Convention (IPPC) – defines pests and pathogens of plants and plant products.	Risk assessments conducted based strictly on science and using the international standards as reference points to prevent unnecessary.
TBT	Protection of human, plant, animal and environmental health from deceptive products.	Has mandatory (technical regulations) and voluntary (standards) product requirement that do not require the same rigorous standards of scientific basis stipulated by the SPS agreement.
TRIPS	Regulates and sets standards for the patenting of products and/ or processes of innovation in all fields of technology including new varieties of plants.	The guiding principles are aimed at finding a balance between creating incentives for private sector investments in technology innovation development and ensuring public health and safety.
CPB	Regulates the movement of GMOs across borders and within countries to protect national biodiversity from the risks posed by the movement and use of GMOs.	Upholds the precautionary principle that requires advance information sharing on GMO products and provides for countries the right to disallow any of the products even in the absence of scientific evidence of risk.

Sources: Compiled from Sheldon 2002; Stewart 2009; institutions websites

The key significance of the global conflicts and responses to GM crops in food and agriculture is their scope of influence and implications at regional and national levels, like in the southern African region. The scope of influence extends beyond the scientific reasoning

[2] Although the organisation changed its name from International des Epizooties to World Organisation for Animal Health it has maintained its historical acronym OIE

to include the broader social, economic and political objectives of the different countries. Therefore, the implications at regional and national level should be assessed within the relevant socio-economic and political contexts.

2.5 Significance of genetic modification in food and agriculture for southern Africa

This section provides a narrative of the how the countries in southern Africa have reacted against the backdrop of the global controversies and responses to the presence of GMOs in food and agriculture. The section concludes with a review of the implications of these reactions on the region – particularly highlighting the issues of consequence on the contribution of regional agricultural trade to the countries' food security, as identified in previous research. The section specifically makes reference to the most relevant aspects of the policy positions and responses of three selected countries that considered by the study to epitomise the GM policy differences in the region; namely South Africa, Zambia and Zimbabwe. These three countries are also considered to be major players in the regional market (either as importers or exporters) and they also constitute the main focus of the analysis for this study.

2.5.1 Southern Africa's regulatory reactions to GM crops and commodities

Virtually all governments in southern Africa commonly believe in the need for putting in place some form of restraint on the production and trade of GM crops in their countries. Nonetheless countries have varying degrees of tolerance for GM crops as exhibited by the different policy positions on the adoption and acceptance of GMOs. While some countries have readily embraced GM crops or products, South Africa, there are some that have out-rightly rejected all GM crops or products, Zambia, and others that have made some concessions allowing GM crops or products under specific conditions, Zimbabwe (Lewin 2009). Accordingly, production-wise South Africa remains the only country in the region that is engaged in the commercial production of GM crops, producing HR, IR and stacked varieties of GM cotton, maize, and soybeans (Chambers *et al*. 2014; James 2013). Other countries such as Zimbabwe and Malawi have conducted confined field trials while Mozambique and Tanzania are in line for future drought tolerant maize stacked with Bt under

the Water Efficient Maize for Africa (WEMA) project (Grueré & Sengupta 2008; James 2014).

In the case of trade in GM crops and products, the need to address GM trade issues emerged in 2002 when Zimbabwe, Zambia, Mozambique, Malawi, Lesotho and Swaziland rejected US food aid containing GM products. During that time southern Africa had just had a dismal 2001/02 agricultural season, owing to the severe drought that affected food production and plunged the region into a major food crisis (Herrick 2008; Clapp 2013; Clover 2002; Lieberman & Gray 2008). According to Herrick (2008), media and non-governmental organisations (NGO) reports then proclaimed that approximately 15 million people in the southern African nations of Angola, Lesotho, Malawi, Mozambique, Swaziland, Zambia and Zimbabwe were in severe need of food. Given this context, the rejection of the GM food aid was highly publicised, with many questioning the wisdom of the refusal of aid in the face of the starving populations (Clover 2002). A number of different explanations have been contemplated to be motivations for the rejection of GM in Southern Africa. These explanations are largely in line with the various global concerns that include the loss of natural biodiversity, the perceived unknown consumer health risks, and the issue of market competition as well as the added concern of the loss of the European Union market (Keeley & Scoones 2003).

However, regardless of the reasons for the rejections, an important point to note is that at the time of this crisis, many of the countries in the region had no domestic regulatory frameworks that could be applied to the importation of GMO either as food aid or commercial imports. Only South Africa and Zimbabwe had biosafety regulatory frameworks (Clapp 2013). South Africa's regulatory system enabled the research, development and commercial production of GM varieties while Zimbabwe's system had a provision for a Biosafety Board that was instrumental in advising the government and influencing the eventual decision by Zimbabwe to accept GM maize only on condition that it was milled. Meanwhile Zambia had no legal and regulatory framework but the government called upon the precautionary principle and was uncompromising as it maintained its requirement for only non-GM food aid (Chambers *et al*. 2014). Subsequently, the World Food Programme (WFP) procured non-GM maize from South Africa and Tanzania to supply Zambia (Paarlberg 2013b).

In the international scene, the regulations governing GM trade were also not clear until after 2003 when the CPB legally came into effect (Clapp 2013). When the CPB came into effect its precautionary principle guidelines for the transboundary movement of GM crops was received positively by many of the countries in southern Africa as the general principle for developing regulatory frameworks. Having signed and ratified the CPB the countries then undertook to amend or develop regulations that are aligned to the CPB. South Africa amended its GMO Act of 1997 in 2006, while Zimbabwe also amended its Biosafety Regulation of 2000 in 2006 to give way to the National Biotechnology Act (NBA) and Zambia instituted its Biosafety policy in 2007 (Chambers *et al*. 2014). Nonetheless the sharp differences in the policy positions adopted during the crisis have been maintained to this date. Zambia remains resolute in maintaining its GMO-free status by prohibiting the production and consumption of GM crops and/ or products through its highly stringent Biosafety policy. South Africa has continued to enable and support the developments of GM crops with new crops and new varieties being under development (Chambers *et al*. 2014). And in Zimbabwe, although the practise is often shrouded with secrecy resulting in uncertainty as to what the policy is, the country has continued to allow GM maize only when it is milled and in some cases has reportedly allowed the importation of GM grain as long as it is supervised to ensure that none of the grain is planted (Keeley & Scoones 2003).

2.5.2 Implications for food security

Considering the various governments' interests of securing food security at national level, the position taken by each country in the region has important implications for intra-regional trade and consequently its contribution to the national food security objectives. Food security remains a major challenge for most of the countries in the southern African region (Africa Centre for Biosafety 2010). The region is prone to recurring prolonged and/or episodic downturns in food availability and accessibility that corresponds with regular, cyclic drought events (Herrick 2008; Clover 2002). In addition, agricultural performance and productivity varies among the countries in the region with many of the countries' domestic agricultural production failing to meet the domestic consumption requirements. For this reason the majority of the countries are net importers of agricultural produce and also rely on food aid. As a result the region is vulnerable to the volatility of global food markets, especially the high price fluctuations experienced in these markets. Intra-regional trade has been found to contribute to ensuring price stability and to the overall goal of food security (Quigley 2008).

However, while there are some countries that produce surpluses, there is limited intra-regional trade in southern Africa. The reasons for the limited intra-regional trade are diverse and complex but there are some elements that are GM trade policy and regulation related (Kapuya *et al*. 2010; BFAP 2010). Since most of the internationally traded GM crops are intended for food, feed or processing (Gruére 2014), that is dominated by net importing countries who face the challenge of providing affordable food to its citizens, it is important to consider the implications of the regulatory frameworks on the regional food supply chains and the overall effect at the end of the supply chain.

2.6 Conclusion

The literature review has provided a glimpse into the number of controversies about the commercial production of GM food crops. The controversies have resulted in the binary division of the global agricultural trade markets. The southern African region has not been spared from the contests and the polarizations. The reactions of the countries in the region have consequently been similarly influenced by the tug of war between protagonist and antagonists of GMOs with countries adopting distinct regulatory regimes that limit trade in GM food crops in varying degrees. However, for the countries in southern Africa this raises questions about the implications of the regulations in the broader socio-economic context of food security. In particular the questions are centred on the contribution of regional agricultural trade to the provision of affordable food for consumers.

For Zimbabwe, despite being consistently applied since the 2002 food crisis, the policy and regulation is particularly idiosyncratic in that the exceptions of allowing milled maize suggest that GM foods are safe to consume, yet the costs of limiting GM food imports are theoretically expected to be borne by consumers. Therefore, this makes Zimbabwe a pertinent case in point for the study of the impact of regulations on consumers.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The purpose of this chapter is to define and explain the methodology used to answer the study's research questions. The chapter presents the theoretical foundations underpinning the research, discusses the overall research design and, describes the data collection process and the empirical techniques applied in data analysis. In addition, the chapter also highlights the methodological challenges and limitations encountered by the researcher.

The research design used in this study is exploratory, descriptive and contextual. To support the nature of the design and meet the overall research objective of determining the costs and benefits of the GM import regulation, the study employed a multi-method research strategy that is founded on the Value Chain Analysis (VCA) approach. Specifically, the study used the Total Landed Cost method from the Supply Chain Management (SCM) branch of VCA to model the cost of the regulation within the agricultural and food market. The costs are then counterbalanced by examining consumer behavioural aspects through consumer perception analysis to estimate the benefits value of the regulation.

3.2 Theoretical background

There are four theoretical foundations from the economics discipline of policy analysis that have guided this research, namely welfare economics, cost benefit analysis, value chain analysis and consumer perception theory. This section presents the broad principles of theoretical foundations that have been considered in the research design. The section is deliberately not comprehensive as it only focuses on the relevant points of theory. Firstly, an overview of each theoretical foundation is presented then the section concludes by indicating the combined significance of all the theories.

3.2.1 Theory of welfare economics

Representing the normative branch of economics that deals mostly in value judgements and theoretical scenarios in assessing the impact of particular policies on the well-being of society, the fundamental theory of the research design is rooted in the neo-classical welfare economics theory. From the traditional welfare economics perspective individuals and not government, are assumed to be the best judges of their wellbeing and accordingly the implications of any given policy. The basic principles underlying welfare economics is that 1) the individual forms the basis of society, 2) individuals have preferences when choosing between alternatives, 3) individual welfare is an indication of the values indicated by their choices and 4) when the values of many individuals are combined, they determine the social desirability of the policies applied (James 1994; Muthukrishnan 2010; Freeman III *et al*. 2014). Based on these tenets it follows that the welfare implications of any given policy should be informed by the observations of the individuals that make up the society. In line with highlighted principles of welfare economics this study aims to work out the preferences and values of Zimbabweans as a means of determining the implications of the GM import policy and biosafety regulation.

3.2.2 Theory of cost benefit analysis

The theoretical underpinnings for Cost Benefit Analysis (CBA) lie in welfare economics, with the overall concept being that a socially desirable policy is one in which social benefits exceed social costs. The main notion behind this is that social benefits are defined as increases in the sum of individuals' welfare while the social costs are defined as decreases in sum of individuals' welfare (Pearce *et al*. 2006). Thereupon, CBA is a particular method used in welfare economics to determine the social desirability of a policy. The methodology used in the approach relies on assessing the costs and benefits associated with particular policies. Generally, the CBA approach computes the net social benefit (NSB) and off-setting those social benefits with the social costs as indicated in the formula below:

$NSB = TSB - TSC$

Where

- *TSB = Total Social Benefits*
- *TSC = Total Social Cost*

The costs and benefits may be monetary or non-monetary. This study combines both monetary and non monetary measures to establish possible monetary benefits or costs surrounding maize grain imports and maize meal prices as well as the potential non-monetary costs or benefits for any likely environmental impacts and peace of mind for consumers.

3.2.3 Theory of value chain analysis

Adapted to provide quantitative assessments of the impact of policy measures, Value Chain Analysis (VCA) has progressively grown to become an important tool for policy analysis (Bellù 2013). It provides a framework for cost analysis in markets. The concept of the value chain was conceived from Michael Porter's theory of Competitive Advantage, where he provides the generic description of a value chain as a sequence of activities firms engage in, in order to make available to their customers products with value that exceeds the costs of the activities. Since then the definition of the value chain has been extended to include the wider linkages between firms, their suppliers and channels of distribution. As a result, the value chain may be defined as a set of interdependent economic activities of vertically linked economic agents, typically starting with the supply of inputs for the production of a primary commodity and ending with the consumption of final product; the economic activities undertaken between these phases include processing, delivery, wholesaling and retailing (Bellù 2013). These activities are not isolated from each other, in fact the costs of the activities accumulate along the value chain with each activity setting-off the costs of the next one.

A variety of disciplines have contributed to the development of the value chain theory. Trienekens (2011) classifies the different disciplines into four groups based on the different perspectives on inter-company relationships for each group namely the New Institutional Economics (NIE), Supply Chain Management (SCM), Social Network and Global Value Chains. The relevant discipline for this study is Supply Chain Management (SCM). However, according to Pala (2013) SCM is a comparatively new theoretical construct that also lends itself to a wide range of perspectives of different theoretical disciplines. For the purposes of this study the SCM concept is applied from the perspective of the Transaction Cost Economics (TCE), which Pala (2013) identifies to be concerned with the cost of sourcing and supplying products. In line with this viewpoint the study specifically computes the Total Landed Cost (TLC) of GM and non-GM maize and utilises it in establishing the impact of the

policy on the maize meal prices. The TLC is a measure used for making strategic decisions on where to source imported goods. It takes into account all the costs associated with moving imported consumer products from international sources and delivering it at the end of the importing company's distribution centre (Gettinger 2013).

3.2.4 Consumer behaviour theory: the concept of perception

There are a variety of consumer behaviour theories; however, for the purposes of this study focus is on the psychological construct of perception. The concept of perception lends itself from the field of marketing where behavioural economics and psychological theory has been used to understand consumer behaviour by analysing the factors that influence their purchasing decisions. "Perception is an approximation of reality" (Perner, 2010). It serves as an illustration of the way in which consumers process and interpret information about a product and ultimately how the consumer views the product (Durmaz & Diyarbakirlioğlu 2011). As such, the concept represents the perception of value (Sánchez-Fernández & Iniesta-Bonillo 2007). It is this perception of value that eventually determines consumer demand and willingness to purchase a particular product.

The perceived value is assumed to be constructed rationally with each individual consumer weighing the benefits and risks of the product. The main principle guiding the construction of perceived value is that, there is a negative correlation between perceived risks and perceived benefits (Frewer *et al*. 2005). This means that the higher the perceived benefits the lower the perceived risk and consequently the greater the net value that will be placed by the consumer on the commodity. Against this backdrop the study will apply this consumer perception principle to determine the perceived value of GM products by Zimbabwean consumers. The perceived value is then used as a measure of whether the consumers foresee a benefit or a cost in the application of the GM import regulation.

3.2.5 The nexus of the theories

Consumers are at the nexus of the theories described above. The consumer is the final customer at the end of the value chain. The effects of trade policies such as the GM import regulations impacts on domestic prices of goods and services. Compliance with the regulation has implied added costs along the food supply chain, which ultimately impacts on the price of

the final product, affecting the affordability of the product for consumers. However, like any other new products, GM products are subjected to consumer perception value judgements. Subsequently, consumers make choices and attach values to avoiding or consuming the GM products thereby making consumer valuation a key variable in the cost-benefit assessment of the policy. As such, the added costs and the price effect as well as the consumer valuation of GM products form the basis of the research design that is discussed in the next section.

3.3 Research design

This section outlines and discusses the framework and process of the research. The framework and process are specifically focused on the consumer by way of assessing the complementarities and trade-offs between the GM import policy objectives and the national socio-economic objectives of ensuring access to affordable food for consumers.

3.3.1 Analytical framework

The framework of analysis that guided the research process of the study was centred on determining the balance between the costs and benefits of the GM import regulations (Figure 3.1). Indicated in the diagram is that the cost analysis of the framework rests on breaking down the added costs of the regulation in maize grain import supply chain while, the benefits are valued by analysing the consumer risk and benefit perceptions on GMOs.

a. Cost modelling

The framework defines the cost of the regulation to be the additional costs incurred in the supply chain and the eventual consumer price-effects of complying with the regulatory requirements. Using the TLC method, the study estimates the costs of sourcing and delivering maize grain to Zimbabwe and conducts a cost analysis of the added costs along the import supply chain. Principally two different total landed cost structures for imported maize grain were constructed depending on the country source of the imports. The two country sources focused on are South Africa and Zambia. Because South Africa is a GM maize producer, the landed cost structure for South African maize imports represents the costs that are inclusive of the regulatory compliance costs. On the other hand Zambia does not produce any GM crops therefore the total landed cost structure from Zambia represents the comparative non-GM counterfactual scenario. The South African and Zambian total landed costs are compared

and the differences are used to measure the impact of the compliance requirements. Subsequently, the total landed costs are incorporated into a further analysis of the milling costs and the final prices of maize meal at the end of the supply chain. These costs and prices, in particular their effects on consumers represent the cost of the regulation.

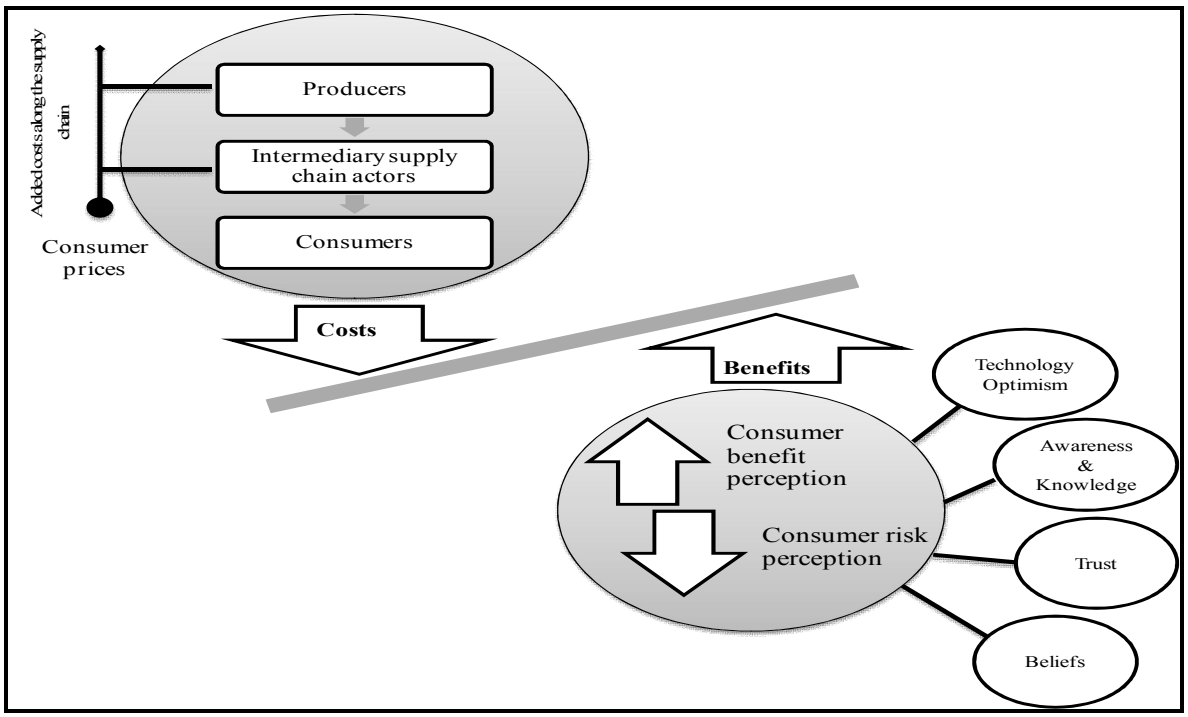


Figure 3.1: Illustration of the analytical framework

Source: author

b. Benefit valuation

In alignment with the welfare economics principle that individuals are the best judge of their welfare, the valuation of the benefit of the regulation is determined by weighing the perceived risks and benefits of GMOs by consumers. Gaskell *et al*. (2004) found that the risk perception is negatively associated with acceptance and willingness to consume GM food while benefit perception is positively associated. For the reason that the perceived risks may be viewed as potential future costs by the consumer, the framework assumes that when perceived risk is greater than perceived benefits it implies that the consumers may implicitly be finding the regulation beneficial. Specific risk and benefit components are further examined separately to establish the exact concerns of the consumers. Extending beyond the risk and benefit perception measurements the framework also explores the factors that are influencing the formulation of the observed perceptions. These factors enable the study to understand the significance of the implied policy benefit. There are various factors that lead

to the formation of perception of risks and benefits (Goyal & Gurtoo 2011). The factors that were particularly applied in this study are presented and explained in Table 3.1 below. Under the framework the study assesses each factor for the Zimbabwean consumers and compares the findings to the findings from other international studies, as indicated in Table 3.1.

Table 3.1: Factors influencing the risk benefit perception

Factor	How the factor influences perceptions
Technology optimism	How people view technology plays an integral role on acceptance and integration of any new technology (Goyal & Gurtoo, 2011). According to findings from a study conducted by Traill *et al*. (2004), attitude to technology is a significant variable in the determination of the perception of risk and benefits by individuals. The general conclusion in the studies is that people with a positive attitude towards science and technology perceive a low level of risk and are more accepting of GM technology. In this regard Gaskell *et al*. (2006) found that consumers in Europe that were opposed to GM food were also generally disheartened by science and technology.
Awareness & Knowledge	According to House *et al*. (2004) there are two types of knowledge that influence the construction of consumer perceptions towards GMOs, i.e. objective (tested) and subjective (self-rated) knowledge. Objective and subjective knowledge each influence acceptance differently. Subjective knowledge has a significant influence on the acceptance of GM while objective knowledge has no significant influence (Costa-Font *et al*. 2005; House *et al*. 2004). In addition, how and where people learn about the risks and benefits of GM technology has an influence on the knowledge levels about GMOs (Costa-Font *et al.* 2005). The impact of the information sources on knowledge and awareness is however, largely dependent on the level of subjective knowledge the individual has. The higher the levels of subjective knowledge the less influenced by new information consumers are (Costa-Font *et al*. 2005).
Trust	By definition trust may be considered as having confidence and seeing credibility in someone or something. Several studies have therefore found trust or the lack of trust to be highly influential in the risk benefit perception of GM foods. More so, the level of trust or lack thereof is particularly important in the assimilation of knowledge on GM foods from the different sources of information (Costa-Font *et al*. 2005; include other sources). In particular the influence of trust on the risk and benefit perceptions depends to a large extent on the level of trust the consumers have on the government and regulatory bodies relative to their trust in other institutions such as media, market actors and NGOs. To this end, Marris (2006) in Goyal and Gurtoo (2011) postulates that if people place higher trust in media and NGOs than government, scientist and industry then they will perceive higher risk. Contrarily, if more trust is placed in the ability of government and regulatory bodies as well as industry and science in adequately playing their roles in risk management and offering more benefits to the public respectively; the public's level of perceived risks have been found to be low.
Beliefs	The belief system of people is based on ethical, equity and morality issues surrounding the individual values. Costa-Font *et al*. (2005) found that individual values such as environmentalism, conservationism, materialism, equity etc. significantly influence the risk and benefit perceptions towards a GM product. The more value placed on the beliefs the higher the likelihood of consumers perceiving more risks than benefits.

3.3.2 Sub-units of analysis

The analytical focus of the framework is the maize grain supply chain from South Africa to Zimbabwe. The focus on maize is explained by the fact that maize is the main staple food crop grown and most traded crop in the region. As a result of this circumstance and the fact that maize is one of the four leading crops with GM equivalent Gruère and Sengupta (2008) noted that maize is the most scrutinized commodity at the borders. The emphasis on consumers is motivated by the assertion from FAO (2001) that the impacts of the regulations are likely to be felt more at the consumption end rather than the production end. In this regard, the Zimbabwean consumers are at the centre of the analysis because Zimbabwe is a country that has been largely opposed to GM crops and has reportedly been consistent in its application of import regulations in the region despite facing food security challenges. South Africa is particularly important in the analysis because the country is a major GM maize producer and supplier of maize globally and regionally. Furthermore, Zimbabweans have historically had strong migrant ties to South Africa dating back to the early 1900s after the discovery and establishment of gold in Witwatersrand (Crush *et al*. 2005; Wentzel 2003). Since then the migration of Zimbabweans has increased with large numbers of Zimbabweans living temporarily and/ or permanently in present day South Africa yet still maintain close relations with kin remaining in Zimbabwe. For this reason the consumer section of the research focused on studying Zimbabwean consumers living in both Zimbabwe and South Africa.

3.3.3 Sampling

The overall sampling strategy employed in the research was purposive random sampling. For the value chain the sample was selected from a range of actors in the maize value chain that are especially directly involved in the importation and/ or exportation of maize between South Africa and Zimbabwe. The actors mainly included maize traders and regulatory authorities or other service providers involved in the process of complying with the GM import policy. Although the process of compliance is in effect applied to the whole supply chain, trade-related actors were sampled because trade is the pivot for the whole process. The actors were identified through secondary sources and discussions with key informants, invitations to participate in the study were sent to the identified representatives for the

respective institutions and the individuals that responded to the invitations and confirmed availability automatically constituted the sample.

For the consumers in Zimbabwe the sample was selected from the two main cities of Harare and Bulawayo while in South Africa they were selected from Gauteng province's two main cities of Johannesburg and Pretoria. Gauteng province is the destination choice of most Zimbabweans. The sampling process differed in the two countries; in Zimbabwe simple random sampling of consumers at different supermarket location sites were selected when they entered the store. In South Africa it was mainly based on referrals to known acquaintances of respondents and generally easily accessible consumers were interviewed.

3.3.4 Data collection

Data was collected from both secondary and primary sources. The secondary data collected is mainly focused on trade information between Zimbabwe and South Africa, as well as alternative regional maize sources. Specifically the trade information collected are the figures for the different cost components for the total landed cost model, the trade flow statistics and the overall status of the regional maize value chain for southern Africa. This data was collected from the records of the trade authorities of the two countries (where available) as well as from documented research conducted by various institutions such as the FAO.

On the other hand primary data collection concentrated on getting an understanding of the GM import requirements from the industry perspective and the Zimbabwean consumer perspective on GM food. The industry perspective data was collected using face to face un-structured interviews with maize traders and support service providers in GM import policy compliance in both countries, using a list of question guidelines (see Annex A). Data collected identified key points of compliance of the GM import policy. For the consumer perspective, face-to-face interviews with consumers in both Zimbabwe and South Africa were conducted using structured questionnaires in a survey. A total of 260 consumers were interviewed; 160 in Zimbabwe and 100 in South Africa. Two questionnaires were designed, one targeted at the respondents in Zimbabwe and the other at respondents in South Africa. The Zimbabwean questionnaire is attached in Annex B while the South African questionnaire is attached in Annex C.

3.3.5 Data analysis

This section describes in detail how the approaches to the data analysis for both cost modelling and benefit valuation.

a. Cost Modelling: Total Landed Cost Model

The model applied in this study focuses on the total landed costs of maize grain from SA to Zimbabwe as the primary focus while Zambia is computed as an alternative source of maize. The specific cost components that are included in the computation of the total landed costs are listed and defined in Table 3.2.

Table 3.2: Cost components that are included in the total landed cost calculation

Purchase Price	Transport & logistic cost	Import regulatory and compliance costs
Original market rice	Freight	Import permit application
Non-GM premium	Insurance	Regulatory body support letters
		Inspection or supervision costs

Using the different total landed costs; the final prices of maize meal at the end of the channel are computed to determine the impact of the GM regulation. The main underlying assumption in the analysis is that South Africa, as the only known GM producer is the only source that is subjected to compliance with the regulation.

b. Benefit Valuation: Consumer Risk-Benefit Perception Analysis

Drawing on the approach by Gaskell *et al.* (2004), this study measured risk benefit perceptions by mainly using agreements and disagreements on a five-point scale to statements provided in the survey questionnaire. An analysis of the responses on the risk and benefit perceptions was used to determine allocation of the consumers into four judgement groups. According to Gaskell *et al*. (2004), consumers can be classified into four groups based on the risk and benefit perceptions regarding GM food. Figure 3.2 below provides an illustration of the consumer groups.

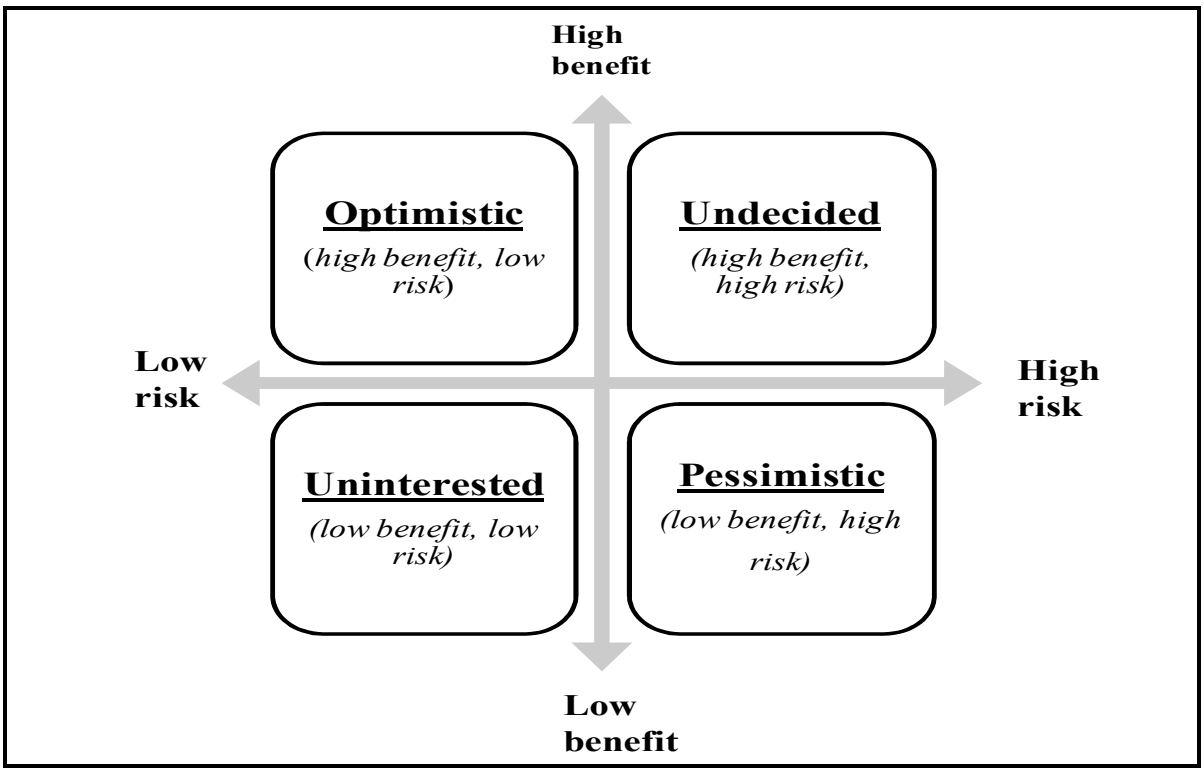


Figure 3.2: GM acceptance consumer groups
Source: compiled by author from Gaskell et al. (2004)

This classification is used to identify and separate those consumers that are concerned with the potential effects of GM food from those that are not concerned as well as determine in which group the majority of the Zimbabwean consumers fall. Based on this classification Costa-Font *et al*. (2005) found that consumers can be considered to be optimistic, pessimistic or un-decided about GM food. The optimistic consumers perceive high benefits and low risks therefore they may be considered as the GM acceptors. The pessimistic consumers perceive low benefits and high risk thus they are most likely to be anti-GM. The undecided consumer, perceiving high risk and high benefits may be able to accept GM food when sufficiently assured that the risks are managed. The uninterested sees low risk and low benefit and may consider GM and non-GM food to be perfect substitutes.

In order to classify the consumers the study employed a method of assigning scores to the risk and benefit perception statement responses. The responses were then aggregated together to come up with risk-benefit perception scores per individual. The risk-benefit perception scores were calculated based on the assumption of negative correlation between risks and benefits, i.e. the perception of high risks would tend to go with a low perception of benefits and vice versa. As a result, the single scores were calculated using a reverse scoring method.

Table 3.3 demonstrates how the reverse scoring method was applied to come up with the single risk and benefit scores. By plotting the consumer risk and benefit perception scores the consumers were classified into the four groups.

In addition to this analysis the study conducts a descriptive analysis on the individual benefit and risk statements as well as the factors that have been expected to influence the formation of the perception. The descriptive analysis has enabled the study to find out the main concerns of the consumers and the drivers of these concerns.

Table 3.3: Assigning the risk – benefit perception score

Benefit Perception Statements	**Strongly disagree** *(score = -1)*	**Disagree** *(score = -0.5)*	**Neutral** *(score = 0)*	**Agree** *(score = 0.5)*	**Strongly Agree** *(score = 1)*	**Don't know** *(score = 0)*
a) GM technology increases productivity and offers solutions for food supply b) GM has a potential to create enhanced nutritional value c) GM has a potential to reduce the use of agricultural pesticides and other chemicals d) GM crops that have gone through a strict biosafety regulatory process are safe to consume						
Risk Perception Statements	**Strongly disagree** *(score = 1)*	**Disagree** *(score = 0.5)*	**Neutral** *(score = 0)*	**Agree** *(score = -0.5)*	**Strongly Agree** *(score = -1)*	**Don't know** *(score = 0)*
a) GM threatens the environment b) GM leads to a loss of biodiversity (original plant species as well as death of good insects) c) Consuming GM food can damage one's health d) Consuming GM food can cause allergic reaction to people						

3.3.6 Ethical considerations

The following ethical guidelines were put in place during the course of the research study

1. The integrity and dignity of all the key respondents from industry as well as the consumers was protected all the time.
2. Permission for participation was requested from all respondents before interviews were conducted (see Annex D for the letter of invitation to participate sent to key informants).
3. Considering the political sensitivity around GM issues as well as general sensitiveness on company operations issues, the confidentiality of all respondents was upheld at all times.

3.3.7 Internal and external validity

Industry data and South African consumer data was collected mainly by the researcher whilst the Zimbabwean based consumer data was collected by trained enumerators. The consumer survey questionnaires were pre-tested to ensure their applicability. While the questionnaires were lengthy they were made comprehensive to ensure triangulation on the various aspects being measured. This is particularly important to address the challenge observed in Traill *et al*. (2004), of consumers overstating their risk perceptions in surveys. To ensure the accurateness of the industry data collected the interviews were conducted with those directly involved in the trade processes.

3.4 Summary

Desquilbet and Bullock (2009) found that although there are different types of consumers that will be affected differently by the introduction of GMOs, the losers and winners from the introduction of GMO technology are not obvious from a theoretical perspective. Hence the need for using the multi-method study approach described in this chapter. Because limited research has been done in Africa and the research that has been done in other parts of the world has yielded contradictory results, a number of assumptions are made for the analysis and the assumptions will need to be tested in future empirical research. Furthermore, as already alluded to by Costa-Font *et al*. (2005) consumer risk and benefit perceptions are dynamic processes, which are always evolving and are not exact, the research design described above is applicable as far as the context under which the research was conducted, prevails.

CHAPTER 4

COST MODELLING

THE TOTAL LANDED COST ANALYSIS

4.1 Introduction

This chapter is the first of two analytical chapters and presents an assessment of the cost component of the cost–benefit analysis of the Zimbabwean GM maize import policy. Grounded in the value chain approach, the analysis focuses on mapping the maize grain-to-maize-meal (flour) supply chain segment of the value chain. The primary analysis traces the maize import supply chain from South Africa to Zimbabwe and compares it to maize imports from Zambia. The Zambian maize import value chain represents the comparative non-GM counterfactual scenario.

The chapter sets off by providing an overview of the overall maize market in the Southern African region based on secondary data sources. Following the overview, the maize grain-to-maize-meal GM and non-GM import supply chains are described, with emphasis on the GM import regulation cost compliance junctures along the chain. The chapter concludes by providing a cost analysis of the supply chain based on the country of origin and light is shed on the maize meal retail price effect of the GM policy compliance for (potentially GM) maize imported from South Africa.

4.2 Overview of the southern African maize market

This section provides a synopsis of the southern African maize regional value chain. Taking into account the key value chain components of demand, supply and governance, the section demonstrates the importance of maize in the broader context of the region. In particular, it highlights the dependence on regional imports as a major source of maize by most countries and identifies Zimbabwe and South Africa as major players in the regional maize market.

4.2.1 Demand

Maize is the most important food crop in southern Africa and it constitutes a major part of the diets of the majority of the population in these countries. On average the crop provides 70% of the calories intake of the cereal diet and 41% of total diet of most of the population in the region (Grant, Wolfaardt & Louw 2012). In addition, the region's low income consumers spend 30% of their household income on maize (Sibanda 2005). Maize is consumed either in its raw form or in its various processed forms. According to Grant, Wolfaardt & Louw (2012), the consumption of the maize is divided into four main categories; that is, direct human consumption, animal feed consumption, industrial uses and bio-fuels. Generally, human and animal feed consumption are the biggest consumers of maize in the region, with data from the FAOSTAT commodity balance sheet database indicating that both categories accounted for over 90% of the total maize consumption in Southern Africa, between 2000 and 2011. Important to note however is that the data further indicates that within the same period, in most countries in the region over three-quarters of the maize is used for human consumption while only about a tenth is used for animal feed (this excludes South Africa that has an almost equal allocation between the two categories). White maize is the preferred choice for human consumption and it is processed and prepared in various forms depending on the country. Maize meal (flour) is the single most common processed form of maize preferred by consumers. Depending on the channel (whether formal or informal), the meal may be processed industrially, then packaged and retailed to consumers by commercial milling companies, or it is milled directly at the household level, using either a traditional mortar and pestle, small hand mills or through small local hammer mills. The resultant processed meal ranges from very finely milled products to a coarsely milled product. The maize meal is generally prepared for final consumption by cooking it with water to make a runny porridge that is taken as a morning meal or a thick porridge which constitutes the starch component of the afternoon and evening meals.

4.2.2 Supply

Supply for maize in the region is either from domestic production or trade between the countries in the region and those from outside.

a. Domestic Production

Occupying up to 60% of the total agricultural area under crop production in some countries, maize is the most produced crop in the region (Akinnifesi *et al*. 2011). Production in the region is generally characterised by a dualistic structure, which categorises farmers into two broad types, namely commercial and smallholder farmers. The commercial farmers are typified by the use of capital intensive, advanced production practices on large tracts of generally privately owned land, largely driven by the economic objective of profit making. In contrast, smallholder production is driven mainly by household consumption needs, sales of maize are only made when surplus production is realised and is often practised on small size land holdings using basic, traditional production techniques and relying heavily on rainfall (Mudhara 2010; Grant, Wolfaardt & Louw 2012). As a result, there is a significant difference in the productivity levels and vulnerability to production shocks between the two groups, with the smallholders being the most susceptible.

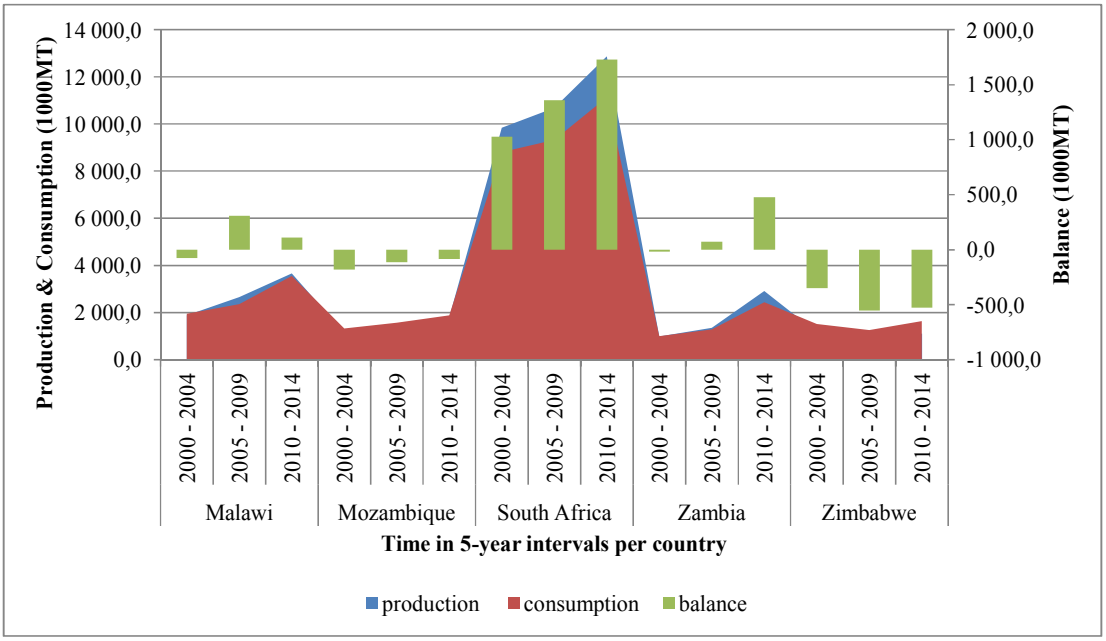


Figure 4. 1: Average maize production, consumption and balance comparison for selected southern African countries (2000 – 2014)

Source: Compiled from data on Index Mundi (2014)

The proportion of commercial farmers and smallholder farmers differs from country to country. While in South Africa there is a comparably large number of large scale commercial farmers and in some countries like Zambia there is a growing number of larger farmers

(driven mostly by inter- and intra-regional investments) (Hall 2011); the bulk of maize consumed in Southern Africa is produced by the smallholder farmers, producing on a subsistence level under generally constrained conditions. Due to the rainfall dependant nature of the production practices of the smallholder farmers and the historically observable high variability in rainfall (prone to severe droughts and floods), annual national maize crop levels tend to be inconsistent and often fail to meet the national consumption requirements. Figure 4.1 demonstrates the temporal and spatial differences in the ability of domestic production of the countries in meeting consumption requirements.

Comparing the average maize production and consumption figures in five – year intervals over the last 15 years for selected countries in the region, the figure shows South Africa to be the only country to have consistently produced a maize surplus in the period, Zambia and Malawi have been able to produce surpluses in the last ten years while Mozambique and Zimbabwe have consistently been in deficit. Low productivity in the predominant smallholder subsector is among other factors, a major contributor to the negative production and consumption balances. Grant, Wolfaardt & Louw (2012) pointed out that in general; productivity in the region (excluding South Africa) has stagnated leaving increases in production to be driven by increases in the area under cultivation. When countries fail to meet their requirements they respond by supplementing the local maize production by importing from other countries via commercial arrangements and food aid.

b. Trade

Despite maize being the most produced cereal in the region, most of the southern African countries are net importers of maize. Low productivity and production levels have resulted in most of the countries to, more often than not, importing to meet their domestic requirements. Table 4.1 shows that the surplus producing countries tend to export more into the region (interregional) than to other regions while the deficit countries import more from the region. Also clear from the table is that South Africa is the main supplier of maize to the regional market. However, for South Africa, even though markets outside the region have a significant share, the regional market represents a stable and reliable market for its surpluses compared to markets from outside the region (Kapuya & Sihlobo 2014). This evidently demonstrates the importance of the regional market in ensuring food security through trade flows.

Table 4.1: Comparison of intra-regional trade and trade (HS100590) with outside countries for selected countries in the region (2004 – 2013)

Country	Imports Total Value (US$1million)		Exports Total Value (US$1million)	
	SADC	Non-SADC	SADC	Non-SADC
Malawi	78.6	6.1	143.3	39.6
Mozambique	138.5	10.8	16.0	10.6
South Africa	38.9	445.1	1481.9	2260.5
Zambia	56.0	2.3	513.4	24.0
Zimbabwe	1044.6	31.1	0.6	0.0

Source: ITC World Trade Map

The regional maize trade market has two channels, informal and formal trade. The informal trade refers to transactions conducted entirely or partially outside of the Governments' regulatory frameworks. This type of trade is often carried out with incomplete or without any formal documentation as traders seek to avoid the costs associated with complying with the regulatory requirements for the relatively small consignments of products that are typically traded through this channel. For this reason most of the informal trade is seldom recorded by customs authorities and difficult to measure. The border monitoring system established and managed by the Famine Early Warning System Network (FEWSNET) and the World Food Programme (WFP) has been able to record the substantive informal maize trade flows in Southern Africa. Focusing the monitoring on maize, rice and beans, the data collected for the 2011/2012 season estimated the maize flows at almost 140,000MT and revealed that maize accounted for more than 80% of the informal flows, thus making maize the most informally traded commodity. This maize is often the maize that is milled and processed at small-scale at the local household level and hammer mills.

In contrast, the formal trade channel comprises of formally registered firms that are operating fully within the regulatory framework – complying with the trade policy and regulatory requirements. Maize imports within this channel are strongly linked to the large industrial millers and processors and the commercial maize meal markets responsible for supplying consumers with the milled products through retail. By comparing informal (FEWSNET) and formal (FAOSTAT) maize flows, it would appear as if the formal channel is the most prominent source of maize imports, with informal maize trade comprising about 5% of total maize trade. This finding underscores the importance of trade policy and regulations as these

play a vital role in shaping costs through the value chain and ultimately the cost of the final product.

4.2.3 Policy and regulation

Maize is by and large the most politically important crop in the region not only due to its importance as food crop but also because it is produced by a huge number of smallholders (voters) in the rural areas. As a result policies and regulations affect the maize market in two main ways: firstly indirectly through the general policies and regulations that affect the total economy but have a particularly significant impact on maize as it is the most important crop in the region. Secondly it is affected directly by sector-specific policies which are targeted specifically at regulating the maize industry.

The salient feature of the policy and regulatory environment of the maize industry in the region is the considerable government interventionist and protectionist policies implemented at national level. To tackle food insecurity, governments tend to intervene in domestic maize markets and impose trade restrictions aimed at stabilising prices and protecting producers from competition and the consumers from price increases. While in the domestic markets governments intervene through establishing regulatory state controlled marketing boards and enforcing price control mechanisms, the trade markets have been typified by protectionist measures that restrict imports and exports of maize. Specifically, Governments have in most cases instituted ad-hoc and seasonal import and export bans in the trade markets, mostly in response to internal maize price increases or price depressions resulting from cheaper imports.

Maize trade in the region is governed via multilateral trade agreements under the World Trade Organisation (WTO) and Regional Economic and Trade blocs (e.g. SADC, COMESA and SACU), as well as bilateral agreements with neighbouring countries. Most of the countries in Southern Africa are members of SADC. Therefore, their trade is conducted under guidance of the SADC Trade Protocol. Through the Protocol, countries agreed to provide for preferential access to regional trade partners through reduced tariffs on certain products that include maize. Veritably under the protocol, tariffs for maize were reduced to zero. To qualify for the zero rated tariffs exporting countries have to comply with the Rules of Origin (RoO) requirements of the Trade Protocol as well as the SPS measures and quality standards.

Generally the quality standard required for maize for food is that the maize should be suitable for human consumption.

4.3 The Zimbabwe maize grain import supply chain

Drawing from the overall regional maize value chain described above, this section sets apart the formal maize channel for grain imports into Zimbabwe. In particular, the section is divided into two sub-sections that discuss the key demand and supply aspects of the import supply chain for maize grain intended for food. The first sub-section highlights the distinctive domestic production, marketing and consumption factors that influence the demand for imported grain while the second sub-section explores the maize trade patterns and the unique features of production of the two main sources of imports (i.e. South Africa and Zambia), that have influenced the trade patterns.

4.3.1 Maize grain demand

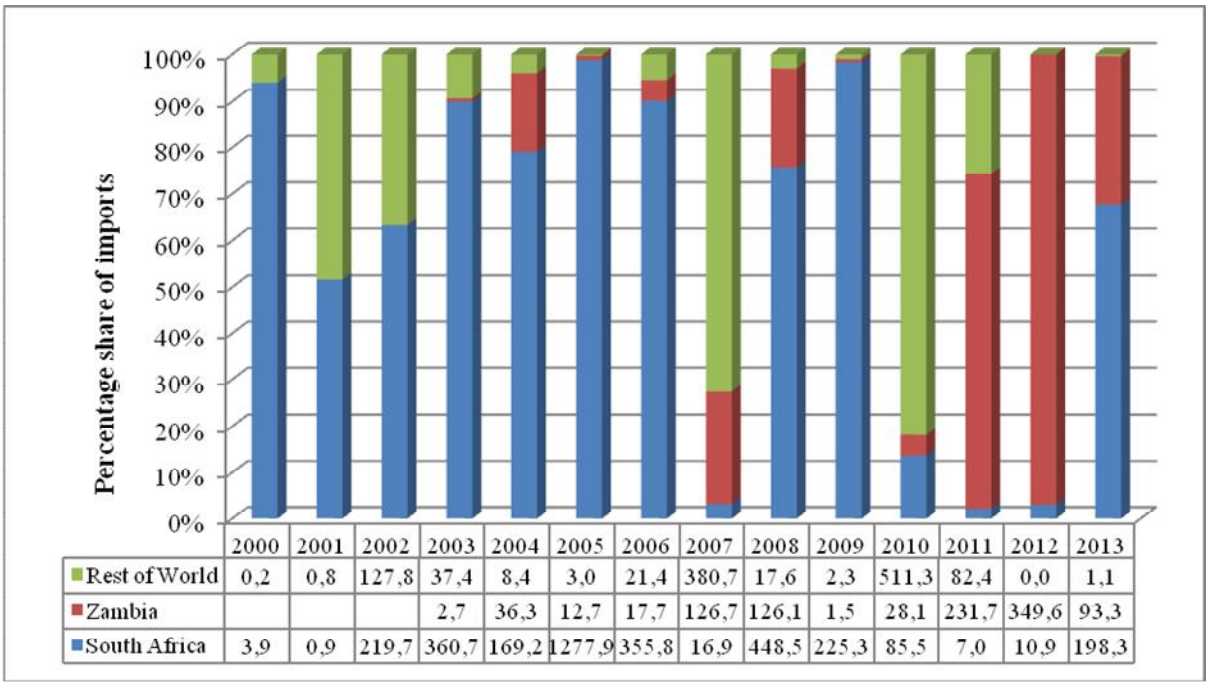
Like in all the other Southern African countries, maize is a major staple food crop in Zimbabwe. With the consumption of the crop estimated at over 100kg per capita per year and contributing 43% of the total caloric intake, Zimbabwe is admittedly one of the highest consumers of maize in the region (Smale, Byerlee & Jayne 2011). Historically, domestic production in the country has been able to not only meet but exceed these consumption requirements and accordingly surpluses have been exported to markets in the region and beyond. However, since 2000 when Zimbabwe undertook the drastic political and economic policy shifts embodied in the Fast Trek Land Resettlement (FTLR) Program, the country has progressively experienced a negative maize stock balance year-on-year, as local production failed to meet the maize demand (see Figure 4.1).

Through the FTLR – a programme that was designed to redistribute land mainly from white large-scale commercial farmers to the majority black Zimbabweans – the structure of the agriculture sector changed notably. The large scale commercial farming sub-sector contracted remarkably from 4,500 farms occupying 70% of the agricultural land to a few hundred farms occupying less than 10% of the agricultural land (Theron 2010; Chikuhwa 2006). On the other hand, the smallholder sector grew rapidly in terms of the numbers of farms and the amount of land held to become the main agricultural actors. As a result, the combined effect

of the general productivity challenges faced by smallholder farmers and the implementation of unfavourable economic and agricultural policies resulted in reduced national production figures. Consequently, Zimbabwe became a net importer of maize grain.

4.3.2 Maize grain import supply

Persistent maize deficits have resulted in increased imports (both formal and informal) and food aid into the country over the years. Much of the imports are sourced from the region. South Africa has traditionally been the main supplying market although in recent years Zambia has emerged as the alternative favourite regional source. Figure 4.2 shows how for several years South Africa has consistently provided over half of Zimbabwe's maize imports and only since 2011 has Zambia become a major contributor providing about 70% and 99% of the imports in 2011 and 2012 respectively; and then again about a third of the supply in 2013.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Rest of World	0,2	0,8	127,8	37,4	8,4	3,0	21,4	380,7	17,6	2,3	511,3	82,4	0,0	1,1
Zambia				2,7	36,3	12,7	17,7	126,7	126,1	1,5	28,1	231,7	349,6	93,3
South Africa	3,9	0,9	219,7	360,7	169,2	1277,9	355,8	16,9	448,5	225,3	85,5	7,0	10,9	198,3

Figure 4.2: Share of Zimbabwe's maize (HS 100590 corn excl seed) imports from South Africa, Zambia and the Rest of the World from 2000 to 2013 (1000 tonnes)

Source: UNCOMTRADE Database as reported by Zimbabwe's Partners

The significant decrease in maize supply from South Africa and increased importation of Zambian maize has largely been attributed to the widespread production of GM maize in South Africa and increased availability of surplus guaranteed non-GM maize in Zambia.

Conversely the decline in Zambian imports in 2013 may be attributed to the export ban that was instituted by the Zambian Government in that year which resulted in most imports being stopped until a Government-to-Government agreement was signed between the two countries. In order to provide in-depth context on Zimbabwe's main grain suppliers, the national production aspects as well as trade arrangements of South Africa and Zambia are discussed next.

a. South Africa

Trade between Zimbabwe and South Africa is largely governed by a standing bilateral trade agreement between the two countries, which was initially signed in 1964 during the era of the Rhodesian government to provide for preferential rates of duty, rebates and quotas on certain goods traded between the two countries. A follow up trade agreement was then signed in August 1996, allowing RSA products to be extended lower tariffs and quota levels on textile imports into Zimbabwe. More recently in 2008, the agreement further extended lower tariff rates on basic commodity imports into Zimbabwe including maize. As a result of this agreement, raw grain imports and maize meal imports from South Africa have been entering Zimbabwe, duty free (zero rated in duty and tariffs). This arrangement resulted in South Africa being ranked among the top 3 maize supplying countries to Zimbabwe prior to 2008 (JADAFA *n.d.*).

In terms of production, maize is produced across all of South Africa under wide-ranging environments and climatic conditions. Although annual national production of the crop varies considerably due to climatic variability, productivity has generally remained relatively constant and significantly higher in comparison to other countries in the Southern African region (Figure 4.1 and Figure 4.3). Most of the maize is produced by commercial farmers; in 2005 it is estimated that over 90% of the maize in the market is produced under the commercial production system by more than 10 000 commercial farmers (SAGIS 2005 in JADAFA, *n.d.*). Notwithstanding the advanced production techniques that provide for higher productivity in the commercial subsector, a combination of the liberalisation of the market and technological advancements like precision farming, high yielding hybrids and the adoption of genetically modified maize varieties since 1998 is considered to be major drivers of the higher productivity levels. As can be noted in Figure 4.3, GM maize production has been increasing steadily over the years to account for a significant share of total maize production. Moreover significant yield increases have been recorded on GM maize crops.

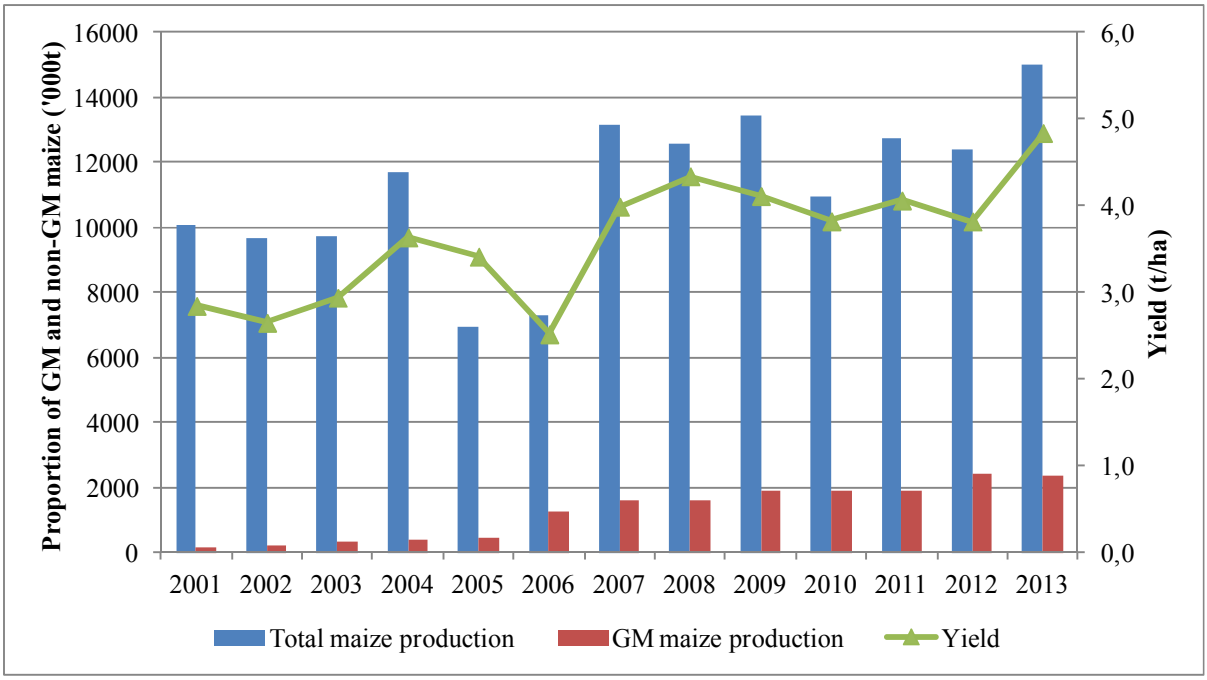


Figure 4. 3: Total and GM maize production and average yield in South Africa (2001-2013)

Sources: Index Mundi Database, ISAAA South Africa Biotech Facts and Trends (2014)

Facing some pressure internally and externally about the presence of GM commodities in the market, a dual marketing system has emerged in South Africa, with some suppliers opting to supply only non-GM products. Subsequently an elaborate process was set up to preserve the identity of non-GM products. While for the domestic South African market there is no segregation or identity preservation (IP), suppliers have undertaken a segregation and identity preservation system firstly on a voluntary basis to meet the local non-GM market and secondly on a mandatory basis to meet their export market requirements. In line with its obligations under the Cartagena Protocol on Biosafety and in a bid to maintain its trade relations, the SA Government recognises the import market requirements of GM sceptic countries like Zimbabwe, regarding the GM status of the consignment being imported from SA. As a result it has put in place a Standard Operating Procedure (SOP) for the issuance of non-GMO status certificates by the Department of Agriculture, Forestry and Fisheries (DAFF). The SOP has been approved by the Directorate of Biosafety as the standardised procedure to be followed by all exporters exporting a crop, which has a GM equivalent that is commercially available in SA. The certificates indicate the GMO status of consignments

being exported from SA and are only issued based on the specific threshold requirements imposed by importing countries.

b. Zambia

The increase in Zambia's market share in Zimbabwe is largely driven by the surplus domestic production of guaranteed non-GM maize. Zambian domestic maize production has generally been on the increase since 2000, which can be credited to the expansion in area under maize, yields realised and in the ratio of area harvested to planted, as indicated in Figure 4.4 below.

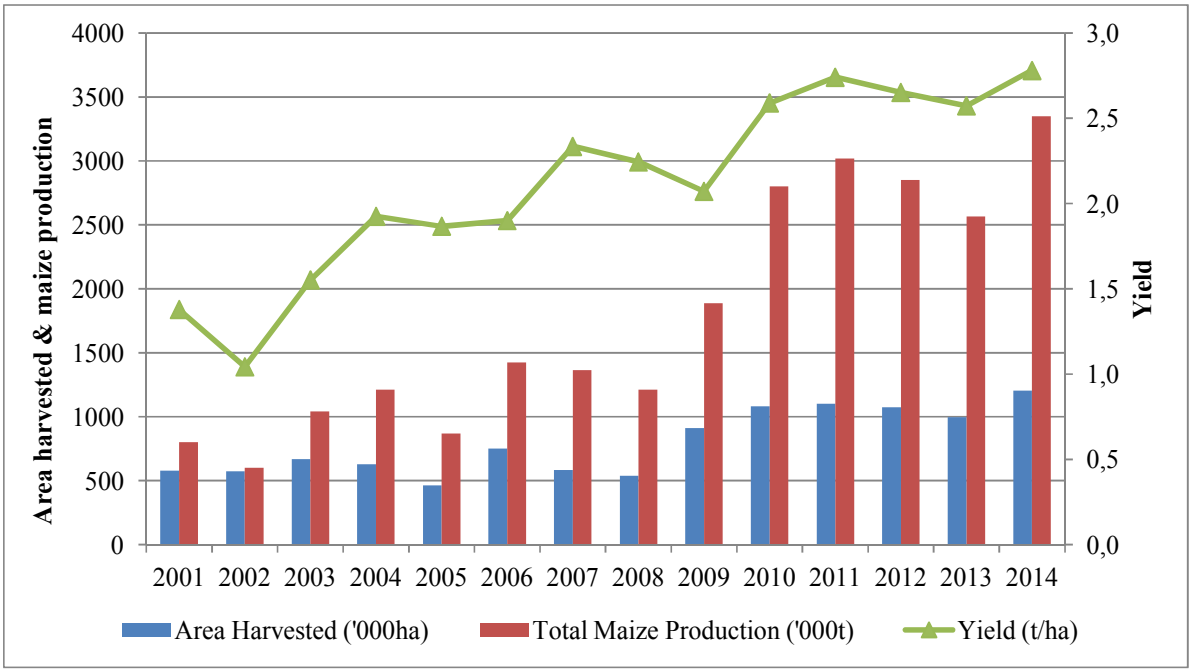


Figure 4.4: Area harvested, total maize production and yield in Zambia from 2001 to 2014

Source: Index Mundi Database

Yield expansion has been observed due to the combined effect of favourable rainfall, access to quality and improved inputs (mainly hybrid seeds and fertilisers) for the smallholder sector and expansion in the commercial farming sector. Producing 33% more maize per household in 2010/11 than in 2000/0, the Zambian small-medium farming sector has been very instrumental in the maize production increases experienced by the country. Responding to the incentives created by the Food Reserve Agency (FRA) and the Farm Input Subsidy Program (FISP), a greater proportion of the farmers are producing a surplus and becoming semi-commercialised. The commercial sector expansion is attributed to the increase in foreign

investments in farming as well as the migration of the displaced commercial farmers from Zimbabwe (Hall 2011; Derman & Kaarhus 2013).

Although Zambia has managed to realise sustained maize yield increases and exportable surpluses, it still faces a number of challenges in exporting its surpluses. Among the challenges are *ad hoc* export bans that are put in place by the Government whenever they face increased prices in the domestic markets. The most recent export ban was in 2013 that resulted in most maize exports to Zimbabwe being stopped, only to be resumed after a Government-to-Government agreement was brokered.

4.3.2 Maize grain import policy and regulations

This section explores in detail the maize grain import policy and regulations that have been instituted by Zimbabwe to govern the importation of maize grain into the country. It provides an enumeration of the complete regulatory requirements an importer must satisfy when importing maize grain and showing where the GM regulation features in the wider context of the import regulatory environment. The section then presents and briefly discusses the relevant sections of the principal policy document – the National Biotechnology Act. In conclusion, the section outlines the specific GM regulatory requirements as they apply to the importation of maize grain for food uses.

a. Overall import regulations

Imports of maize grain into Zimbabwe are regulated through the Control of Goods (Import and Export) (Agriculture) Order, 2007 and as stipulated in the Statutory Instrument (SI) 350 of 1993. Specifically all the imports are subject to specific licensing administered by the Ministry of Agriculture, Mechanization and Irrigation Development (MoAMID). MoAMID issues import permits with the main intention of conforming to the WTO SPS standards of protecting human, animal or plant health and life. In the case of food maize grain imports the Ministry has the added purpose of managing the interface between imports and domestic production in meeting national food demand. As such, for importers to be issued with an import permit, they must comply with a list of requirements that satisfy the above-mentioned purposes (among other things).

The list of requirements that have been set by MoAMID for the issuance of import permits for maize grain intended for the maize meal channel involves importers approaching various

statutory and industry bodies to provide letters supporting the permit application based on their assessment of the situation with regard to SPS standards and food requirements (Table 4.2).

Table 4.2: List of statutory and industry bodies, their overall mandate and their import permit compliance

Statutory/ Industry Board	Mandate	Import Compliance Requirements
Agricultural Marketing Authority (AMA)	- Established under the Agricultural Marketing Authority Act, it is responsible for the administration of the SI 140 (2013). It regulates and coordinates the participation in production, buying and processing of agricultural products. It does this by registering all merchants and processors that buy and sell agricultural products that include grains and maintains the directory of these actors.	• Industry or market registration as a trader or processor of maize grain • Support letter
Grain Marketing Board (GMB)	- Initially established as the Maize Control Board, under the Maize Control Act in 1931, it is a wholly state owned commodity trading enterprise responsible for the control of the marketing of grains and oilseeds in order to manage the availability of supply to meet local demand.	• Support letter indicating that GMB do not hold sufficient stock of maize grain
Grain Millers Association of Zimbabwe (GMAZ)	- An apex representation body of the grain milling industry in Zimbabwe that includes maize meal processors. The Grain Millers Association lobbies for the interests of milling industry.	• Support letter
Plant Quarantine Services (PQS)	- Is responsible for administering the Plant Pests and Diseases (Importation) Regulations which allows for the provision for the safe movement of plants and plant products across borders without exposing the country to the entry of pests and diseases from other countries.	• Issues a plant permit • Potential inspection at point of origin for plant pests & diseases
National Biotechnology Authority (NBA)	- Is an independent research and development body whose mandate is to regulate and supervise the importation for food, feed and processing so as to minimise possible adverse impacts of the products of biotechnology on human health, environment, national economy and security.	• Registration with the NBA • Issues an NBA permit • Potential inspection at point of origin (for non GM presence or approved GM content) • Supervises transport and milling (in the case of GM maize that has been allowed to enter

Source: key informant interviews and company websites

The Ministry issues the import permits upon receiving the supporting letters and permits as well as other company documents attached to the application. In addition to the import permit

requirements the importer must also comply with the normal customs clearance procedures as administered by the Zimbabwe Revenue Authority (ZIMRA) operating under the portfolio of the Ministry of Finance. ZIMRA specifically enforces the various controls on the imports on behalf of MoAMID. At the time of importation the importer has to produce the permit together with all the other clearance documents. Clearance documents include certificate of origin (based on the RoO that allow for duty exemptions) and the non-GMO certificate (in the case of non-GM maize). During customs clearance the cargo may be subject to border inspections that will be conducted by ZIMRA and the PQS staff stationed at the border post.

b. Outline of the provisions contained in the policy document governing GM imports

The principal legal framework for the regulation of the importation of genetically modified crops (including maize) is the National Biotechnology Authority Act of 2006. The Act is by definition not specific to GMO crops or agricultural products as it broadly governs the application of all forms of biotechnology in all economic sectors that include medicine, agriculture and industrial processing. Furthermore, the Act does not make special provisions for the regulation of trade issues as it covers all regulatory issues that include research, production, import and export. However, in section 22 (1) the Act makes provision for the promulgation of "biotechnology guidelines and standards of practice and procedure that shall be binding on... all users of products of biotechnology..." The matters of which the biotechnology guidelines and standards may be issued for, include trade matters as indicated in subsection (2) (k) of section 22 (Box 4.1).

Box 4. 1: Excerpt of section 22 subsection (2) (k) of the Act

> *"(k) the requirements and procedures for the importation and exportation of products of biotechnology that are likely to have adverse effect on human health, the environment, the economy, national security and social norms and values."*

The Act authorises the establishment of the National Biotechnology Authority (NBA) of Zimbabwe to administer the provisions of the Act and issue the biotechnology guidelines and standards of practice and procedure. Taking specifically into account the provisions of the Cartagena Protocol on Biosafety (CPB) which provide for separate screening and approval processes for GMOs in trade, the Act empowers the NBA to oversee compliance to the

national guidelines and standards in respect of such matters as the requirements and procedures on the import of GMOs. However, in spite of the fact that Section 5 sub sections (2l) and (2m), empowers the NBA to oversee the safety aspects of the import and export of biotechnology production (Box 4.2), the Minister is provided overall oversight in defining the regulations for executing the Act. Important to note is that though matters regarding science and biotechnology fall under the auspices of the Ministry of Science and Technology, by the definition given in the Act, the term Minister also refers to "any other Minister to whom the President may, from time to time, assign the administration of the Act." This definition is particularly significant for this study in that there appears to be a difference in opinion between the Ministries of Science and Technology and that of Agriculture.

Box 4. 2: Excerpt of section 22 subsection (2) (k) of the Act

"(l) to approve the safety aspects of the import, export, manufacture, processing and selling of any products of biotechnology, including substances, foodstuffs and additives containing products of biotechnology
(m) to advise the customs authorities on the import and export of biologically active material and products of biotechnology"

The current Minister of Science and Technology Professor Henry Dzinotyiwei has been on record in Parliament time and again advocating for biotechnology especially GMOs, citing the lack of scientific evidence on the negative impact of GM crops on health and the environment, as indicated by the World Health Organisation (WHO), the Food and Agriculture Organisation (FAO), the Royal Society in the UK and the Food and Drug Administration (FDA) in the USA. However, in contradiction the Minister of Agriculture Dr. Joseph Made is on record within the same parliament saying that the government is concerned with the basic protection of consumers, local biodiversity and seed Intellectual Property Rights (IPR) issues. For the reason that most of the contention around biotechnology especially on matters of the importation of GMOs emanates from the Ministry of Agriculture, MoAMID has been instrumental in defining the regulatory requirements for as provided for in under section 59 (2) (a) and (2) (b) (Box 4.3).

Box 4. 3: Excerpt of section 59 subsections (2) (a) and (2) (b) of the Act

(2) Regulations made in terms of subsection (1) may provide for-
(a) standards of quality, classification and grading of any product of biotechnology
(b) the prohibition of the production, sale, import or export of any product of biotechnology that does not comply with standards referred to in paragraph (a)

In terms of the motivations and/or concerns of government driving the policy and regulations, the Minister of Agriculture's sentiments are reverberated in the definition of the scope of the Act in section 3 subsections (2b) and (2d) of the Act as well as in section 26 subsection (1) (Box 4.4). Evident from the excerpts of these sections is that the government is concerned about the potential negative consequences of biotechnology processes, products and applications on human, plant, animal and national security that may result from *inter alia* the importation of any of biotechnology products.

Box 4. 4: Excerpt of section 3 subsections (2) (b) and (2) (d), and section 26 subsection (1) of the Act

"(2) This Act shall apply to-
(b) the import, export, contained use, release or placing on the market of any product of biotechnology that is likely to have adverse effect on human health, the environment, the economy, national security or social norms and values.
(d) all measures aimed at minimising the impact of biotechnological processes on national security, human health, animals, plants and the environment."

"26 General duty of care to be observed by users of products of biotechnology
(1) Every user of products of biotechnology shall in addition to the requirements of this Act and any biotechnology guidelines or standards, ensure that appropriate measures are taken to prevent or minimise any foreseeable danger to persons, animals or plants pr to the environment generally that may arise from the use of such products"

c. The GM import regulatory requirements

Under the direction of MoAMID, the NBA has released guidelines to importers of food, feed and seed for the issuance of an import permit, which is contingent on the GM status of the consignment. The regulatory guidelines provided by the NBA and MoAMID stipulate that all

non-GM imports of seed and grain have to be accompanied by a non-GM certificate from accredited testing facility that is most 3months old. Based on the provisions of the CPB these regulations require additional testing, information labelling and prior notification from the traders. The additional processes have become an integral part of the licensing and customs clearance procedures. The regulatory requirements for importing non-GM maize rely on proving the non-GM status of the consignments from import permit application right up to customs clearance at the border. For a consignment to be classified as non-GM, the GM content should not exceed the threshold of 0.02%. According to these guidelines, GM grain is only permitted in its milled form. However, through past experiences GM grain has also been occasionally allowed entry into the country. The GM grain is known to be only imported under strict supervision throughout its journey (transportation) and is also milled under supervision by the NBA to ensure that the grain is not released for seed and that the by-products are not used for livestock feed. The times in which Zimbabwe has been known to import GM has been in times of severe food shortages mainly in 2002 and in 2008. In 2002, was the first time, the decision and policy was passed to allow milled GM food or supervised un-milled grain. The decision to accept milled GM grain was perceived as an indication that GM maize is safe to consume.

According to the regulatory requirements, the NBA maintains the national surveillance system for GMOs and no one is allowed to import, export without a permit from the NBA. As such, in the importation of food, feed and processing the NBA is tasked with the responsibility of providing for internal market segregation of GM imports from non-GM grain by preventing the unintentional entry of GMOs into the country through the surveillance of GMO testing and the supervision of the imports.

4.4 Implications of GM policy and regulations on maize meal channel

In the next section the study examines the extent to which the GM import policy has impacted on the maize supply chain starting with a mapping of the channel, followed by an analysis of the estimated total landed costs of maize grain from Zambia and South Africa. The section ends with considering the likely effect of the landed costs on the price of the end product in the maize meal channel, i.e. the impact on Zimbabwean consumers.

4.4.1 Market segregation

The internal market segregation of GM imports from non-GM imports crops has created dual marketing channels for the import supply chain. The two channels only meet at wholesale and retail level when the milled maize has been packaged and is ready for sale to consumers. Figure 4.3 indicates the GM and non–GM channels highlighting the points of compliance along the supply chain. The two channels are differentiated by the regulatory requirements for each channel. Of note is that while the compliance for the non-GM channel is focused on defined points along the channel, the compliance for the GM channel is a process occurring throughout the channel from the source right up to milling.

In order to comply with the non-GM status the following steps need to be followed:

1. A GMO free certificate is issued by the Directorate of Biosafety (in South Africa) based on tests conducted by approved laboratories.
2. Plant inspectors may be deployed by the NBA and the Ministry of Agriculture to go to SA to test and validate the non-GM status.
3. Another test (a strip test which is not 100% accurate but a good indication) is done at the border.
4. A final test is conducted at the final destination or point of arrival of the consignment.

In cases when GM maize grain is permitted to be imported, there are extra security measures:

1. A security detail is ensured from the border to the milling point.
2. The silo or storage points that are used (usually the big capacity millers – such as National Foods / GMB) are quarantined.
3. Because 15 – 20% of the hulls from processed maize is normally passed on for livestock or animal feed, to prevent the hulls from GM maize ‘contaminating’ animal feed, the leftovers from the processing are incinerated
4. After all the grain is cleared from the storage facility the storage is not used for 1 – 2 months.
5. Policy stipulates that the processed products should then be labelled so that the consumers make an informed decision.

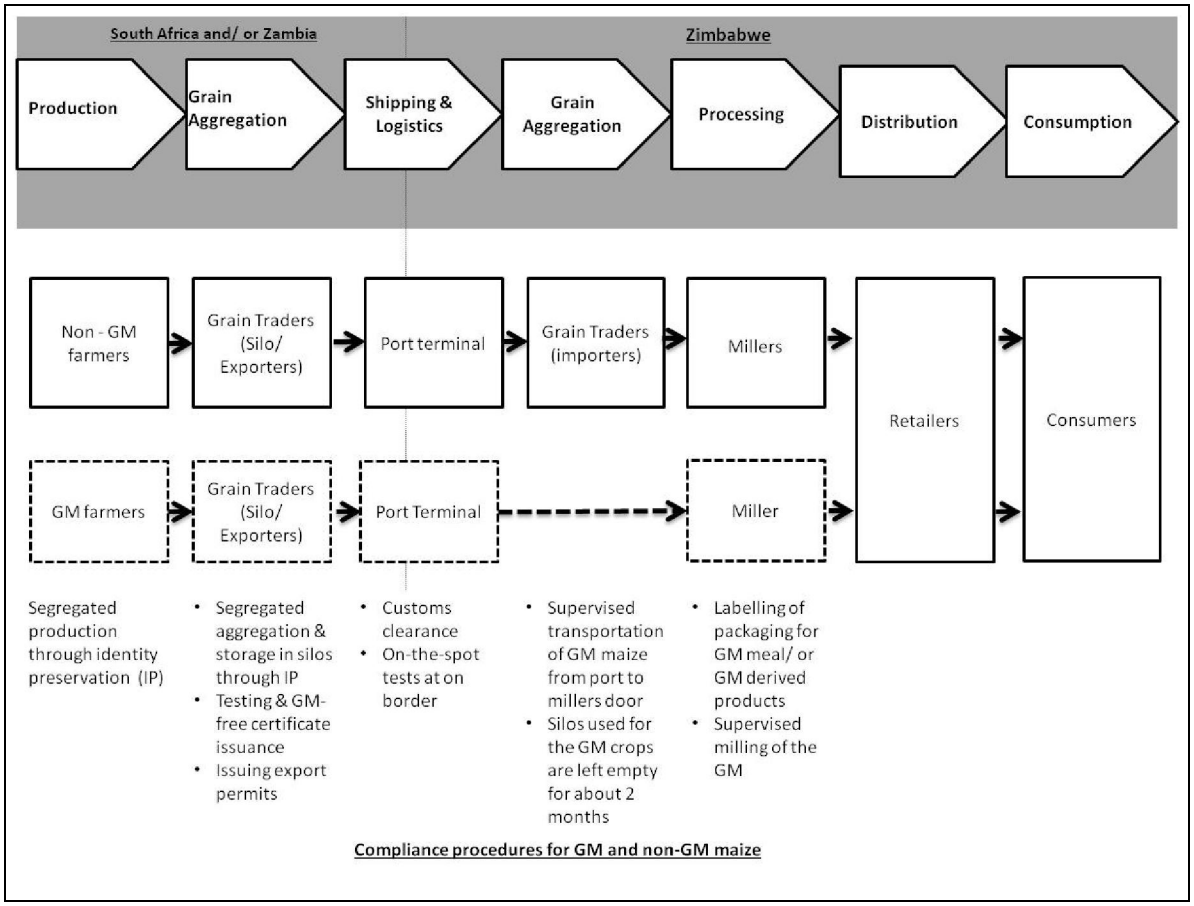


Figure 4.4: GM import regulation compliance in the GM and non-GM maize grain import channels

Source: author

Specifically indicated in Figure 4.4 and represented by solid lines, the non-GM channel is the most established and prevalent channel given the high preference towards non-GM maize as governed by the policy. The GM maize channel (represented by broken lines) is used sporadically in times of severe food shortages and emergency situations. As such, the importation of GM grain may be considered more as an exception than a rule and has only officially occurred in 2002 and 2008.

4.4.2Total landed cost differentials of maize grain imports

Having mapped the import supply chain and distinguished between the GM channel and the non GM channel, this sub-section examines the impact of the GM regulatory requirements, on the cost of importing maize grain in each channel. Specifically, the sub-section estimates and discusses the direct costs associated with meeting the import requirements indicated in sub-section 4.3.2. The costs were calculated based on information from key informant

interviews (mainly traders and regulators) as well as secondary sources. Because of the confidentiality surrounding most of the data and information requirements used in the TLC calculations the study had to some extent relied on anecdotal information from media reports to make inferences.

a. Non-GM Import Channel

The non-GM import channel is divided into two, depending on the country of origin of the grain imports i.e. South Africa and Zambia. The main distinguishing feature between the sources is the production and presence of GM maize in the country of origin. Because South Africa is a major GM maize producer and for their internal maize market GM and non-GM maize are not segregated, virtually all the non-GM maize from South Africa is treated as suspicious and is subjected to GM status certification. Zambia on the other hand has a strict preventive policy that does not allow the production of GMOs. As such maize imported from Zambia is treated with less suspicion and is not subjected to the same level of scrutiny as SA maize. In addition, for guaranteed non-GM maize from South Africa, a R200 – R300 per tonne price premium (2013/2014 marketing season) is charged on the normal SAFEX price. Furthermore, in some instances there is an added transaction cost linked to transport when non-GM maize cannot be sourced from silo sites that are conveniently situated near the port of entry. To this end, according to discussions with key informants, traders tend to prefer sourcing from Zambia as there are less administrative requirements and associated costs.

A closer examination of the estimated total landed cost of non-GM maize indicated in the calculations provided in Table 4.3, reveals that the total landed cost of non-GM maize from SA was about 8% more than the landed cost of non-GM maize from Zambia. In alignment with the points raised by the key informants, the analysis of the breakdown of the landed cost components affirms the significance of the difference in regulatory compliance. The import regulatory and policy compliance costs for maize from SA were almost 40% more than the costs for Zambia. According to one of the key informants, maize from Zambia is ideally also supposed to be tested for GM content but, because Zambia does not produce GM maize, the maize is treated with less suspicion compared to South African maize. Therefore this explains the higher import regulation and policy compliance costs incurred through importation of maize from South Africa. It can be noted that these figures may be considered to be conservative, as they do not take into account the costs that are often associated with the

border delays owing to procedures related to customs clearance and consignment compliance checks by the customs authority, ZIMRA. However, given the scrutiny the South African maize is subjected to, the cost of the delays would be expected to be greater for the maize imports from SA. Indeed, research conducted by Mbekeani (2012) that compared delays at various border points in southern Africa showed the delays at the South Africa – Zimbabwe Beitbridge border to be 12 hours more than the delays experienced at the Zambia – Zimbabwe Chirundu border. Nevertheless, despite the premium charged on the non-GM price in SA, the purchase price of maize per tonne was 20% less than the price in Zambia. Thus, the lower price in South Africa significantly negates the compliance differences by about 50%.

Table 4.3: Estimated total landed cost (ex-Harare) comparison for 5000MT of maize consignments from SA and Zambia (November 2014)

Cost Components (US$/t)	Channel and Country of Origin		
	GM Channel	Non-GM Channel	
	SA	SA	Zambia
Purchase Price at Origin	176.00	200.00	240.00
Total Transport & logistic cost (Randfontein – Harare and Lusaka – Harare)	139.57	139.57	75.04
Import Regulatory and Policy Compliance Costs	1.35	0.45	0.33
TOTAL LANDED COST	**316.92**	**340.02**	**315.05**

Source: Author calculations based on key informants and various secondary sources

Also notable from Table 4.3 is that the differences in the landed costs are highly attributed to the transport and logistics costs in the South African channel that are more than 80% higher than in the Zambian channel. The lower costs in Zambia are explained by the liberalisation of the road transport service markets that have allowed for the extensive entry of foreign (mostly South African) trucking companies to operate at lower fuel, financing, depreciation and insurance costs in Zambia (Raballand, Kunaka & Giersing *et al.* 2008) and as well as the fact that Harare is considerably closer to Lusaka than Randfontein.

b. GM import channel

The only source of imports in this channel is South Africa, as it is the only country that produces GM maize. The costs of the regulatory requirement for the strict supervision (i.e. the travel related costs of supervising regulators) of GM maize imports all the way from the port of entry up to the millers' door are met by the importer. These high costs of compliance in the GM channel are shown in Table 4.3 whereby the compliance costs were about three times and four times more than the South African non-GM channel and the Zambian non-GM channel, respectively. Nonetheless, in spite of the transport differences between South Africa and Zambia (discussed in the sub-section above), and the relatively high regulatory compliance costs, also indicated in Table 4.3, is that the total landed cost for GM maize was 6.8% less than the landed cost for SA non-GM maize and only less than 1% more than Zambian non-GM maize. The relatively comparable total landed cost on the GM maize may be explained by the significantly lower price of maize grain in the channel, which was about 14% and 37% less than South African non-GM price and Zambian non-price, respectively.

c. Implications of the Total Landed Costs Differentials

Firstly, when transport and logistics costs are not taken into consideration, the cost of maize from South Africa is considerably lower than maize from Zambia. On this basis alone it may appear that the per-unit costs of the regulatory costs may be insignificant. However, according to the costs provided at the NBA offices, the costs to be incurred by the importers include a registration fee, permit fee, and inspection fees at the point of entry. Excluded from the TLC analysis are the annual registration costs of all the various organisations that provide support letters for import permit application including the NBA registration fee because they are paid once a year and the per unit cost would vary depending on the frequency of imports and the size of each consignment in any given year. On the other hand, the permit fee is charged per consignment and on the basis of the size of the consignment. In addition the GM channel regulatory costs include costs of inspectors from NBA accompanying and supervising the movement of the grain to the mill. Traders have indicated that the costs of complying with the regulations in the GM channel are prohibitive especially for small and medium scale importers. Therefore in the few times that GM maize has been imported it has been done so by large-scale traders with economies of scale. Figure 4.5 below shows the cost per tonne based on the size of consignment being imported. The Figure demonstrates that the bigger the consignment the lesser the unit costs hence the advantage of the economies of scale. However this poses a challenge in that since the deregulation of grain trade in 2009,

trade industry is still under development with a few key players (Kapuya *et al*. 2010) that have these economies of scale.

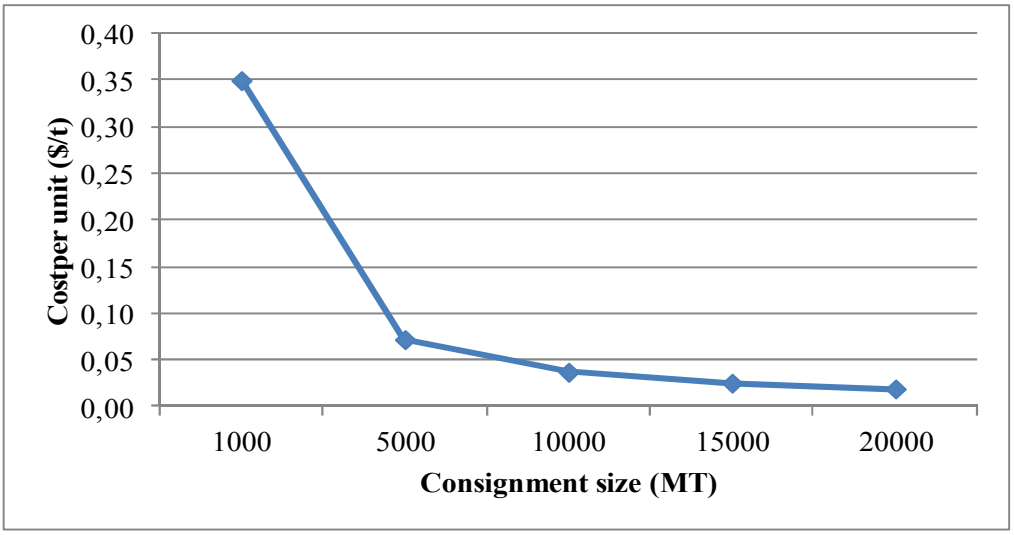


Figure 4.5: NBA import permit fee costs per metric tonne, based on the size of consignment

Source: NBA import permit fee structure

Secondly, the significant counteractive price advantage of South Africa's grain (both GM and non-GM maize) suggests that the most significant impact of the GM import regulation requirements in the food market is its effect on reducing access to low-cost maize grain in regional markets.

4.4.3 Maize meal cost-price effect

To demonstrate the import regulation's effect on consumers, Table 4.4 below compares the maize meal price differentials based on country of origin of maize grain. The calculations in the table are based on the assumption that maize from the different sources is priced differently within Zimbabwe's domestic maize market. Directly evident from the table, is that similar to the landed costs differentials, the price of maize meal from the South African non-GM grain is significantly higher than price of GM maize and Zambian non-GM maize. This reveals that the landed costs differences are carried over to the maize meal market, as the price of grain constitutes the major cost component for maize meal production. However, considering the requirement for destruction of the hulls and the by-products of milled GM

maize the cost structure for GM maize milling and consequently the price of maize meal may not be simply an extension of the landed costs. In fact, millers in the GM channel are faced with a loss on added revenue from the sale of the by-products to the livestock feed industry because of the incineration requirement. The implication of this scenario is that the cost of the production of maize meal in the GM channel would include the foregone revenue from the sale of the by-products. Rationally, this loss would be factored into the price of the meal and eventually passed on to the consumer in order to reduce the implied loss. For instance, based on the figures presented in Table 4.4, the actual cost of maize meal production in the GM channel would be $751.73/t (i.e. C + D + I) and when the profit mark-up is added, the price of GM maize meal would add up to over $900/t. This means that for a 10kg bag of maize meal[3], the consumer would pay either 30% or 40% more than the maize meal from the non-GM channel, thus making the channel uneconomic for consumers, at prevailing regulatory conditions.

Table 4.4: Estimated cost - plus pricing for roller meal (at 85% extraction rate), based on channel and source of imports

Cost and Price Components	GM	Non-GM	
	SA	SA	Zambia
A. Mill-door Price of Maize Grain	421.50	452.23	419.02
B. Quantity of maize required to manufacture 1t of maize meal	1.18	1.18	1.18
C. Costs of maize grain required to produce 1t of maize meal (A*B)	497.37	533.63	494.44
D. Overhead maize meal production costs	41.73	44.77	41.47
E. Percentage mark – up	30%	30%	30%
F. Wholesale Price of maize meal/ t	**700.83**	**751.92**	**696.68**
G. Quantity of by-product in process of making 1t of maize meal (i.e. maize bran)	0.81	0.81	0.81
H. Price of maize bran $/t	262.50	262.50	262.50
I. Approximate market value of the by-products for livestock feed (G*H)	**212.63**	**212.63**	**212.63**

Source: Author calculations based on key informants and various secondary sources

[3] This is the commonly referenced amount for maize meal in the food basket when the Consumer Council of Zimbabwe (CCZ) calculates the consumer price index (CPI)

Although the price differentials indicated above may be theoretical, the market does not simply differentiate based on the different sources. Therefore, considering that the GM channel is in reality, only operational in times of severe food needs, and that during these times the government would most likely intervene to make prices affordable for the consumer, the study will at this point discount the effect of the channel on the consumers and will instead focus on the most established non-GM channel. Taking into account that in the non-GM channel, traders tend to prefer Zambian grain because of lesser associated compliance costs (demonstrated in Table 4.3), the study assumes that the non-GM Zambian channel is the most dominant channel. As a result, the prevailing prices in the Zimbabwean maize meal market are assumed to be the prices of the Zambian non-GM channel.

To determine the implication on the consumers, the study assumes a scenario whereby Zimbabwe has a permissive policy that subjects GM products to generally the same regulatory processes as non-GM products in accordance with WTO rules and regulation. Additionally, the use of GMOs in animal feed would be permitted. In this regard imports from SA are assumed to have the same regulatory cost structure as Zambia. In addition, because the SA market does not segregate GM and non-GM grain, the assumed grain purchase price for the imports in the scenario will be the price from the GM import channel, which does not have a premium attached to it. The finding from the scenario was that the eventual price of maize meal would be $698.57/t. This price is only less than 0.5% of the price of maize meal in the Zambian non-GM channel computed in Table 4.4. The price also would mean that the consumer would pay $0.50 less than what the consumers would pay in the presence of compliance requirements especially in situations when Zambia implements its *ad hoc* export bans. These differences appear to be negligible and imply the regulatory requirements to be of little consequence to consumers. This may be because transport and logistics costs from SA contribute significantly to the total landed costs of the maize grain. This means that consumers may only be able to benefit from the lesser priced South African GM products if the transport and logistics costs are lowered.

On the other hand, the compliance requirements may have acted as a mechanism for protecting the domestic producers from inexpensive grain imports. For instance, in mid-2014 the government passed the SI (122) of 2014, Agriculture Marketing Authority (Minimum Grain Price, 2014) setting a domestic producer price of $390/t. Compared to price in the total landed cost calculation, this minimum price is about 60% more than grain prices in Zambia

and South Africa. However, after factoring the compliance costs the stipulated price is at least 15% higher than the landed prices of both the GM and non-GM maize. Traders and millers use the total landed prices ex-Harare to compare and select between domestic and imported grain (Kapuya *et al*. 2010). If the prices of imports are significantly higher than domestic prices then traders opt for imported products. Therefore, when the GM compliance requirements increase the costs of imports the result is that domestic producer prices become relatively competitive.

4.5 Conclusion

The chapter demonstrated that by its dominance in production and consumption, maize remains crucial for food security in the Southern African region. Demand and supply for maize in the region are influenced by the diversity of production among countries. Deficits and surpluses characterise the demand and supply patterns for maize in the region, consequently countries that have experienced surpluses export their surplus to the countries with deficit. Zimbabwe is one of the countries that have consistently had deficits in maize production in the last decade. Therefore the country has had to import much of its maize from the region, to meet its domestic needs. However, the GM import policy instituted by Zimbabwe restricts access to low-cost maize imports.

Based on its regulatory guidelines and standards, Zimbabwe has embraced a fully preventive trade policy that strictly prohibits the importation of GM seed and animal feed while undertaking a more precautionary policy on imports intended for food and food processing. Consequently, in addition to the general import regulations Zimbabwe imposes separate and more restrictive regulations on imports of GM commodities based on both SPS and biosafety grounds. The Zimbabwean GM import policy has thus divided the maize grain import supply chain into two channels, i.e. the GM and the non-GM channels. The GM channel which is only applicable to maize from South Africa only operates during times of severe food shortages and is characterised by costly and prohibitive procedures. The non-GM channel costs depend on the source of the maize with non-GM maize from South Africa being more costly than non-GM maize from Zambia. However, the most significant cost in the non-GM maize market is the price premium that is applied to non-GM maize. This is the main factor that sets apart the cost differentials between Zambian non-GM maize and the South African

product. The premium indirectly covers the compliance cost of identity preservation from production level.

Examining the nominal value of the likely maize meal price effect of the different costs of each channel and source of imports in the maize meal market, the non-GM maize channel from South Africa would yield the most highly priced maize-meal because of the price premium. However, a closer inquiry revealed that the GM maize is the most costly as a result of the foregone benefit of sale of the by-products of the milling process. Although Zambian maize in total is less costly, it is a more expensive commodity at origin but the comparatively lower transport cost makes Zambian maize an economic option. However, the impromptu export bans that are often instituted by Zambia, make the Zambian market an unpredictable and unreliable source of maize.

South Africa is a consistent source of maize but the institution of the GM regulatory compliance requirements makes it an unattractive source of grain for traders. Nonetheless, despite the lower grain prices in SA if the GM policy had to be revised to allow for GM imports, the effect of the GM regulation (in the absence of quantified related border delays) may be insignificant compared to the effect of the transport differences. For consumers to realise the benefit of lower prices of GM maize the high transport cost must be addressed.

What can be concluded from the findings is that the GM import regulatory requirements do not really have any impact on consumers. It appears that the beneficiaries of the policy and the regulations are in fact Zimbabwe's maize producers. In the next chapter the perceptions of consumers are examined to determine alignments with the policy intentions and the outcomes observed in this chapter.

CHAPTER 5

BENEFIT VALUATION

CONSUMER BENEFIT-RISK PERCEPTION ANALYSIS

5.1 Introduction

This chapter presents the benefit valuation of the cost-benefit analysis by analysing Zimbabwean consumers' risk and benefit perceptions on GM food. The chapter is organised into three parts. The first part is a presentation of the demographic characteristics of the sample of respondents that participated in the survey. The second part presents the findings of Zimbabwean nationals' GM product risk-benefit perceptions. The purpose of the chapter is not to assess the determinants for risk benefit perception but to determine what Zimbabwean consumers' perceptions are regarding GMOs and to use the findings to infer whether they are in support of the GMO regulation, or not. As such, the third part explores various aspects that have been widely revealed in research to contribute in shaping consumer perceptions on GM. In this regard the analysis provides an insight into what is really driving the perceptions of the Zimbabweans. This insight is then used to substantiate the implied impact of the GM import regulations.

5.2 Overview of sample demographics

The survey sample comprises of a group of respondents that is relatively comparable to the country's demographic range that show a country dominated by the black Shona ethnic group of Christian following (National Geographic, Maps of the World) and has an almost equal proportion of males and females (UN in Zimbabwe, CIA World Factbook, 2014). In this regard the sample can be considered to be representative of the Zimbabwean society. Examining the sample demographics closely in Table 5.1 it should be noted that the numbers of male and female respondents are almost equal and therefore total sample results cannot be attributed to gender biases. In terms of age across all the three survey sites the average respondent age is in the early 30s to mid-30s, although notably there is a wider range in the ages of the Bulawayo respondents, as indicated by the higher standard deviation. Despite the average ages of the respondents being higher than 60% of the population it still represents

about a third of the population of Zimbabwe according to the populations statistics published on the CIA World Factbook site in 2014.

Table 5. 1: Frequency distribution of socio-demographic characteristics of the survey respondents

Demographic Characteristics	Harare	Bulawayo	Gauteng (SA)	Overall
Gender (%)	**N=80**	**N=78**	**N=100**	**N=258**
Male	52.5	48.72	44	48.06
Female	47.5	51.28	56	51.94
Age (years)	**N=79**	**N=79**	**N=97**	**N=255**
Mean	32.8	36.5	34.3	34.5
Standard deviation	8.24	12.94	6.84	9.60
Min	17	18	21	17
Max	57	71	49	71
Education –Highest Level Attained (%)	**N=77**	**N=79**	**N=100**	**N=256**
Primary	0.0	2.5	0.0	0.8
Secondary	18.2	44.3	16.0	25.4
Vocational	28.6	25.3	15.0	22.3
Under graduate	35.1	17.7	30.0	27.7
Post graduate	18.2	10.1	39.0	23.8
Employment status (%)	**N=80**	**N=80**	**N=100**	**N=260**
Employed	86.3	68.8	79.0	78.1
Unemployed	5.0	11.3	6.0	7.3
Studying	8.8	13.8	15.0	12.7
Retired	0.0	6.3	0-0	1.95
Income (%)	**N=64**	**N=56**	**N=77**	**N=197**
< US$150	1. 6	16.1	10.4	9.1
US$150 - 299	9.4	28.1	14.5	16.8
US$300 - 449	12.5	25.0	10.4	15.2
US$450 - 599	7.8	12.5	11.7	10.7
US$600 - 750	21.9	5.4	7.8	11.7
> US$750	46.9	12.5	45.5	36.6

Respondents in South Africa had the lowest standard deviation and a small age range as the ages of most of the group tendered to be closer to the mean. This can be explained by the fact that SA is an immigrant population thereby typifying the age group that is most inclined to migrate. Similar to figures provided by the CIA World Factbook (2014) in other fields the sample displayed a significantly educated population with all the respondents having at least gone through primary education and about 99% having gone past the primary level of education. In addition, although the majority of the respondents are employed, a little over

two-thirds of Bulawayo respondents are employed compared to more than 75% of respondents in the other sites. Consistent with the education and employment status data, it is noted that incomes are greater in Harare and SA with Harare respondents earning the most - approximately 68% of the respondents earned in the two uppermost ranges and almost 50% earned in the top most range. It can be concluded that Harare and South Africa represent the relatively more affluent segment of the population which can be associated with the metropolitan nature of the cities where the respondents are situated. The relatively less affluent population of Bulawayo can be considered to be more representative of the smaller cities and towns in Zimbabwe.

A further analysis of the demographics shows a more diversified sample in Bulawayo, in its distribution of race, ethnicity (determined by language spoken most at home) and religious characteristics compared to Harare and SA. In South Africa all the respondents were black, of which 96% claimed to be Christian, 1% traditionalist and 3% non-religious; Harare was similarly concentrated around the black racial group with 95% belonging to the group and 5 % being either white or mixed. In terms of religion and ethnic grouping, all the respondents in Harare indicated that they were Christian and 83.75% predominantly spoke only Shona at home, 7.5% English only and 5% Ndebele only. The remaining 3.75% either spoke Ndebele and Shona or English and Shona. For South Africa, data on the language spoken at home was not collected. Table 5.2 demonstrates the diversity in the Bulawayo sample. It is clear that although the majority of the respondents are black, Ndebele speakers and Christian, in comparison to Harare and SA there are notably higher proportions of other groups that are either limited or do not exist in the samples.

Table 5.2: Distribution of respondents by race, religion and ethnicity in Bulawayo

	Percentage of respondents
Race (n= 80)	
Black	60.0
White	21.3
Indian	8.8
Mixed & Chinese	10.0
Ethnicity (n= 80)	
Ndebele only	26.3
Shona only	18.8
English Only	22.5
Hindi only	3.8
Ndebele + Shona/ English	11.3
Shona + English	2.5
Hindi + English	1.3
Chinese + English	1.3
Religion (n= 79)	
Christian	83.5
Traditionalist	6.3
Muslim	3.8
Not Religious	5.1
Jewish	1.3

In South Africa the in-depth analysis considers where in Zimbabwe the respondents originate from as well as their length of stay and planned stay in SA. More than three quarters of the respondents said they originate from near Harare and Bulawayo (Figure 5.1) while over 40% of the respondents have stayed for between five to ten years in SA. Therefore most of the respondents have been in South Africa for a relatively long period. The majority of the respondents have temporary residency and have indicated that they will be going back to Zimbabwe some time and the two most equally perceived time frames for return are either in less than 5 years or in more than 10 years.

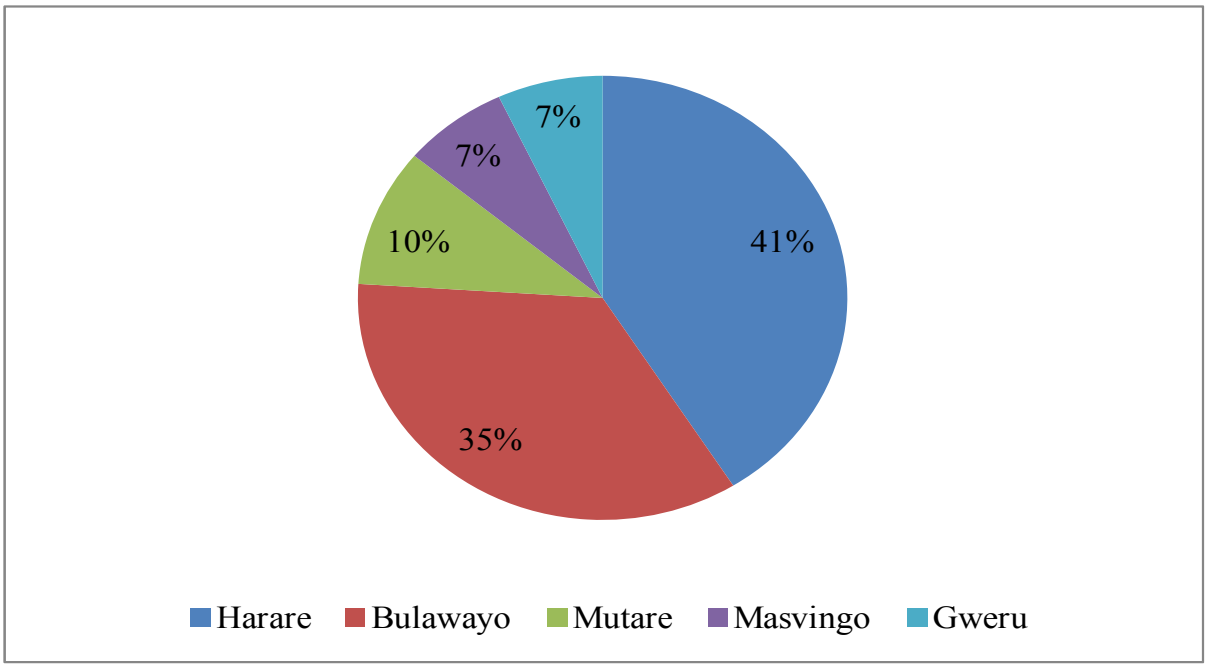


Figure 5.1: Proportion of SA respondents by nearest city or town in Zimbabwe

Table 5.3: Residency status, length of stay and planned stay in South Africa

Length of stay in SA (n=100)		**Residency status (n=100)**	
<1 year	10.0%	Permanent residence	33.0%
1 – 5 years	29.0%	Temporary residence	62.0%
5 – 10 years	44.0%	Now citizen	5.0%
>10 years	17.0%		
Do you intend to go back to Zimbabwe one day? (n=100)		**When do you think you will be going back to Zimbabwe? (n=60)**	
Yes	60.0%	In less than 5 years	36.7%
No	11.0%	In 5 – 10 years	28.3%
Maybe	29.0%	In more than 10 years	35.0%

This discussion of the demographic characteristics is critical in understanding the differences that are observed across all the sites and reported on in the next two sections.

5.3 Risk benefit perception

The next section first presents the risk-benefits scores for surveyed consumers according to their location and gender; and then explains these scores through a more in-depth discussion on the different elements of consumers' risk and benefit perceptions to determine where the most perceived gains and concerns for consumers are. The risk-benefit perception indications are calculated using the method discussed in section 3.3.5 in Chapter 3 in order to classify the consumers. The risk calculation was based on a reverse scoring method for the risk

perception statements and to enable plotting on a graph in line with the presentation presented in Chapter 3, the scores were then multiplied by a factor of -1. Multiplying by -1 enabled plotting the aggregated reverse scores in the format of the risk-benefit matrix framework presented in Chapter 3. The resultant risk and benefit scores where then plotted together. The risk and benefit perception findings are presented in two parts. The first part is focused on the analysis of site specific differences while the second part is focused on the gender differences.

5.3.1 Site specific risk-benefit findings

The three graphs presented in Figure 5.2 illustrate that the majority of the Zimbabwean consumers in all three sites generally see a trade-off when it comes to GMOs. Consumers perceive GM crops to have a relatively high level of risk but also a high benefit level. Noteworthy is that there is a significantly higher number of respondents in Bulawayo that are more pessimistic about GMOs, as they perceive low benefit and high risk. Zimbabweans in South Africa however, are more optimistic as a considerable number perceiving high risk and high benefit.

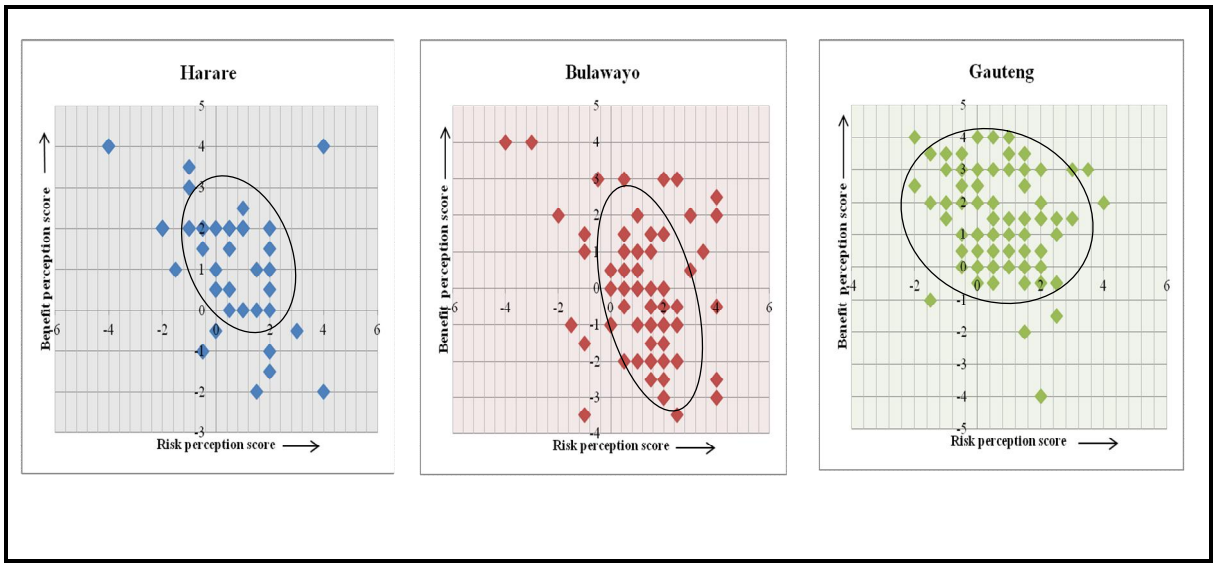


Figure 5.2: Aggregated benefit and risk scores' matrix per site

The optimism in South Africa may be attributed to the greater exposure to GM products given the fact that consumers in South Africa have been consuming GM maize and soybeans for more than a decade. The pessimism in Bulawayo may be attributed to the general laid

back nature of the city and that the society is more conservative, reserved and cautious compared to the generally bold and daring venturous Harare society.

Also notable from the three sites is the distribution of the responses; while the responses in Bulawayo and Gauteng are widely distributed Harare responses are concentrated with a few outliers, indicating that respondent scores overlap. This shows that there are more mixed views on the GMOs in Bulawayo and Gauteng than in Harare. The mixture may be explained by the higher level of diversity observed in the Bulawayo sample and the different cities and towns of origin for the consumers in Gauteng. To come up with these score the consumers were asked on a 5-point Likert scale to agree and disagree with the benefit and risk perception statements indicated again in Table 5.4 below for reader convenience.

Table 5.4: The benefit and risk perception statements

Benefit perception statements	Risk perception statement
1. GMOs increase food production and supply 2. GMOs have the potential to enhance nutrition 3. GMOs reduce chemicals on food and environment 4. GMOs that have gone through strict regulations ensures safe food	1. GMOs are a threat to the environment 2. GMOs result in loss of biodiversity 3. GMOs damages one's health 4. GMOs cause allergic reactions

A decomposition of the aggregated benefit and risk scores provides an insight into the specific risk elements that are of concern to the consumers as well as the benefit elements that they anticipate to be brought by the technology. These insights are particularly important in determining whether there is a match between the concerns of the policy and those of the consumers. In this regard, Figure 5.3 presents first of all, the evaluation of the four benefit statements that were presented to the respondents. The overall observation is that most of the respondents in all sites regard GM technology as a means of increasing food production and supply. Examining the differences in the three sites, there appears to be a distinctly polarised viewpoint in Harare, in that most of the respondents either agreed or disagreed with the benefit statements. On the other hand, in Bulawayo and Gauteng consumers either agreed with the benefit statements or were unsure of the benefits (as indicated by the considerable neutral and "don't know" responses recorded in each site). The observations are consistent with the cautious tendency of the Bulawayo society while in Gauteng the consumers may be distracted by their consumption of GM products combined with the negative reporting on the subject matter (covered in section 5.4.3). For Harare, the polarised point of view and presence of a significant number of consumers that do not agree with any of the benefit statements may

be owed to the proximity of the consumers to the policy makers and the political institutions that have been most vocal in emphasising the risk elements of GM foods.

It is interesting to note that although in all sites there seems to be the belief that GM foods, that have undergone strict regulation, are safe to consume, in Harare there is sizeable number that disagrees with this statement while in Bulawayo and Gauteng they are unsure. Although the survey question is not specific on the type of regulation (i.e. whether import or health and safety testing regulation), the disagreement and uncertainty may be a result of most consumers presuming that they have or are consuming GM products already despite the strict regulations that have been communicated by the Government of Zimbabwe. Thus, this may point to the consumers trust in their Government's ability to ensure the safety of the food they are consuming. Also worth mentioning is that the most unclear or least appreciated benefit in all areas was that of reduced chemical usage on the food and environment, as in all three sites there was a uniformly significant number of respondents that were neutral or did not know. Perhaps this is a result of limited knowledge on the current marketed GM traits, the process of genetic modification or the aspects it entails.

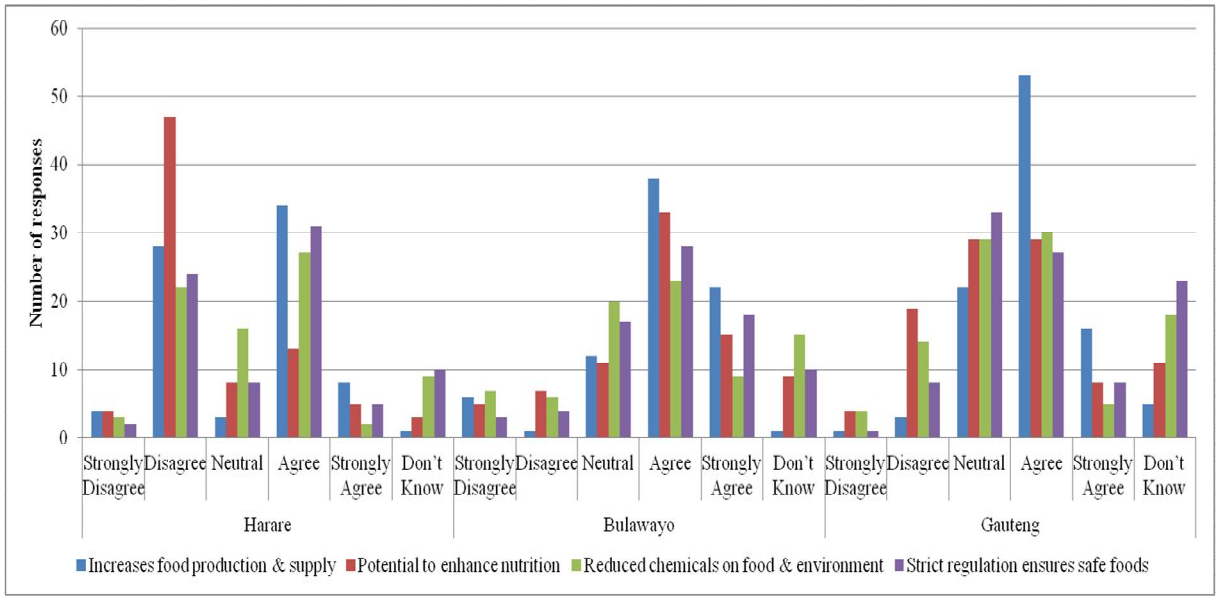


Figure 5.3: Break down of the benefit perception per site

The evaluation of the risk perception statements concerned with either the environment or human health (Figure 5.4) confirmed the low benefit perception of the Harare consumers, as a noticeable agreement with all the risk statements was observed. For Bulawayo the responses

were mixed; the main risks that are perceived by the consumers concern their health, as a significant number agreed with the statements that GM damages one's health and causes allergic reactions. Most respondents disagreed with the risk statements concerned with the environment. Also observed in Bulawayo was an uncertainty especially concerning the loss of biodiversity, further corroborating the lack of understanding on the interplay between GMOs and the environment. Typically there was a mixture of responses among South African respondents with most responses almost equally distributed between agreeing with the statements and indicating uncertainty. This persistent tendency among this group of consumers may suggest that the consumers are perhaps not confident in the information they have regarding GM in order to make judgements. This logic is explored further in a later section when awareness and knowledge among the respondents are analysed.

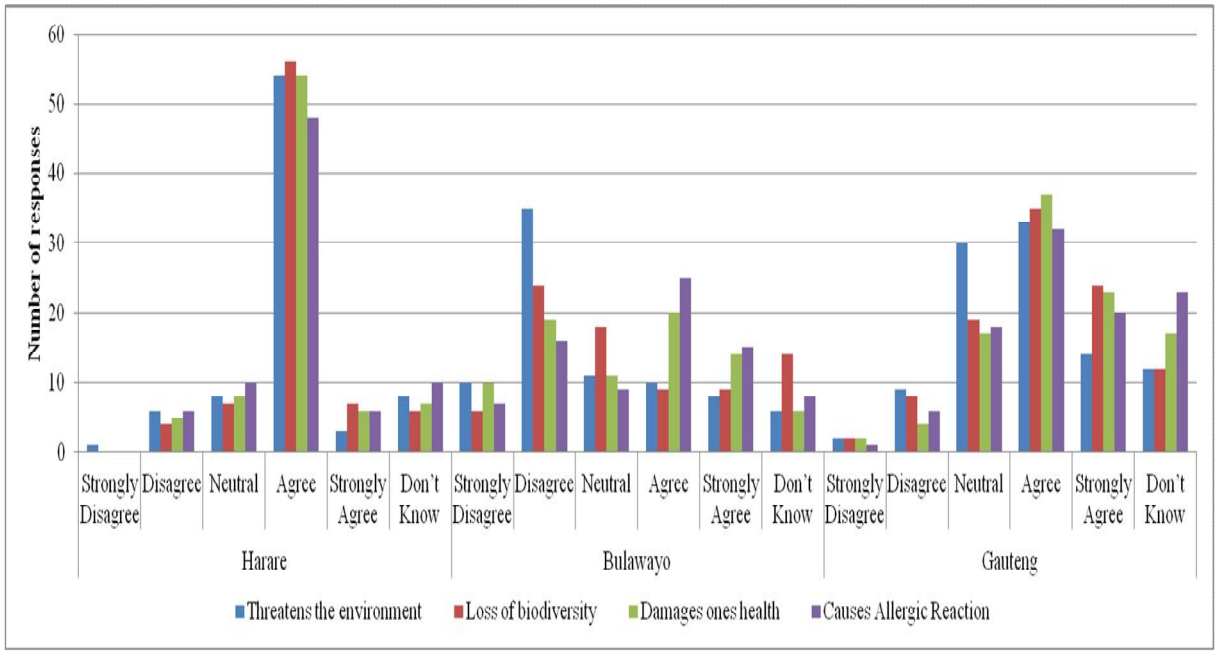


Figure 5.4: Breakdown in risk perception per site

Regardless of the perceived benefits and risks, the study attempted to assess the potential buying behaviour by determining the reasons that might motivate consumers to buy GM food. In so doing all respondents were asked directly about the different circumstances under which they would purchase GM foods. Figure 5.5 indicates that consumers in Harare were generally not keen on buying GM products; however, a significant proportion indicated they would consider buying GM food if it proved to be more nutritious and if the GM application resulted in use of less pesticides and chemicals in the production of the crops. Considering that GMOs result in reduced chemical usage; the assertion by most respondents that they

would buy GM food if it reduced chemical usage may be an indication of a limited understanding of the GM technologies. Also noteworthy is that cheaper GM food may have some of the respondents consider purchasing GM. Contrary to earlier pessimistic perceptions in Bulawayo, a number of people indicated they would buy GM food if it was cheaper, more nutritious and reduced chemical usage. In South Africa the responses were mixed with almost equal number of responses. Interesting to note is that even though 38% of Zimbabwean consumers in SA indicated that they will not buy food containing GM crops and 39% is not sure, it is very likely that the vast majority of them have been consuming food derived from or containing GM maize or soybeans for more than a decade.

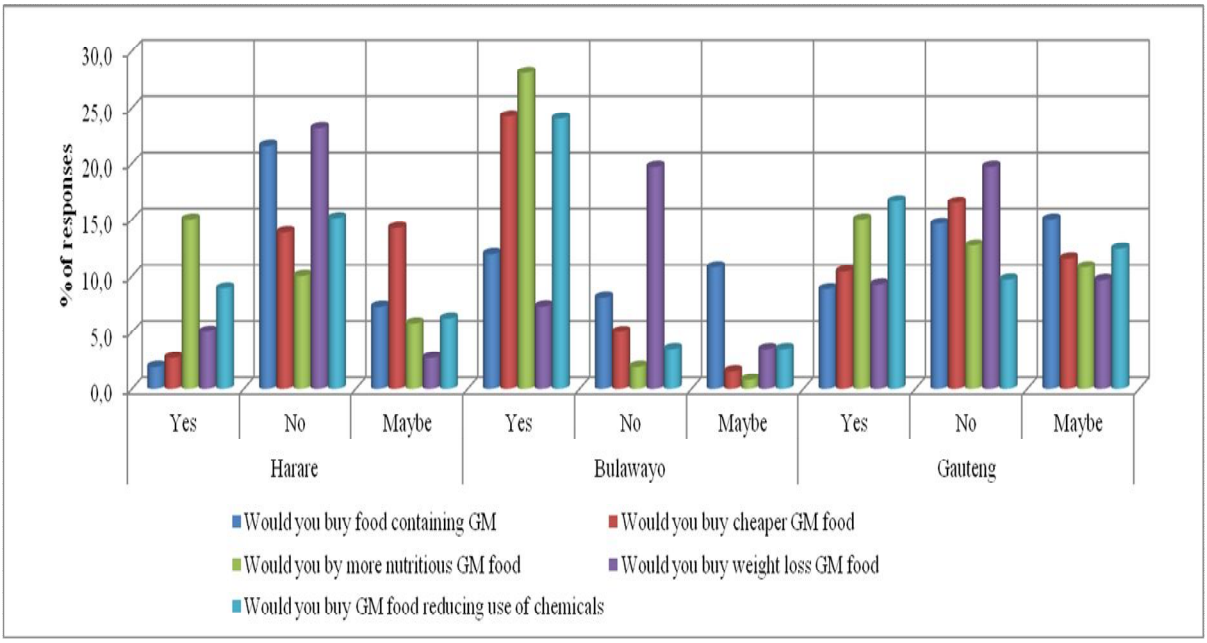


Figure 5. 5: Reasons for buying or not buying GM food, per site

Consistent with other international studies (Chern 2006; Lusk *et al*. 2005; Gonzalez, Johnson & Qaim n.d.), Zimbabwean consumers consider increased nutritional value to be a preferred trait. Interesting to note also is that consumers are willing to consume GM products if less chemicals are used in the production of these crops. International and regional studies (Smale *et al.* 2009; Gouse *et al* 2006; Brookes & Barefoot 2006) found that insect resistant crops like Bt maize requires less insecticide applications than conventional maize and in some countries the use of herbicide tolerant crops have also resulted in lower herbicide usage. On this basis this finding may be a substantiation of the earlier finding where consumers were unsure of the benefit of reduced chemical usage.

Although a small number of consumers are willing to purchase GM products if it assisted with weight loss, this tendency is more substantial for the more positive Gauteng and Bulawayo respondents. Perhaps this is also linked to consumers' inclination to be more acceptant of medicine created through genetic modification, than food (Figure 5.6).

When asked directly about what they think about the application of the science of genetic modification in medicine and in crop production the results obtained are consistent with the perception findings above. Presenting the results in Figure 5.6 it is clear that the consumers in Harare have a considerably more positive attitude towards the application of the science in medicine rather than in crop production. Bulawayo has an overall positive attitude as most respondents are optimistic about genetic modification in both medicine and crop production. In South Africa, however while the majority were positive about the application in medicine a high number of respondent were neutral when it came to the application to food production. This finding is consistent with international consumer studies (Rimal, Moon & Balasubramanian 2003; Bhullar & Bhullar 2009) and can be linked to the easily observable consumer benefits of a medicine GM application, compared to the less clear consumer benefits derived from the currently commercialised GM agricultural applications.

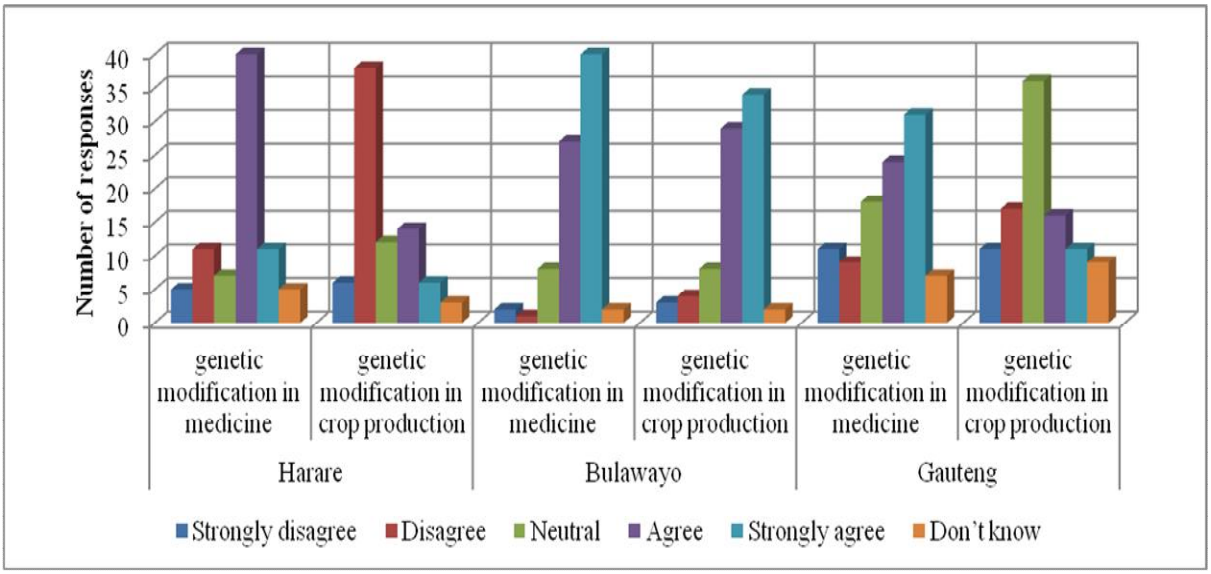


Figure 5.6: Attitude towards the application of the science of genetic modification in medicine and in crop production, per site

5.3.2 Gender specific risk-benefit findings

An analysis of the risk-benefit perception according to gender reveals that although the majority of both male and female consumers perceive high benefits as well as high risks, females tend to be more optimistic about the benefits of GM crops.

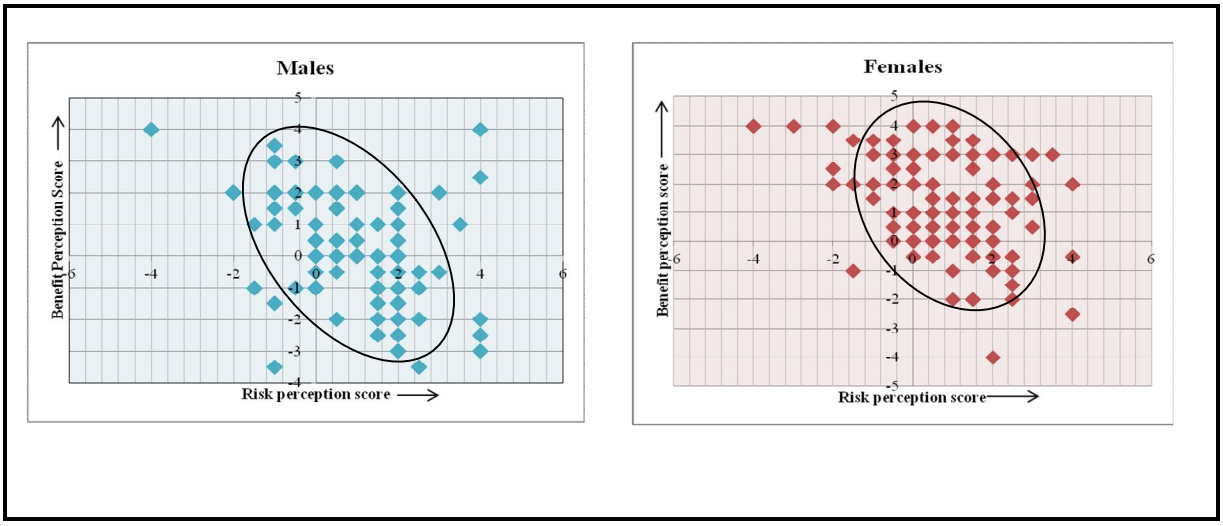


Figure 5.7: Aggregated benefit and risk matrix by gender

The breakdown of the benefits in Figure 5.8 shows a similar distribution of responses for both males and females. Generally, the majority of both genders agree with all the benefit statements. Despite this there seems to be an overall disbelief that GM foods have the potential to enhance nutrition and an obscurity regarding the reduction of chemical usage that may result from GM production. In both cases, the female responses are considerably higher than that of males, an indication that females possibly have a lesser knowledge and understanding of the GM issues.

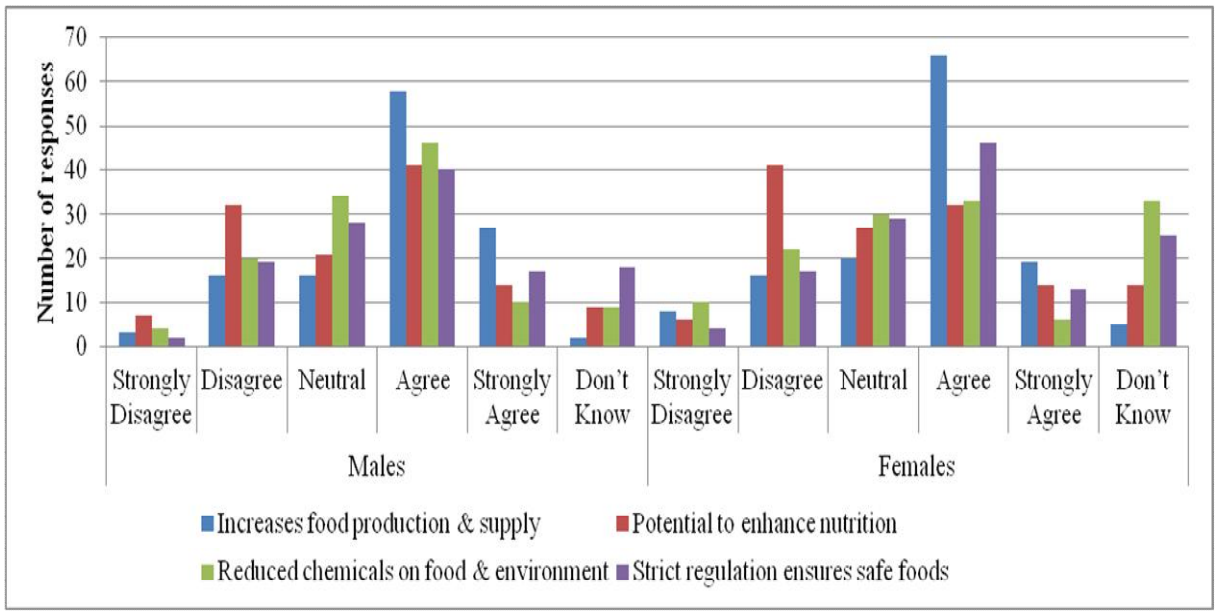


Figure 5.8: Breakdown on the benefit perception by gender

The analysis of the breakdown of risks yielded results similar to the breakdown of benefits, with the responses between males and females being similarly distributed. Overall both the majority of males and females agree with the risk statements. In comparing the two it would appear as if males are more concerned with the risk elements associated with the human health aspects, as they either disagree or are neutral to the environment related risk assessments. In contrast the females seem to have a higher concern for the environment as comparable number agreed with the statements.

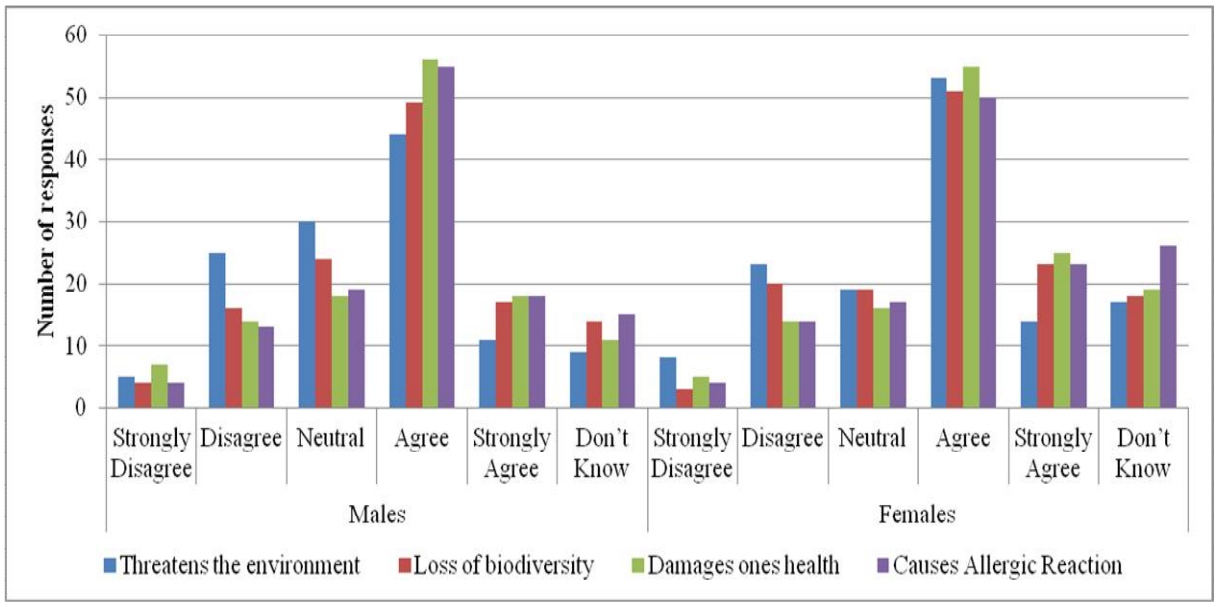


Figure 5.9: Breakdown on the risk perception by gender

A further analysis of the elements that would motivate the purchase of GM food (Figure 5.10) and comparing the attitudes towards the application of GM to medicine and to food (Figure 5.11) shows unvarying results. The differences between males and females are inconsequential given the observed similarities in their responses. For most respondents they would purchase GM food if it were cheaper, nutritious and it reduced the use of chemicals.

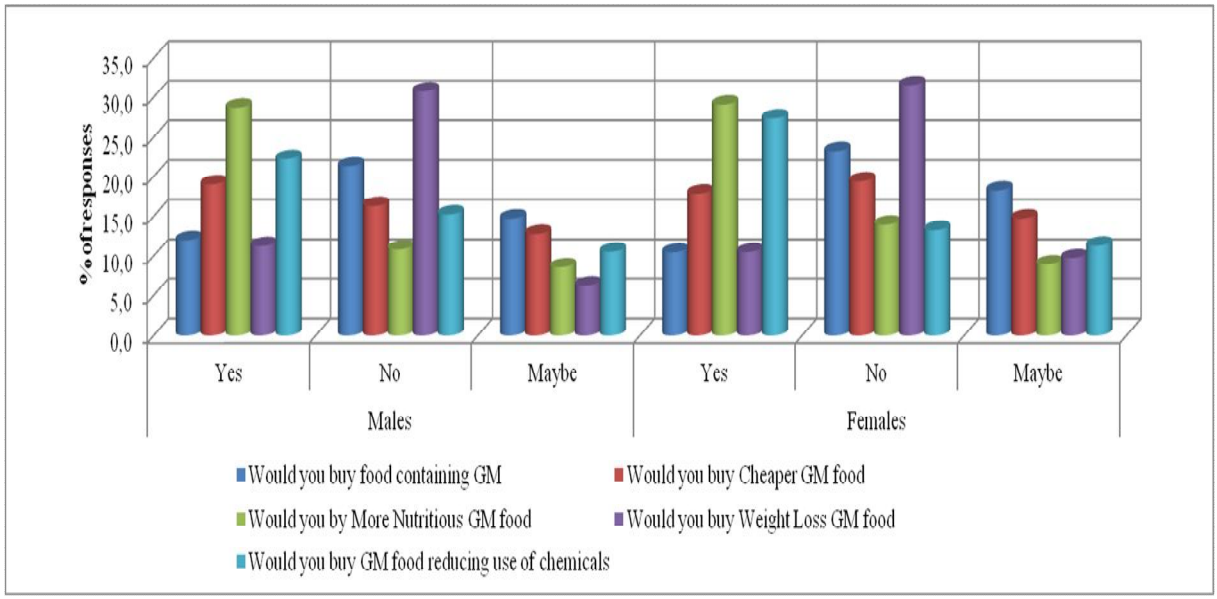


Figure 5.10: Reasons for buying or not buying GM food by gender

The application of GM in medicine is most preferred than in food. Contrary to the risk benefit perception analysis, the males have a comparatively more positive acceptance of GM food than the females.

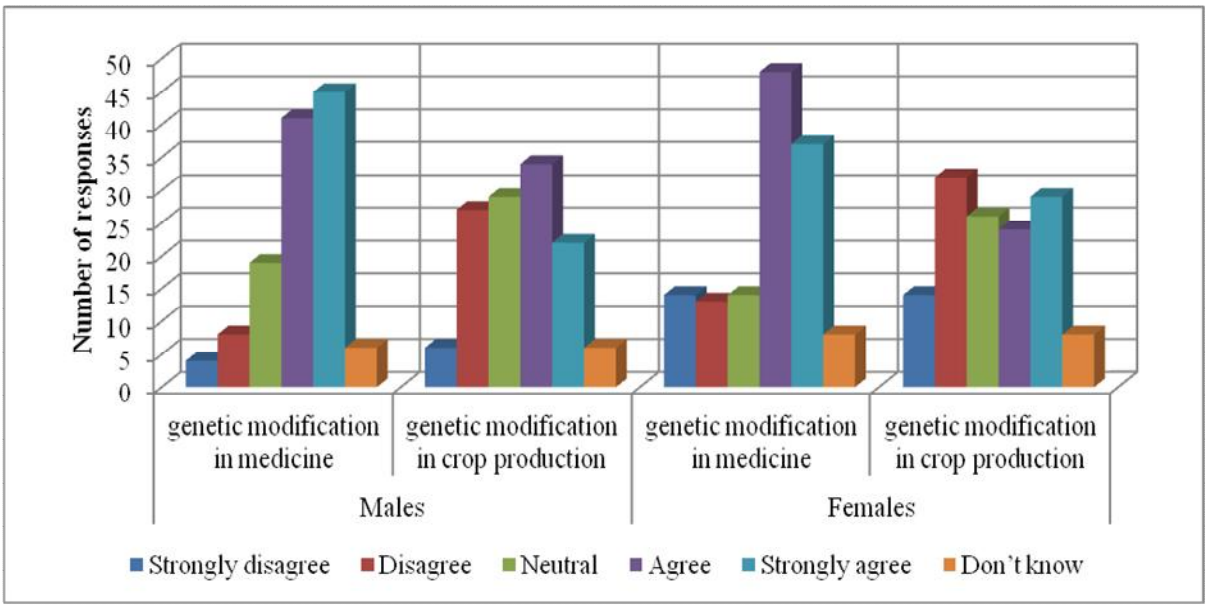


Figure 5.11: Attitude towards the application of the science of genetic modification in medicine and in crop production

Having determined how consumers perceive GM food by location and by gender, it is apparent that the most significant differences that exist are based on the characteristics of people residing in different locations and that by gender the perceptions are similar and negligible. However, the contradictions observed in the location raises question about what influences the formation of these perceptions. As a result the next section explores and discusses the factors that have been found to influence the formation of consumer perceptions. The factors discussed include the attitudes towards science and technology; awareness and knowledge about science and GMOs; trust in market system actors; and the ethical, equity and moral concerns.

5.4 Factors shaping the risk benefit perceptions

5.4.1 Attitude to science and technology

Generally, consumers across all survey sites have a positive attitude towards science as in each site over 80% of the respondents indicated that they were amazed by what science (in general) can do today and that they find science playing a major role in improving livelihoods in this day and age (Table 5.5). On the other hand, despite the positive attitude towards the achievements of science and its role in today's life, there is some fear associated with what science can do - more than half of the respondents from each site indicated that they were terrified by what science and technology can do. This finding is in line with the predominant

benefit and risk perception indicated in the first section, where a sizeable number of people perceived both high benefits and high risks. The consumers in Bulawayo are the most 'fearful' with over 40% strongly agreeing with the statement of concern, compared to the 9% in Harare and 14% in South Africa. This finding is consistent with the risk benefit perceptions.

Table 5.5: Attitude to science and technology

	Percentage of responses		
	I am amazed at the achievement of science today	**Science is important to make a better living in today's world**	**The achievements of science and technology today are terrifying**
Harare (n=80)			
Strongly disagree	0.0	0.0	2.5
Disagree	0.0	2.5	24.1
Neutral	8.8	3.8	17.7
Agree	68.8	78.8	46.8
Strongly agree	22.5	15.0	8.9
Bulawayo (n=80)			
Strongly disagree	1.3	2.5	12.5
Disagree	2.5	0.0	17.5
Neutral	7.5	3.8	6.3
Agree	35.0	35.0	22.5
Strongly agree	53.8	58.8	41.3
Gauteng (n=100)			
Strongly disagree	1.0	0.0	4.0
Disagree	3.0	2.0	21.0
Neutral	12.0	12.0	20.0
Agree	45.0	40.0	39.0
Strongly agree	38.0	44.0	14.0
Don't know	1.0	2.0	2.0

Advancing from understanding the attitudes towards science and technology, the respondents were asked to rate themselves in terms of adoption of technology. In this regard, a

considerable proportion of the total sample indicated that they are medium adopters of technology who are willing to embrace a new technology when they understand how it fits into their lives (Figure 5.12). However, in Bulawayo the respondents tended to have a significantly higher proportion of late to very late technology adopters with almost 50% of the respondents indicating that they adopt late because they would rather stick to what they know or they adopt new technology in reaction to peer pressure or emerging norms or economic necessity. In line with the earlier assertion of the conservative nature of the people of Bulawayo, this may imply that in Bulawayo people may have lesser interest in new technology and are less affected by it. Or perhaps the fact that the majority of the respondents earnings are in the lower ranges (Table 5.1) and Bulawayo has a lower percentage of employed respondents, people will be more inclined to be technologically averse as they cannot afford to purchase new technologies, which are often costly.

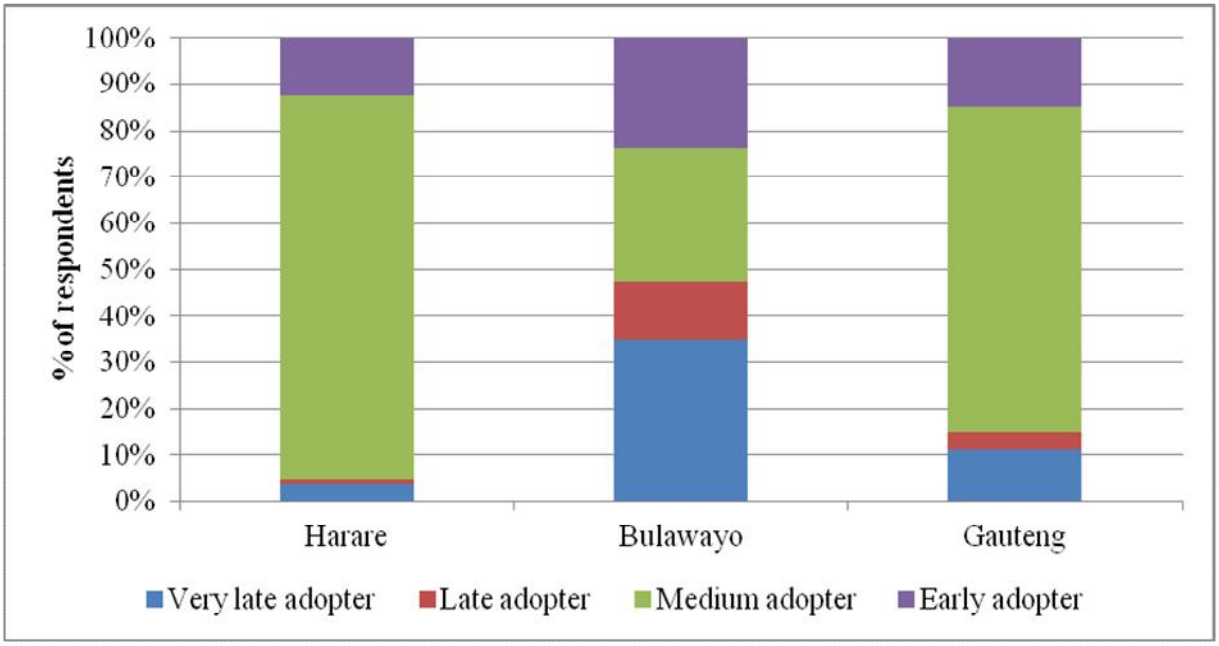


Figure 5.12: Technology adoption grouping

This observation is supported by the findings in Table 5.6 below, which shows that over 80% of the Bulawayo respondents own 0 to 3 of the 8 common latest technologies that were indicated in the survey. The questionnaire provided responses with a list of the common latest household technologies that include smart phone, iPad/ tablet computer, laptop, digital video camera, xbox video games, HDTV, 3DTV and MP# player/ iPod. Although technology adoption of information technology, communication or household goods is different from the technology adoption in food, it is arguably an acceptable proxy because it has been shown

that those who are supportive of one group of technologies is likely to be more supportive of other new technologies such as biotechnology (Gaskell *et al*. 2004). Following this logic the results of the analysis suggest that the consumers in South Africa would be the most likely to have a more positive attitude towards genetic technology compared to their counterparts in Zimbabwe - more than 50% of the respondents in Gauteng have 4 to 5 technologies. In fact of the three sites South Africa is the only site where there were respondents with all of the 8 technologies. On the other hand although more respondents in Harare have more of the latest home technologies – there is still a relatively significant number owning 1 to 3 technologies. Unlike Bulawayo respondents in Harare owned at least one of the technologies while the 11 of the respondents in Bulawayo owned none of the technologies.

Table 5.6: The number of latest technologies owned or used at home

	Harare (n=80)	**Bulawayo (n=80)**	**Gauteng (n=100)**
0 – 1	20.00%	47.50%	19.00%
2 – 3	48.75%	35.00%	27.00%
4 – 5	21.25%	8.75%	35.00%
6 – 8	10.00%	8.75%	19.00%
Median	3	2	4
Minimum	1	0	0
Maximum	7	7	8

Although higher income and employment may explain technology ownership in Harare and Gauteng compared to Bulawayo, the variation in technology ownership between South Africa and Zimbabwe may also be attributed to the availability and affordability of these products in SA markets compared to Zimbabwe. A case in point is the price differential for a similar brand of cell phone between a major cell phone accompany in Zimbabwe and another in South Africa. While in Zimbabwe a lower version of the phone was being sold for USD995 (i.e. ZAR11, 931 at rate USD1:ZAR11.99 based on OANDA website rate for 23-03-2015) per, a more advanced version of the same phone in South Africa was being sold for ZAR11, 439 in the same period.

5.4.2 Awareness and knowledge on genetically modified organisms

Almost 90% of all the respondents have read or heard about GMOs (Table 5.7). Harare emerged as the site with the greatest exposure to information on GMOs with the entire sample indicating that they have read or heard about GMOs. Bulawayo, is least exposed with about a third of the respondents saying that they have not heard or read about GMOs. Perhaps this would explain the pessimism observed and could imply that this is a case of a fear of the unknown

Table 5.7: Number of respondents that indicated they have read or heard about GMOs

	Harare (n=80)	**Bulawayo (n=80)**	**Gauteng (n=100)**	**Overall (n=260)**
Yes	100.0%	65.0%	96.0%	87.7%
No	0.0%	35.0%	4.0%	12.3%

Although a significant number of consumers indicated that they know about GMOs it would appear as if they are not confident in their knowledge of GMOs. Figure 5.13 shows the self-rated level of awareness among those that indicated that they had heard of GMOs. Consumers in Zimbabwe consider themselves relatively less informed about GMOs compared to those in South Africa. About 60% of the respondents in SA rated themselves to be either moderately or very informed compared to about a third and a half in Harare and Bulawayo, respectively. Interestingly despite having the least number of people who have heard or read about GMOs, respondents in Bulawayo that do have some knowledge about GMOs rated themselves comparably higher than the respondents in Harare saying that they are either moderately or very well informed. This self-rated knowledge is equivalent to subjective knowledge. According to research subjective knowledge is the most influential in formation of perceptions (House *et al*. 2004). As a result what the consumers think they know, whether fact or fiction, is the 'knowledge' that informs their stated perceptions.

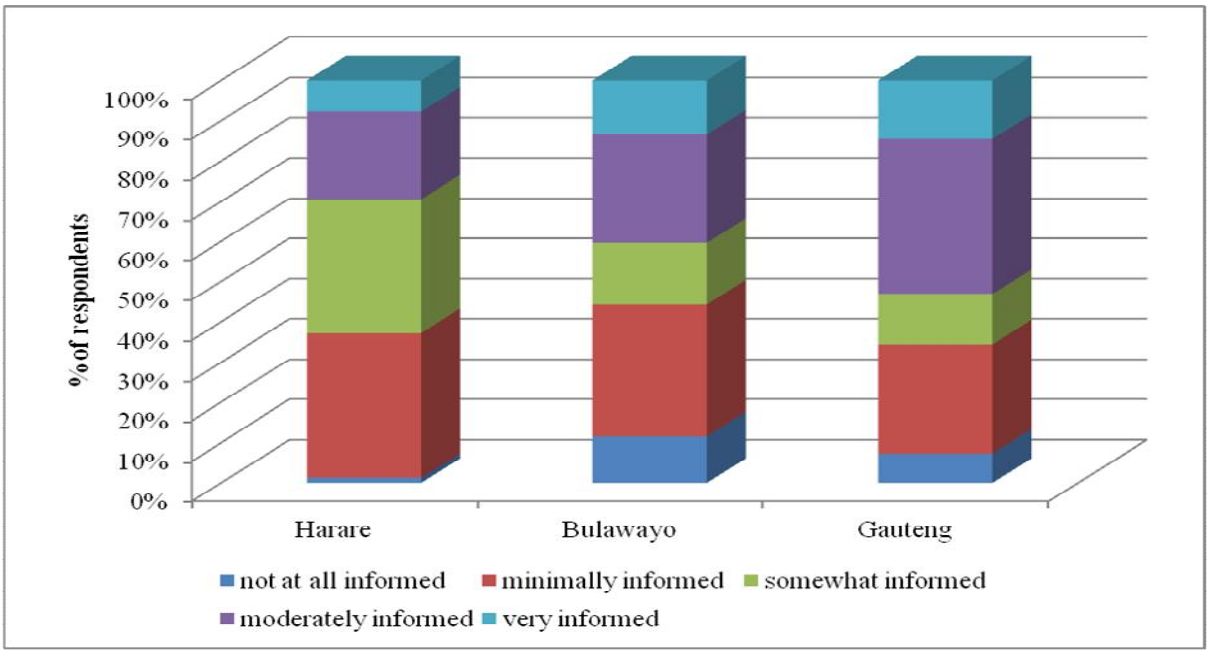


Figure 5.13: Percentage of respondents indicating level of awareness

To test the objective level of awareness and knowledge on GMOs (which are the facts that the consumers do know), the survey posed two simple tests. The first tested the awareness of five different terms of the variety of names used to refer to GM crops. Secondly the respondents were presented with true or false test of six statements on science, genetic modification in food production and consumption. Table 5.8 reveals that although the average number of known terms is 2, the majority of the respondents indicated that they are only familiar with one term. Further analysis that regards each individual term separately shows that the most commonly known term across the board is the term GMOs (figure 5.14). This is the term that has been found to be widely used in most media sources that have reported on GM crops. The least known terms are biotech and bioengineered crops.

Table 5.8: The frequency distribution of the total number of terms known by the Respondents

Number of Known Terms	Harare (n=80)	Bulawayo (n=80)	Gauteng (n=100)	Overall (n=260)
0	0.0%	35.0%	5.0%	12.7%
1	37.5%	21.3%	34.0%	31.2%
2	32.5%	20.0%	29.0%	27.3%
3	17.5%	10.0%	15.0%	14.2%
4	8.7%	8.8%	10.0%	9.2%
5	3.7%	5.0%	7.0%	5.4%
Mean	2.1(n=80)	2.3 (n=52)	2.2 (n=95)	2.2 (n=227)

Consumers in South Africa were aware of most of the terms that refer to GM crops thus suggesting a high level of objective knowledge. This may be explained by the higher education level status of the respondents in South Africa compared to other areas. Although Bulawayo has comparably less people that know at least one term, when considering the mean number of known terms the average is 0.1 percentage point greater than the other areas implying that they know more. This may be an indication that in Bulawayo there exists two distinct groups i.e. the well informed consumer and the uninformed consumer, of which the well informed consumer is confident in their knowledge level.

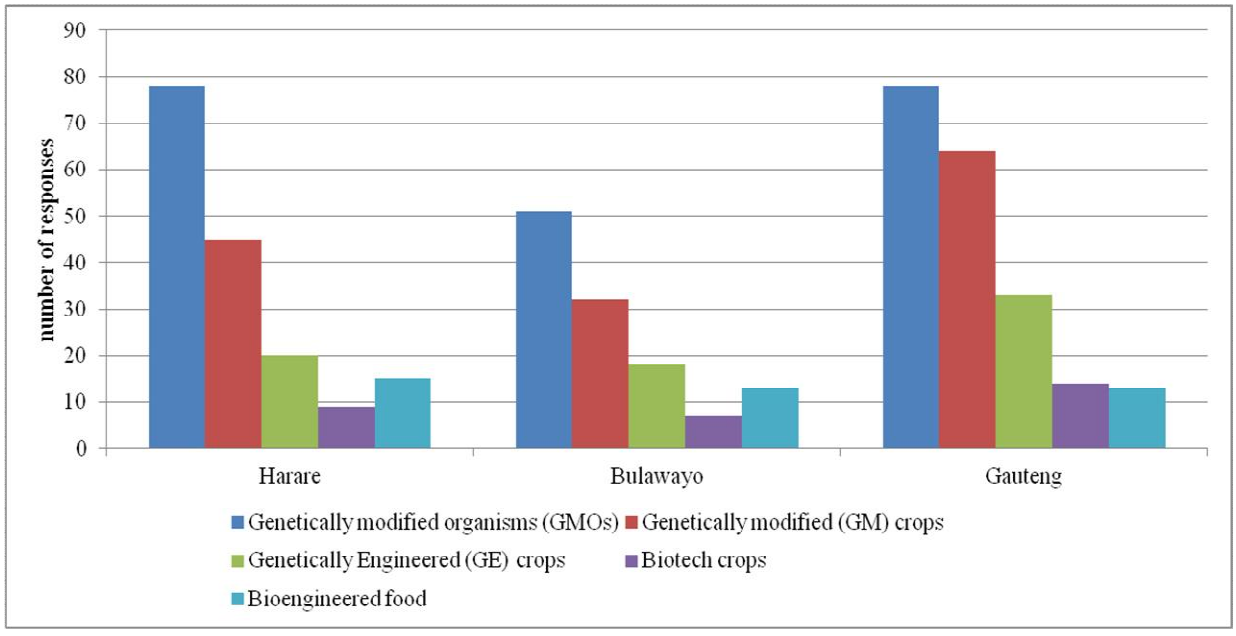


Figure 5.14: The number of responses on awareness and knowledge of each term

In the true and false test, the first three questions tested respondents' knowledge on the basic science of genetics and digestion while the last three questions tested general knowledge on the application of genetic modification of food to date. Presented in Table 5.9 are the results of the test. The results of the responses in all three areas would imply that while Zimbabweans in Zimbabwe appear to be more knowledgeable on the basic digestion science and general knowledge, they are somewhat limited in their understanding of basic science of genetics. These findings are in line with the findings of a pilot survey that was conducted on 17 people by Natural Products Research for Eastern and Central Africa Zimbabwe (NAPRECA - ZIM) during the Harare Agricultural Show in August 2011. In the pilot survey NAPRECA - ZIM found that there is a general misunderstanding of the scientific fundamentals on GMOs. Because the science of genetics is the foundation of GM technology these results suggests that there is subsequently a limited understanding of GM technology. Interesting is that contrary to research (FUTURELIFE 2013) many of the respondents were under the impression that GM maize tastes differently from conventional hybrid maize.

Table 5.9: Aggregated results of the responses on the true/false test on awareness and knowledge on science, genetic modification and production (in percentage) - Correct answers indicated in grey

Question	Harare			Bulawayo (n = 52)			Gauteng			Overall		
	True	False	Don't Know	True	False	Don't Know	True	False	Don't Know	True	False	Don't Know
4a) Conventional foods do not contain genes	50.00	37.18	12.82	32.69	63.46	3.85	23.40	55.32	21.28	34.82	50.89	14.29
4b) By eating GM crops a person's genes are altered	62.34	28.57	9.09	73.08	25.00	1.92	31.91	42.55	25.53	52.02	33.63	14.35
4c) When consumed, food is broken down into simple sugars, fatty acids and amino acids	92.31	3.85	3.85	94.23	3.85	1.92	92.63	3.16	4.21	92.89	3.56	3.56
4d) GM maize tastes different from other hybrid maize[4]	84.62	10.26	5.13	57.69	40.38	1.92	63.16	18.95	17.89	69.33	20.89	9.78
4e) South Africans have been eating GM maize for more than a decade	74.68	1.27	24.05	61.54	34.62	3.85	69.15	4.26	26.60	69.33	10.22	20.44
4f) Genetic modification is a tool used for increasing agricultural productivity	95.00	3.75	1.25	94.23	1.92	3.85	82.98	9.57	7.45	89.82	5.75	4.42

[4] Although the issue of taste maybe highly subjective, the correctness of this answer is based on assertions by organisations such as FUTURELIFE (a company supplying non-GM products in SA) that GM and non-GM food may not be distinguishable through taste but through labelling.

5.4.3 Trust in information sources

Figure 5.15 summarises the findings on information sources shaping GM crop perceptions. It is clear that besides family and friends the internet, television, newspapers and radio are the most common sources of information in all the three survey sites. However, the internet is more widely accessed in South Africa while in Bulawayo the most common is television and in Harare, newspapers are the most widely accessed. Worth mentioning is that while the internet and newspapers represents a wide source of information that includes both public and private sources of information, TV in Zimbabwe is dominated by the state. Therefore, those in Bulawayo can be assumed to be more exposed to the government designed information.

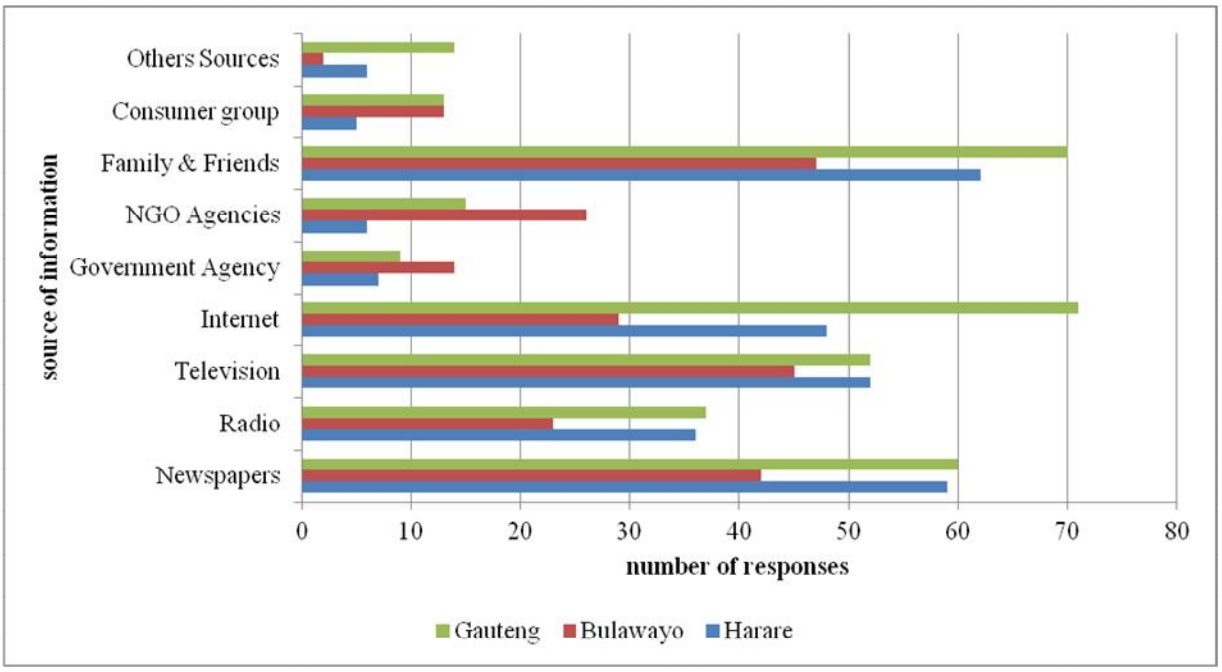
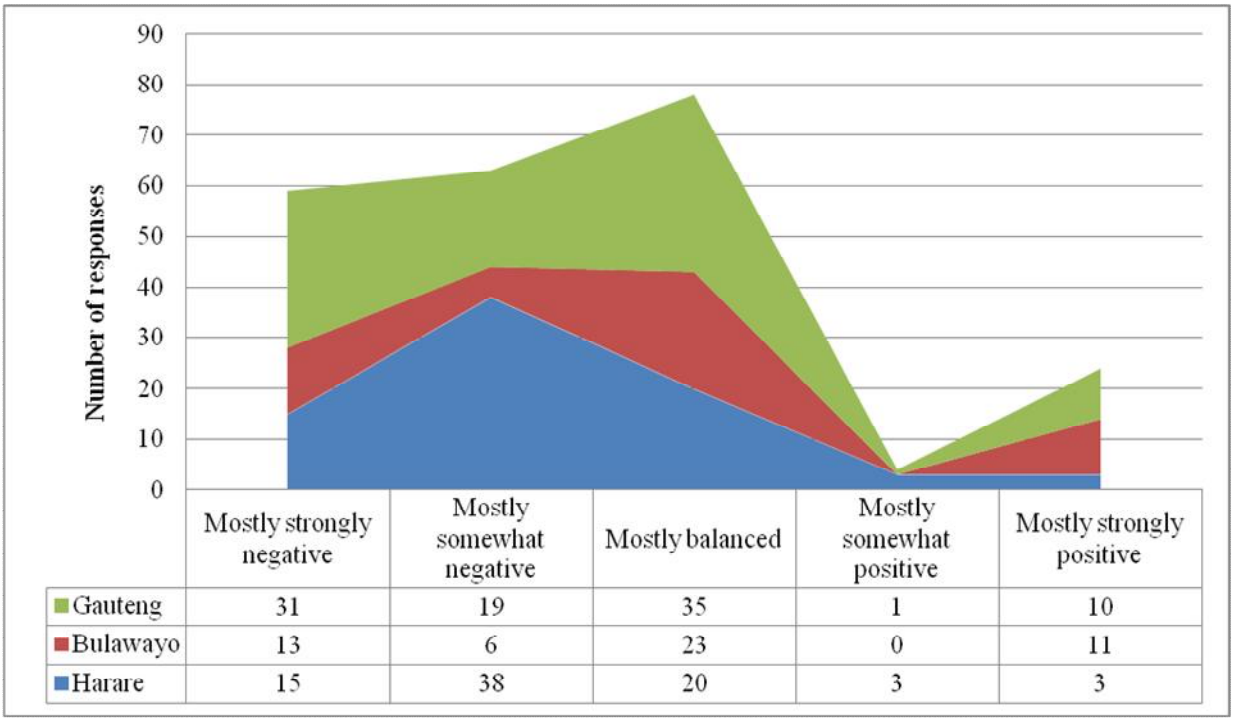


Figure 5.15: Sources of information

When asked whether the information they accessed on GMOs was positive or negative the majority of the consumers in Zimbabwe and South Africa are exposed to negative information on GMOs (Figure 5.16). More significant is the comparably higher number of consumers in South Africa that have accessed the strongly negative information. Then again, given the vast amount of information available on the internet from different sources that can be either supportive or against GM foods, there was even a higher number of respondents that reportedly accessed balanced information, i.e. information that is equally positive and negative. In view of the much contradictory positive and negative information that has been

disseminated (that was alluded to in the literature review in Chapter two), suffice it to say this is probably the reason why there was a greater number of uncertainty indicated by the don't-know responses in the perceptions section, for Gauteng. Also worth mentioning is the rather large number of respondents who accessed mostly strongly positive information in Bulawayo and Gauteng.



	Mostly strongly negative	Mostly somewhat negative	Mostly balanced	Mostly somewhat positive	Mostly strongly positive
Gauteng	31	19	35	1	10
Bulawayo	13	6	23	0	11
Harare	15	38	20	3	3

Figure 5.16: Positive or negative information on GMOs

In terms of trust, although most information sources seem to be deemed trustworthy, there are a significant number of respondents who generally find the information source neither untrustworthy nor trustworthy (Figure 5.17 below). Also noteworthy is that there is generally a higher level of mistrust in Harare and Gauteng compared to Bulawayo with newspapers being the least trusted in both areas followed by television in Harare and government agencies and internet in Gauteng. The other sources are mostly family and friends. This would imply that in Gauteng and Harare people would rely more on their perceived knowledge rather than any new knowledge that would be communicated through these information sources.

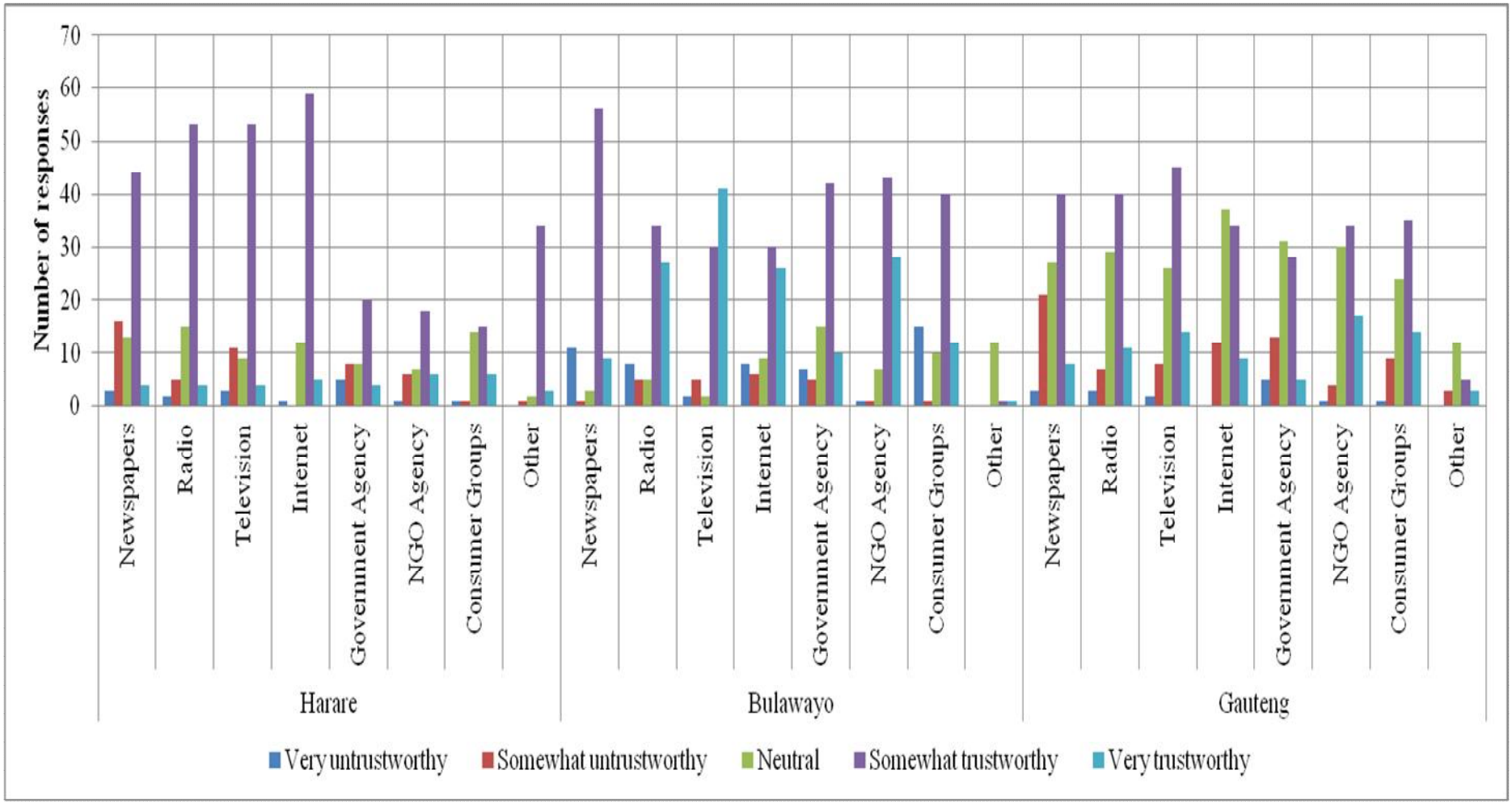


Figure 5.17: Trust in information sources

5.4.4 Trust in food chain actors

In general consumers have a high degree of trust in the food chain actors. However common across all three sites is that there appears to be a relatively high level of trust in farmers compared to the rest of the actors, while food processors are trusted the least (Figure 5.18). Interesting is the general low level of trust in the South African food chain with really only farmers being trusted a reasonable amount.

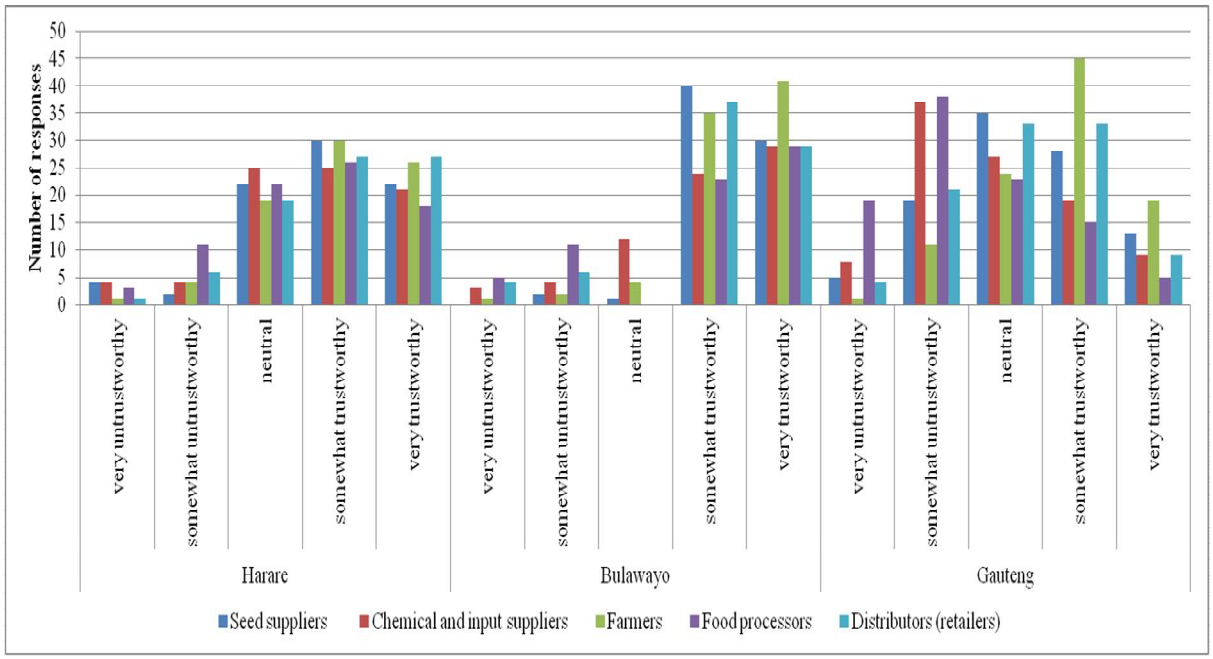


Figure 5.18: Trust in the food chain actors

5.4.5 Trust in regulators

First the consumers were asked to identify the organisations they know or think to be involved in the regulation if GMOs. From the responses it is apparent first of all that the consumers are unaware about who is involved in the regulation (Table 5.10). The most recognised in Harare is the SAZ – an independent standards organisation. The Ministry of Agriculture is the most recognised with almost a similar number of responses in Harare. The main instrument for biotechnology regulation and consequently where the mandate of GM monitoring lies, i.e. the NBA, is not well known in Harare but is better known in Bulawayo. Other key regulators that are better known in Bulawayo are ZIMRA and the Plant Protection unit. Although this observed better knowledge of regulators may be expected to imply that

Bulawayo would know more about the regulations, results of the survey (Table 5.11) reveal that Harare has better knowledge of the regulations.

Table 5.10: Number of respondents that identified key regulatory actors in Zimbabwe

	Harare	Bulawayo
Ministry of Agriculture	80.0%	81.3%
Plant Protection Unit	23.8%	57.5%
National Biotechnology Authority (NBA)	26.3%	50.0%
Zimbabwe Revenue Authority (ZIMRA)	40,0%	71.3%
Standards Association of Zimbabwe (SAZ)	87.5%	48.8%
Consumer Council of Zimbabwe	80.0%	52.5%

Also indicated in the table is the that there is generally a lack of knowledge about the GM regulations among consumers as there were less than half of the respondents from each site that indicated that they knew of the regulations. The best known appears to be the regulations with respect to the importation of GM products.

Table 5. 11: Knowledge of GM regulations in Zimbabwe

	Harare (n=78)		Bulawayo (n=77)		Gauteng (n=100)	
	Yes	No	Yes	No	Yes	No
Regulation on production and consumption of GM crops	34.6%	65.4%	30.8%	69.2%	33.0%	67.0%
Regulation on importing GM crops and/ or GM derive food	41.0%	59.0%	32.5%	67.5%	32.0%	68.0%

In spite of the relative limited knowledge of the key actors and the regulation in particular with regard to the GM regulation there is generally a high level of trust in the regulatory actors, as can be observed in Figure 5.19. For the reason that a comparably higher number of respondents in Bulawayo rated the regulatory bodies as very trustworthy, Bulawayo seems to be more trusting of the regulators than Harare. However, what is worth mentioning is that, the few people that know of the NBA in Harare, have a level of trust that is relatively higher than of Bulawayo, which seems to be mostly unsure (indicated by the neutral responses) of the trustworthiness of this organisation. Perhaps consumers in Bulawayo only know of the existence of the NBA but do not understand its role and function. On the other hand the location and centralisation of the NBA offices in Harare may imply that consumers have better access to NBA and hence have a better knowledge of the entity.

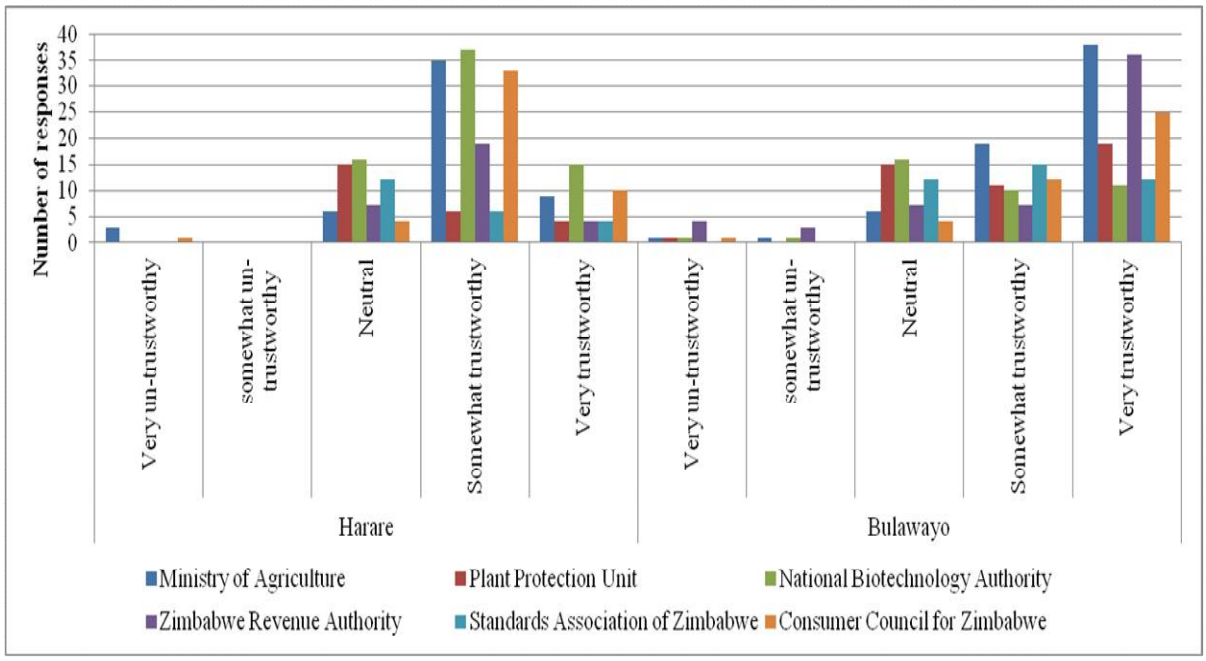


Figure 5.19: Trust in regulatory actors

To further understand the influence of trust in regulatory actors in perceptions the study has examined the extent of which consumers have moved or accessed potentially GM products from across the borders. To this end, the respondents in Zimbabwe were asked if they have ever consumed any South African products while in South Africa they were asked if they had sent any maize products to Zimbabwe. More than 50% of the respondents in Bulawayo and in Harare indicated that they have consumed maize products from South Africa (Figure 5.20). Surprisingly, a considerable greater proportion of consumers from Harare indicated that they have consumed South African products, yet Bulawayo has traditionally been closely associated with South Africa and more often than not shops have stocked more South African products compared to Harare.

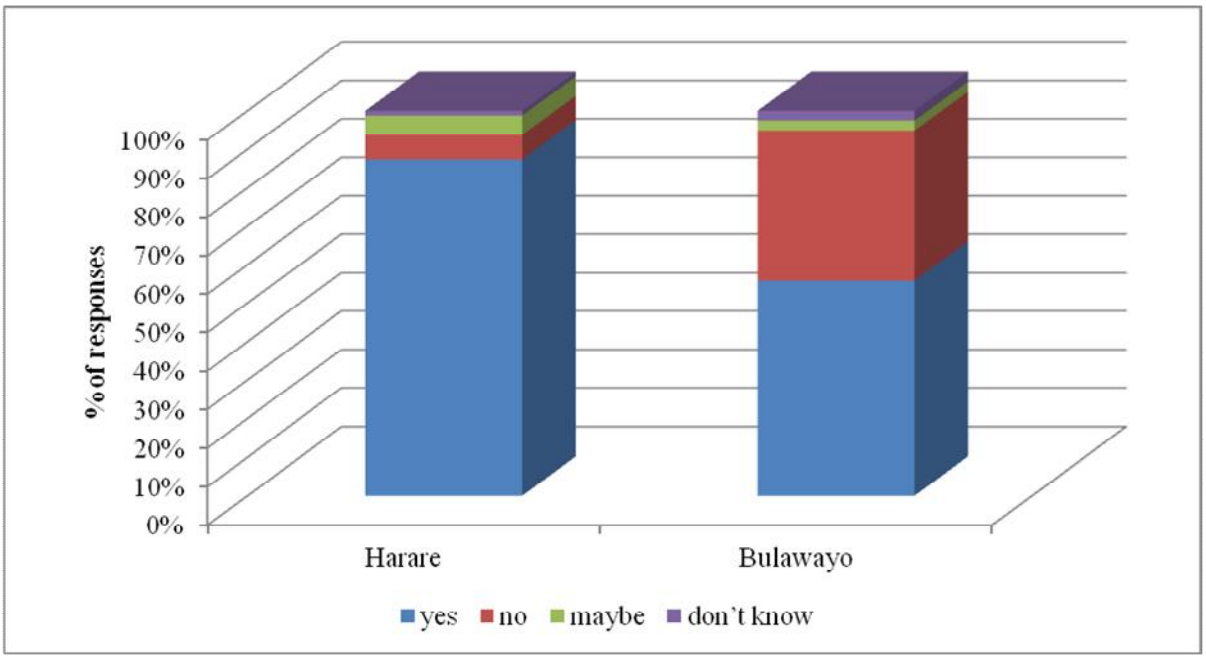


Figure 5.20: Consumers in Zimbabwe that have consumed maize products from SA

On the other hand, for those in South Africa only about a quarter said they have sent maize once or a number of times (since moving to SA) to their kin in Zimbabwe (Table 5.12). Of those that have sent to Zimbabwe a little over 10% claimed to have had their goods confiscated at the border. A number of the Zimbabwean consumers in SA mentioned that they have had guaranteed non-GM food brought in from Zimbabwe because the local markets are flooded with GM products and also due to the coarseness of the maize flour. The informal movement of products from SA shows the porosity of the borders and explains to some extent the uncertainty regarding strict regulation that is supposed to ensure food safety that respondents recorded in the benefit perception section. The indicated high SA maize product consumption could perhaps partly explain why Harare consumers are less trusting of the regulators compared to Bulawayo. Also interesting to note is that of the interviewed Zimbabweans in SA who sent products to Zimbabwe, 7% sent grain and another 7% also sent seed from SA to Zimbabwe. Although the survey was not able to determine whether the seed or grain sent was GM or non-GM, as the respondents did not know the varieties, this represents a contravention of the import regulations and possibly a contamination to the biological diversity. This possibility may perhaps be of concern for the regulatory policy, as it calls to question the effectiveness of the implementation process and thereupon an examination of the policy implications of the potential contamination.

Table 5.12: Sending of maize products from SA

Questions from Survey	Proportion of responses (%)
Have you ever sent or do you send any maize or maize products to back to Zimbabwe?	
Yes	27.0%
No	73.0%
Have your products ever been confiscated for non-compliance with the border requirements?	
Yes	11.1%
No	88.9%
Products sent	
Maize meal	74.1%
Samp	37.0%
Maize grain	7.4%
Instant porridge	3.7%
Seed	7.4%
Chicken feed	3.7%

5.4.6 Ethical, equity and moral concerns

In spite of the religious nature of the population the overall feeling in the three sites is that the companies producing GM foods are not "playing God" (Figure 5.21). The main ethical concerns appear to be "naturalness" of GM products as many respondents seem to believe that GM foods are unnatural and artificial. Equity issues around the GM foods benefiting multinationals and/or that the products are being dumped by developed countries on developing countries appear to be the least of consumers' worries.

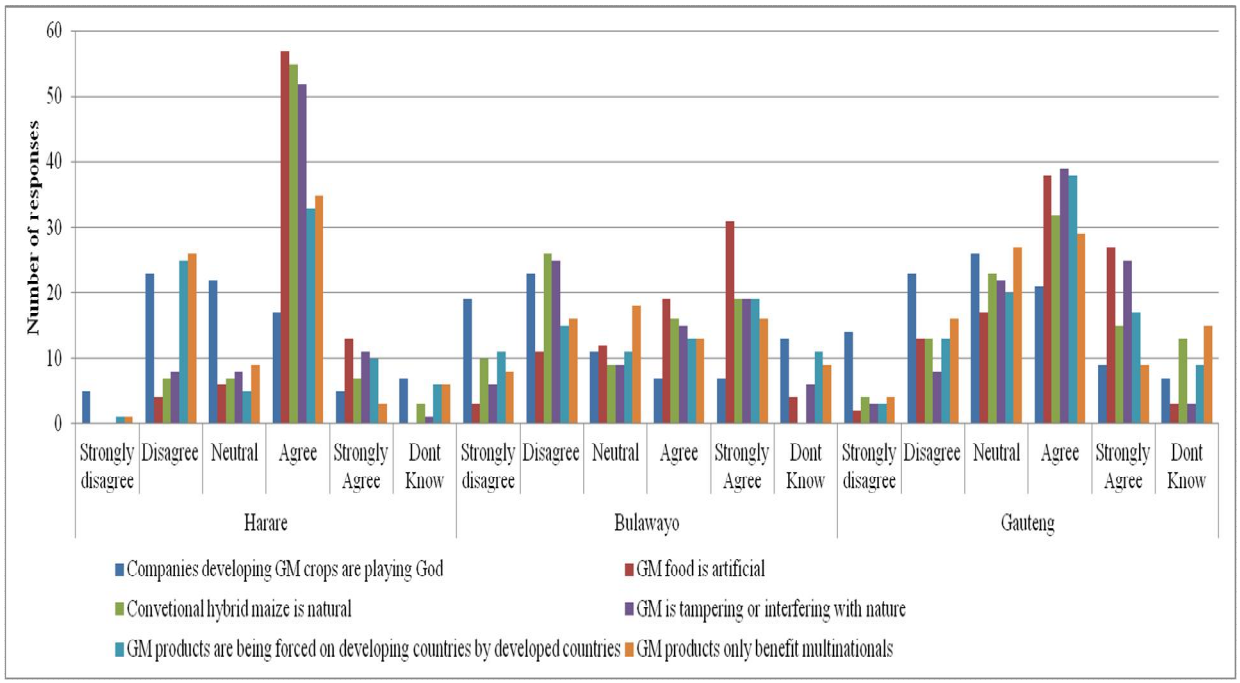


Figure 5.21: Ethical, equity and moral concerns

5.5 Conclusion

This analysis of the consumers' perspectives on the application of GMOs has revealed that while Zimbabwean consumers acknowledge the potential benefit of increased food supply they are also concerned about the potential effects of the consumption on their health. Considering the text contained in the National Biotechnology Act, as well as the pronouncements by the Minister of Agriculture, Dr. Made; the government motivation of seeking to minimise any likely negative health effects of GM food through the GM import policy is in alignment with the concerns of the consumers. Nevertheless, the absolute disapproval of GM seed imports, while allowances are provided for GM grain intended for human consumption to be milled either immediately upon arrival or prior to entry in the country's borders in order to prevent the planting of the grain; may suggest that the government may be more concerned with the environment. In addition, this may imply that the government is undecided on the health effects and therefore may, to some extent consider GM food to be safe to consume. This ambiguity sends mixed messages to consumers, leaving them confused and in a conundrum. Hence, the observed indecision, as consumers perceive both high risks and high benefits in GMOs.

Examining the perceptions in the context of the factors that have been known to influence perception formation, Zimbabweans appear to be a moderately technology averse society that only adopts new technology when they understand how it fits into their life. Notwithstanding the effect of low incomes on technology adoption, the low levels of knowledge on the science of genetic modification suggest a limited understanding of how GM technology would be of benefit to the consumers. Consequently, despite having to consume GM foods on occasions, Zimbabwean consumers may not be willing to positively accept GM food. The greater access to negative information for less informed sceptical consumers may serve to emphasise and exacerbate risk perceptions. As such consumers will be less inclined to be interested in the consumption GM products. Judging on the basis of limited knowledge alone what may be concluded is that the perceptions of the Zimbabwean society may be poorly informed.

Despite the seeming higher level of trust in regulators compared to the food chain supply chain actors, consumers appear to have limited faith in the effectiveness of their regulators as witnessed by the substantial amount of potential GM foods consumed from South Africa and the uncertainty indicated by most respondents about the safety of foods that have undergone strict regulations. Moral issues are not of concern to consumers but the 'un-naturalness of GM products is what seems to be of greater concern.

Generally it would appear as if consumers in Zimbabwe would be more ready to accept GM if they offered clear health benefits in the form of more nutrition. However given that the majority of the consumers do not perceive the benefit of reduced chemicals on food and the environment in spite of the documented evidence, the knowledge gap would probably need to be addressed before they can accept any new and more nutritious GM products that may possibly be introduced. In addition, because for many of the respondents particularly in Harare and South Africa, the cost of GM food was not a definite determining factor for purchasing GM crops, it may suggest that a price advantage alone might not be enough of an incentive for the purchasing GM food. Then again, this may have been the case because of the observed relatively higher income levels in the Harare and South Africa samples. This finding is not conclusive and further research would be required, using the quantitative willingness to pay methodologies.

Price does however seem to be a particularly important factor for Bulawayo because a significant number of respondents identified it as a key determining factor for whether they

would buy GM food on not. A combination of the observed low incomes and employment figures of the Bulawayo respondents supports the price consciousness in the Zimbabwe's second largest city. Furthermore, for the reason that Bulawayo is located in a region of low maize production and that most of the maize milling activity is concentrated in Harare, Bulawayo consumers are faced with higher maize meal prices compared to Harare and South Africa (Kapuya *et al*. 2010). This implies that perhaps the welfare of the Bulawayo consumers would likely be the most affected by the prices increases effected by the regulatory compliance procedures. Important to note from these observations is that the price concerns are context-specific based on the degree of urbanisation where the consumers reside. Therefore, the more urban (like the big metropolitan centres like Harare and Gauteng) the least likely for the consumers to be affected by price. On the other hand for smaller urban areas like Bulawayo price is more important and following this line of logic it is expected that moving further away from the urban areas to the rural areas, price is likely to become even more important especially considering the lower income and employment levels in these areas. This conclusion will however need to be verified through future research to determine differences between rural and urban areas.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This is the last chapter of the study. Firstly, the chapter provides an overview of the study and jointly summarizes the findings presented in the two previous analysis chapters to provide the aggregated cost–benefit outlook for the GM import regulation. Secondly and finally, the chapter outlines the conclusions drawn from the findings as well as the recommendations for action and further studies.

6.2 Summary

GM import regulations are considered to represent a significant threat to intra-regional trade. Accordingly the GM import regulations acts as a barrier to accessing affordable food and agricultural imports and consequently limits the contribution of intra-regional trade towards food security in southern Africa. Net importing countries like Zimbabwe have established regulatory systems based on the Cartagena Protocol on Biosafety, which provides for countries to put in place strict requirements for importation of GMOs. South Africa is the single most established steady supplier of food and agriculture imports in the regions and has for the last 15 years been a substantial producer of especially GM maize and soybeans. This, while the majority of the countries in the region are more often than not, net importers, there is a need to understand the costs and benefits of the GM regulatory requirements in food import supply chains.

As such, the purpose of the study was to assess the social and economic effects of the implementation of the GM product focussed biosafety regulatory policy import requirements of Zimbabwe. To accomplish this goal the analysis of the study was centred on the maize grain-to-maize-meal import supply chain from South Africa to Zimbabwe. Using a non-traditional cost benefit analysis approach, the study utilized a multi-method research design that made use of a structured consumer perception survey and unstructured key industry informant interview techniques to collect data. A questionnaire served as the instrument for

collecting data in the consumer survey while a guideline of questions was used in the key informant interviews. 260 Zimbabweans living in Zimbabwe and South Africa were respondents in the consumer survey, and 7 industry actors in Zimbabwe and South Africa participated in the key informant interviews. The survey and the interviews were conducted during the year 2014. Where key informants have exercised their confidentiality in the provision of information, inferences have been made based on industry data and information from secondary sources.

All the data collected was analysed and interpreted on the basis of the objectives and hypotheses of the study and the following findings were made:

The Cost Component

- The GM food import regulatory requirements stipulated by the Government of Zimbabwe have separated the maize supply chain into two marketing channels that only come together when the grain is milled, namely the GM channel and the non-GM channel. The two channels are differentiated by the specific requirements importers must comply with. The main distinguishing feature is that while compliance in the GM channel occurs all along the supply chain as the grain enters the country and is milled under the supervision of the National Biotechnology Authority; compliance in the non-GM channel is directed at certain points in the supply chain. Of note is that the GM channel operates only on occasion and as an exception in times of severe food shortages and during those times the involving compliance procedures importation is limited to large scale importers with economies of scale.
- Given the major presence of GM maize in the South African maize markets and the recent increases in maize productivity and production in Zambia, there has been a shift in Zimbabwe's trade patterns with Zambia emerging as an alternative supplier for Zimbabwe's maize imports. Zambia has become the preferred supplier because of Zambia's policy that prohibits the production of GM crops thus guaranteeing non-GM maize. As a result there are two main competing sources of maize in the non-GM channel. Important to note is that although maize from both channels is expected to be subjected to the same compliance procedures, all maize from South Africa is treated with suspicion and is subjected to a higher level of scrutiny than maize from Zambia.

- The first and foremost observed cost difference is the price differentials for maize grain between the two main channels and the sources of non-GM maize. Non-GM maize in South Africa is priced at a premium of almost 15% on the normal SAFEX price. The premium covers the costs of the identity preservation processes of ensuring that the maize remains within the stipulated threshold for non-GM maize especially considering the widespread production of GM maize in South Africa. Maize prices in Zambia are 36% and 10% higher than prices of South African GM and non-GM maize, respectively.
- Despite the high prices of maize in Zambia and notwithstanding the differences in transport costs, the differences in the regulatory compliance cost associated with the consignment of grain being shipped across the border are significant. The main difference is attributed to the GM import regulatory requirements. To import GM maize it costs importers three times more and four times more than importing non-GM maize from South Africa and Zambia, respectively. The main contributor to the high cost of the regulatory cost of GM maize is the cost of the supervision that is met by the importer. When comparing the cost on non-GM maize from South Africa and Zambia the cost in the South African channel are 30% more than the costs of the Zambian channel.
- Examining the final Total Landed Costs of maize in the different channels and from the country of origin, what is noticeable is that regardless of the regulatory costs in the GM channel being significantly higher than the non-GM channel, the Landed Cost for GM is considerably less than non-GM maize from South Africa and marginally higher than non-GM maize from Zambia. Therefore the main cost for the preferred non-GM is derived from the premium price.
- In the GM channel the costs of the regulatory compliance are mainly driven by the loss of about $200/t from the non-sale of by-product that have to be incinerated. This figure represents an added cost to the production of maize meal in the channel.
- The maize meal market does not separate the price according to source and channel.

The Benefit Component

- The majority of consumers interviewed perceived GM crops to have both high benefits and high risks. While there were a notable number of consumers that perceived low benefits and high risks in Bulawayo, there was also a considerable number in South Africa that perceived high benefits and low risks. In Harare there was generally uniform perception of high benefits and high risks.

- An analysis of specific benefit components separately revealed that the majority of the consumers agree or strongly agree that GM crops increase food production and supply. However, the consumers disagreed with the potential for GM crops to enhance nutritional value of crops. In terms of the reduction in use of chemicals in food and the environment, and the ability of strict regulations to ensure safety, the consumers were largely unsure.
- On the risk perception, the major concern for consumers in Zimbabwe and South Africa was the effect on human health and the development of allergic reactions. Harare and South Africa generally agreed with all the risk statements although there was a significant number in South Africa that was basically unsure of the all the risk statements.
- Factors that would influence consumers' GM food buying decision include: if the food was more nutritious and it reduced the use of chemicals in crops and foods. However, provided a choice between genetic modification in medicine and food production the consumers largely had a more positive attitude towards medicinal application than food production.
- Attitude to Science & Technology: More than 80% of consumers are amazed at science and believe science is important to make a better living today. More than 50% are also fearful of the achievements of science. The Consumers generally consider themselves to be medium adopters of technology.
- Awareness and Knowledge on Genetically Modified Organisms: Almost 90% of the respondents had heard or read about GMOs and at least a third of that number classified themselves as moderately to very informed. Testing the knowledge level of the respondent; on average consumers knew 2 terms of the 5 terms provided with the most known are GMOs and GM. A further test revealed that the majority of the consumers know about the general knowledge on the science of digestion but on the specific genetic modification science the knowledge levels were low.
- Trust in Information Source, Food Chain Actors and Regulators: Besides family and friends internet, TV and newspapers are the most common sources of information. Most respondents accessed negative or strongly negative information. Generally there is a high level of trust of the information sources. Considering food actors consumers trust farmers the most and food processors the least. When it came to regulators although the consumers had high trust in them there were also high numbers that did not know the regulations or the organisations involved in regulation.
- Ethical, Equity and Moral Concerns: the main concern was that GM food is "unnatural".

6.3 Conclusions

Based on the findings summarized in the section above and the questions and hypotheses presented in the first chapter, the study has yielded the following conclusions:

Question 1: What are the effects of complying with the strict GM import regulatory requirements on a) the costs of activities in the maize value chain and b) on the prices of maize meal at the end of the chain?

Hypothesis 1: The actions of complying with the GM import regulation add to the costs in the maize value chain. Consequently the additional costs are factored into the price of maize meal for Zimbabwean consumers.

- The GM import regulatory requirements lead to increased cost in the maize value chain by reducing access to cheaper grain as importers purchase from the alternative market at higher prices. However, the potential benefit of importing more affordable GM maize is nullified by higher costs of other economic factors such as transport and logistics. Furthermore, the maize meal price effect of the GM import regulations, for consumers is indistinct because the prices depend on the interaction between local prices and import prices. The price effect seems particularly important at grain wholesale level because it brings the lower import prices closer to higher local prices thereby suggesting that the domestic market distortions may in fact lead to the trade restrictions to improve the welfare of the Zimbabwean consumers. Considering all the different factors at play in costing and pricing in the maize meal supply chain, a different outlook may be expected in future.

Question 2: What are the benefit and risk perceptions on GM food of Zimbabwean consumers, and what is shaping these perceptions?

Hypothesis 2: Consumers perceive low benefits and high risks in GM food crops that are shaped by a) attitude to science and technology, b) awareness and knowledge on GMOs, c) trust in information sources, food chain actors and regulators, and d) ethical, equity and moral concerns.

- Generally Zimbabwean consumers perceive high benefits and high risk on GM food. These perceptions are driven by both an appreciation and a fear of science and technology. The perceived benefits are largely driven by the recognition of the potential for GM crops to increase food production and availability, while the high risks may have been influenced by the limited knowledge and understanding of GMOs as demonstrated by the observed misconceptions such as that of the impact of GM crops on the use of chemicals. Furthermore despite the lack of evidence on the potential negative health effects of GM crops, the observed high levels of trust in the regulators (who have been particularly instrumental in emphasising the potential risks) may be considered the main reason leading to accentuated risks. The perception of both high risks and high benefits may suggest that consumers may be willing to accept GM food if they are assured that the risks have been assessed, are minimal and managed.

Question 3: Are the concerns emerging from consumer perceptions in alignment with the Zimbabwean Government's motivations for implementing the GM import regulations? What is the implied cost benefit ratio?

Hypothesis 3: The consumer concerns are in alignment with the desired policy outcome of the Zimbabwean Government's GM policy and regulations, thereby implying that consumers stand to benefit more than lose from the resulting trade impact.

- The concerns of surveyed consumers have mostly to do with their health rather than the environment and other concerns. These concerns are in line with the government aim to minimise any likely negative impacts on human health as indicated by the law governing GMOs and statements released by the Ministry of Agriculture. However, the occasional acceptance of GM milled food suggests uncertainty and ambiguity within government which conceivably leads to uncertainty amongst consumers. Limited and contradicting information and the generally technology-shy demeanour of the Zimbabwean consumer may further exacerbate their concerns around GM products. Therefore, as the situation stands, the implied benefits of the regulation may generally outweigh the resulting costs.

6.4 Limitations of the Study

The study attempted to simplify a complex matter by relying on subjective measures of consumer acceptance and willingness to consume GM products. While this has served as a contribution to the advancement of a discourse on the social and economic impact of GM regulation in the context of Southern Africa, future direction would be better aimed at using more quantifiable measures such as a binomial willingness to pay regression model.

6.5 Recommendations

This study may be considered to be an exploratory move in the direction of chartering a country specific consumer discourse in GMO policy development. As much as the findings of the study do not provide a definitive answer on the impact of GM policy and regulation, the results have the following important implications for policy and opportunities for further research:

6.5.1 Recommendations for policy

1. There is a need for consistency between government's policy statements, public utterances, and regulatory actions in order to avoid confusion amongst the public. The government needs to take a clear stance on whether they consider regulated GM food as safe or not.
2. There is a need to demystify GM crops and food through the promotion of evidence based discussions on the effect of GM crops and about the government conditional acceptance of GM food. Policy makers and scientists can address this through conducting public awareness initiatives and perhaps involving the public more in policy development.
3. At regional level and for regional integration and trade to adequately capture the potential gains of trade in GM food, member countries have to address all the aspects that are critical for unlocking the regional trade barriers such as transport and logistics costs.

6.5.2 Recommendations for further research

1. There is a need to conduct in depth study of actual border processes in order to provide a more comprehensive cost analysis on the impact of the GM import policy and regulation.
2. The quantifying of the willingness to pay for non GM and GM products by consumers would provide a more decisive result on the costs and benefits of the regulation.
3. A empirical assessment of Zimbabwean consumers' willingness to buy and the drivers thereof could be conducted.
4. Food sensory comparison studies between GM and non-GM food may be necessary to increase the understanding and acceptance of GM food.
5. A study comparing perception differences between rural and urban consumers could be enlightening.
6. A scientific environmental appraisal of the extent of possible contamination of local production means through GM seed or grain crossing the border informally and the implications for policy.

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ANNEX A: KEY INFORMANT INTERVIEW GUIDING QUESTIONS

1. What is the policy regarding GM food and agriculture imports?
2. What are the regulatory requirements in relation to the GM policy?
3. What are the costs that are met by the importer when meeting the regulatory requirements?
4. What are the organisations that are involved in the process of complying with the regulatory requirements?
5. How has the regulation affected operations in the trade on maize?
6. What are the key differences (if any) between importing from South Africa and from Zambia?

ANNEX B: ZIMBABWE CONSUMER QUESTIONNAIRE

CONSUMER GMO PERCEPTION QUESTIONNAIRE

ZIMBABWE SURVEY

This questionnaire has been prepared by a student in the Dept. of Agricultural Economics, Extension & Rural Development, in the Faculty of Natural & Agricultural Sciences, at the University of Pretoria; in support of the research requirements for the degree of MSC (Agric) Agricultural Economics. The purpose of this survey is to determine the perception of Zimbabwean consumers regarding the use of Genetically Modified Organisms (GMOs), as part of a study of the socio-economic impact of GM regulations in agriculture and food markets

CONFIDENTIAL

All information you provide is considered confidential; your name will not be included or, in any other way, associated with the data collected in the study. Furthermore, because our interest is in the average responses of the entire group of participants, you will not be identified individually in any way in written reports of this research.

Date: _____ **Time - Starting:** _____ **Ending:** _____

Interviewer: _____ **Language of interview:** English 1 Shona 2 Ndebele 3

Location:

Harare 1 Bulawayo 2

Supermarket:

TM 1 OK/ Bon Marche 2 Spar 3 PnP 4 Greens 5

Branch: _____

SECTION I: AWARENESS & KNOWLEDGE

1. Have you read or heard about the use of biotechnology, genetically engineered (GE), genetically modified (GM), genetically modified organism (GMO) or bioengineered ingredients in the production of food?

Yes, I have read or heard about GM foods	1
No, I have never read or heard **anything** about GM foods	2

If your answer to to question 1 was yes, please answer questions 2 through to 5. Otherwise go to question 6

2. Using a 5 point scale, how well informed would you say you are about GMOs, where 1 means you are not at all informed and 5 means you are very informed

not at all informed	1	minimally informed	2	somewhat informed	3
moderately informed	4	very informed	5		

3. Which of the following terms are you familiar with (allow for multiple responses) *(ask all)*

Genetically modified organisms (GMO)	1	Genetically modified(GM) crops	2		
Genetically engineered (GE) crops	3	Biotech crops	4	Bioengineered food	5

4. Knowldege of science, genetic modification and food production	TRUE	FALSE	don't know
a) Conventional foods do not contain genes	1	2	88
b) By eating GM crops a person's genes are altered	1	2	88
c) When consumed, food is broken down into simple sugars, fatty acids and amino acids	1	2	88
d) GM maize tastes different from other hybrid maize	1	2	88
e) South Africans have been eating GM maize for more than a decade	1	2	88
f) Genetic modification is a tool used for increasing agricultural productivity	1	2	88

5. Have you ever come across any GM maize/ GM derived maize products in your local supermarket or grocery store?

Yes	1	No	2	Don't Know	88

6. If answered yes, which foods? (allow for multiple responses)

Maize meal	1	Seed	2	Green mealies	3
Samp	4	Chicken feed	5	Other (specify): _____	

7. From what sources of information did you learn about GMOs? (multiple responses)

Newspapers	1	Radio	2	Television	3
Internet	4	Government Agency	5	NGO Agencies	6
Family & Friends	7	Consumer Group *(e.g.CCZ)*	8	Other (Specify): _____	

8. How frequently do you read/ use the source of information that you have selected

Every Day	1	Once a week	2	Once a month	3	Only read it once & its been a while	4

9. On a scale of 1 to 5, is all the information you have access to mostly negative or positive about GMOs and/ or GM crops, where 1 means mostly strongly negative and 5 means mostly strongly positive

Mostly strongly negative	1	Mostly somewhat negative	2	Mostly balanced *(Neither negative nor positive)*	3
Mostly somewhat positive	4	Mostly strongly positive	5		

SECTION II: ATTITUDE TO SCIENCE, TECHNOLOGY & OTHER APPLICATIONS OF GENETIC MODIFICATION

10. What do you think about the following statements about science, technology and the different applications of genetic modification?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
a) I am amazed by the achievements of science in today's world	1	2	3	4	5	88
b) Science is important to make better living in today's world	1	2	3	4	5	88

c) The application of genetic modification to medicine (e.g. for the creation of vaccines) is good	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

d) The application of genetic modification to agricultural crop production is good	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

e) The achievements of science and technology today are terrifying	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

11. When it comes to technology, which of the following statements describe you the best?

a) I am generally a late adopter of technology; I would rather stick with what I know	1
b) I generally adopt new technology in reaction to peer pressure or emerging norms or economic necessity	2
c) I am generally willing to embrace a new technology when I understand how it fits into my life	3
d) I am generally passionate about technology, I try to have the latest innovations and usually one of the first to have new technology	4

12. Which of the following latest technologies do you own or use in your home? *(ask all)*

Smart Phone	1	iPad/ Tablet computer	2	Laptop	3
Xbox/ Video games	4	Digital Video Camera/Recorder	5	HDTV	6
3D TV	7	MP3 player/ iPod	8	None of the above	9

SECTION III: TRUST IN FOOD CHAIN ACTORS, INFORMATION SOURCES & REGULATORS

13. On a scale of 1 to 5, where 1 is "very untrustworthy" and 5 is "very trustworthy"; to what extent would you say you trust that the food chain as a whole (from farm to the plate) is producing food that is safe for consumption	Very un-trustworthy	somewhat un-trustworthy	Neutral	Somewhat trustworthy	Very trustworthy
	1	2	3	4	5

14. Of the following food chain actors how would you rate you level of trust

	Very Untrustworthy	Somewhat Untrustworthy	Neutral	Somewhat Trustworthy	Very Trustworthy
Seed suppliers	1	2	3	4	5
Chemical & input suppliers	1	2	3	4	5
Farmers	1	2	3	4	5
Food Processors	1	2	3	4	5
Distributors (retailers)	1	2	3	4	5

15. Which of the following organisations do you think or are you aware of having a role in food/ GM regulation and monitoring?

Min. of Agriculture	1	Plant Protection Unit	2
Environmental Management Agency	3	Standards Association of Zimbabwe	4
Consumer Council of Zimbabwe	5	Zimbabwe Revenue Authority	6
National Biotechnology Authority	7	I don't know / I have absolutely no idea	8

16. On a scale 1 to 5 where 1 is " extremetly untrustworthy" and 5 is "extremely trustworthy"; to what extent do you trust the identified organisations' ability in regulating and monitoring food and GM

	Very Untrustworthy	Somewhat Untrustworthy	Neutral	Somewhat Trustworthy	Very Trustworthy
Ministry of Agriculture	1	2	3	4	5
Plant Protection Unit	1	2	3	4	5
Environmental Management Agency	1	2	3	4	5
Standards Association of Zimbabwe	1	2	3	4	5
Consumer Council of Zimbabwe	1	2	3	4	5

Zimbabwe Revenue Authority	1	2	3	4	5
National Biotechnology Authority	1	2	3	4	5

17. Of the information sources you use to what extent do you trust their information? (*Can have multiple responses*)

	Very Untrustworthy	**Somewhat Untrustworthy**	**Neutral**	**Somewhat Trustworthy**	**Very Trustworthy**
Newspapers	1	2	3	4	5
Radio	1	2	3	4	5
Television	1	2	3	4	5
Internet	1	2	3	4	5
Government Agency	1	2	3	4	5
NGO Agency	1	2	3	4	5
Consumer Groups *(e.g. CCZ)*	1	2	3	4	5
Other (Specify):	1	2	3	4	5

SECTION IV: PREFERENCES

18. Can you rate the importance of the following aspects when making purchasing decisions for maize and maize products? (multiple responses are allowed)

	very un-important	**somewhat un-important**	**neutral**	**somewhat important**	**very important**
Price	1	2	3	4	5
Brand	1	2	3	4	5
Food Safety (e.g. allergic reaction considerations)	1	2	3	4	5
Quality (nutritional)	1	2	3	4	5

Production process	1	2	3	4	5

19. How often do you read the ingredients section of food labels?	Never	Rarely	Sometimes	Often	Always
	1	2	3	4	5

20. How often do you read the nutritional section of food labels?	Never	Rarely	Sometimes	Often	Always
	1	2	3	4	5

	Yes		No		Maybe
21. Would you purchase food if you knew that it contained GM ingredients (like GM Maize or GM Soyabean)	1		2		3

22. Would you purchase GM food if it was cheaper than conventional foods	Yes		No		Maybe
	1		2		3

23. Would you purchase GM food if it was more nutritious than conventional food	Yes		No		Maybe
	1		2		3

24. Would you purchase GM food if it could make you lose weight?	Yes		No		Maybe
	1		2		3

25. Would you purchase GM foods if it reduced the amounts of pesticides/ chemicals applied to crops?	Yes		No		Maybe
	1		2		3

SECTION V: BELIEFS (ETHICAL, EQUITY & MORAL CONCERNS)

26. Which of the following statements would you agree on?

a) Companies developing GM crops are playing God	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

b) GM food is artificial	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

c) Conventional hybrid maize is natural	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
d) GM is tampering/ interfering with nature	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
e) GM products are being forced on developing countries by developed countries	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
f) GM products only benefit multinationals	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

SECTION VI: RISK BENEFIT PERCEPTIONS

27. Which of the following statements would you agree with?

a) GM technology increases productivity and offers solutions for food supply	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
b) GM has a potential to create enhanced nutritional value	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
c) GM has the potential to reduce the use of agricultural pesticides and other chemicals	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
d) GM threatens the environment	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

e) GM leads to a loss of biodiversity (original plant species as well as death of good insects)

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
1	2	3	4	5	88

f) Consuming GM can damage one's health

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
1	2	3	4	5	88

g) Consuming GM food can cause allergic reaction to people

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
1	2	3	4	5	88

h) GM crops that have gone through a strict biosafety regulatory process are safe to consume

Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
1	2	3	4	5	88

SECTION VII: Maize Consumption Habits

28. Wich of the following maize and maize product do you consume and how frequently do you use or consume any of the following maize and maize products?

Product	Never	Occasionally	Frequently
a. Grain	1	2	3
b. Mealie Meal	1	2	3
c. Samp	1	2	3
d. Chicken Feed	1	2	3
e. Seed	1	2	3
f. Green Mealies	1	2	3

29. Where do you normally get these products that you use? (*Can have multiple responses per product*)

	Product	Remittances	Own Production	Purchase from retail	Purchase from informal market
a.	Grain	1	2	3	**4**
b.	Mealie Meal	1	2	3	4
c.	Samp	1	2	3	4
d.	Chicken Feed	1	2	3	4
e.	Seed	1	2	3	4
f.	Green Mealies	1	2	3	4

SECTION VIII: Possiblity of GM Consumption

30. Have you ever consumed any maize or maize products that you *know or think* to be GM? Yes 1 No 2

31. *If yes*, how did you tell it was GMO or what made you think it was GM?

It was labelled 1 | It looked different 2 | It tasted different 3

Someone told 4 | Other (specify) _____

32. Where did you get these products that you thought or where sure they were GM?

bought from local supermarket or grocery store	1
received as remittance from outside the country	2
purchased from outside the country	3
received from friends and/ or neighbours	4

if selected specify from where? _____

if selected specify from where? _____

33. How many times have you consumed these products that you thought or know to be GM	Once	Occassio-nally	About half the time	Usually	Always	Dont Know
	1	2	3	4	5	88

34. Have you ever consumed any maize or maize products from South Africa	yes	no	maybe	don't know

35. If yes or maybe please give an example of the products that you have consumed

SECTION IX: KNOWLEDGE ON GOVERNMENT GM REGULATION

36. Do you know if the government has a rule/ regulation on:

a) production and consumption of GM crops? Yes [1] No [2]

b) GM crops and/ GM derived food imports? Yes [1] No [2]

(if answer is no - skip question 37 & 38)

37. If yes, from your understanding what are the rules / regulations?

38. Where did you hear about the rule/ regulation? _____

Section X: Demographics

Gender: Male [1] Female [2]

Age: What is your age in years? _____

Race:

Black [1] White [2] Indian [3]

Mixed [4] Other (Specify): _____

Ethnic Group:	What is the main language that you speak at home?							
	Ndebele	1	Shona	2	English	3		
	Other (Specify): _____							
Religion:	Which religion do you practice?							
	Christian	1	Traditionalist	2	Muslim	3		
	Not religous	4	Other (specify): _____					
Employment Status:	What is your current employment status?							
	Student	1	Full-time employed	2	Part-time employed	3		
	Self- employed	4	Retired	5	Not employed	6		
	Other (specify): _____							
Employment Sector:	*If you are employed*, in which sector are you employed?							
	Government	1	Private Sector	2	NGO	3		
	Informal	4	Other (Specify): _____					
Industry:	*If you are currently employed or a student*, which category best describes the industry you are in?							
	Education	1	Agriculture	2	Health	3		
	Media	4	Retail	5	Other (Specify): _____			
Income (US$):	in which range does your gross monthly income fall under							
	< 150	1	150 - 299	2	300 - 449	3		
	450 - 599	4	600 - 750	5	>750	6		

Education: What is you highest level of qualification? If you are a student what level of education are you currently pursuing?

No Education	1	Primary Level	2	Secondary Level	3
Vocational/ Technical	4	Undergraduate	5	Post graduate	6

Residence: In which suburb do you reside? _____

Household Data: a) Are you the head of the household you come from?

Yes	1	No	2

b) If not what is your relation to the head of the household?

Spouse	1	Child	2	Other (Specify):	_____

c) How many are you in your household?

1 to 3	1	4 to 6	2	> 6	3

d) do you have any member of your household living and working in South Africa

Yes	1	No	2

******The end. Thank you for your time******

If you have any comments or questions:

ANNEX C: SOUTH AFRICA CONSUMER QUESTIONNAIRE

CONSUMER GMO PERCEPTION QUESTIONNAIRE

SOUTH AFRICA SURVEY

This questionnaire has been prepared by a student in the Dept. of Agricultural Economics, Extension & Rural Development, in the Faculty of Natural & Agricultural Sciences, at the University of Pretoria; in support of the research requirements for the degree of MSC (Agric) Agricultural Economics. The purpose of this survey is to determine the perception of Zimbabwean consumers regarding the use of Genetically Modified Organisms (GMOs), as part of a study of the socio-economic impact of GM regulations in agriculture and food markets

CONFIDENTIAL

All information you provide is considered confidential; your name will not be included or, in any other way, associated with the data collected in the study. Furthermore, because our interest is in the average responses of the entire group of participants, you will not be identified individually in any way in written reports of this research.

Date: _____ **Time - Starting:** _____ **Ending:** _____

Interviewer: _____ **Language of interview:** English 1 Shona 2 Ndebele 3

Location: Pretoria 1 Johannesburg 2

SECTION I: AWARENESS & KNOWLEDGE

1. Have you read or heard about the use of biotechnology, genetically engineered (GE), genetically modified (GM), genetically modified organism (GMO) or bioengineered ingredients in the production of food?

Yes, I have read or heard about GM foods	1
No, I have never read or heard **anything** about GM foods	2

If your answer to to question 1 was yes, please answer questions 2 through to 5. Otherwise go to question 6

2. Using a 5 point scale, how well informed would you say you are about GMOs, where 1 means you are not at all informed and 5 means you are very informed

not at all informed	1	minimally informed	2	somewhat informed	3
moderately informed	4	very informed	5		

3. Which of the following terms are you familiar with (allow for multiple responses) (ask all)

Genetically modified organisms (GMO)	1	Genetically modified(GM) crops	2		
Genetically engineered (GE) crops	3	Biotech crops	4	Bioengineered food	5

4. Knowldege of science, genetic modification and food production

	TRUE	FALSE	don't know
a) Conventional foods do not contain genes	1	2	3
b) By eating GM crops a person's genes are altered	1	2	3
c) When consumed, food is broken down into simple sugars, fatty acids and amino acids	1	2	3
d) GM maize tastes different from other hybrid maize	1	2	3
e) South Africans have been eating GM maize for more than a decade	1	2	3
f) Genetic modification is a tool used for increasing agricultural productivity	1	2	3

5. Have you ever come across any GM maize/ GM derived maize products in your local supermarket or grocery store?

Yes	1	No	2	Don't Know	3

6. If answered yes, which foods? (allow for multiple responses)

Maize meal	1	Seed	2	Green mealies	3
Samp	4	Chicken feed	5	Other (specify): _____	

7. From what sources of information did you learn about GMOs? (multiple responses)

Newspapers	1	Radio	2	Television	3
Internet	4	Government Agency	5	NGO Agencies	6
Family & Friends	7	Consumer Groups	8	Other (Specify): _____	

8. How frequently do you read/ use the source of information that you have selected

Every Day	1	Once a week	2	Once a month	3	Only read it once & its been a while	4

9. On a scale of 1 to 5, is all the information you have access to mostly negative or positive about GMOs and/ or GM crops, where 1 means mostly strongly negative and 5 means mostly strongly positive

Mostly strongly negative	1	Mostly somewhat negative	2	Mostly balanced *(Neither negative nor positive)*	3
Mostly somewhat positive	4	Mostly strongly positive	5		

SECTION II: ATTITUDE TO SCIENCE, TECHNOLOGY & OTHER APPLICATIONS OF GENETIC MODIFICATION

10. What do you think about the following statements about science, technology and the different applications of genetic modification?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
a) I am amazed by the achievements of science in today's world	1	2	3	4	5	88
b) Science is important to make better living in today's world	1	2	3	4	5	88

c) The application of genetic modification to medicine (e.g. for the creation of vaccines) is good	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

d) The application of genetic modification to agricultural crop production is good	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

e) The achievements of science and technology today are terrifying	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

11. When it comes to technology, which of the following statements describe you the best?

a) I am generally a late adopter of technology; I would rather stick with what I know	1
b) I generally adopt new technology in reaction to peer pressure or emerging norms or economic necessity	2
c) I am generally willing to embrace a new technology when I understand how it fits into my life	3
d) I am generally passionate about technology, I try to have the latest innovations and usually one of the first to have new technology	4

12. Which of the following latest technologies do you own or use in your home? *(ask all)*

Smart Phone	1	iPad/ Tablet computer	2	Laptop	3
Xbox/ Video games	4	Digital Video Camera/Recorder	5	HDTV	6
3D TV	7	MP3 player/ iPod	8	None of the above	9

SECTION III: TRUST IN FOOD CHAIN ACTORS, INFORMATION SOURCES & REGULATORS

13. On a scale of 1 to 5, where 1 is "very untrustworthy" and 5 is "very trustworthy"; to what extent would you say you trust that the food chain as a whole (from farm to the plate) is producing food that is safe for consumption	Very un-trustworthy	somewhat un-trustworthy	Neutral	Somewhat trustworthy	Very trustworthy
	1	2	3	4	5

14. Of the following food chain actors how would you rate you level of trust

	Very Untrustworthy	Somewhat Untrustworthy	Neutral	Somewhat Trustworthy	Very Trustworthy
Seed suppliers	1	2	3	4	5
Chemical & input suppliers	1	2	3	4	5
Farmers	1	2	3	4	5
Food Processors	1	2	3	4	5
Distributors (retailers)	1	2	3	4	5

15. Which of the following organisations do you think or are you aware of having a role in food/ GM regulation and monitoring?

Dept. of Agric, Forestry & Fisheries	1	Dept. of Trade & Industry	2
Dept. of Environmental Affairs	3	South African National Biodivesity Institute	4
Dept. of Science & Technology	5	GM testing Facilities *(e.g UFS, SGS)*	6
I don't know / I have absolutely no idea	8		

16. On a scale 1 to 5 where 1 is " extremetly untrustworthy" and 5 is "extremely trustworthy"; to what extent do you trust the identified organisations' ability in regulating and monitoring food and GM

	Very Untrustworthy	Somewhat Untrustworthy	Neutral	Somewhat Trustworthy	Very Trustworthy
Dept of Agric, Forestry & Fisheries	1	2	3	4	5
Dept. of Trade & Industry	1	2	3	4	5
Dept . Of Environmental Affairs	1	2	3	4	5
South African National Biodivesity Institute	1	2	3	4	5
Dept. of Science & Technology	1	2	3	4	5
GM testing Facilities *(e.g UFS, SGS)*	1	2	3	4	5

17. Of the information sources you use to what extent do you trust their information? (*Can have multiple responses*)

	Very Untrustworthy	Somewhat Untrustworthy	Neutral	Somewhat Trustworthy	Very Trustworthy
Newspapers	1	2	3	4	5
Radio	1	2	3	4	5
Television	1	2	3	4	5
Internet	1	2	3	4	5
Government Agency	1	2	3	4	5
NGO Agency	1	2	3	4	5
Consumer Groups	1	2	3	4	5
Other (Specify):	1	2	3	4	5

SECTION IV: PREFERENCES

18. Can you rate the importance of the following aspects when making purchasing decisions for maize and maize products? (multiple responses are allowed)

	very un-important	somewhat un-important	neutral	somewhat important	very important
Price	1	2	3	4	5
Brand	1	2	3	4	5
Food Safety (e.g. allergic reaction considerations)	1	2	3	4	5
Quality (nutritional)	1	2	3	4	5
Production process	1	2	3	4	5

19. How often do you read the ingredients section of food labels?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

20. How often do you read the <u>nutritional</u> section of food labels?	Never	Rarely	Sometimes	Often	Always
	1	2	3	4	5

21. Would you purchase food if you knew that it contained GM ingredients (like GM maize or GM soyabean	Yes		No		Maybe
	1		2		3

22. Would you purchase GM food if it was cheaper than conventional foods	Yes		No		Maybe
	1		2		3

23. Would you purchase GM food if it was more nutritious than conventional food	Yes		No		Maybe
	1		2		3

24. Would you purchase GM food if it could make you lose weight?	Yes		No		Maybe
	1		2		3

25. Would you purchase GM foods if it reduced the amounts of pesticides/ chemicals applied to crops?	Yes		No		Maybe
	1		2		3

SECTION V: BELIEFS (ETHICAL, EQUITY & MORAL CONCERNS)

26. Which of the following statements would you agree on?

a) Companies developing GM crops are playing God	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

b) GM food is artificial	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

c) Conventional hybrid maize is natural	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

d) GM is tampering/ interfering with nature	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
e) GM products are being forced on developing countries by developed countries	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
f) GM products only benefit multinationals	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

SECTION VI: RISK BENEFIT PERCEPTIONS

27. Which of the following statements would you agree with?

a) GM technology increases productivity and offers solutions for food supply	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
b) GM has a potential to create enhanced nutritional value	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
c) GM has the potential to reduce the use of agricultural pesticide or chemical residue on food and the environment	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
d) GM threatens the environment	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
e) GM leads to a loss of biodiversity (original plant species as well as death of good insects)	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

f) Consuming GM can damage one's health	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
g) Consuming GM food can cause allergic reaction to people	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88
h) GM crops that have gone through a strict biosafety regulatory process are safe to consume	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	Dont Know
	1	2	3	4	5	88

SECTION VII: Maize Consumption Habits

28. Wich of the following maize and maize product do you consume and how frequently do you use or consume any of the following maize and maize products?

	Product	Never	Occasionally	Frequently
a.	Grain	1	2	3
b.	Mealie Meal	1	2	3
c.	Samp	1	2	3
d.	Chicken Feed	1	2	3
e.	Seed	1	2	3
f.	Green Mealies	1	2	3

29. Where do you normally get these products that you use? (*Can have multiple responses per product*)

	Product	Remittances	Own Production	Purchase from retail	Purchase from informal market
a.	Grain	1	2	3	**4**
b.	Mealie Meal	1	2	3	4
c.	Samp	1	2	3	4

d.	Chicken Feed	1	2	3	4
e.	Seed	1	2	3	4
f.	Green Mealies	1	2	3	4

SECTION VIII: Possiblity of GM Consumption

30. Have you ever consumed any maize or maize products that you *know or think* to be GM? Yes 1 No 2

31. *If yes*, how did you tell it was GMO or what made you think it was GM?

It was labelled 1 | It looked different 2 | It tasted different 3

Someone told 4 | Other (specify) _____

32. Where did you get these products that you thought or where sure they were GM?

33. How many times have you consumed these products that you thought or know to be GM	Once	Occassio-nally	About half the time	Usually	Always	Dont Know
	1	2	3	4	5	88

34. have you ever purchased & consumed maize cobs bought from retail or informal sellers? Yes 1 No 2

SECTION IX: KNOWLEDGE ON ZIMBAWEAN GOVERNMENT GM REGULATION

35. Have you ever sent or do you send any maize or maize products to back to Zimbabwe?	Yes	No

36. If yes,

a) which products do you send?

Maize meal	1	Samp	2	Other (specify): _____

b) How frequently do you send

Once in a year	1	Twice a year	2	Four times a year	3	> four times a year	4
It was once-off	5						

c) How do you send these products?

through relatives travelling to Zimbabwe	1
through sending bus drivers	2
though the informal transport "omalayisha"	3
other (specify) :_____	4

d) Have your products ever been confiscated for non-compliance with the border requirements? Yes 1 No 2

37. Do you know if the government has a rule/ regulation on:

a) production and consumption of GM crops? Yes 1 No 2

b) GM crops and/ GM derived food imports? Yes 1 No 2

(if answer is no - skip question 38 & 39)

38. If yes, from your understanding what are the rules / regulations?

39. Where did you hear about the rule/ regulation? _____

Section X: Demographics

Gender: Male 1 Female 2

Age:	What is your age in years? _____							
Race:								
	Black	1	White	2		Indian	3	
	Mixed	4	Other (Specify): _____					
Origin in Zimbabwe:	From where do you come from in Zimbabwe? Which is your nearest main urban area							
	Harare	1	Bulawayo	2		Gweru	3	
	Mutare	4	Other specify: _____					
Religion:	Which religion do you practice?							
	Christian	1	Traditionalist	2		Muslim	3	
	Not religous	4	Other (specify): _____					
Length of stay in SA:	How long have you been staying in South Africa?							
	< 1 year	1	1 - 5 years	2		5 - 10 years	3	
	> 10 years	4						
Residency status:	What is your residency status							
	permanent residency	1	temporary	2		now citizen	3	
Going back to Zim:	a) Do you intend to go back to Zimbabwe one day?	yes	no	maybe				
		1	2	3				
	b) if yes when do you think you will be going back to Zimbabwe?							
	in less than 5 years	1	in 5 - 10 years	2		in more than 10 years	3	

Employment Status:	What is your current employment status?							
	Student	1	Full-time employed	2	Part-time employed	3		
	Self- employed	4	Retired	5	Not employed	6		
	Other (specify): _____							
Employment Sector:	*If you are employed*, in which sector are you employed?							
	Government	1	Private Sector	2	NGO	3		
	Informal	4	Other (Specify): _____					
Industry:	*If you are currently employed or a student*, which category best describes the industry you are in?							
	Education	1	Agriculture	2	Health	3		
	Media	4	Retail	5	Other (Specify): _____			
Income (US$):	in which range does your gross monthly income fall under							
	< 150	1	150 - 299	2	300 - 449	3		
	450 - 599	4	600 - 750	5	>750	6		
Education:	What is you highest level of qualification? If you are a student what level of education are you currently pursuing?							
	No Education	1	Primary Level	2	Secondary Level	3		
	Vocational/ Technical	4	Undergraduate	5	Post graduate	6		
Household Data:	a) Are you the head of the household you come from?							
	Yes	1	No	2				

b) If not what is your relation to the head of the household?

Spouse 1 Child 2 Other (Specify): _____

c) How many are you in your household?

1 to 3 1 4 to 6 2 > 6 3

******The end. Thank you for your time******

If you have any comments or questions:

ANNEX D: INVITATION LETTER TO PARTICIPATE IN STUDY

Invitation for participation in an academic research study

Dept. of Agricultural Economics, Extension and Rural Development

TITLE OF THE STUDY

THE SOCIO-ECONOMIC CONSENQUENCES OF BIOSAFETY REGULATION ON AGRICULTURAL TRADE: THE CASE OF MAIZE TRADE BETWEEN ZIMBABWE AND SOUTH AFRICA

Research conducted by:
Ms. C. S. S. Ngulube (10109481)
Cell: +27 78 053 2215

Dear Participant,

You are invited to participate as a key informant, in an academic research study being conducted by Cleopatra Sikhangezile S. Ngulube, a Masters student from the Department Agricultural Economics, Extension and Rural Development at the University of Pretoria.

The purpose of the study is to determine the effect of GMO import regulations on trade and the overall socio-economic impact on the trading partners, Zimbabwe (as importer of maize) and South Africa (as exporter of maize and producer of GM maize). In line with this purpose, I am seeking information that will help in providing a clearer understanding of the current situation and issues on the policies, processes and procedures of GM maize trade. Therefore, I would be very grateful if you can find time to have discussions with me to provide any relevant information that can help me in my study.

However, should you have any questions or comments for clarification, regarding the study, please contact my supervisor, Dr. Marnus Gouse on email marnus.gouse@up.ac.za or telephone on 012 420 5738.

Yours Sincerely

_____

Cleopatra S. S. Ngulube (Ms.)

Cc: Dr. Marnus Gouse