

Exploring the uptake of genetically modified white maize by smallholder farmers: The case of Hlabisa, South Africa

Mankurwana H Mahlase

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Abstract

The use of genetically modified (GM) crops to resolve food security and poverty issues has been met with controversy and scepticism. The rationale for this research was to highlight the nuanced reasons as to why smallholder farmers are motivated to use agricultural biotechnology.

The aim of this study was to explore the uptake of GM maize by South African smallholder farmers in order to contribute towards understanding the implications of agricultural biotechnology in smallholder agriculture. Using the case studies of Hlabisa in KwaZulu-Natal, the objectives were; (i) to investigate the perceived benefits and problems associated with the uptake of GM maize. (ii) to identify which institutional, political, social, and environmental factors influence the choices and decisions made by smallholder farmers to grow GM maize and (iii) to assess how GM maize has affected the well-being of farmers, including social cohesion in the farming communities.

The reason Hlabisa was selected for the case study is that it represents one of the few areas in South Africa where GM crops (white GM maize in particular) has been cultivated on a long term basis by smallholder farmers.

The necessary information was obtained through the means of a survey in which a number of farmers in the Hlabisa area participated in this regard the participants were; 40 farmers who used white GM maize that possessed the herbicide tolerant and insect resistant traits; seven farmers who used white insect resistant maize and 11 non-GM maize farmers. In addition, five key informant interviews and three focus group discussions were used to collect data.

The history of agriculture in the area reveals that modern maize varieties were introduced when agricultural extension officers started operating in the area, beginning with maize seed hybrids in the 1970s. Maize hybrids were framed as better varieties compared to traditional maize in terms of performance. Later, in the 2000s, the seed company Monsanto, and the local department of agriculture introduced various GM maize varieties through farmers' days. This marked the addition of another institution providing so-called expert knowledge about maize farming in Hlabisa.

It was argued that relationships between the local department of agriculture, farmers' associations and seed companies were instrumental in encouraging the uptake of GM maize seeds. It is also posited that the GM maize farmers in this study received pseudo-extension and advisory services. These had the agenda of promoting GM maize varieties over traditional varieties, relaying inappropriate agricultural knowledge in the process.

There was also a lack of transparency in communicating the potential health and environmental risks associated with GM maize farming. Farmers were unaware that they were legally not allowed to save and exchange the patented GM maize seeds and had to plant refugia to prevent insect resistance.

The uptake of GM maize has not significantly affected the seed saving and exchange practices of farmers. Fifty-two percent (24) of the 47 respondents no longer exchanged or saved any of their maize seeds in the study. A chi-squared test for independence indicated that the GM maize farmers were less likely to save and exchange seeds.

The non-GM maize farmers were deterred from planting GM crops by the expensive input costs. The issue of affordability of the GM technology also extended to GM farmers, most of

whom used social grants to purchase their GM maize seeds. Forty-nine percent of these farmers were in debt due to their uptake of the GM maize. Despite this debt, 74% of respondents claimed that they had perceived an improvement in their quality of life after using white GM maize, as they harvested enough maize to last them to the next planting season and were able to sell surplus maize. However, they only made marginal profits to cover household expenses.

There are several conclusions that can be drawn from this study. First, there is a noticeable shift from farmers relying on their own knowledge and experience to using that of seed companies and agricultural extension officers. Second, Seed companies are beginning to fill the gaps left by public extension and advisory institutions and farmers are vulnerable to making uninformed decisions as they are not given relevant information. It is recommended that farmers are given agency through the provision of transparent information. This should be the responsibility of the government and not seed companies with vested interests. The government should try to move away from the idea that farmers need to scale up production through using modern varieties. A better approach would be the strengthening of appropriate support and extension services for South African smallholder farmers who use various maize systems. Lastly there is a need to raise awareness about the social, economic and environmental implications to farmers who elect to use GM seeds.

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List of abbreviations and acronyms

ANC – African National Congress

Bt- Bacillus thuringiensis

DAFF – Department of Agriculture, Forestry and Fisheries

DoA- Department of Agriculture

ECDoA-Eastern Cape Provincial Department of Agriculture

EU- European Union

FA- Farmers' Association

GM – Genetically Modified

GMO- Genetically Modified Organism

Ht- Herbicide tolerant

IFP – Inkatha Freedom Party

IR- Insect Resistant

MCC- Makhathini Cotton Company

MFPP- Massive Food Production Programme

NGO- Non Governmental Organisation

SAGENE- South African Committee for Genetic Experimentation

SHP- Smallholder Programme

UNWFP- United Nations World Food Program

USAID – United States Agency for International Development

CHAPTER ONE - INTRODUCTION

1.1 Introduction

Genetically modified (GM) crops have been promoted to smallholder farmers in the Global South and elsewhere under the guise of resolving the global food crisis and helping poor farmers to graduate out of poverty (Daño 2007; Stone and Glover 2011; Murphy 2012). This notion of using GM crops to resolve such complex issues has been both disputed and supported by scholars, governments and development activists (Scoones 2002; Jansen and Gupta 2009; Glover 2010b; Arthur 2011; Falck-Zepeda et al., 2013). Besides the issue of whether or not GM crops have the potential to eradicate poverty and deliver economic benefits to smallholder farmers, they have evoked struggles of seed ownership, maintenance of livelihoods, and deepening the inequalities in the food system (Borowiak 2004; Mascarenhas and Busch 2006; Bezner Kerr 2013).

Genetically modified crops are intended to increase yields through genetically engineering desired traits such as resistance to pests, herbicides, or diseases, using modern biotechnology (Ives et al., 2001; PBS and ABSP 2004). The majority of GM crops on the market are cash crops which are either herbicide tolerant (Ht) or insect-resistant (IR), and were initially tailored for commercial farmers (Kiers et al., 2008; Glover 2010b; Barker et al., 2013). Stacked varieties are also available on the markets, possessing combinations of either Ht or IR traits (Kok et al., 2014).

With the promotion of the so-called New Green Revolution on the African continent, GM seeds have become an integral component. The belief is that since Africa missed the first Green Revolution, it is lagging behind agriculturally and remains in economic stagnation (Daño 2007; Hazelle et al., 2010). The Green Revolution was associated with the use of improved crop varieties, fertilisers and pesticides to increase agricultural yields during the 1970s to 1980s (Kohler 2003). Holt-Giménez and Altieri (2013) have postulated that institutions supporting capitalist agriculture used the 2008 food crisis to call for investment into agricultural biotechnology to help increase food production. This new revolution has inherited traits of the former movement, promoting modern varieties and chemicals to farmers, and has opened up room for seed companies to play a role in smallholder agriculture.

The issues with GM crops in smallholder agriculture firstly lies in their status of being the intellectual property of a few seed companies. For instance, Monsanto, DuPont, and Syngenta, control 55% of the commercial global seed market (ETC Group 2015). It is argued that these seed companies are siphoning money away from smallholder farmers by promoting expensive GM seeds and weakening their ability to sustain their livelihoods (Glover 2009; Ramey 2010). Secondly there are claims that GM crops are scale-neutral, in other words suggesting that these crops can equally benefit smallholder and commercial farmers. Even though the GM crops were tailored for contexts that are not congruent with farmers who practice poly-cropping, save and exchange seed varieties (Kiers et al., 2008; Fischer 2016). GM crops are not neutral devices and are associated with financial, environmental and social implications. Lastly the innovation has not been driven by the needs of the farmers (Glover 2010a; Arza et al., 2012; Jacobson 2013; Preston and Wickson 2016).

There are only two countries which commercially grow GM crops on the African continent. South Africa was the first African nation to commercially grow IR cotton and IR yellow maize (used in livestock production) in 1997 (Biosafety South Africa 2013). Egypt followed in 2008 by commercially growing IR yellow maize from 2008 and stopped in 2012. Burkina Faso has been growing IR cotton since 2008 and announced the discontinuation of IR cotton production in 2015/2016, while Sudan started growing IR cotton in 2011 (James 2012; Dowd-Urbe and Schnurr 2016).

The focus in this thesis is on South Africa as the country has been used as a model to promote GM crops to other African nations (Schnurr 2012; Okeno et al., 2013). Smallholder farmers from Hlabisa, KwaZulu-Natal will be used as a case study (Fig 1.1). The study will help generate further knowledge and insight about the implications of GM maize in smallholder agriculture. Past studies in Hlabisa have inquired about GM maize largely from an agricultural economist perspective (Gouse et al., 2005, 2006, 2009, 2012). The issue is that agricultural economics do not fully explain the seed choices made by farmers. Furthermore, the impacts of the technology are not limited to changes in yields and farm income but encompass a much wider suite of social, political, cultural, environmental and institutional dimensions (Soleri et al., 2008; Glover 2010b; Fischer et al., 2015; Preston and Wickson 2016). The thesis will thus adopt a holistic approach when it details the uptake of GM maize by smallholder farmers. The following section provides the motivation for using Hlabisa as a case study.

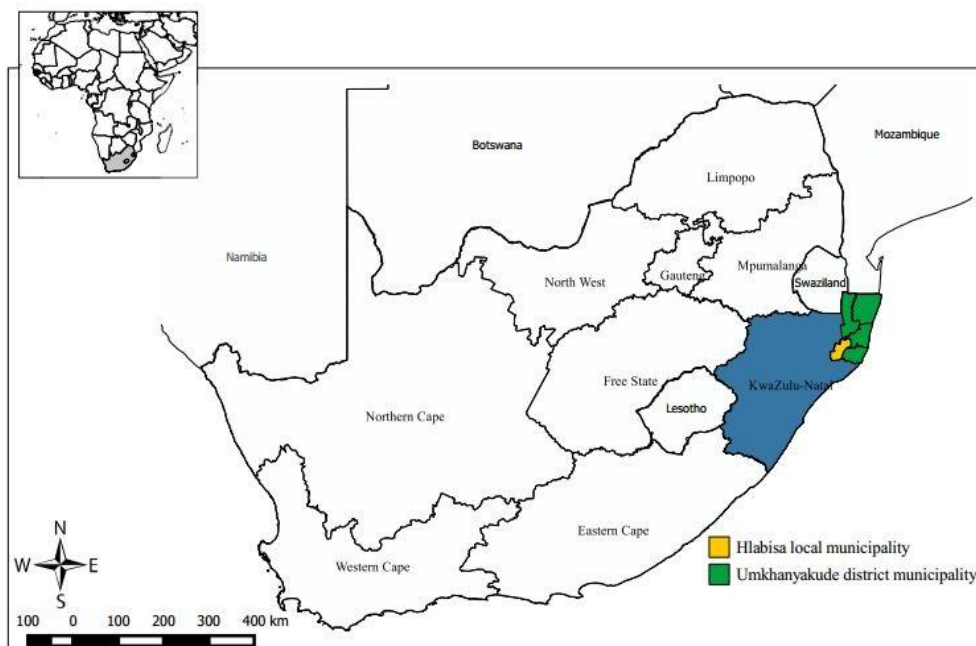


Fig 1.1: The location of Hlabisa local municipality within KwaZulu-Natal province, South Africa (Naik 2016)

Motivation for selecting Hlabisa as a case study area

Hlabisa represents one of the areas in South Africa where smallholder farmers have been using GM maize on a long term basis, i.e. from 2001 to 2010 (Gouse 2012). Several studies have framed a positive narrative about GM maize in Hlabisa (Gouse et al., 2005, 2006, 2006a, 2009, 2012). However outside of Hlabisa, an equally compelling body of evidence has emerged with a contrasting narrative that suggests the failure of GM maize among smallholder farmers in South Africa (van Rensburg 2007; Dirwayi 2010; Kruger et al., 2012; Jacobson 2013).

In Hlabisa, the use of GM maize has been researched by Gouse et al., (2005, 2006, 2009, 2012) from 2003/2004 to 2009/2010 with Manes (2010) reporting on socio-economic factors and labour availability.

The initial studies reported on the productivity and performance of white IR maize among Hlabisa smallholder farmers (Gouse et al., 2005, 2006), where IR white maize supposedly had higher yields than hybrid white maize. Gouse et al. (2009) also described labour changes associated with IR and Ht maize farmers, concluding that the use of Ht maize reduced labour time. In a later study Gouse (2012) reflected on the socio-economic impacts of GM maize on the livelihoods of smallholder farmers from Hlabisa and concluded both that ‘Hlabisa smallholder farmers highly value BT [IR] and Ht maize seed’ (p.174) and that low seed availability prevented the cultivation of IR maize in some seasons. Another study explored gender specific impacts of GM maize on farmers of Hlabisa and Simdlangentsha, KwaZulu-Natal (Gouse et al., 2016). The results of the study indicated that females preferred the Ht and stacked maize varieties as they were perceived to be labour saving while the perceived high yields associated with GM maize motivated males to use GM maize. A thorough review of the studies is provided in section 2.4.4 of the literature review.

In general, Gouse’s studies have focused on the agricultural economics of GM maize in Hlabisa without describing the social, political, and institutional factors that have shaped the decisions taken by farmers to use GM maize or the impacts of GM maize beyond yield, income, and labour changes. There is a need for studies to adopt a wider lens through which they observe the impacts of GM crops in smallholder agriculture including approaches which seek to understand the wide ranging impacts of GM crops on the livelihoods of smallholder farmers (Fischer et al., 2015). This study aims to fill this research gap.

In the following sections the rationale, research aim and objectives, and a description of the case study area is provided.

1.2 Rationale

In South Africa, smallholder farmers operate in a dynamic socio-economic and political climate. Many of the previous studies reporting on the uptake of GM crops ignore this wider context, and describe on the economic and yield changes associated with GM crops rather than incorporating the events which led to the uptake of GM crops or explaining the diffusion of GM crops into smallholder agriculture. Furthermore, there has been a call for studies which account for changes beyond the farm-level economics (Glover 2010b; Fischer et al., 2015). This represents a knowledge gap in the literature. By framing an inquiry which aims to understand which events led to the uptake of GM crops, it becomes easier to extrapolate which factors are most important. More evidence needs to be generated covering how the

social, institutional, political, and cultural aspects of the smallholder farmers' lives, have been affected by GM crops. In the same vein there are challenges in trying to explain how social and institutional dynamics shape the behaviour and experiences of individual farmers (Thoenig 2011; Schoffer et al., 2012). This thesis aims to fill this knowledge gap by illustrating how social and institutional contexts have shaped the seed-selecting behaviour of GM crop farmers and their experiences of the agricultural technology.

The thesis also aims to understand what information about GM crops South African smallholder farmers have access to and how this affects their ability to make informed decisions (Jacobson 2013).

By using a case study of Hlabisa, the thesis aims to give a better understanding of how, when, and why GM crops were taken up by smallholder farmers and the implications of GM crops on and off the fields of these farmers. In so doing it hopes to give better clarity to discussions about the implications of GM crops for small farmers in South Africa and other developing countries.

1.3 Research aim and objectives

Aim

The main aim of this thesis is to explore the uptake of GM maize in order to contribute towards understanding the implications of agricultural biotechnology in smallholder agriculture

The specific research objectives are as follows:

To investigate the perceived benefits and problems associated with the uptake of GM maize in Hlabisa, KwaZulu-Natal.

To identify which institutional, political, social, and environmental factors influence the choices and decisions made by smallholder farmers to grow GM maize.

To assess how GM maize has affected the well-being of the farmers, including social cohesion in the farming communities.

1.4 GM crop of focus

South Africa commercially produces GM soybean, cotton, and maize (James 2014). In most instances commercial farmers are responsible for the cultivation of GM soybean and cotton, but maize is grown by both smallholder and commercial farmers. Therefore, the uptake of GM white maize (used for human consumption) will be the focus GM crop in this thesis. Maize serves both as source of income for smallholder farmers who produce surplus maize, and contributes to household food security (McCann 2007).

White maize was the first GM staple food crop ever commercialised in the world and South Africa remains the only country which consumes a GM crop as its staple food. Moreover, in smallholder farmer systems GM maize exists alongside traditional maize, raising interesting questions around the co-existence of multiple maize systems and farmers' choices.

CHAPTER TWO - LITERATURE REVIEW

2.1 Introduction

This Chapter begins by describing the global experiences of smallholder farmers with GM crops. The next section provides the history of maize in South Africa as a way to illustrate the significance of maize among smallholder farmers and provide background on South African maize seed companies. This is followed by exploring the motives behind the introduction and uptake of GM crops in South Africa using two known cases and the Chapter concludes with a discussion about conceptualising the uptake of technology in agriculture.

2.2 Global experiences with GM crops among smallholder farmers

Like the broader debate about GM crops, the narrative about the uptake of GM crops by smallholder farmers is divided and contested (Qaim 2003; Scoones 2008; Arthur 2011; Jacobson 2013). Four key issues have emerged around the use of GM crops in smallholder agriculture in particular. Using examples from countries where smallholder farmers have taken up GM crops, this section discusses three key issues, (1) yields, (2) costs and profitability of GM crops, (3) and contamination of traditional varieties.

2.2.1 A profile of GM crops

Herbicide tolerant (Ht) and insect resistant (IR) crops were supposedly created to respectively address issues of weeds and pests (Qaim 2003; Huesing and English 2004; James 2012). Stacked varieties possessing combinations of both Ht and IR traits are also sold to farmers (Glover 2010b, Barker et al., 2013; Kok et al., 2014). The majority of GM crops grown globally possess the Ht trait (Fig 2.1). It is useful to understand how each trait functions in a GM crop.

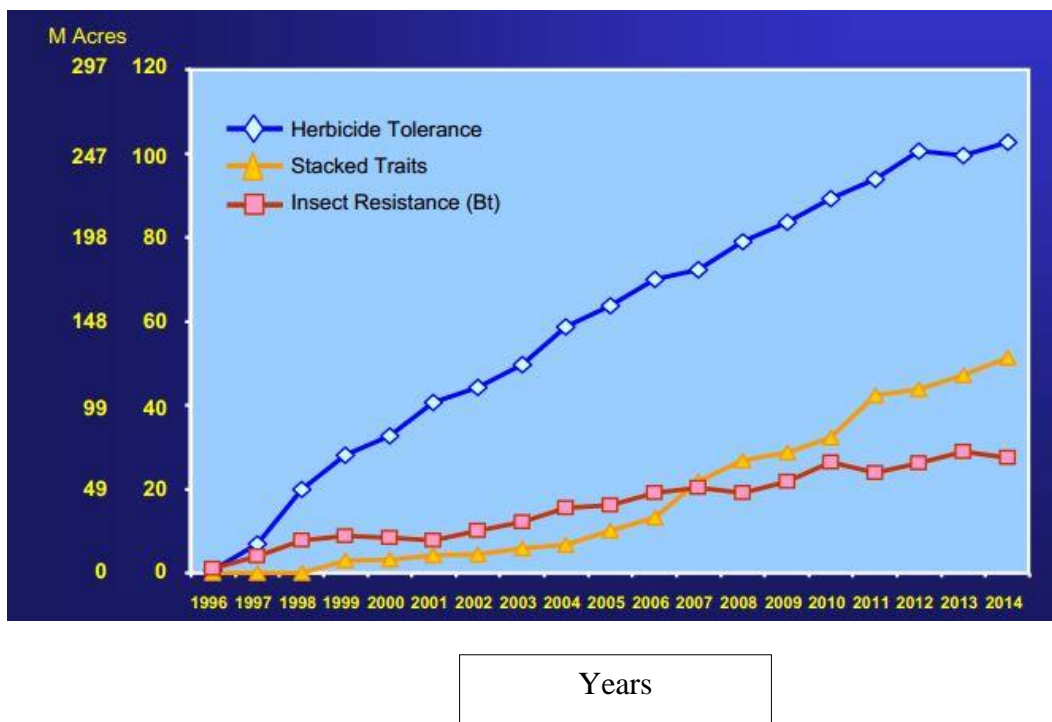


Figure 2.1: Global area of GM crops planted from 1996 - 2013 by trait (James 2014)

The function of GM traits

Roundup, a common herbicide found on the market, is associated with herbicide tolerant (Ht) or Roundup ready crops. Ht crops have been genetically engineered to be Roundup tolerant. When Roundup is applied to weeds, Ht crops survive without dying in contrast to weeds and non-GM crops. The spraying of Roundup supposedly reduces labour time as farmers do not have to till soils to remove weeds (Dewar et al., 2000). However, there are studies showing a growth in Roundup resistant weeds among commercial farmers. Furthermore, there are claims that glyphosate, an active ingredient found in Roundup, is carcinogenic and degrades the environment (Nandula et al., 2005; Owen and Zeleya 2005; Mason 2013; WHO 2015).

Insect resistant crops are those which possess genes taken from a soil bacterium: *Bacillus thuringiensis* (Bt). A plant with inserted Bt genes will start to produce crystal insecticidal proteins. When an insect eats a Bt crop, the insecticidal proteins get dissolved and release toxins. The insect dies as a result of the binding of these Bt toxins to its gut wall (USA EPA 1995).

The claimed benefits of the so-called Bt trait include a reduction of pesticide applications which could have a reduced environmental impact through prevention of yield losses to pests (Ismael et al., 2002; Huesing and English 2004; Kathage and Qaim 2012).

Farmers using Bt crops are required to plant refugia as a way to delay the development of Bt resistant insects. Refugia are areas where a certain amount of non-Bt crops have been planted together with the Bt crop. The theory behind using refugia is to suppress any genes in the insect pest that might be resistant to the Bt toxins. The idea is that the target insect pests feeding on both the non-Bt crops and Bt crops will have an opportunity to mate, decreasing chances of Bt resistance in the offspring (Van Rensburg 2007). The development of Bt resistance could be attributed to farmers failing to plant refuge areas and the failure of the technology itself (Kruger et al., 2012; van den Berg 2012). There are cases which indicate that smallholder farmers are not planting any refugia in their fields because they are unaware that they need to comply with this requirement (Jacobson 2013).

2.2.2 Yields

GM crops have been framed as high yielding varieties that can help address increasing global food demands (Carpenter 2010; Falck-Zepeda et al., 2013). Some scholars have criticised this notion and suggest that global yields are limited by numerous factors such as climate, irrigation, and land (Mueller et al., 2012). Critics of the Bt trait suggest that yield gains should rather be regarded as a yield gap reduction from potential yields (Barker et al., 2013; Glover 2010a). A yield gap is the difference between yields where crops grow in irrigated or humid climates or where crop production is limited by water and actual yields (van Ittersum et al., 2013). It is claimed that the prevention of yield losses to pests is not the same as incremental yield gains because the use of Bt crops does not increase yields in the presence or absence of pests (Glover 2010a; Gaurav and Mishra 2012).

It has been claimed that the yield gains from Bt cotton crops can benefit farmers financially and reduce pesticide costs (Pray et al., 2001, 2002; Bennett et al., 2006a). In 1999, 283 farmers were surveyed to establish the impacts of Bt cotton on small scale farmers in the Northern region of China. The farmers reported a reduction in pesticide use and normal

quantities of cotton were produced without any decline in the cotton quality (Pray et al., 2001). In a different region, Yellow River in China where 4 million farmers grow Bt cotton have also reported less spraying of pesticides and pesticide poisoning (Pray et al., 2002). Glover (2009) however questions how a Bt cotton farmer would have an economic advantage over a non-Bt cotton farmer in scenarios where the Bt trait offers no yield advantage in seasons with low pest pressure.

The critique of the success of Bt cotton in India from Glover (2010) stems from work based on field trial results. Qaim (2003) conducted field trials in 295 areas in seven states of central and southern India. The farmers who participated in the study were chosen based on their willingness to participate. The results showed that pesticides were applied less in areas planted with Bt cotton than conventional cotton. In addition, there was an 80% yield increase on Bt cotton fields. The same positive outcome was reported by Qaim and Zilberman (2003).

In China the need for Bt cotton has been questioned as critics state that Bt-technology has a limited function and does not address other threats such as secondary pest infestations which can lead to further yield losses (Glover 2009; Wang et al., 2006). In some cases, there were concerns over pest replacement species infesting crops (Wang et al., 2006; Chen et al., 2013).

2.2.3 Costs and profitability of GM crops

GM seeds can cost up to 50% more than non-GM seeds depending on the number of transgenic traits (Fernandez-Cornejo et al., 2014). GM crops are priced at high levels because companies add a technology fee for introducing a trait into a seed and to redeem the costs for research and development of the GM seeds (Glover 2010b; Barker et al., 2013).

The price of GM seeds indicates that these agricultural products were targeted at affluent commercial farmers who can afford to buy expensive seeds compared to poor smallholder farmers. Arza and van Zwabenberg (2014) have claimed that local cotton varieties have disappeared in some parts of Argentina where some smallholder farmers buy copied GM seeds at low prices or on credit.

Some research conducted in smallholder farmer systems claims that GM crops in India and Mexico have increased farm incomes (Traxler et al., 2001; Kambhampati et al., 2005; Carpenter 2010; Kathage and Qaim 2012). A model predicted that about US\$ 19.7 billion could be made using Ht soybeans with 77.45% of the monetary benefits captured by farmers during the period of 1996 to 2005 in Argentina (Trigo and Cap 2006). These claims are contrasted by Arza et al. (2012) who report that Argentine smallholder farmers using Bt cotton are trapped in cycles of debt. The authors argued that the profitability of Bt cotton was low for smallholder farmers compared to commercial farmers. For instance, the smallholder farmers sold their raw Bt cotton to intermediaries who provided credit for inputs at high interest rates. These intermediaries also controlled the cotton price which meant that the farmers were sometimes forced to accept the price. In addition, Bt cotton did not result in cost reductions as some family members who worked on the cotton fields migrated to cities which forced the older smallholder farmers to hire labour. Apparently the money made from Bt cotton only covered basic foods and school fees (Arza et al., 2012).

Other cases of debts as well as farmer suicides in India have been reported through the uptake of expensive Bt cotton technology (Gruère et al., 2008; Hesselbrath 2013). It was argued that

since Bt cotton failed to reduce yield losses, Indian smallholder farmers found themselves in positions where they were unable to settle their debts with moneylenders who provided loans for production. It was postulated that the Indian farmers with high debts lost their social status and might have seen suicide as a route to avoid social disgrace (Gruère et al., 2008; Hesselbrath 2013; Stone and Flachs 2015).

Supporters of Bt cotton in India suggest that Bt cotton has created sustainable and positive impacts on social and economic growth. For example, Kathage and Qaim (2012) used farm data from 2002 to 2008 and concluded that the adoption of Bt cotton by smallholders has resulted in a 24 % yield increase per acre and 50 % gain farmer incomes.

2.2.4 Contamination of traditional varieties

There are claims that GM crops could reduce genetic diversity as there is a high probability that transgenes (genetic material from GM crops) can flow and cross-pollinate with traditional crops (Aheto et al., 2013).

An example of a known case of transgene contamination is from Mexico's maize landraces (traditional crop varieties to an area). Quist and Chapela (2001) were the first to report on the presence of transgenes in Mexico's landraces. The results of the 2001 Quist and Chapela study served as a catalyst for more studies investigating the contamination of traditional Mexican maize. Several studies have detected transgenes in the Mexican landraces (Ezcurra et al., 2002; Serratos-Hernández et al., 2007) while other studies did not detect any transgenes (Metz and Fütter 2002; CIMMYT 2002).

Another example of transgenes contamination is from the Mayan region. Monsanto announced in 2012 that Ht soybeans would be planted on 60 000 hectares of land, with 26% of this land comprising the Yucatan Peninsula of the Mayan region. The Mayan honey is highly valued by foreign markets because of its status of being GM free but the continuing expansion of Ht soybean fields will possibly increase chances of contamination through drifting GM material. In 2011 Mayan honey was rejected in Europe because of potential contamination from GM pollen (Court of Justice- EU 2011).

In parts of the Eastern Cape transgenes have been found in some local maize varieties. In this case Iversen et al. (2014) tested the maize varieties used in villages where smallholder farmers had previously used Bt maize for seven years. The traditional act of recycling and sharing seeds has fostered the spread and maintenance of transgenes in local maize at the local and possibly regional level. The following sections explore the events which led to the introduction of maize and GM maize to South African smallholder farmers.

2.3 History of maize in South Africa

Maize in Africa

Maize (*Zea mays L. spp. mays.*) originates from Mexico and was domesticated 6 000 years ago (Matsuoka et al., 2002). It is now considered one of the world's staple crops, particularly in Africa and Central America.

Maize types are distinguished based on their endosperm (tissue produced inside seeds) and kernel composition. There are six maize types: flint, dent, waxy, pop, sweet, and floury (Darrah et al., 2003).

Flint maize kernels have a hard endosperm and a small centre, while dent maize types have a hard endosperm covering all the sides and base of the kernel. In addition, the kernel contains some small soft starch. Flint maize is usually used for food compared to dent maize which is used for grain and silage as it has a high percentage of hard endosperm (Darrah et al., 2003).

The remaining maize types are unusually different from the flint and dent maize types. For instance, with the sweet maize type there are recessive mutations which prevent the conversion of sugar to starch thus increasing the sugar content. The hard endosperm found in pop maize is harder than in any other maize type. Lastly, waxy maize has no amylose starch molecules which are found in other maize types. Instead it is composed of amylopectin molecules. This type of maize is consumed as food in some parts of East Asia (Darrah et al., 2003).

The exact date of when maize was introduced to African agrarian systems remains unknown. It is said to have arrived in Cape Verde in 1540 and had not reached the shores of the Western Cape province of South Africa by 1652 (McCann 2007). The Portuguese explorers have been cited as those who most likely introduced yellow and orange flint maize from Brazil to South African Xhosa and Zulu farmers. On the other hand, the Spanish travellers are believed to be responsible for bringing in Caribbean red flint maize to Africa (McCann 2007).

On arrival the flint maize was able to grow in the same soil types as millet and sorghum, and to share soils with other new world crops such as beans, pumpkins, and potatoes which were already changing African diets (McCann 2007).

Maize became increasingly preferable over the long maturing sorghum as it was able to mature relatively earlier and feed people during the “hungry season” or before sorghum was ready for harvesting (McCann 2007, p. 253).

2.3.1 Maize in South Africa

Maize was considered a “*Kaffir*”¹ crop by white commercial farmers in South Africa with little commercial value (Burt-Davy 1914). However, the value of maize in the white commercial farmers’ eyes began to change with the introduction of a dent variety from the US, Hickory King, which yielded faster than the local flint maize types. Both black sharecroppers and white commercial farmers had profitable businesses for themselves through feeding the migrant black labour at the mines using dent maize in the 1910s (Beinhart and Coates 1995).

A Maize Breeder’s Association was formed in 1917 and there were institutions experimenting and developing seed varieties for farmers (Rusike 1995). Similarly, in Zambia, by the 1920s, Hickory King, began to replace the local flint maize types used by smallholder farmers and commercial farmers (Byerlee and Eicher 1997).

The gold and diamond rush of the late 19th century drew black male labour away from agriculture to the mines. This had implications for the rise of maize as a staple crop for many black South African families. The black miners living around the gold and diamond mining

1 Kaffir was used disparagingly to refer to black people of South Africa during the colonial and Apartheid era and today the use of the word is constituted as hate crime (Baderoon 2004).

towns created a demand for more maize-based food. Furthermore, it was postulated that with the loss of black male labour to mines, it became preferable for female black farmers to take up low labour crops which matured earlier than sorghum and wheat (McCann 2007).

A turning point was reached in South Africa on June 19, 1913 with the announcement of the Natives' Land Act No. 27 of 1913. This law prevented any native person from hiring or purchasing land owned by non-native persons (Dodson 2013).

The 1913 Natives' Act included a 'Schedule of Native Areas', which comprised eight percent of South Africa's surface area earmarked to be occupied by black people. The Natives Land Commission acquired another 6.2 million hectares under the coalition government in 1933. This was made possible through passing the Native Trust and Land Act No.18 of 1936 which further augmented the marginalisation of black South African farmers (Dodson 2013). Black people who had occupied land for generations were deemed as unlawful tenants through these Acts and were forcibly removed to start over in Bantustans and excluded from the rest of white South Africa.

These two Acts tipped the scales to favour white over black farmers. White farms grew in size and farmers were supported financially and received access to extension and markets by the government. Black tenants and sharecroppers were left with marginal land and were forced to engage in crop farming for subsistence purposes (Dodson 2013).

By the 1930s maize was a staple crop, and by 1948 maize was sustaining the Apartheid economy of South Africa through supplying cheap food to the mines for migrant labour (McCann 2007). By the late twentieth century maize was recognised as an important staple crop, and agricultural economists and international policy makers began to take notice.

2.3.2 An overview of key maize seed companies in South Africa

During the 1950s the Apartheid government was already encouraging commercial farmers to adopt maize hybrids, fertilisers, and pesticides (Zapiain 2008). In 1958 Pannar established itself as an African seed business in Greytown, KwaZulu-Natal, and began producing its own maize hybrids in the 1960s (Pannar 2015). In contemporary South Africa Pannar is the largest seed company (Gouse 2012).

The passing of the Plant Breeders' Act No.15 of 1976 allowed for the protection of new varieties which triggered further investment into private breeding. Pioneer, a US-based company, strategically allied itself with Pannar to gain entrance into the country in 1968. This was a way for Pioneer to gain access to the South African maize seed commercial markets. By 1980 commercial farmers were mostly growing only hybrid maize varieties (Rusike 1995).

In 1976 Monsanto, at the time an American chemical company, entered the South African herbicide market when it commercially released Roundup (Glover 2010b; Gouse 2014). The transition into agriculture by Monsanto had begun earlier in 1960s and over the years the company invested money into research and development of agri-biotechnology. By 1982 Monsanto scientists had successfully modified the genetic material of a plant cell and had launched GM soybeans, canola, cotton by 1996 (Glover 2010b).

During the period of 1996 to 1999 Monsanto spent more than US\$ 8 billion buying and acquiring seed companies around the world to become the second largest seed company

behind Pioneer at the time. Monsanto acquired the large US seed companies such as Asgrow Agronomics and DeKalb Genetics which produced soybean and maize seeds respectively. DeKalb Genetics had the second largest share in the US maize seed market and had various subsidiaries around the world (Robin 2008). Carnia was the first South African maize seed company to be acquired by Monsanto in 1999 (Gouse 2012). In 2002 Monsanto bought Sensako, a South African maize, soybean and wheat seed company and merged it with Carnia in 2004. This made Monsanto a dominant player in the South African seed industry. In 2005 Monsanto became the largest seed company in the world through the acquisition of Seminis, a US fruit and vegetable seed company (Robin 2008).

In 2012 Pioneer merged with Pannar (DuPont 2012). The implications of this merger meant both Monsanto and Pioneer became dominant players in the commercial seed markets in South Africa. There are concerns over foreign companies owning the country's germplasm of crops like white maize and wheat (Swanepoel 2014). Germplasm refers to the collection of genes within a plant species (Spooner and Williams 2004). The GM traits are inserted into the germplasm of seeds and patents prevent farmers and public institutions from accessing the germplasm for experimentation. The innovation and breeding processes are thus in the hands of the seed companies (Hubbard 2009; Barker et al., 2013).

In summary, the introduction of maize into Africa and its rapid uptake by farmers has been accompanied by key political and development interventions to advocate for the use of modern maize varieties over traditional maize varieties. The implications for smallholder farmers are that varieties may not necessarily be suited to their environments and style of farming.

2.4 Promotion of GM crops in South Africa

2.4.1 Why are GM crops promoted to smallholder farmers?

The political and economic reasons

There was no investment in smallholder agriculture throughout the colonial and Apartheid era. In contrast, policies acted against smallholder farmers. Things changed in 1994 with the election of a democratic government and investments increased but these were not necessarily in the best interests of the smallholder farmer (Aliber and Hall 2012; Jacobson 2013). In an attempt to better understand the promotion and criticism of GM crops in smallholder agriculture in South Africa, it will be useful to draw on the work that has been done on the political economy of biotechnology, development, and agriculture policies.

From an economic standpoint it can be argued that the aim of introducing agricultural biotechnology in small farm settings has been to capture low-income markets where companies can expand their businesses. Hence a pro-poor growth stance has been adopted by companies promoting GM crops in the Global South (Prahalad and Hart 2002; Daño 2007; Glover 2010b). Pro-poor growth is achieved when policies and institutions are geared towards generating employment and addressing biases against the poor (ADB 1999). Scoones (2002) argued that agricultural biotechnology cannot be pro-poor without addressing the fundamental problems associated with food security. These include fostering better access to and distribution of food. Another concern is that only a few companies have control and ownership of crop varieties (Newell 2009). For instance, the top six companies, BASF, Bayer, Dow, DuPont, Monsanto and Syngenta in 2013, collectively controlled 63% of the

commercial seed market and made over \$65 billion in agrochemicals and GM traits sales (ETC Group 2013). A common criticism is that in the bid for increased profits companies have hyped up the potential of GM crops to be pro-poor, while downplaying the potential risks offered by the technological innovation (Glover 2010b).

Laws and policies

Unlike many other African nations South Africa was suitable to introduce GM crops based on its infrastructure and research capacity (Wynberg and Fig 2013). It had already begun laying foundations for the monitoring and regulation of genetically modified organisms (GMOs) during the Apartheid regime when it established the South African Committee for Genetic Experimentation (SAGENE) in 1979 (Gouse 2012).

By 1992 SAGENE was recognised legally as a body that provided advice and guidelines for the regulation and monitoring of biotechnology which allowed Monsanto to conduct Bt cotton trials in 1992/1993 (Wolson and Gouse 2005; Scoones 2008). Wynberg and Fig (2013) revealed that SAGENE was made up of voluntary scientists who were closely associated with companies such as Monsanto, DuPont and Syngenta, and others. The promotion and development of GM crops was supported by the companies and local research bodies.

The initial commercial plantings of GM crops in South Africa were done without any biosafety laws in place. Biosafety is a framework that guides the implementation and regulation of biotechnology applications. The GMO Act No. 15 of 1997, which essentially regulates and monitors all GM crops grown in South Africa, was only passed after the fact (Wynberg and Fig 2013). In contrast to other laws at the time the GMO Act No. 15 of 1997 became a law without adequate public participation and a proper policy framework (Wynberg and Fig 2013).

Later in 1999 SAGENE was superseded by an Advisory Council which essentially consisted of the same voluntary scientists. The Advisory Council and Executive Council were delegated the responsibility of implementing the GMO Act and provided scientific recommendations on the development and use of GMOs. The National Department of Agriculture still had the final decision by approving applications for the development or release of GMOs into the environment. A permit was provided by the registrar of the GMO Act if the application was successful (Cooke and Downie 2010; Wynberg and Fig 2013).

2.4.2 The uptake of Bt cotton in the Makhathini Flats

It is within this context that Bt (*Bacillus thuringiensis*) cotton permits were issued and about 3000 smallholder farmers in the Makhathini flats became the first to cultivate GM cotton from 1999 to 2001 (Thirtle et al., 2003). There are polarised views on whether or not the uptake of Bt cotton in Makhathini flats was successful (Glover 2010a; Gouse et al., 2012). The Makhathini Flats Bt cotton initiative broke down in 2002/2003 (Witt et al., 2006; Glover 2010a).

The institutional support provided by Vunisa (local cotton company) and the Land Bank (credit agency) in the form of credit, loans, agricultural inputs, and access to markets motivated the rapid uptake of Bt cotton by smallholder farmers (Glover 2010a). Some studies have indicated that the farmers practiced mixed-cropping but there were no markets available to them and they received no institutional support on a par with that of Bt cotton (Pschorn-Strauss 2005; Witt et al., 2006; Fok et al., 2007).

Numerous studies were published after two seasons of Bt cotton cultivation based on the results obtained from a single survey of 100 smallholder farmers out of 3 000 Bt cotton smallholder farmers. The picture painted by those studies was that the uptake of Bt cotton had been successful in this region (Ismael et al., 2002; Thirtle et al., 2003; Shankar and Thirtle 2005; Bennett et al., 2006a). For instance, the studies reported increased yields among Bt cotton farmers who reportedly became more efficient and used less pesticides compared to non-Bt cotton farmers. This belief was contested by Witt et al. (2006), Fok et al. (2007), Glover (2010a) and Schnurr (2012) who offered alternative analyses to the success narrative of the Bt cotton in the Makhathini flats. Critics of GM crops in small farmer settings deem Bt cotton production as a risky venture that does not address the needs of smallholder farmers in the region (Glover 2010; Witt et al., 2006; Fok et al., 2007).

The erection of a new gin by Makhathini Cotton Company (MCC) in 2001 led to the breakdown of the institutional support provided by Vunisa and the Land Bank. The act of obtaining credit from one agency and supplying a different agency is not uncommon in Africa (Fok et al., 2007). In this case smallholder farmers processed their cotton with MCC instead of Vunisa and were not repaying their debts. The gin was located close to the marketing depot of Vunisa. Vunisa was unable to enforce repayment of loans given to the smallholder farmers. The potential cotton harvest was used as collateral for the loans (Fok et al., 2007; Witt et al., 2006).

The number of smallholder farmers using Bt cotton in Makhathini flats had been reduced to less than 400 by 2002/2003 (Fok et al., 2007). By 2005/2006 this had grown to 2 169 Bt cotton growers due to the subsidy programme started by the KwaZulu-Natal Department of Agriculture (DoA), which helped farmers purchase the expensive seeds, but the number dropped to 853 when the programme ended in 2006/2007 (Cotton South Africa 2011; Schnurr 2012). The Monsanto Agent claimed that Bt cotton was still cultivated in the Makhathini flats in 2014/2015, however he did not know the specific numbers (Johannesburg, 10 September 2015).

Critics of the Bt cotton in Makhathini flats have questioned the profitability of Bt cotton and have claimed that increased yields reported by Ismael et al., 2002 and Bennett et al., 2006a, have been exaggerated and Bt cotton yields were low compared to other parts of the world (Fok et al., 2007; Glover 2010a). Profits made from Bt cotton production were reported to be equivalent to the monthly pensions received by the smallholder farmers in the region, and Bt cotton farmers were shown to have suffered more financial losses, and were in debt compared to non-Bt cotton farmers (Thirtle et al., 2003; Pschorn-Strauss 2005; Fok et al., 2007).

It is argued that the promotion of Bt cotton was politicised and favoured better-off farmers and businessmen who did not consider the needs of the poorer farmers without additional income. For instance, the Ubongwa Farmers' Association in Makhathini flats was locally powerful and managed to release dam water for Bt cotton farmers without including farmers growing food crops (Pschorn-Strauss 2005). Moreover, the Bt cotton technology disregarded the agronomic conditions in the area and offered no protection against risks and shocks such as floods and droughts. Bt cotton does not resolve constraints faced by dryland smallholder farmers. MCC attempted to resolve the issue through irrigation schemes. This indicated the limitations of Bt cotton in addressing the needs of smallholder farmers (Glover 2010a; Witt et al., 2006; Fok et al., 2007).

2.4.3 The Massive Food Production Programme

Another well-known initiative to introduce GM crops to smallholder farmers in South Africa was the Massive Food Production Programme (MFPP). It was initiated as a rural development programme in 2002 by the Eastern Cape provincial government in partnership with Monsanto. The MFPP had hoped to modernise smallholder agriculture through the introduction of Bt maize in five district municipalities of the province (Eastern Cape Provincial DoA (ECDoA) 2002; Masifunde Education and Development Project Trust 2010).

The MFPP required individuals or groups of smallholders to dedicate about 1 hectare of their land in order to participate in the programme. The aim was to get 50 hectares of land under cultivation and reach target yields of 7 tons per hectare of Bt maize in the long term. The smallholder farmers received input and production subsidies of about R2 300 per hectare from the provincial government and soft loans from Uvimba Bank for tractor services (Fukweni 2009; Mtero 2012).

In the case of the MFPP, institutional inertia prevented timely farm operations and resulted in maize crop failures (Manona 2005). By 2007 there was a strong consensus that the MFPP was unsuccessful. Participating smallholder farmers did not manage to reach the set goal of 7 tons per hectare. Instead they produced an average of 3.6 tons per hectare in the 2006/2007 season. Farmers also experienced crop failures with both participant and non-MFPP participant communities experiencing food shortages for three months during the 2007/2008 season (Dirwayi 2010; Mtero 2012).

The MFPP had a flawed design; several scholars have noted some of the limitations of solely using agriculture to graduate rural people out of poverty (Ashley and Maxwell 2001; van der Ploeg et al., 2010; Hebnick et al., 2011). The programme was limited to agriculture and did not take into account the diverse livelihood strategies employed by rural people (Dirwayi 2010; Jacobson 2013).

There was clearly a mismatch between the technology, local conditions, and the capabilities and needs of the participating smallholder farmers. It is widely acknowledged that the MFPP did not improve the livelihoods of smallholder farmers; instead it disempowered people even further (Manona 2005; Fukweni 2009; Dirwayi 2010; Masifunde Education and Development Project Trust 2010; Jacobson 2013).

2.4.4 GM maize in Hlabisa

Hlabisa represents one of the areas where Bt maize was initially introduced to South African smallholder farmers (Gouse 2012). This section details some of the previous studies which have been conducted in the area.

The initial study from Gouse discussed the performance of white Bt maize (Gouse et al., 2005). The results of this study were based on surveys from 33 commercial farmers and 368 smallholders. The smallholder farmers were selected from six areas where Monsanto gave out Bt seed samples. Hlabisa was among the six areas where local agricultural extension officers and enumerators surveyed smallholder farmers. It was not clear how many smallholder farmers were surveyed from Hlabisa. "The sample sizes in each site were calculated so as to be significant and representative of the population that received the maize seeds from Monsanto", (Gouse et al., 2005, p. 91). The study found that Bt maize performed better than conventional hybrid maize. In addition, farmers reduced their pesticides costs and

the farmers rated the Bt maize grain quality above that the local and conventional maize (Gouse et al., 2005).

Gouse et al (2006) investigated the impacts of GM maize on yields, labour, and minimum tillage in Hlabisa (Gouse et al., 2006). A focus was placed on minimum tillage as it was a practice which was encouraged by both Monsanto and local agricultural extension officers as a way to address erosion problems in the area. The results of the study are based on a 2003/2004 survey of 135 farmers where some practised minimum tillage and cultivated Bt maize. The study found that Bt maize gave a 38% higher output per hectare in comparison to hybrid maize. It was noted that Bt maize gave no yield advantage in a season with low insect pressure and that numerous years were required when assessing the performance of Bt maize. The use of minimum tillage improved yields by 15 % and saved 63 % of the labour time. The authors pointed out that since land was limiting factor in areas like Hlabisa, perhaps the attention should be shifted towards improving labour productivity in tandem with maximising yields (Gouse et al., 2006).

Gouse et al., 2006a asked whether smallholder farmers of South Africa had benefitted from using Bt maize. The results of the study were based on three seasons (2001/2002, 2002/2003 and 2003/2004) in multiple areas from Limpopo, Eastern Cape, Mpumalanga and KwaZulu-Natal. Hlabisa was one of the areas which featured in the study. It was concluded that smallholder farmers had benefitted from Bt maize. This type of GM maize produced higher yields than conventional hybrid maize and acted as an insurance policy against pest outbreaks (Gouse et al., 2006a).

The 2009 study assessed whether the different GM technologies, Bt and Ht, and minimum tillage affected the efficiencies levels of farmers in three districts of KwaZulu-Natal. The results of the study were based on data collected from Hlabisa, Dumbe and Simdlangentsha in the 2006/2007 season (Gouse 2009). A total of 249 farmers were surveyed who used Bt, Ht and conventional hybrid maize types. The factor which contributed to high efficiency levels was minimum tillage whilst Bt and Ht maize produced higher yield outputs.

Gouse (2012) also provided an overview of the research findings from 2001 to 2010 and focused on conveying the methodological challenges associated with conducting GM maize research in Hlabisa. In the latest study gender specific impacts of GM maize were investigated in Hlabisa using the data which had been collected from 2001 to 2010 (Gouse et al. 2016). A key finding was that male farmers were motivated to use GM maize as it produced higher yields while female farmers enjoyed the labour saving benefits offered by Ht and stacked maize types. The conclusion was drawn that this labour saving quality can be a great asset especially in areas that experienced labour shortages. However, GM maize alone cannot be effective in addressing problems in smallholder agriculture. There are other issues that need to be considered such as access to land, affordability of the technology and access to training and information (Gouse et al., 2016).

In summary, the focus of past studies in Hlabisa have centred on how GM maize performed in comparison to other maize types, impacts on labour time, and efficiency levels of the farmer. The picture painted about GM maize is fairly positive but Gouse cautions that the findings should not be extrapolated to other areas as they are specific to Hlabisa (Gouse 2012). There is a need for studies to adopt a wider lens through which they observe the impacts of GM crops in smallholder agriculture including approaches which seek to

understand the wide ranging impacts of GM crops on the livelihoods of smallholder farmers (Fischer et al., 2015).

2.5 Conceptualising technology uptake

2.5.1 Introduction

The empirical evidence suggests that smallholder farmers are not only using GM seeds for economic reasons and that there may be other underlying motivations (Glover 2010a; Arza et al., 2012). This section of the thesis will draw on theories and concepts that attempt to explain why a farmer takes up an innovation. The aim is to illustrate that there are more nuanced reasons which could provide further insight on the criteria used by smallholder farmers when they make the decision to use agricultural technology (Edwards-Jones 2006; Pereira 2011). I do not provide an extensive overview of the existing theories, but rather use the ones that are relevant to the study.

Risk and uncertainty are recurring themes in the early theoretical literature explaining why individuals adopt innovations. However, it has been accepted that farmers operate in uncertain and risky situations. Smallholder farmers are less likely to use technology that exposes them to risk, reduces their assets, and increases their vulnerability (Meinzen-Dick et al., 2004). This understanding led to the development of other theories to explain why farmers are motivated to use innovations in their farming practices (Mas-collel et al., 1995; Taylor and Adelman 2003; Mendola 2007; Pereira 2011; Juma 2013). Studies placed emphasis on understanding factors such as farmer's perceptions, and their social and institutional contexts (Adesina and Zinnah 1993; Edwards-Jones 2006; Bandiera and Rasul 2006; Oreszczyn et al., 2010). It is important to recognise why social and institutional contexts in particular are relevant when conceptualising how smallholder farmers take up innovations. These institutional and social contexts have been typically overlooked in technology adoption (Fok et al., 2007; Glover 2010a; Dowd-Urbe and Schnurr 2016).

2.5.2 Influence of social learning and networks on technology uptake

Farmers are not completely autonomous and rely on their own farming knowledge and experiences, coupled with those of neighbouring farmers, friends and knowledge from public and private institutions (Edwards-Jones 2006; Bandiera and Rasul 2006; Oreszczyn et al., 2010). It is theorised that farmers, friends, and institutions form a complex social learning system where individuals may be socially pressured or influenced by others to use new technology.

The general definition of social learning is centred on the collective and collaborative approaches to solving problems and decision-making (Keen et al., 2005). Farmers may have access to different sources of information through their social networks and institutions. The argument here is that external innovations and knowledge are inserted into social networks in farming communities through their learning platforms. A few key entry points may be targeted within the network by actors or institutions who then rely on social learning to facilitate the diffusion of technology (Oreszczyn et al., 2010; Beaman et al., 2015).

Other models suggest that a farmer's position or embeddedness in a social network will shape the knowledge and access he or she has about the technology and therefore determine the choice made by the farmer to use the technology and inform others (Monge and Halgin 2008). To further deepen this point about the relevance of the social context in innovation studies, others have directed their attention to understanding how an individual's attitude and beliefs

could be used to predict behaviour. For instance, the theory of planned behaviour, suggests that we can use an individual's intention to predict behavioural performance (Ajzen 1991). The criticisms of this theory relate to problems with psychological reasoning and lie outside the thesis but, the theory itself does provide a gateway into recognising the role of an individual's perceptions, attitudes, and beliefs in the uptake of technology. This indicates how challenging it is to explain decision-making and highlights that a more inclusive approach, drawing on multiple theories and bodies of knowledge, could be useful to explain the uptake of technology (Meijer et al., 2014; Sniehotta et al., 2014).

2.5.2 Influence of institutions on technology uptake

Institutions set rules that govern social interactions and are thus not arbitrary in their nature (Masahiko 2001). The implications are that social interactions or behaviours are enabled and/or constrained due to these formal and/or informal rules. Several authors maintain that institutions play a major role in fostering the adoption of technology by farmers (Fok et al., 2007; Hall et al., 2009; Newell 2009; Pereira 2011; Dowd-Urbe and Schnurr 2016).

There is a need to better qualify how institutions influence the decisions taken by farmers to use technology on their farms. Bergek et al. (2008) suggested dissecting the functions of the institutions and understanding their impacts on knowledge generation and dissemination. There is also a need to recognise the impact of the incentives and disincentives provided by institutions promoting the innovation.

The navigation of the institutional landscape can help ascertain how institutions affect the uptake of modern crop varieties. The presence or absence of particular institutions can impact on the adoption and diffusion of technology in a farming community (Newell 2009). For instance, resource constrained farmers are likely to innovate on their own in the absence of institutions. These farmers will use their own knowledge, experiments, and experiences to innovate and develop practices which are suited to their local context. The applications of these innovations may be limited to one farmer or type of activity or can be applied widely (Assef 2007).

The presence of institutions such as extension and advisory agencies and community based organisations can play a role of introducing farmers to new knowledge, practices and technology. However, access to institutions does not equate to the uptake of the innovation (Uaiene et al., 2009; Coudel 2013). Agricultural extension officers serve as links between farmers and innovators. Farmers are presented with the opportunity to learn about the claimed benefits and/or effectiveness of technology through experimentations and demonstrations (Mwangi and Kariuki 2015).

Some studies have highlighted that the access to credit institutions does help facilitate the process of technology uptake by farmers (Glover 2010a; Dowd-Urbe and Schnurr 2016). For instance, the Bt cotton farmers of the Makhathini flats were provided with credit and subsidies to grow the crop (Schnurr 2012). Simtowe and Zeller (2006) showed how increased access to credit motivated some financially constrained smallholder farmers to adopt hybrid maize in Malawi.

These ideas can be applied to the uptake of GM crops by African smallholder farmers where seed companies and agricultural extension officers represent institutions which are part of the social networks of farmers. Farmers are offered top-down knowledge from these institutions

who promote their ideas about improving productivity through using modern seed varieties and chemical inputs (Abdu-Raheem 2014).

This section highlighted that there are clearly more nuanced reasons as to why farmers may choose to use technology besides attempting to maximize profit and production for economic reasons. Knowledge and innovations imparted onto farmers by institutions should not disservice farmers but rather provide benefits to farmers (Ogueri 2013).

2.6 Summary

In the modern South African context maize is no longer viewed as a “Kaffir” crop but as both a staple and profitable crop which has been made possible through the extensive maize breeding programmes which were developed locally and internationally. For a significant period of time smallholder farmers used their local flint maize types but this slowly changed with the introduction of dent hybrids and GM maize. GM crops are promoted to smallholder farmers under the guise of being pro-poor. When in reality the owners of the agricultural biotechnology want to claim the untapped markets in the Global South to increase their profit margins and GM crops have not been able to solve hunger issues. From the perspective of smallholder farmers, the presence of financial and institutional support has proved to be the strongest motivators to use GM crops such as Bt cotton and maize. Finally, the global empirical record shows mixed impacts of GM crops in smallholder agriculture where more problems exist than solutions. The Chapter concluded with theories and concepts that provide reasons as to why farmers adopt technology and help with the wider conceptualisation of GM crop uptake by small farmers.

CHAPTER THREE - METHODS AND AREA

3.1 Introduction

This section of the thesis gives an overview of the case study area, research and methodological approach used in the study. It starts off by giving a description of the study area and reasons for its selection. This is followed by the rationale behind using a critical research approach and details the various ways in which data was collected in this study.

3.2 Description of area

Hlabisa local municipality has eight wards. These eight wards are associated with three traditional councils namely: (i) Aba kwa Hlabisa, (ii) Mpembe and (iii) Mdletshe traditional councils.

This locality was selected for the research as it represents one of the few areas in South Africa where smallholder farmers have been reported to be using GM maize continuously from 2001 to 2010 (Gouse 2012). In addition, the experiences of Hlabisa smallholder farmers with GM maize have been mainly documented by Gouse (Gouse et al., 2005, 2006, 2009, 2012, 2016). However, these studies have tended to focus on the agricultural economics of GM maize and have failed to highlight the role played by institutions in the uptake of GM maize in the area. As seen from the literature review both negative and positive accounts are frequently given of smallholder farmers who have chosen to use GM crops. This study thus served to re-evaluate the uptake of GM maize by the smallholder farmers of Hlabisa.

The respondents in this study were selected from wards one and two which fell under the traditional authority of Aba kwa Hlabisa (Fig 3.1). These two wards formed the geographic boundaries of the case study area and henceforth will be referred to as Hlabisa. These area limitations were placed mainly because this area contained farmers who have been using GM maize on a long term basis compared to the remaining wards. For instance, in the area of Mpembe smallholder farmers were introduced to GM maize in 2012 (Agriculture extension officer, Hlabisa, 20 November 2014).

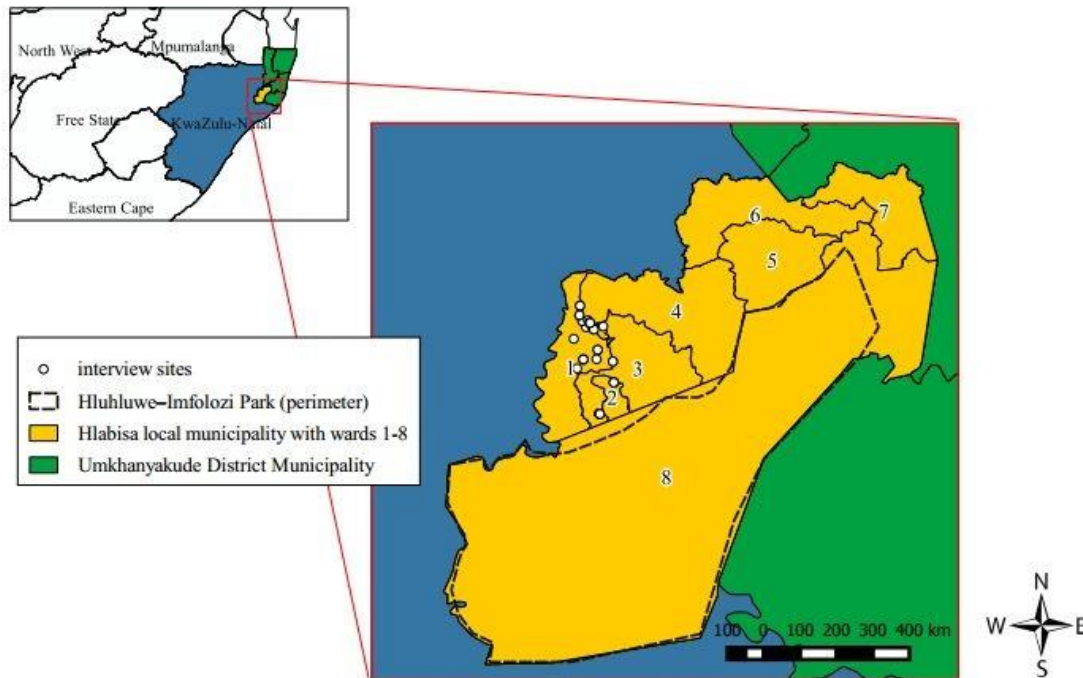


Fig 3.1: The location of surveyed farmers within Hlabisa (Naik 2016)

Hlabisa has one female chief who has 11 *Ndunas* (right-hand men) and the major settlements are Hlabisa and KwaQunwane. The 2011 census from Statistics South Africa captured 7 254 agricultural households in the local municipality with a household average of six people (Stats 2012). The agricultural extension officer placed the number of smallholder farmers in Hlabisa (or wards 1 & 2) at 1 100. Only one agricultural extension officer serviced this area (Agriculture extension officer, Hlabisa, 20 November 2014).

This study was conducted in the 2014/2015 season when the Hlabisa was experiencing a drought. This was relevant because it presented an opportunity to gather the perceptions about the performance of non-GM and GM maize in dry conditions.

3.3 Research approach

There are various ways in which the social world can be studied depending on the philosophical assumptions or worldview held by the researcher which guides the research approach used (Creswell 2008). In this case an interpretative approach (or interpretivism) is adopted where the notion that the world and knowledge are socially constructed (Klein and Myers 1999).

The premise behind using the interpretive approach is to understand how farmers view their situations and create, receive, and understand knowledge in order to build a theory about the particular process or issue (Kelly and Terre blanche 1999). A researcher using the interpretive approach will be dealing with the complexities generated from receiving the various subjective views about the issue of study. In addition, the researcher needs to recognise how his/her positionality will affect the interpretation of the findings from the study. Lastly the relationship between the subject and researcher is participative, cooperative, and interactive in nature (Creswell 2008). The thesis is not embedded in a particular

theoretical framework and hopes that through using an interpretive approach, a theory will emerge from the data that will explain the phenomena taking place on the ground (Bitsch 2005).

A next step is required where the researcher needs to determine *how exactly to interpret* the understanding of the social phenomena under study. Butler (1998) has identified critical interpretivism as one of the variants of the interpretive approach. Bohman (2013) believed when a researcher takes a critical stance, he or she must show what is wrong with the current state and propose ways to bring about change. Therefore, giving a critique of this agricultural innovation through the eyes of smallholder farmers will attempt to highlight how they have been disenfranchised and explain how politics of the global seed industry places them in vulnerable positions in the scheme of things.

3.4 Scoping

Prior to the commencement of the data collection scoping trips were arranged in three villages, Maphophoma, Nongoma and Hlabisa, in the northern parts of KwaZulu-Natal province where there were previous known cases of GM maize use during November 2014. The villages were identified with the help of representatives from Biowatch South Africa, a NGO working with smallholder farmers in the province. Biowatch South Africa helped with liaising between agricultural extension officers serving in Maphophoma and Nongoma, who then facilitated meeting up with smallholder farmers who were previously, or currently are, using GM maize. During these visits the farmers' survey was piloted among the farmers in Maphophoma and Nongoma. These areas were not included in the study due to the relatively short time period of GM maize use as compared to Hlabisa farmers who were reported to be using GM maize for more than 10 years (Gouse 2012). It was necessary to visit Maphophoma and Nongoma in case the farmers were also long term users of GM maize as there was little literature on these areas related to GM maize.

I contacted Dr Marnus Gouse, a research fellow at the University of Pretoria, South Africa, via email to help with accessing local contacts in Hlabisa as he had published extensively on GM maize use in the locality. Farmers surveys were used to derive information presented by Gouse et al., (Gouse et al., 2005, 2006, 2009, 2012). The farmers were identified through the records of farmers who attended workshops organised by Monsanto, sales records from both Monsanto and a farmers' cooperative which sold GM maize seeds in the area. In addition, agricultural extension officers and farmers' associations were used to identify farmers cultivating GM maize in Hlabisa (Gouse 2012). I did not have access to the sales records from Monsanto and farmers' cooperative, nor to the database of farmers used in the various studies by Gouse. Instead the local agricultural extension officer served as my primary key informant which helped build up my sample of respondents. Key informants are individuals who can provide expert knowledge and insight about the topic of interest in a relatively short period (Marshall 1996).

A face-to-face meeting was arranged with the agricultural extension officer who was interviewed to help gather the background to GM maize in Hlabisa and to understand the farming issues of the area. He helped with the identification of three Farmers' Associations which were known to be using GM maize seeds. I visited two of the heads of the Farmers' Association at their homes and piloted the farmers' surveys and enquired about the history of GM maize in Hlabisa. IsiZulu is not my first language so I needed to use a translator who

accompanied me during my scoping trips to provide additional support when asking questions.

The scoping trips helped with revising the questions asked in the farmers' surveys, familiarised me with the area of Hlabisa, informed people about the goals of my research, and also enabled me to secure permission from the traditional authorities in order to proceed with the research.

3.5 Data collection

3.5.1 Identifying other key informants

Traditional authorities formed part of the key informants who were used in this research along with a representative from Monsanto South Africa and AfricaBio (Table 3.1).

Table 3.1 List of key informants

Date	Key informant	Number	Institution
20.11.2014	Local agricultural extension officer	1	Local department of agriculture, Hlabisa
10.09.2015	Monsanto agent	1	Monsanto South Africa
23.10.2015	AfricaBio representative	1	AfricaBio (GM crop lobby body)
11.01.2016	Chief of Hlabisa	2	Traditional authority of Aba kwa Hlabisa
	<i>Nduna</i> of Hlabisa		

Farmers were asked to identify one of the *Nduna* (or headman of the chief) of Hlabisa. I proceeded to make direct contact with him by visiting his home and informed him of my intentions with the research. I asked the *Nduna* to notify *Nkosi* (or chief) that I was in the area intending on doing research and requested to have a meeting with her. In addition, I was met by 10 other *Ndunas* of Hlabisa at the offices of the traditional authority of Aba kwa Hlabisa, where I requested permission to interview farmers of the areas they served and reiterated my request to meet the *Nkosi*.

I contacted Monsanto South Africa telephonically at their headquarters in Johannesburg where I was directed to the Monsanto agent used in the study. He was selected due to his past involvement with farmers of Hlabisa. I contacted AfricaBio via email where I explained that I was seeking an informed individual who worked with smallholder farmers using GM crops in South Africa. The key informant from AfricaBio contacted me via email explaining his role in the institution and based on this information I considered him as a suitable key informant.

3.5.2 Conducting the surveys

In the broader context GM maize farmers were a narrow population and were mainly associated with three Farmers' Associations. The known number of GM maize farmers within these three Farmers' Associations was 134 in the 2014/2015 season. This did not eliminate the possibility of the existence of other GM maize farmers outside these groups.

The local agricultural extension officer was used to identify the areas where there was a high concentration of GM maize farmers in Hlabisa. Once these areas were identified a snowball

sampling approach was used where GM maize farmers were asked to answer a survey. The snowballing sampling technique is commonly used in qualitative, descriptive and explorative studies as it is an efficient way to identify participants and has the potential to generate unique social knowledge (Atkinson and Flint 2001; Noy 2008). With a snowball sampling approach, the initial sample of GM maize farmers was selected by the researcher and field assistant through door-to-door visits. The identified smallholder farmers would then identify other smallholder farmers using GM maize in the area and so forth (Sadler 2010).

One of the biases of snowball sampling is that the initial group sampled was not selected randomly and the data may be biased towards the selected individuals who share similar characteristics. There is also the potential of excluding other farmers as they might have not been identified by the former informants. Moreover, it is challenging to make any statistical inferences as the obtained sample was not selected randomly (Heckathorn 1997; Magnani et al., 2005; Sadler 2010).

Different sets of surveys were created for farmers using GM maize and non-GM maize (Appendix I and II). The inclusion of non-GM maize farmers was to provide better insight on how GM-technology has affected smallholder farmers of Hlabisa as there are differentiated farming experiences based on who chose to take up or reject the innovation. A simple random sampling strategy was used to select the non-GM maize farmers who were integrated in the community of different types of maize farmers.

These surveys took approximately 45 minutes to complete, and took place at the homes and farming fields of the farmers with a field assistant helping with translation where needed. The survey included both closed-ended and open-ended questions which were asked in isiZulu. Permission was also obtained to audio record the interviews and answers were taken down in English on the survey sheets.

The surveys intended to retrieve household socio-economic profiles, farm labour used and labour changes, crops planted, cover the mode of GM maize introduction to the farmer and the farmers' relationships within the community and support institutions (Appendix I and II). They also aimed to investigate the perceived benefits and problems associated with GM maize in Hlabisa and identify factors which influenced the decision to uptake GM maize. Farmers were at liberty to answer or decline any questions they were not comfortable answering. The surveys also contained questions which uncovered how farmers socially learnt about GM maize and which institutions influenced the decision to take up GM maize.

When saturation was reached the sample size consisted of 47 GM maize users (14 males and 33 females) and 11 non-GM maize users (three males and eight females). The number of non-GM maize users were low as the survey questions were designed for farmers who had previous knowledge of GM maize. This means any non-GM maize farmer with no knowledge of GM maize was not included in this research.

To ensure that farmers understood which type of GM maize I was referring to during the interviews, I posed this question: can your maize from Monsanto get stalk borer? This would help identify Bt maize farmers. To determine whether farmers were using Ht maize, I asked if they sprayed their maize with Roundup. Lastly, to determine if they used stacked maize, I asked them whether their maize type could be sprayed with Roundup and had protection from stalk borer.

3.5.3 Use of focus groups

A focus group can be thought of as a formal discussion among selected individuals where a moderator introduces topics for discussion. The main purpose of a focus group is to uncover the viewpoints of the selected individuals through the way they describe, understand, and interpret the discussion topic (Liamputtong 2010). Here focus groups were used to get in-depth details about the social and economic history of Hlabisa, local institutional dynamics, and changes in traditional farming, as these were not covered in the farmers' surveys.

The details of the focus group discussions are noted below. Representatives from the three Farmers' Associations were invited to attend focus group discussions on selected days in Hlabisa (Table 3.2).

Table 3.2 Details of focus group discussions *Names of Farmers' Associations have been changed for anonymity purposes

Date	Name of farmers' association	Associated village	Female participants	Male participants	Total number of participants
12.01.2016	Ndlovukazi	Swohlo	6	9	15
13.01.2016	Phakamani	Mgovuzo	8	4	12
13.01.2016	Amaqawe	KwaMadondo	8	1	9

The first activity that took place during the focus group discussion was the establishment of a timeline of the important events or changes in smallholder agriculture and retracing of the history of the traditional farming in the selected villages through using the living memories of the participants. This was followed by asking the participants to identify institutions in the area which worked closely with them. This step of using Venn diagrams helped with the ranking of the institutions which greatly influenced the agricultural decisions taken by the GM maize farmers. The last activity which took place intended to explore the type of relationships the GM maize farmers had with the institutions which provided them with support. This was also done through the use of Venn diagrams.

Explaining Venn diagrams

Venn diagrams were used to visually understand the institutional landscape of Hlabisa and to understand interactions among the institutions by using different sizes of circles (See an example of a Venn diagram in Fig 3.2) (Geilfus 2008). Once the participants in each focus group had identified and ranked institutions which influenced the decisions they had taken on their farms, circles of different sizes were cut out and assigned the ranking number given by the participants, i.e. the size of the circle indicated the ranking. So a small circle depicted an institution which played a minimal role in the studied context and the converse applied. The next step was to place the circles on a board and determine how close the institutions worked with each other. If institutions did not work closely with each other, the circles were further apart and the opposite when they worked closely with each other.

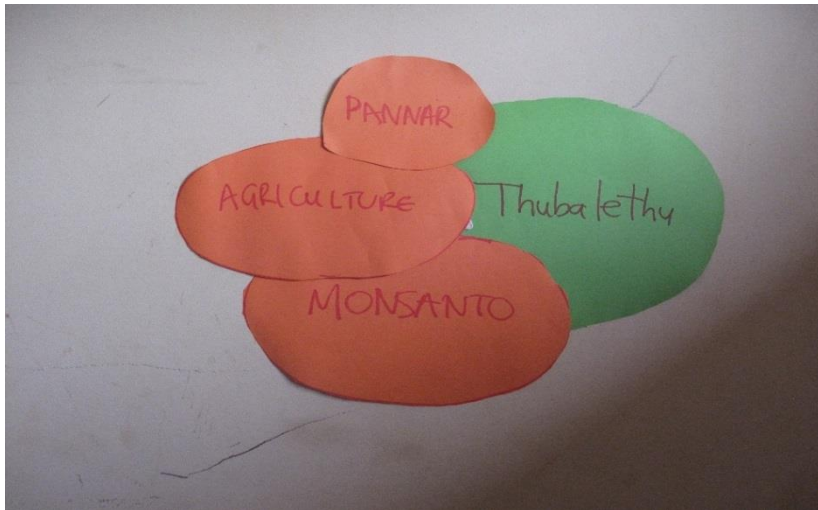


Fig 3.2 An example of an institutional Venn diagram

Permission was obtained to record the focus group discussion sessions which were then transcribed from the isiZulu audio material into English.

3.6 Data analyses

Qualitative analysis and coding

Coding was used to analyse the transcribed audio material from the farmers' surveys, focus group discussions and answers taken down on the survey sheets. Open coding was used in this research where labels or codes were assigned through a line by line perusing of the text in the farmers' surveys and transcripts from recorded audio of interviews and focus group discussions. The advantage of using 'open coding' allowed the researcher to derive the themes or categories from the raw data.

Statistical analysis

Descriptive statistics were generated using the quantitative data such as determining the proportion of respondents receiving a certain monthly household income; grouping respondents who had received the same level of education; changes in crops grown before and after the uptake of GM maize seed; and the factors influencing the choice to use GM maize seed. This was done using Microsoft Excel. Further statistical analyses were performed using sign and chi-squared tests to check for any statistically significant differences in the results (See Chapter Five).

3.7 Research ethics

Ethical clearance was obtained from the Science Faculty Ethics Committee prior to the commencement of the study. There were ethical issues that needed to be taken into consideration in this thesis such as granting anonymity and protection of confidential information that was provided by the participants. Before the study commenced, prior informed consent was obtained from participants and the traditional authority council where the purpose of the study was explained in their home language. The research outcomes of this thesis were reported back to those who participated in the research.

It is important to mention some of the institutional issues and gender dynamics that were noticed between the male and female farmers during the focus groups. In the case of the

focus group discussion with Phakamani Farmers' Association, when the chairperson was not present in the focus group discussion venue, the farmers readily answered the questions but became silent when he joined the discussion at a later stage. All farmers were encouraged to add their perspectives on a particular issue if they disagreed with the chairperson and not let the chairperson dominate the discussion. The chairperson did also encourage them to engage in the discussion if they wanted to share their viewpoint but they would often agree with him. However, this happened intermittently, he was regarded as the man who was more knowledgeable about GM maize in his community than anyone else as he was one of the first farmers to use GM maize and encouraged his counterparts to cultivate GM maize. The chairperson died shortly after the focus group meetings and has been succeeded by his deputy.

Male respondents were generally more vocal during the focus group discussions than female respondents. A different pattern was noticed with one female-led Farmers' Association (Amaqawe) in Hlabisa. There were more females in this group than males, and females answered more readily than they did in the male-led Farmers' Association such as Phakamani and Ndlovukazi.

3.8 Research limitations

The results reflected in this thesis are context-specific and cannot be extrapolated to other areas. Nonetheless, they present valuable findings as there has been little work done contesting the claims of benefits of GM crops in this area and institutional dynamics at play.

The unequal sampling of non-GM and GM maize farmers is an important limitation. Future studies should thus attempt to explore the experiences of those not planting GM crops. This will help to enable a richer understanding of why smallholder farmers in the same geographic area choose to uptake, reject, or abandon an agricultural innovation. Finally, the data lacks the perspectives of the national and provincial Department of Agriculture. Several attempts were made to reach the representatives through email and telephone calls, with limited success.

3.9 Summary

This Chapter introduced Hlabisa as a case study area and provided reasons why it was selected. The first reason was due to the long-term use of GM maize by smallholder farmers of Hlabisa, and secondly due to existing research narrowly focusing on the area from an agricultural economist perspective. This research attempted to include more of the social changes associated with the uptake of GM maize. The Chapter also provided an overview of the methods used where a sample of 47 GM maize farmers and 11 non-GM maize farmers were used as a counterfactual situation. The data was analysed using qualitative coding and a few statistical tests were performed. Research limitations and ethical issues were also noted. The following Chapter provides the results obtained from the study.

CHAPTER FOUR - HISTORICAL PERSPECTIVES ON AGRICULTURE: HLABISA

4.1 Introduction

This Chapter provides a brief review of the origins of Hlabisa as a settlement and associated livelihood changes. In addition, the Chapter retraces how smallholder farmers engaged in traditional farming pre and post the introduction of modern maize varieties in Hlabisa. This is important as it provides insight on changes that have occurred within smallholder agriculture.

4.2 Origins of Hlabisa and history

4.2.1 Historical background on Hlabisa

The area of Hlabisa came to be through the wars among chiefs fighting for the Zulu kingdom. Mthumbu kaMbopha, a chief, ruled over the southern part of Zululand in the late 1880s and allied himself with King Cetshwayo, ruler of Zululand (See Masina 2006 for more on the life and times of King Cetshwayo). However, Cetshwayo and his allies were resented by a chief in the north, Zibhebhu kaMaphita, who challenged and fought with Cetshwayo (Laband 2009). The *Nduna* of Hlabisa recounted: *“My forefather Mbopha was a great warrior who fought in many of the royal battles. After the battle at Ondini, his [Mbopha] warriors were given land. Hlabisa [a warrior] was given this land we know as Hlabisa today. It stretched from Mvelase to Mfolozi and all the way round to Hluhluwe... He [Hlabisa] was given this land and he was told to rule over the land. Cetshwayo granted Mbopha’s request to share some of his land with his younger brother, this area is known as Mpembeni [sub-area of Hlabisa]. Mbopha’s reign was good and Mtubatuba [neighbouring area of Hlabisa] was given to another relative from the Hlabisa family. The same thing happened with Mdletsheni [sub-area of Hlabisa], a relative was given land to rule over as sub-chief”* (Hlabisa, 11 January 2016).

Historical records suggest that Hlabisa was likely to have emerged as a settlement in the late 1880s (See Masina 2006; Laband 2009 for more detailed historical accounts of King Cetshwayo’s battles and territories). During the focus group discussions and surveys some respondents revealed that their families arrived in the established settlement of Hlabisa in the late 1940s to 1970s from areas like Vryheid, Ngome, and Mahlabathini. Reasons for settlement varied. One woman noted that she moved to Hlabisa for marriage whilst another remarked she ran away from Vryheid because she could not endure the harsh working conditions as a farm labourer on a white-owned farm (Respondent 21, Hlabisa, 27 March 2015).

Hluhluwe and Umfolozi game reserves were established in the late 1890s during colonial rule and in 1989 they were merged (Brooks 2000). The establishment of these reserves took away land that was occupied by people of KwaZulu, who used it to cultivate crops and rear livestock (Henkel 1937). In the 1960s the Hlabisa area was divided into two, Hlabisa, KwaZulu and Hlabisa, Natal. The *Nduna* revealed that the Umfolozi game reserve was further away from the settlements in 1968 compared to today. This has some implications on livestock farming, for instance it was revealed during the Ndlovukazi focus group discussion

that the game reserve also expanded. “*Before the 60s, we farmed there [there being the area which was absorbed by the game reserve when it expanded] and our cows ate there... Those soils [soils found in the game reserve] were more fertile but we were driven out*” (Male farmer 1, Ndlovukazi focus group discussion, 11 January 2016, Hlabisa). Over the years the boundaries of Hlabisa have also expanded and contracted due to chiefs raiding each other’s territories and changes made by the district municipality (Laband 2009; Hlabisa municipality draft IDP 2013/2014). This suggests that the land in Hlabisa has been strongly contested.

4.2.2 Changes in livelihood options over time

Agriculture in Hlabisa has a long and contested history, beginning with colonisation in the late 17th century to now.

Bundy (1984) traced the emergence of African peasantry in the KwaZulu-Natal and Eastern Cape provinces showing it has experienced both peaks and falls over time. Maize had made its way to the agricultural fields of Southern Africans by the 15th century. This was through the trading of local goods with the Portuguese traders at Delagoa Bay in Mozambique (South African History Online, 2015).

The former Zululand, an area between the Pongola River in the North and Tugela River in the South, experienced good rainfalls and had fertile soils conducive for people to live off the land. Masina (2006) referred to ‘homestead economies’ which sustained the livelihoods in Zululand. A homestead economy manifests itself through its social and economic units. A male head would lead a homestead, a central kraal² surrounded by his wives’ homes and dependent relatives where members engaged in cattle and crop farming to sustain their livelihoods, and in social exchanges.

Homestead economies in Zululand have experienced several shocks over time. For instance, the loss of cattle, land, and taxes imposed by the white colonialists weakened homestead economies. This made it challenging for Zulus not to turn to wage labour offered by whites in mines, factories, and farms (Laband and Thompson 1989).

During Apartheid, Zululand became known as KwaZulu, a semi-independent homeland from 1972 - 1994. KwaZulu was considered a labour farm where white people could draw out cheap labour (Ntuli 2006). Respondents affirmed their continued use as cheap labour throughout and beyond Apartheid.

After democratic elections in 1994, people of Hlabisa continued to engage in crop and cattle farming to make a living for themselves. Sixty-four percent of the respondents in this study had been farming for more than 10 years. However, the area is prone to droughts and farmers of Hlabisa are thus constrained (Hlabisa Municipality Draft IDP 2013/2014). In addition to droughts, smallholder farmers of Hlabisa operate with a diminished farm labour force. Some respondents in this study expressed that the youth were disinterested in agriculture and often moved away in search of non-farm employment in the cities.

The unemployment rate in Hlabisa was 52.6 % with minimal employment opportunities in agriculture or other commercial activities (Hlabisa Municipality Draft IDP 2013/2014). This was significantly higher than the provincial (33%) and national (29.8%) unemployment rates (Statistics South Africa, 2012) (see Table 4.1). In this study 38% of the sample were unemployed while 10% of the respondents were formally employed, 25% self-employed, and another 25% were pensioners. The occupation status of the remaining two percent was unknown.

Table 4.1: Unemployment rates noted in relation to provincial and national statistics (Hlabisa Municipality Draft IDP 2013/2014; Statistics South Africa 2012)

Region	Unemployment rate
Hlabisa	52.6 %
Provincial	33%
National	29.8%

2 Kraal is a South African term for a livestock enclosure

The location of Hlabisa could be useful in the future if the local municipality develops its tourism sector. Currently it has failed to exploit its close proximity to the Hluhluwe-Umfolozi Park, also acting as a corridor to the cultural site of Nongoma, the capital of the Zulu kingdom (Hlabisa municipality draft IDP 2013/2014). Instead, the Hluhluwe-Umfolozi Park poses as a problem to smallholder farmers who neighbour the borders of the nature reserve. For instance, wild pigs escape to forage in the agricultural fields causing damage to crops. The following section provides an overview of the traditional farming history and associated changes.

4.2.3 History of traditional farming in Hlabisa

4.2.3.1 The 1950s and 1960s

The 1950s - 1960s marked the starting point where respondents in all focus groups were asked to recall their history of farming. This period was selected because this was when some of the respondents were actively participating in agriculture, or had living memories of how their parents practised traditional farming.

Traditional farming refers to the farming knowledge, experience, styles, and techniques which have been used by smallholder farmers over the years typically with minimal use of external inputs or agricultural technology (Altieri and Koohafkan 2008). During the 1950s - 1960s farmers of Hlabisa cultivated their traditional crops on large fields outside their homesteads where there was labour division between the sexes. *“There was no such thing as buying meat or groceries; we would just grow our food in those days [1950s - 1960s]”* (Male farmer 1, Phakamani focus group discussion, 12 January 2016). Examples of traditional crops planted include Zulu (or traditional) maize (*Zea mays*), Zulu potatoes (*Solanum tuberosum*), sorghum (*Sorghum bicolor*), jugo beans (*Vigna subterranea (L.)*), African sweet potatoes (*Ipomoea batatas L.*), calabashes (*Lagenaria siceraria*), sesames (*Sesamum indicum*), kidney beans (*Pennisetum glaucum*), groundnuts (*Arachis hypogea*), watermelons (*Citrullus lanatus*), taros (*Colocasia esculenta*) and cassavas (*Colocasia esculenta*). Taros were not planted often as they did not grow well in Hlabisa. *“It [taro] needs a lot of water so we do not plant much of it”* (Male farmer 1, Ndlovukazi focus group discussion, 12 January 2016). *“You [researcher] need to understand that not all areas are the same. Yes, some may grow taro in KwaZulu but not here [Hlabisa]”* (Male farmer 5, Phakamani focus group discussion, 13 January 2016).

The types of Zulu maize identified by the farmers included *umbila omhlophe* (white maize), *umbila obomvu* (yellow maize), and *umthubi* (yellow and white maize). A mixed coloured maize variety (*umbila oxubile*) and red maize were planted when rain was scarce.

Farmers historically saved and exchanged seeds amongst each other. For instance, maize cobs would be dried and hung so that seeds were available for the next planting season. A bride would be presented with a gift of a hand-hoe, sickle, and seeds when she left her home to be with her groom. *“It [the act of giving the bride a gift] was just something we did. It was tradition”* (Female farmer 2, Phakamani focus group discussion, 12 January 2016).

In general men were responsible for removing weeds and pulled oxen and donkeys to plough fields, while those who did not have oxen used hand-hoes. Women were responsible for sowing seeds, harvesting, and making food. *“We used oxen and planted maize with cow dung*

as a family. Women would grind the maize and make beer. We would also till together” (Female farmer 1, Phakamani focus group discussion, 12 January 2016). The farmers revealed a traditional method of storing maize usually by their mothers. They offered help in the form of labour. *“After we had de-kernelled the maize, we [them as children] would help dig a hole in the kraal and place the maize and then cover it with cow dung for storage. After a while we would remove it and grind it and make mielie pap and eat it with cabbage”* (Female farmer 1, Phakamani focus group discussion, 12 January 2016).

In addition to farming as family units, farming groups called *ilimo* existed where farmers helped each other with tilling fields, sowing seeds, and harvesting. Farmers would reward each other in the form of providing reciprocal labour or sharing some of their harvests with one another. The respondents claimed that this period was marked with good rainfall where farming was the predominant livelihood strategy.

4.2.3.2 The 1970s

The farmers associated the 1970s with the KwaZulu government, established by the Apartheid state in 1972, and its attempts to improve agriculture.

The KwaZulu government had to face the challenges of overgrazing and low productivity with limited funding for agricultural development projects, research and training of agricultural extension officers. Moreover, this institution attempted to create markets for farmers, improve the numbers of livestock, introduce irrigation schemes, and improve yields of maize (Ntuli 2006).

The respondents claimed that they were still receiving some benefits from agriculture and livestock in the form of food and good health during the 1960s, but noted major changes which took place in their style of agriculture in the mid to late 1970s.

In the mid-1970s smallholder farmers were first exposed to white farmers and agricultural extension officers from the department of agriculture (DoA), under the government of KwaZulu. They offered some technical advice to the farmers. Some respondents reported that the white farmers told them about turning the soil over before planting. *“They [extension officers] changed things by telling us how to farm. They told us: ‘one home one garden’. So each home needed to have a home garden. We were told that we must have our home gardens and start communal gardens and not leave our fields.”* During these times farmers were mostly cultivating crops on their large fields (Female farmer 6, Phakamani focus group discussion, 13 January 2016). This was when vegetables such as spinaches, cabbages and tomatoes started appearing in home and communal gardens (Male farmer 1, Ndlovukazi focus group discussion, 12 January 2016).

Futhermore, the agricultural extension officers told them to start forming co-operatives in their various villages and began using demonstration plots and organising information days to relay agricultural information to smallholder farmers at the local DoA. *“They [extension officers] were showing us how to farm and teaching us how to farm better so we can get benefits. We used cow dung to make the soil fertile but they introduced manure and introduced the seeds they [seeds made by a local seed company, Pannar] made and sold them to us”* (Male farmer 1, Ndlovukazi focus group, 12 January 2016). The farmers associated the disappearance of their traditional maize seed varieties with the arrival of agricultural extension officers in Hlabisa. *“They said we should stop using these seeds we get from the*

maize that we hang and use these Pannar ones [seeds] to see how we will benefit” (Female farmer 1, Amaqawe focus group discussion, 13 January 2016). Here Pannar refers to the hybrid maize seeds introduced to farmers. Pannar is the name of the seed company producing the seeds. It was claimed that some farmers began switching from traditional maize to Pannar maize in 1976, and began selling surplus hybrid maize for the first time. Moreover, farmers would not share their Pannar maize harvests with others as they used the money from selling the maize to purchase the seeds. However, they would share their traditional maize with one another when it was planted (Female farmer 6, Amaqawe focus group discussion, 13 January 2016). So it can be deduced from this that the system of saving and exchange began its erosion with the introduction of hybrids. The fact that hybrid seeds cannot be easily saved and exchanged also contributed to the erosion as the performance of hybrids gets weaker with replanting from year to year (Baranwal et al., 2012).

The local department of agriculture and the traditional authorities, *Nkosi* and *Ndunas*, were used as a conduit by Pannar to access smallholder farmers and introduce them to hybrid maize seeds through using demonstration fields (*Nduna* of Hlabisa, Hlabisa, 11 January 2016). So there was a shift from using or relying on farmer experience to using the guidance offered by the agricultural extension officers. *“Extension officers would come and say here is a better way of farming and we did not argue with them because it is what they have studied”* (Male farmer 3, Ndlovukazi focus group discussion, 13 January 2016).

The respondents reported that they applied the advice they received from the agricultural extension officers such as cultivating Pannar maize instead of their traditional varieties. They said that they stopped turning the soils and opened furrows where they would sow their seeds. Moreover, they began vaccinating livestock as advised by the department of agriculture (Male farmer 4, Phakamani focus group discussion, 13 January 2013).

Besides the provision of technical advice, the agricultural extension officers also encouraged women to sell baked goods and needlework and arranged areas where women could sell their items (Female farmer 1, Ndlovukazi focus group discussion, 12 January 2016; Female farmer 6, Amaqawe focus group discussion, 13 January 2016).

4.2.3.3 1980s and 1990s

The period of the 1980s - 1990s was marked both with an escalation of farming groups and changes in rainfall patterns. In 1982/1983 South Africa experienced a devastating drought. This was preceded by two consecutive years of no summer rain in the country. KwaZulu-Natal was among the most severely affected areas and had food shortages (Shandu 2004). Respondents were able to recall this event where livestock died and agricultural fields were eroded and scarred by dongas. Furthermore, some respondents claimed that the drought conditions may have pushed some farmers towards Pannar maize seeds as they were perceived to be more resilient in dry conditions than the Zulu maize (Amaqawe focus group discussion, 13 January 2016).

It was during this period that a number of Farmers' Associations were formed. Amaqawe Farmers' Association was established in 1982, while the predecessor of Phakamani Farmers' Association was formed in 1983 and named after the *Nkosi* of the area. It was called “*Vuka Mwelase*” meaning rise Mwelase³. This Farmers' Association fell apart when the chairperson left the area to build a house elsewhere. The members of Ndlovukazi Farmers' Association could not recall when the organisation formed.

Each Farmers' Association had its own demonstration plots for the purpose of showcasing Pannar hybrid maize varieties, and later both Pannar hybrid and Monsanto maize varieties. One of the respondents recalled first using CG4141, a hybrid maize seed variety from Cargill, in the 1980s and later using PAN6479, a hybrid maize seed variety from Pannar in 1998/1999. Different arrangements were made by the Farmers' Associations for field trials. The Ndlovukazi Farmers' Association asked for land from the *Nduna* which they could use for demonstration purposes. Amaqawe Farmers' Association requested land from a community member on a sharecropping arrangement while the former head of Phakamani Farmers' Association gave away some of his land to the organisation where it was firstly used as a communal garden and then became land used for Pannar hybrid maize field trials.

4.3 Rise of GM maize in Hlabisa

4.3.1 Introduction of Bt maize

In many ways this history created a pattern which set the scene for the entrance of GM seed to Hlabisa. In 2001, the national DoA approved the release of YieldGuard, a white Bt maize variety from Monsanto (CRN 4549B). Monsanto representatives met with various members of the KwaZulu-Natal provincial DoA who then identified localities within the province which were “*struggling agriculturally*”. Hlabisa was among the five selected areas chosen for the introduction of CRN 4549B to smallholder farmers (Monsanto Agent, Johannesburg, 10 September 2015).

When Monsanto entered Hlabisa, “*information days were organised by Monsanto and the [local] DoA where farmers were invited to a hall or we met under a tree to inform the farmers about these new seeds*”. In addition, a meeting was also held with the *Nkosi* of Hlabisa to discuss the introduction of the new agricultural technology in his area (Monsanto Agent, Johannesburg, 10 September 2015). An interview with this *Nkosi* of Hlabisa was not obtained as he died in 2004 and his successor later died in 2007. The current *Nkosi* of Hlabisa came into office in 2007 and does not deal directly with smallholder farmers of Hlabisa. “*They [farmers] ask for help from agriculture [DoA] and not from the office of the chief because there is no budget set aside for farmers. I [Chief of Hlabisa] just deal mainly with local rule.*” (Chief of Hlabisa, Hlabisa, 11 January 2015). The *Nduna* remarked that the new [GM] maize seeds were welcomed in the area as “*there is no Nduna that will reject any form of development that might help his community*” (Hlabisa, 11 January 2016).

In November 2001 a YieldGuard training session was organised by Monsanto at Hlabisa where smallholder farmers were invited to learn more about the Bt maize technology. Those

3 The surname of the *Nkosi* has been changed to protect anonymity.

attending this training session were shown videos of how to use YieldGuard and received attendance certificates (Table 4.2).

Smallholder farmers were also exposed to the differences between YieldGuard and conventional white maize using field examples - *“We used demonstration plots planted with conventional [hybrid] maize and the Bt maize so farmers could see [observe performance differences] for themselves”* (Monsanto Agent, Johannesburg, 10 September 2015). Smallholder farmers who wanted to use YieldGuard on a trial basis were given 250g of YieldGuard seeds (CRN 4549B) as well as CRN 3549, white hybrid maize seeds, to plant on their fields and assess the differences between the two maize types (Gouse 2012).

One of the respondents interviewed (Respondent 8) began using white Bt maize seeds following the training session while another (respondent 38) waited eight years before she started using any GM maize seeds. The reasons she provided for delaying the planting of GM maize seeds were related to the breakdown of a smallholder farmers’ co-operative where she had membership; later a disability befell upon her which prevented her from engaging in farming. She remarked. *“My neighbours said I was a witch because I had beautiful maize which did not burn in the sun and wanted to know what I was doing with my maize.”* (Respondent 38, Hlabisa, 10 April 2015). Monsanto has used video material from this farmer as an advertisement of the success of GM maize farming to other non-GM maize farmers elsewhere.

Respondent 8 was subsequently identified as a Champion GM maize seed farmer due to his extensive knowledge about GM crop farming compared to other respondents in this study. Moreover, he was regarded as an auxiliary farming advisor by some of the respondents. Although some of his quotations are used widely in this thesis, it is important to note that his views on some topics were not a necessarily representative of the group of farmers.

4.3.2 Introduction to Ht maize

Ht or Roundup Ready technology, DKC 78 - 35R, was registered and approved by the national DoA in 2003. Hlabisa again found itself among the five villages invited to attend Ht maize field trials held at the agricultural development centre at Pongola.

Representatives were drawn from each village to be accompanied by an agricultural extension officer from their local DoAs. Agricultural extension officers were invited in order to receive a once off training session in Ht maize farming along with the invited farmers.

Following the training session in Pongola, an agent from Monsanto came to Hlabisa to teach farmers more about Roundup (Table 4.2). *“In 2003 they [Monsanto] came. There was a trial here [the Champion GM maize farmer volunteered a plot of his land to be used for trial tests of the Ht maize seeds and this serves as the second demonstration plot of Phakamani Farmers’ association] and it was very hot that year because we got them [Ht maize seeds] in November and in December we had to control [spray] the weeds. They gave us five litres of the spraying chemical to control the weeds. We were afraid because it was the first time using these seeds, we knew how to use Roundup but now there were Roundup Ready seeds. We were afraid of using Roundup so we called the Monsanto agent. We had already sprayed*

but it did not seem like we did it correctly... He [Monsanto agent] said, 'the weeds are this much? Why don't you spray to control the weeds?' We said, 'we are afraid of burning the maize', but he said, 'Must I spray?' We said, 'yes, you do it' and he said, 'no, I won't'. He said bring the container, bring some water and the chemical and we sprayed... Many farmers came to see this because no one knew about it [no one knew how to correctly burn weeds using Roundup and Roundup Ready maize seeds] and the Monsanto agent left. It was hot, we saw the maize burn and we had accepted that the maize was going to burn. Around 3pm the sun was still very hot and the maize was opening up and was no longer wrinkled but the weeds were burning throughout the days and we saw that the weeds were burning and the maize wasn't burning so that's how we started [started using Roundup Ready maize seeds]." (Champion GM maize farmer, Hlabisa, 28 March 2015).

With a membership of 15 smallholder farmers, Phakamani Farmers' Association, collectively began using GM maize seeds in 2004. The head of this Farmers' Association (who was the Champion GM maize farmer) could not recall the exact numbers of who was planting Ht and/Bt maize in this period. These 15 smallholder farmers were most likely the first Monsanto maize farmers in Hlabisa. By 2006 this number had grown to 26. In the 2014/2015 season Phakamani Farmers' Association had 90 farmers. Each member of Phakamani Farmers' Association placed an order of the type of GM maize seeds he/she required as well as associated chemicals with the Champion GM maize farmer. The Champion GM maize farmer would later collect the money from the Phakamani Farmers' Association members and buy the GM maize seeds and chemical inputs at a co-operative located in Hlabisa CBD. Transport arrangements would be made by Phakamani Farmers' Association for the delivery of the GM maize seeds and inputs from the CBD to their village.

The heads of Phakamani and Ndlovukazi Farmers' Associations were introduced to GM maize seeds via the Champion GM maize farmer in 2004, who in turn introduced the seeds to members of their organisations. *"What I will say is this, I saw these seeds [Monsanto maize seeds] with Cebekhulu [head of Ndlovukazi Farmers' Association, surname has been changed]. He planted them for two years with good yields and we [Ndlovukazi] followed him. I cannot speak for others but I saw from Cebekhulu and he showed me that these seeds are better."* (Male farmer 3, Ndlovukazi focus group discussion, 12 January 2016).

4.3.3 Introduction to stacked maize

In 2007 Monsanto released a stacked maize variety, a GM seed containing both the Ht and Bt traits. It was however challenging to retrieve background information about the introduction of this maize variety and other varieties from respondents other than the Champion GM maize farmer. The Champion GM maize farmer claimed that the smallholder farmers did not write down information related to GM maize seeds when they were being taught by agricultural extension officers and seed representatives during the information days so they forgot. It was plausible that the participants in the focus group discussions were not aware of the exact release dates of GM maize varieties in Hlabisa as the Champion GM maize farmer was regarded by other farmers as an auxiliary advisor in his community. Moreover, the Champion GM maize farmer was part of the Leader's Farmers' Association (LFA) of Hlabisa where he had the platform to tell his counterparts of these new seeds he learnt about from his visit to Pongola and various farmers' days he has attended at the local DoA.

The co-operative which sold GM and hybrid maize seeds to the farmers shut down in the 2006/2007 season due to some unexplained money issues. “When I [Monsanto agent] asked what happened to the money, they told me it just disappeared” (Monsanto agent, Johannesburg, 10 September 2015). In 2008 Phakamani Farmers’ Association complained about needing a centre closer to their homes instead of needing to travel to town for their agricultural inputs.

The outcome was a Monsanto depot (a shipping container) stationed at the homestead of the Champion GM maize farmer in 2008 (Table 4.2). He thus began selling GM maize seeds and associated inputs to the locals in his community and surrounding areas from 2008. “I first started using those Monsanto seeds after hearing about a man [Champion GM maize farmer] who sold good maize seeds in 2008.” (Respondent 40, Hlabisa, 04 April 2015)

Table 4.2: Timeline covering the introduction of GM maize in Hlabisa

Year	Activities
2001	Hlabisa selected by provincial department of agriculture & Monsanto for the introduction of YieldGuard
	November: YieldGuard training session held at Hlabisa
2003	Champion GM maize farmer along with agricultural extension officers from local DoA went to Pongola to learn about Ht maize seeds
2004	15 smallholder farmers from Phakamani Farmers’ Association started using GM maize seeds
2006	Number of GM maize farmers grew to 26 from 15 in 2004
2008	Monsanto depot stationed at Champion GM maize farmer’s homestead
2012	First farmers’ day held at Mgovuzo, village which is associated with Phakamani Farmers’ Association
2015	Monsanto depot removed from Champion GM maize farmer’s homestead and taken to Jozini

In 2012 the area with the most number of GM maize farmers, Mgovuzo, had its first farmers’ day. A farmers’ day is organised by the local DoA where seed companies such as Monsanto and Pannar, are invited to show their field trials of maize varieties to a group of farmers in a specific village.

On March, 31, 2015 the local DoA had an information day in the Mgovuzo area where the events of the day were observed. Those who attended received small bags of cabbage seeds and manure from the DoA (Fig 4.1). There were over 20 smallholder farmers and two agricultural extension officers in attendance. The smallholder farmers were first shown the Pannar (hybrid) demonstration field by agricultural extension officers where the performance

of white and yellow Pannar maize varieties was assessed. Some farmers asked questions. *“How are these seeds made and where do they come from?”* (Female farmer, Farmers’ day, 31 March 2015). There may be various reasons why these questions were posed, the farmer could have been attending the session for the first time and was requiring further information, or she had not fully conceptualised what GM maize seeds were.

In the second session of the information day farmers went to the homestead of the Champion GM maize farmer to assess the Monsanto maize field trials. In this situation the Champion GM maize farmer led farmers around the Monsanto maize field trial with the assistance of the agricultural extension officers. The farmers’ day session concluded with the local DoA presenting a new member in their advisory and extension services branch and the local manager encouraging the smallholder farmers to continue with agriculture just like their parents did and not use the lack of a tractor as an excuse not to farm. This provides some insight into the nature of interaction between farmers and the local DoA. The Champion GM maize farmer seemed to be trusted by the local DoA to guide his counterparts on GM maize seeds as he was given the opportunity to act in his capacity as auxiliary advisor. The farmers’ days could potentially be useful vehicles for social learning where they could be an exchange of knowledge between the farmers and local DoA. However, the transmission of knowledge and provision of advisory services seemed top-down and showcased various seed varieties that farmers could use without showing how traditional maize performed alongside these modern varieties.



Figure 4.1: Examples of bags of cabbage seeds and manure given to smallholder farmers who attended the farmers’ day

The Monsanto depot was removed from the Champion GM maize farmer's homestead in September 2015 by Vemken, a local seed and chemical distributor based in Pongola, which reverted the farmers back to the situation of having no selling facilities nearby. The depot was provided by Vemken, in partnership with Monsanto. "*They [Vemken] said people are not buying any seeds [Monsanto maize seeds] in Hlabisa so they [Vemken] took it to Jozini [an area 114km way]*" (Champion GM maize farmer, Phakamani focus group discussion, 13 January 2016). The number of farmers using GM maize seeds in Hlabisa stood at 134⁴ in the 2014/2015 season compared in 15 in 2004/2005. This was a slow growth over ten years, especially when considering that there are about 1 100 smallholder farmers in the study area who could potentially be users of GM maize seeds. This suggests that the uptake of GM maize might not be as widespread in Hlabisa and farmers exist in pockets or are found mostly in the villages associated with the Farmers' Associations.

There were two farmers who were unable to plant their desired Bt white maize seeds in 2014/2015 due to a seed shortage and opted to plant hybrid maize seeds instead. Moreover, one of the farmers chose to plant beans instead of GM maize, another left her fields fallow, while the rest of the farmers chose to cultivate their GM maize and non-GM maize despite the late rainfalls in the 2014/2015 season. When the drought was more pronounced in the 2015/2016 season, farmers reported that they chose not to cultivate any crops at all.

4.4 Summary

This Chapter reviewed the type of GM crops that have been introduced to South African smallholder farmers with a particular focus on GM maize. This was followed by the origins of Hlabisa as a settlement and a discussion about the types of activities that have been sustaining livelihoods in Hlabisa from the pre-colonial to post-Apartheid years. Important changes that have occurred in traditional farming were also noted where the exposure or presence of agricultural extension officers influenced the decision making processes of smallholder farmers on their agricultural fields such as using hybrid and GM maize seeds. In the case of Hlabisa, the Champion GM maize farmer was strategically used to promote GM maize to other farmers. He was selected to attend GM maize field trials in Pongola and relayed the information he learnt to other non-GM maize farmers. Moreover, he had volunteered his land to be used for field trials and later became the trader of these seeds in Hlabisa and was considered an auxiliary advisor by his counterparts.

4 The number is based on the total number of farmers using GM maize seeds from the three Farmers' Associations in the study area. This does not eliminate the possibility of the existence of other GM maize farmers outside these groups. Interestingly Gouse's team reported to have surveyed 58 Bt maize plots in 2001 from Hlabisa, this might suggest that the initial farmers were greater than 15 if the assumption is that one individual has one plot for himself or herself (Gouse et al., 2016). However, this does not necessarily equate to 58 farmers as field observations indicated that some farmers cultivate GM maize on multiple plots.

CHAPTER FIVE - GENETICALLY MODIFIED MAIZE IN HLABISA

5.1 Introduction

This Chapter begins by giving a profile of farmers using GM maize in terms of monthly household incomes, type of farm labour used, and levels of education. This is followed by a description of factors which influenced smallholder farmers to uptake GM maize. A discussion of farm level changes which occurred after the uptake of GM maize seeds such as types of crops grown, cropping patterns, and changes in insect and weed pressure will also be addressed. Prior to concluding the Chapter, an evaluation of the level of understanding of GM maize technology, as well as the impacts on the quality of life of the farmers, is provided.

The study sampled a total of 47 GM maize farmers and 11 non-GM maize farmers from wards one and two of the municipality which had an estimated number of 1 100 smallholder farmers. Of the 47 GM maize farmers, 40 of them cultivated white stacked maize compared to seven who planted white Bt maize.

Within the broader local municipality, Stats SA (2012) recorded 7 254 agricultural households of which 32% were engaged in livestock farming compared, to 36% and 23% who were engaged in poultry and vegetable farming respectively. Nine percent were engaged in “other” farming activities (Stats SA 2012).

Box I: Who is the typical non-GM maize farmer?

Name: Luthando Mabaso * Name has been changed

Age category: 55-64

Occupation: pensioner

Monthly household income: R 1 001 – R 1 500

Ms Mabaso first heard about GM maize seeds from the local agricultural extension officer during a farmers’ day a year ago. She remarked that she could possibly cultivate GM maize if the price was significantly reduced and she received more information about the seeds. *“What exactly are these seeds? I want to know more...for now I cannot afford to buy them. I have no husband and my children do not work either.”* She grows both Pannar and traditional maize, *“When I grow Pannar maize, I can sell it and make a little bit of money. I like the Zulu maize for its sweet taste.”*

5.2 Demographics of the respondents

5.2.1 Ages of respondents

The majority of GM maize farmers interviewed fell between the ages of 55 - 65 years old and represented 39% of the sample population (Fig 5.1). Farmers which fell into the 45 - 54 and 34 - 44 age range were 19% and 17% respectively. The younger farmers between the ages of 18 - 24 years made up two percent. Another two percent represented older farmers of 88 years and more while the 66 - 76 age range accounted for 19% and the middle aged farmer of 34 – 44 years comprised two percent of the sample population.

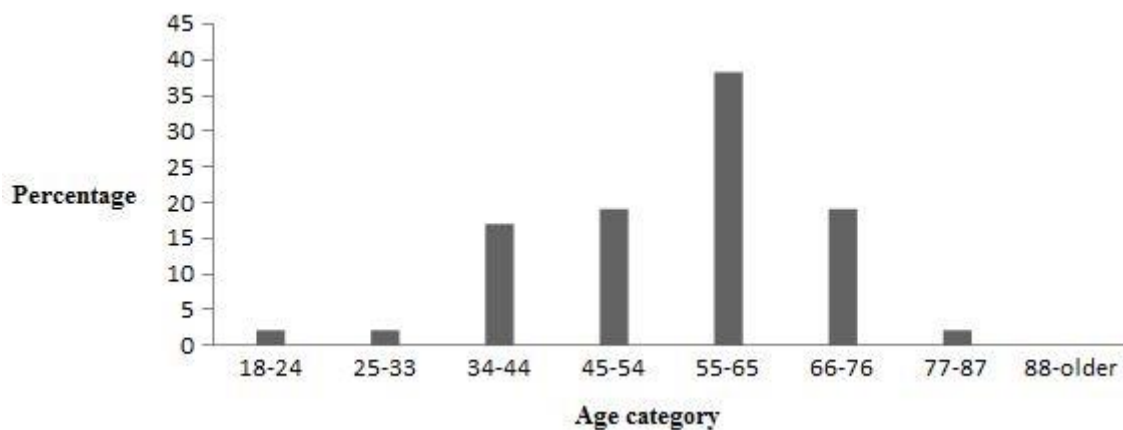


Figure 5.1: Ages of the interviewed GM maize farmers

5.2.2. Sources of income

The farmers were asked to identify the three most important sources which contributed to their monthly household income and these were tallied in Table 5.1. Pensions, self-employment, and child grants were among the most identified sources of incomes. Self-employment in this study included activities such as providing transport for school children, and selling poultry, vegetables, and reed mats. Those who received formal income included two cleaners and two school teachers.

Table 5.1: Income sources

Sources of income	Number of times identified by respondents
Pension	22
Child grant	12
Employment	4
Self-employment	20

5.2.3 Monthly household income

The largest proportion of GM maize farmers interviewed (53%) had a monthly household income between R1 001 - R 1 500 compared to 28% who received R1 501 - R 3 500 (Fig 5.2). A further fifteen percent had a monthly income of less than R1 000. Less than five percent of farmers had a monthly household income between R3 501 - R5 000. No respondent reported receiving more than R5 000 on a monthly basis.

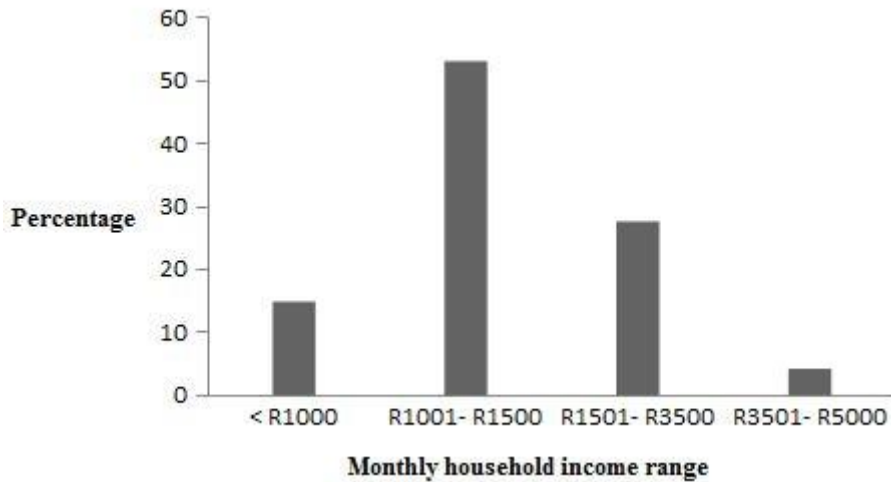


Figure 5.2: The monthly household income range of the GM maize farmers

These monthly household income ranges were below both the black household national average of R5 051 and provincial average of R6 921, indicating that Hlabisa is among the poorest areas of South Africa. These amounts are also significantly lower than the national monthly household income of the white population of South Africa whose average was R30 427, highlighting the continued inequalities within South Africa (Stats SA 2012).

5.2.4 Levels of education

Only 17% of the sample population had completed their high school education, while 49% of respondents had not completed their primary school education (Table 5.2). The percentage of respondents who had incomplete high school education matched those who had no formal education. This was represented by 15% of the sample population. Of the sample population, four percent had completed their primary school education.

Table 5.2: Comparison of education levels between Hlabisa respondents and local municipality (Stats 2012)

Levels of education	Case study area percentage	Hlabisa local municipality percentage
No formal education	15%	21%
Incomplete primary school education	49%	17%
Complete primary school education	4%	5%
Incomplete high school education	15%	27%
Complete high school education	17%	27%
Tertiary education	0%	3%

The levels of education revealed by Stats SA (2012) diverge from the results captured in this study. Of the people in Hlabisa local municipality, 27% had completed their high school education and three percent had some level of post Grade 12 education, compared to 17% of people who had some level of primary school education (Table 5.2). However, the Stats SA data was aggregated from the population of the local municipality versus the data in this study which were obtained from a narrow sample size.

5.2.5 Type of labour utilised

Some of the interviewed GM maize farmers expressed that their sources of farm labour had diminished over the years due to a lack of interest by their children in agriculture, and the children in turn migrating to the city in search of non-farm employment. Reciprocal labour from neighbouring farmers, friends, or members of their Farmers' Association was used by 15%, while 11% were self-reliant and used no additional farm labour. Farmers who used both family and hired labour accounted for four percent of respondents. Another 11% used only hired labour. As can be seen from Fig 5.3 the majority (59%) of GM maize farmers interviewed have relied on family members to carry out farming activities in the past years.

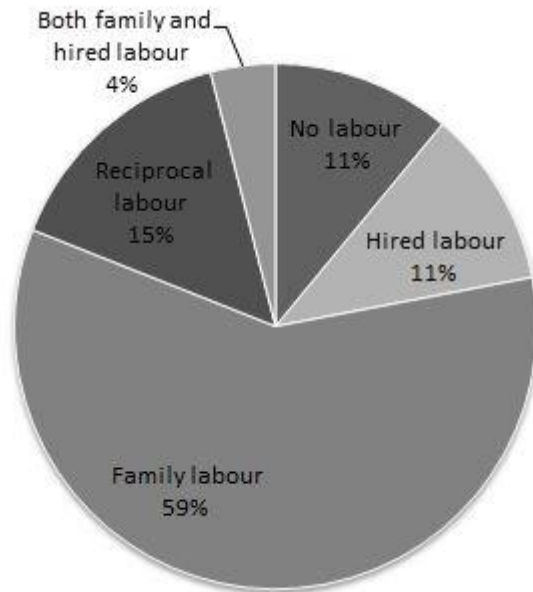


Figure 5.3: Type of farm labour used by the respondents

Forty percent of the interviewed GM maize farmers reported that they experienced farm labour changes when they cultivated GM maize seeds; the remaining 60% reported no changes. The most common farm labour changes were linked to experiencing less labour intensive work and using more reciprocal and hired labour.

5.3 Factors influencing the choice to use GM maize

Respondents who had continuously been using GM maize seeds for one to five years accounted for 40% compared to 17% who had been using GM maize seeds for 10 years (Table 5.3). This might suggest that there have been low levels of uptake of GM maize in the area.

Table 5.3: The number of years of GM maize seed use by GM maize farmers

Number of years	Number of respondents (n=47)	Percentage (%)
1. 10 years	8	17%
2. 5 - 9 years	7	15%
3. 1 - 5 years	19	40%
4. Years not remembered	13	28%

Another 15% of farmers had been using GM maize seeds for five to nine years, and 28% could not remember the number of years they had been using GM maize seeds (Table 5.3).

Of the smallholder farmers interviewed, 28% stated that their experience with receiving or witnessing “good yields” motivated them to use the GM maize seeds. The GM maize farmers did not explicitly state that the performance of traditional maize weakens over time but rather that they first perceived the performance of hybrid maize to be better than their traditional

maize. With the introduction of GM maize, the perception evolved to GM maize performing better than both traditional and hybrid maize (Fig 5.4).

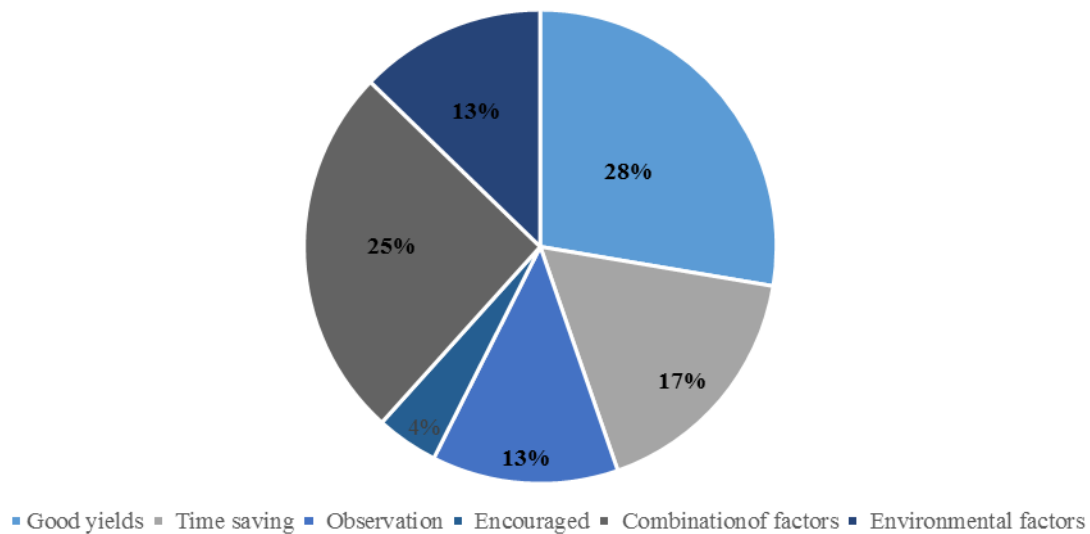


Figure 5.4: The range of factors motivating the uptake of GM maize by the respondents

A range of factors motivated 25% of the GM maize farmers to cultivate GM maize. These included witnessing “better” yields from GM maize compared to non-GM maize in field trials or a neighbouring GM maize farmer. Another influencing voice came from agricultural extension officers who advised non-GM maize farmers about the benefits of GM maize over traditional maize (Fig 5.4). Of those farmers using GM maize seeds, 17% did so because they perceived them to be less labour intensive, which saved them time, compared to 13% who believed that GM maize performed better than traditional or Pannar hybrid maize in hot conditions. Another 13% observed the performance of GM maize on other fields which motivated them to use the seeds. Only four percent of farmers stated explicitly that they began using GM maize seeds after being advised by other GM maize farmers of the DoA, and provided no additional motivating factors.

If information is regarded as a resource, it can be argued that farmers who were part of the Champion GM maize farmer’s social network/s were more knowledgeable about GM maize seeds than farmers outside the social network/s. For instance, some non-GM maize farmers claimed that they knew nothing of farmers’ days. Informing farmers about farmers’ days was the responsibility of the local DoA, but it would be easier for a smallholder farmer to know about such events if he or she were a part of an informed social network. For instance, a first time user of GM maize seeds was disappointed with her yields because she claimed that she was not aware that she had to buy manure and fertiliser with these new seeds. *“The way I understand farming and what my mother told me was that there is already some richness in the soil. I did not know that I had to buy fertiliser with these seeds.”* (Respondent 31, Hlabisa, 10 April 2015).

It can be argued that the GM maize farmers and information days are vehicles for social learning. Farmers had the opportunity to learn about GM maize from a fellow farmer. The

Champion GM maize and others, who initially experimented with the GM maize seeds and who were seemingly successful. This could have diffused GM maize in Hlabisa.

5.3.1 Key institutional and social factors influencing GM maize farmers

The section will firstly analyse institutional and social factors which have played a role in the decision-making processes of the respondents, and then delve into those factors that were most influential⁵.

There were mixed views on the influence of traditional authorities over agricultural decision-making processes of the farmers in Hlabisa. The chief received a higher ranking from Phakamani Farmers' Association as they recognised her role in local land issues and governance (Table 5.4). Others gave her a ranking of zero as they believed that she had no influence over their agricultural decisions. The chief claimed that she had minimal influence over agriculture in Hlabisa or in assisting farmers, "*They ask for help from agriculture [DoA] and not from the chief because there is no budget for them [no budget to support farmers in the area]*" (Chief of Hlabisa, 11 January 2016, Hlabisa). The chief expressed that she had no working relationship with Monsanto and had only met the seed company once at the Mgovuzo' farmers' day in 2012.

Some of the farmers recognised the *Ndunas'* roles⁶ in allocating land for demonstration plots and communal gardens, thus the *Nduna's* circle was larger compared to other institutions (Fig 5.5). "*We cannot just farm anywhere without asking land from the Nduna*" (Female farmer 3, Amaqawe focus group discussion, 13 January 2016).

Focus group respondents unanimously agreed that a farmer had the most influence over his/her agricultural decisions, "*The farmer has the most power, he decides what seeds to plant because agriculture [DoA] advises and Monsanto supplies the seeds*" (Male farmer 1, Ndlovukazi focus group discussion, 12 January 2016). Farmers' Associations were considered to be the most important and influential actors followed by the local DoA. This sentiment was held by members of both Amaqawe and Phakamani compared to Ndlovukazi which ranked Monsanto higher than the local DoA (Table 5.4).

⁵ Venn diagrams were used to illustrate the relative importance of institutions to the farmers by using different sized circles (See Fig 5.5). A ranking of one is the most influential and as the number ranking increases, it implies the institution is less influential.

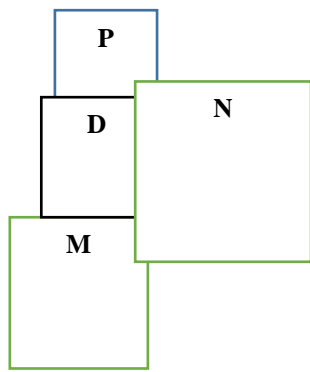
⁶ Under African Customary Laws chiefs and their ndunas can allocate land for settlement, grazing fields, and communal lands (Himonga and Nhlapo 2014).

Table 5.4: Ranking of institutions helping GM maize farmers in Hlabisa

Institution	Rankings		
	Ndlovukazi	Phakamani	Amaqawe
Farmers' Association	1	1	1
Local Department of Agriculture (DoA)	2	2	2
Monsanto	3	7	3
Pannar	4	7	6
Chief	0	4	0
Nduna	0	5	4
Municipality			5
Ward councillor		6	
Vemken		7	
Leader Farmers' Association (LFA)		3	

Another important institution operating in Hlabisa is the LFA (Leader Farmers' Association) according to the Champion GM maize farmer. The LFA is a committee which consists of representatives from five areas in Hlabisa and agricultural extension officers who meet annually to review issues faced by farmers and discuss potential solutions.

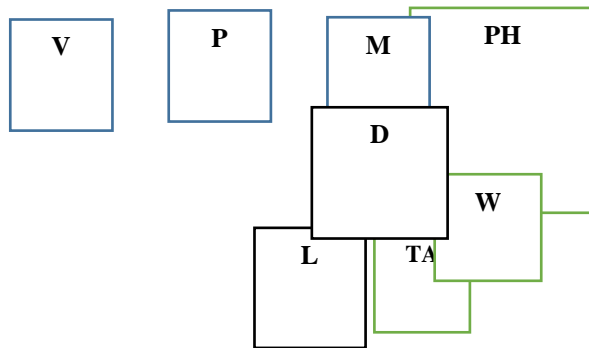
Ndlovukazi Venn diagram



Venn diagram key:

A-Amaqawe	TA -Nduna
D-Local DoA	W-Ward
L-Leader's Farmers' Association councillor	V- Vemken
M- Monsanto	
MC- Municipality	
N- Ndlovukazi	
P- Pannar	
PH- Phakamani	

Phakamani Venn diagram



Amaqawe Venn diagram

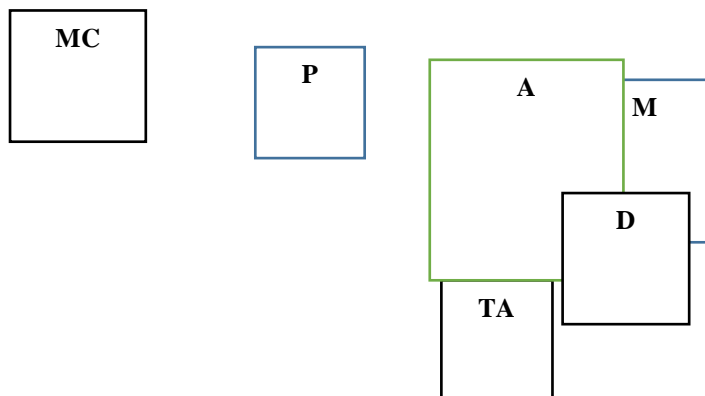


Fig 5.5: Venn diagrams of all the focus groups

5.3.1.1 Ward councillor and municipality

Another interesting observation came from the inclusion of the ward councillor and municipality in the farming decisions of Phakamani and Amaqawe (Fig 5.5). Ndlovukazi did not regard the municipality as an influential body, but rather viewed it as an institution which was associated with the local governing political party, either Inkatha Freedom Party (IFP) or African National Congress (ANC), and was responsible for handling basic services such as water, electricity, and maintaining roads. Phakamani and Amaqawe regarded these local government representatives as people who could raise their agricultural issues and concerns beyond the community level.

5.3.1.2 Vemken

Vemken, a local seed and chemical distributor based in Pongola, was seen as an extractive institution by one, “*they [Vemken] just want our money. They do not feel for us, they don’t empathise with us. I do not even think they will contact us ever again [He did not think Vemken would return the Monsanto depot⁷]*” (Champion GM maize farmer, Phakamani focus group discussion, 13 January 2016). Interestingly, he did not see Monsanto in the same light even though the seed company charges them heavy prices for their products.

5.3.1.3 Seed companies and local department of agriculture

The agricultural extension officers were regarded as the local DoA, so farmers would interchange the two terms. The farmers had the longest working relationship with agricultural extension officers who encouraged them to form Farmers’ Associations, and have acted as intermediaries between smallholder farmers, traditional authorities, and seed companies. The local DoA was perceived to be strongly supportive of GM maize farmers and farmers in Farmers’ Associations. Tractor services, packets of fertilisers, and manure were reportedly received from the local DoA by 42% of the interviewed GM maize farmers compared to 58% who claimed they received no support with their use of GM maize seeds. A non-GM maize farmer also claimed that she was denied gardening tools and assistance from the local DoA because she was a stand-alone farmer. “*I asked for help at agriculture [DoA] for farming equipment and they told me that I can get it at Spar [a supermarket]. I would get stuff [tools] if I were part of a farmers’ group*” (Respondent 8a, Hlabisa, 07 April 2015). Moreover, the local DoA seemed selective in its provision of tractor services; the agricultural extension officer explained that some smallholder farmers have the option of either using/hiring oxen to plough their GM maize fields, hiring a tractor, or applying to use a tractor provided by the local DoA. However, the heads of the Farmers’ Associations had the privilege of using the tractors without applying to the local DoA because their lands were used as demonstration plots. “*He [Champion GM maize farmer] is the only one who gets the tractor, what about us?*” (Respondent 21, Hlabisa, 27 March 2015).

The GM maize farmers indicated that they had a closing working relationship with Monsanto compared to Pannar (Fig 5.5). The Champion GM maize farmer remarked on how he perceived the relationship he had with Pannar and Monsanto. “*They [Pannar] just planted them [maize seeds] but they did not come to check their trials. Monsanto is always with us, if*

7 The depot was provided by both Monsanto and Vemken (Monsanto Agent, 10 September 2015, Johannesburg)

we want seeds, they [Monsanto] are here. If we run out seeds, they are here [they will deliver the seeds]. Pannar has distanced itself from us They have changed the way they do things. The extension officer had an account with them but this changed in 2014. They said if farmers want their seeds, they must say how much they want and collect money for the payment. If you want [Monsanto's] seeds they will bring them [to you], they will give you an account number, [and] you go and deposit the money. They [Pannar] are Monsanto's competitors. The communication with Monsanto is excellent" (Champion GM maize farmer, Phakamani FA focus group discussion, 13 January 2016).

The presence of Monsanto at the farmers' day may have transformed Monsanto into additional agricultural advisors in Hlabisa. At the superficial level it may seem like Monsanto was embedded in the communities (Fig 5.5), but at a deeper level it actually sent 'agents' or salesmen. These provided pseudo-extension and advisory services to a subset of smallholder farmers who have been influenced to use these seeds, and who have close links with the local DoA. The term pseudo is used here because the agents were promoting GM varieties instead of enquiring about, or being aware of, the local needs and problems of farmers in Hlabisa. Moreover, their services were only limited to GM maize farming.

5.3.2 Financial costs

The pricing and packaging of the GM maize seeds seems to be area dependent. For example, GM maize seeds were available in smaller cheaper packages in Nongoma than in Hlabisa in 2014/2015 (Table 5.5). Nongoma's local DoA sold smaller bags of 1kg and 2kg of GM maize seeds for R100 and R200 respectively.

Table 5.5: GM maize seeds price comparison in Hlabisa and Nongoma*

Area	5kg bag of GM maize seeds	10kg bag of GM maize seeds
Hlabisa	R550	R950
Nongoma	R480	R950

(*Data collected during the scoping trips in KwaZulu-Natal province, November 2014)

In Hlabisa a 10kg bag of GM maize seeds cost R950 in the 2014/2015 season while a 5kg bag of GM maize seeds cost R550. Associated chemical inputs such as fertilisers, manure and Roundup were additional to these expenses and amounted to about R 1 500. The Bt maize farmers cited choosing Bt over the Ht or stacked maize variety because of their inability to afford the herbicides (Roundup and RoundupMax which cost R 120 each per litre).

No debts related to the use of GM maize were reported by 51% of the interviewed GM maize farmers, while 49% experienced debts (Fig 5.6). The farmers with debts asked for loans from friends, farmers, Farmers' Associations, and bought inputs on credit from the trader of these agricultural biotechnology products. Others opted to also borrow Roundup from other GM maize farmers.

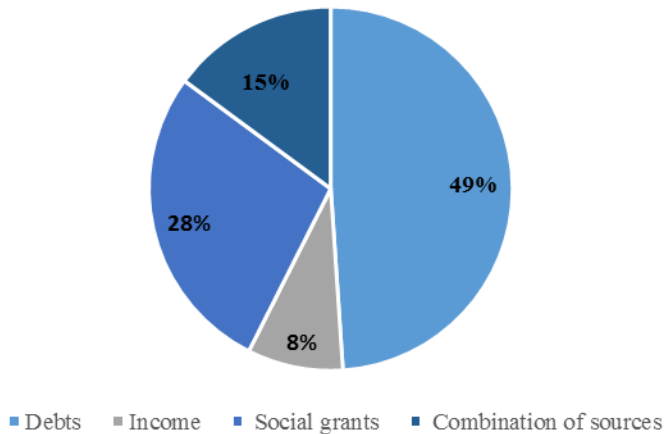


Figure 5.6: The sources of money used to purchase GM maize seeds in Hlabisa

Within the 51% of farmers who experienced no debts, 15% of them used a combination of sources such as their sales from maize, other vegetables, reed mats, and poultry, as well as social grants to purchase the GM maize seeds (Fig 5.6). Another 28% of the farmers used social grants such as their pensions and child grants to pay for GM maize seeds, while 8% used their formal income.

As noted, the farmers are amongst the poorest in South Africa with the majority unemployed. It is thus not surprising that they used social grants to cover their GM maize expenses. *“The money [from child grants] helps us because it is the only money we have, there is no other money”* (Female farmer 6, Amaqawe focus group discussion, 13 January 2016). An important finding was one that explained how farmers justified using their social grants to purchase expensive inputs. *“We use the child grants at first to buy the seeds and then after we have harvested the maize, we can sell it and put money aside for manure, for seeds and use some of it [use some of it on other expenses]”* (Female farmer 2, Amaqawe focus group discussion, 13 January 2016). Perhaps it is not useful to speculate about the purchasing behaviour of the farmers in a scenario where they received no state subsidies, will they find alternative ways to buy their inputs or not buy them at all? These results have highlighted how South Africa’s policies on redistribution of wealth and poverty reduction have yet to see success. The Hlabisa farmers have displayed the financial strains and coping traits of poor and marginalised individuals.

5.4 The GM maize growing areas

There were three areas that were identified as the GM maize growing areas by the farmers namely: (i) the home garden, (ii) a large plot of land within the homestead, and (iii) a plot of land which was a few metres or kilometres away from the homestead. This represented the available land farmers had for growing crops.

Farmers referred to their home gardens as *“igardi”* and the larger plots of land were referred to as *“amasimu”* which means fields. In this study a home garden generally referred to a plot of land which was about an eighth of a hectare. It is important to note that some farmers who had additional land used their home gardens to grow solely non-GM maize crops and exclusively grew GM maize on their larger plots of land. These larger fields ranged from a quarter of a hectare to one hectare or more.

The farmers without any additional land grew their GM maize in their home gardens, and in some cases used communal gardens to grow their non-GM maize crops. Not all respondents had large plots of land within and outside of their homesteads. Moreover, some of the farmers left fallow plots of land which were a few kilometres away from their homesteads due to the lack of fencing. The fencing would offer protection against roaming livestock which would eat the cultivated crops.

GM maize seeds were planted by 54% of GM maize farmers in their home gardens (Fig 5.7). Another 24% grew their GM maize seeds on the plots of land within their homesteads. Twenty-two percent of the respondents grew the GM maize outside their homesteads.

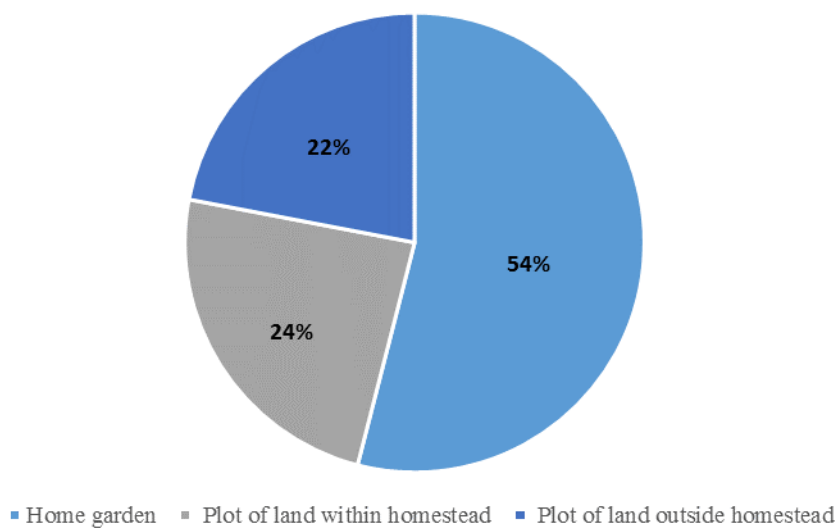


Figure 5.7: The three identified GM growing areas in Hlabisa indicating the percentage of GM maize grown in each area

5.4.1 Changes in crops grown before and after the uptake of GM maize seed

The crops grown before and after the uptake of GM maize seeds included potatoes, sweet potatoes, juko beans, groundnuts, watermelon, butternut, cabbage, and spinach. The uptake of Ht or stacked maize seeds will require the spraying of Roundup. The herbicide will kill all non-GM crops whilst the Ht or stacked maize survive, thus theoretically the uptake of such seeds should prevent intercropping. Farmers in the study grew their non-maize crops separately from the GM maize crops in their home or communal gardens. Table 5.6 lists the crops where changes were noted in terms of the farmers choosing to continue cultivating or abandoning a crop as a direct result of using GM maize seeds.

Table 5.6: Crops grown before and after the uptake of GM maize seed

Types of crops	Grown before GM maize seed uptake		Grown after GM maize seed uptake	
	Number of respondents	Percentage	Number of respondents	Percentage
Traditional maize	20	43%	9	19%
Pannar hybrid maize	12	25%	3	6%
Beans	15	32%	14	30%
Pumpkin	2	4%	1	2%

Prior to the uptake of GM maize seeds, 43% of GM maize farmers reported that they grew traditional maize in their fields. The act of using GM maize seeds reduced this figure to 19%. It was not known how many farmers abandoned traditional maize when they began using hybrid maize. However, there were some GM maize farmers who revealed that they stopped cultivating traditional maize when they started using hybrid maize (Table 5.6).

Only six percent of farmers continued growing Pannar hybrid maize after they began using GM maize seeds, compared to 25% who cultivated Pannar hybrid maize prior to their exposure to GM maize seeds.

5.4.2 Cropping patterns

Images of the GM maize growing areas were drawn to reveal whether or not the GM maize farmers were planting any refugia, and also to depict any changes in crop arrangement.

The dominant cropping arrangement was GM maize mono-cropping. There were a few cases where some farmers planted pumpkin, butternut, or beans in either the first or last GM maize rows (Fig 5.8). There were exceptional cases where some respondents planted their GM maize in close proximity to Pannar hybrid and traditional maize (Fig 5.9). The extent to which GM maize was planted next to non-GM maize was small and mostly found in home gardens. The non-GM maize was not sprayed with Roundup.

The farmers who chose to plant GM and non-GM maize in the same field were attempting to maximise the GM maize growing area, and also to reserve space for growing other crops besides maize. This contravenes the requirement to create a buffer zone between GM and non-GM maize, i.e. GM maize farmers are required to separate non-GM and GM maize to reduce pollen drift and prevent insect resistance (Kruger et al., 2012).

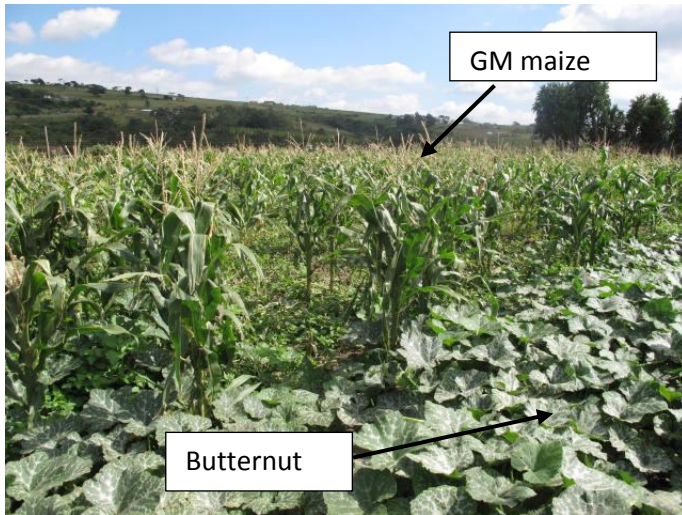


Figure 5.8: Butternut planted next to white stacked maize

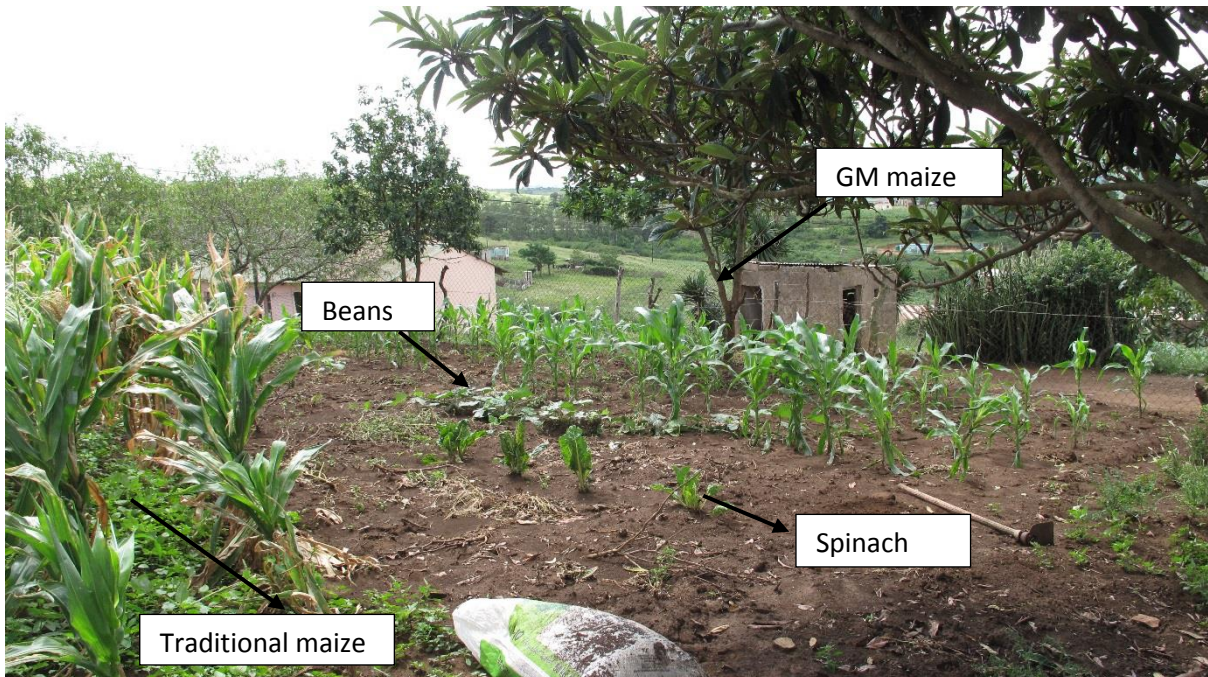


Figure 5.9: An example of a home garden which consists of white stacked maize, non-GM maize and other crops

5.4.3 Using refugia and insect pressure

When GM maize seeds are purchased, a 250g bag of conventional maize seeds is found inside the 10 kilogram (kg) or 5kg bag of GM maize seeds purchased. These 250g of conventional maize seeds are meant to act as refugia when planted. However, in this study the role of these seeds was unknown as only nine percent of the farmers interviewed used them as refugia. Examples of refugia designs used by farmers in this study are shown in Fig 5.10.

Farmers are required to plant a refuge area with the use of Bt crops and under the Technology Use Agreement a farmer is required to firstly indicate where he/she plans to plant the seeds, and secondly to ensure that 20% of the field is planted with non-Bt crops. In a case where a farmer is not spraying any herbicides, 5% of the land should contain non-Bt crops as stipulated in the contract (Thomson 2008).

In this case the farmers claimed they were not aware of any contractual obligations. No farmer reported having signed a contract obliging them to plant their GM maize seeds at a specified site, or prohibiting them from saving or exchanging seeds and using refugia. However, the Monsanto agent suspended three smallholder farmers in Simdlangentsha, KwaZulu-Natal from using Bt maize in 2014/2015 for two years as they had failed to plant refugia. Some respondents had copies of leaflets written in English from Monsanto explaining the concept of refugia. However, the majority of farmers had not completed their primary school education so it was very likely they are not literate and thus the documents were not useful to them. The Monsanto agent claimed that the contract and leaflets were explained to the farmers in isiZulu. He added that Monsanto has outsourced consultants who will inspect whether farmers are practising refugia.

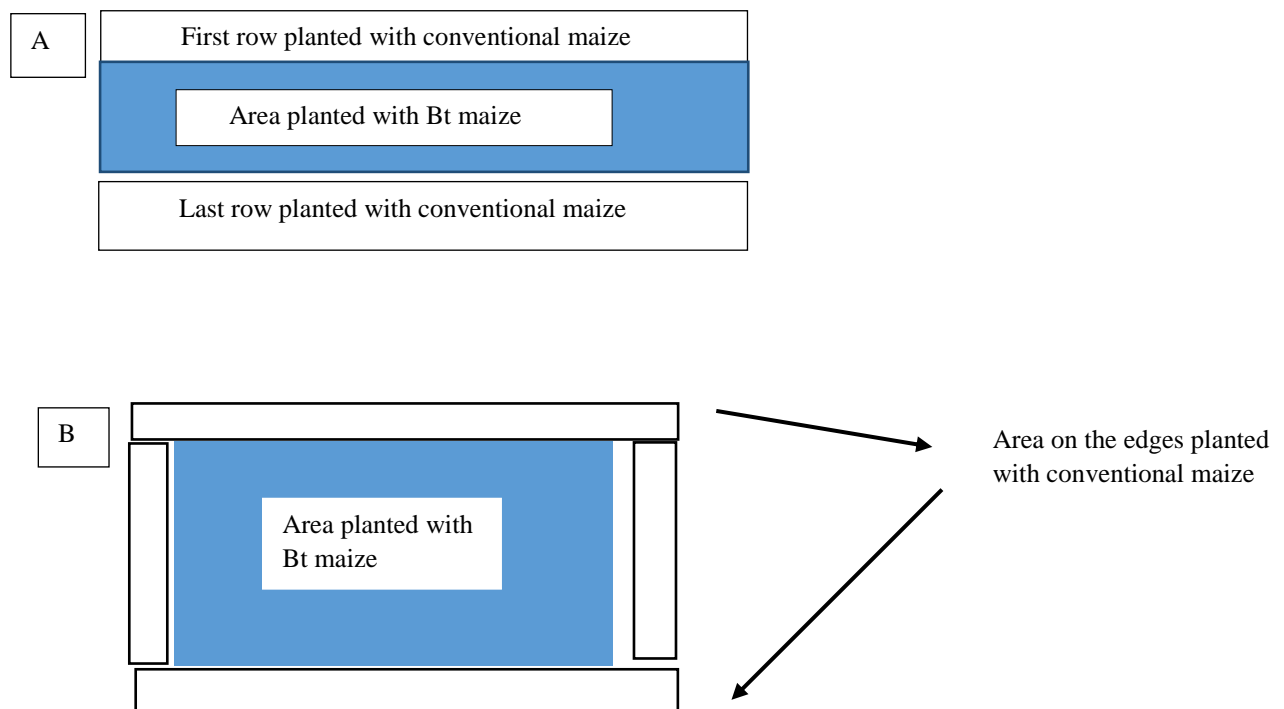


Figure 5.10: Examples of refugia designs used by some the Bt maize farmers

The use of refugia as a strategy to delay the development of Bt-resistant insects seems very *ad hoc*, and it was clear that refuge compliance and monitoring occurred, or was occurring, after the fact in Hlabisa. The implications of non-adherence could hasten the evolution of Bt-resistant insects which could make the technology less effective and might require increased pesticide use (van den Berg 2012).

When they began using the GM maize seeds, 69% of GM maize farmers claimed that they had not received any advice to deal with insect pests. Those who received advice got it from agricultural extension officers during farmers’ days. The advice came in the form of teaching farmers how the Bt trait prevents attacks from stalk borer, and to place pills ⁸ in their maize storage tanks to prevent attacks from weevils, and using chemicals to target cutworms.

There were some farmers who believed that they only needed to plant their stacked or Bt maize seeds to prevent insect attacks without taking any extra precautions. “*Just use the seeds that have been prevented from getting stalk borer and they will do the work [of killing stalk borer]*” (Respondent 45, Hlabisa, 28 March 2015).

Perceived changes in insect pressure after the uptake of GM maize seed

The perceptions of changes in both insect and weed pressure on stacked maize seed farmers were analysed separately from Bt maize seed farmers as the smallholder farmers used different types of agricultural technology.

It was mentioned earlier that there were seven Bt white maize seed farmers in this study and 86% of them claimed that they experienced no problems with stalk borer while 14% complained about the presence of stalk borer inside the Bt maize cobs.

The respondents were asked to answer whether they had perceived more, less, or no change in insect pressure since they began using their respective GM maize seeds. Of the stacked maize seed farmers, 53% claimed to experience no insect pressure after planting, while 22% reported that they had experienced no changes in insect pressure. One farmer experienced more insect pressure with the uptake of stacked maize seeds compared to 22% which reported experiencing less insect pressure (Table 5.7). A sign test with two-sided alternative, showing that there were more of those stating there was less insect pressure, suggested that there was significantly less insect pressure after the uptake of GM maize seeds at 5% level significance.

Table 5.7: Perceptions of insect pressure after the uptake of white stacked maize seed

Type of insect pressure	Number of respondents (n=40)	Percentage (%)
No insect pressure	21	53
No change in insect	9	22
More insect pressure	1	3
Less insect pressure	9	22

8

A pill is used to supposedly prevent pest infestations while maize is in storage. Farmers were unable to reveal the name of the pill. However, QuickPhos is an example of a storage pill, its main ingredient is Aluminium Phosphide (QuickPhos 2014)

No maize insect pest management strategies were reported by the non-GM maize farmers, “*There is nothing I can do to deal with them [insect pests]*” (Respondent 4a, Hlabisa, 03 April 2015), “*That’s a problem [insect pests are a problem]. There are no chemicals to kill them. I just replant [the farmer replants the maize when it has pest infestations]*” (Respondent 1a, Hlabisa, 30 March 2015).

Among the non-GM maize farmers sample population, some farmers reported that as the insect pressure changes seasonally and they are “*lucky*” at times and “*unlucky*” at others, depending on the amount of rainfall they received in a particular season. “*I was lucky this year. There were no insects because it did not rain a lot so there were not a lot of insects [a lot of insect attacks]*” (Respondent 2a, Hlabisa, 08 April 2015).

5.4.4 Perceived changes in weed pressure after the uptake of GM maize seeds

Less weed pressure was experienced by 40% of stacked white maize seed farmers since they began using Roundup, while 28% of them reported that weeds still persisted in their fields (Table 5.8), “*The weeds die when you have sprayed but they come back again, I do not know how many times I should do it [spray the fields] because it [Roundup] is expensive*” (Respondent 1, Hlabisa, 07 April 2015). Another respondent claimed that Roundup seems to be ineffective when it comes to killing weeds, “*It [Roundup] does not help a lot. It is as if I have not sprayed at all. It [weeds] keeps coming back*” (Respondent 26, Hlabisa, 01 April 2015). There was an emergent weed that one respondent was unable to identify, “*there was a different kind of weed that wasn’t there before*” (Male farmer 1, Phakamani focus group discussion, 13 January 2016). Only one farmer claimed to have experienced more weed pressure, while 30% of stacked white maize seed farmers claimed that they experienced no weed pressure with the use of Roundup.

Table 5.8: Perceptions of weed pressure after the uptake of white stacked maize seed

Type of insect pressure	Number of respondents (n=40)	Percentage
Less weed pressure	16	40%
Weeds are persistent	11	28%
No change in weed	1	2%
More weed pressure	12	30%

A sign test with two-sided alternative, stating that there were more respondents experiencing less weed pressure, did not detect any significance changes at 5% or 20% levels of significance.

The Monsanto agent explained that in order for Roundup to be effective at killing weeds, rain must not fall for three hours after the fields have been sprayed. Now he advises the farmers to use Roundup PowerMax which has a shorter waiting period of two hours. In drought scenarios shorter waiting periods seem irrelevant.

In summary, the face of home gardens has changed from consisting of multiple crops to the mono-cropping of one staple crop. Additional home gardens have emerged where smallholder farmers plant non-GM crops separately from the GM maize. There were exceptional cases where GM maize was intercropped with pumpkin. The farmers were not using the recommended distances to separate GM and non-GM maize in Hlabisa. Furthermore, a few of the farmers used refugia which has implications for insect resistance.

Lastly, the farmers have perceived less weed and insect pressure after the uptake of GM maize.

5.5 Understanding of GM maize

5.5.1 How are GM maize seeds defined by the farmers?

Smallholder farmers used a range of distinct names when referring to maize seeds. Traditional maize seeds were called “Zulu” while modern maize seeds were often referred to as “*izimbewu zesilungu*”. *Izimbewu* means seeds in isiZulu while *zesilungu* means western, i.e. western seeds. In this case the western seeds were either hybrid or GM maize seeds. In this study all of the GM maize farmers were aware that there were three types of GM maize seeds available, i.e. stacked, Ht or Bt maize seeds.

The hybrid maize seeds were referred to as Pannar or “hardware” seeds (farmers bought these seeds at a hardware store located in the Hlabisa CBD) whereas the GM maize seeds were either called Monsanto, or Champion GM maize farmer’s seeds as he was responsible for selling them.

The only respondent who used the terminology of “GM” was the champion GM maize farmer, who was able to describe what these seeds were and referred to them as “MGOs”.

“It has a gene that is not controlled by the chemical so you have to use your hands [you have to remove weeds physically with your hands]. This is DKC 77 - 35B, the B stands for a bacteria [bacterium] which is not eaten by the stalk borer... but this one that says BR means it is combined. It has both the bacteria and Roundup” (Champion GM maize farmer, Hlabisa, 20 November 2014).

The common definitions of GM maize seeds were focused on the characteristics of the GM maize seeds which were perceived to be two to three cobs per stalk; no tillage but using chemicals to control weeds; not affected by stalk borer; and its ability to dry quickly.

In South Africa, maize is harvested when its moisture content falls to between 12 - 14%. This moisture is traditionally removed through sun drying to reduce physiological damage and discolouration (du Plessis 2003). Respondents in the study believed that it took a shorter time to dry GM maize than traditional maize.

Another perceived characteristic of GM maize shared by the respondents was its ability to withstand hot conditions. Some farmers perceived GM maize to be more drought tolerant than traditional maize.

Respondent 15: *“the Zulu burns in the sun unlike this [GM maize]”*

Interviewer: *“But it [GM maize] seems burnt to me “*

Respondent 15: *“Yes, but the Zulu would have just burnt a long time ago* (Hlabisa, 01 April 2015)

This view was however subjective as some non-GM maize fields were not burnt contrary to the belief held by the interviewed GM maize farmers. For instance, Fig 5.11a depicts burnt GM maize compared to Fig 5.11b, where it shows the fields of traditional maize with green non-burnt leaves. The maize in the images was not ready for harvesting. When maize is ready

for harvesting the ear husks dry up and turn brown. No further comparisons were made with other fields.



Fig 5.11a: The burnt stacked maize fields (11 April 2015, Hlabisa)



Figure 5.11b: The field of a non-GM maize farmer (30 March 2015, Hlabisa)

5.5.2 Challenges faced when explaining GM maize seeds to smallholders

The Monsanto agent conveyed that it was difficult trying to explain scientific terminology to illiterate smallholder farmers, and pictorials were mostly used to explain how the varieties of GM maize seed work. For instance, the Monsanto agent used a picture of a mule to explain why GM maize seeds cannot be replanted or saved for the next seasons. *“I try to explain that there are two inbred lines used to make a hybrid which will not reproduce through showing them a mule. They seem to understand that a mule will not reproduce”* (Monsanto agent, Johannesburg, 10 September 2015).

One interesting finding was the level of ease that the Monsanto agent had with explaining the toxicity of the Bt gene to Zulu smallholder farmers, and the difficulty he faced when explaining the same concept to Venda smallholder farmers. The Monsanto agent claimed that the Zulu smallholder farmers traditionally poured soil grains into the funnel of the maize to get rid of stalk borer. He recalled explaining to the Zulu smallholder farmers that the Bt gene was extracted from the soil. *“It was easier for them to understand that the Bt gene would not*

cause any harm to their children who played in the soil as they previously used soil as a pest management strategy in the past”. However, the Venda smallholder farmers he dealt with used to burn particular herbs to kill bees and weevils, and were not familiar with the soil technique used by the Zulu smallholder farmers. This made it difficult to explain how the Bt gene worked to kill stalk borer.

It was revealed through the focus group discussions, that this technique was no longer used by the farmers. However, some traditional insect pest management strategies are still used for other non-maize crops.

5.5.3 Maize seed saving and exchange patterns

Overall the uptake of GM maize has not significantly affected the practice of seed saving and exchange among the respondents. Maize seeds were neither saved nor exchanged by 52% of GM maize farmers, compared to 48% who saved and/or exchanged their seeds. These percentages are not significantly different from each other (Table 5.9). The sample size was too small to draw any major conclusions from the data.

A chi-squared test for independence was run, with a null hypothesis that respondents in the three groups, “Monsanto”, “Monsanto and Pannar hybrid and/or traditional maize”, and “Pannar and/or traditional maize only”, were equally likely to save and/or exchange seeds as they were to do neither. The null hypothesis can be rejected at the 0.1 level of significance, i.e. there was very strong evidence that Monsanto maize growers were less likely to save and exchange seeds than other farmers.

Table 5.9: Number of farmers exchanging and saving maize seeds*

Type of seed	Number of farmers who save and/or exchange	Number of farmers who neither save or exchange
Monsanto	3 (7%)	18 (39%)
Monsanto and Pannar hybrid and/or traditional maize	6 (13%)	6 (13%)
Pannar hybrid and/or Monsanto	13 (28%)	0 (0%)
Total	22 (48%)	24 (52%)

*Three respondents were excluded from the analysis as they did not fit into the listed categories in the table.

The data in Table 5.9 was disaggregated to create Table 5.10 to give a better understanding of the farmers’ behaviour per maize seed, as opposed to giving analyses on “Monsanto and Pannar hybrid and/or traditional maize”.

Table 5.10: Percentage of GM maize farmers saving and exchanging different types of maize seeds

Type of seed	Percentage farmers who save and/or exchange	Percentage of farmers who neither save or exchange
Traditional maize	26% (12)	17% (8)
Pannar hybrid maize	15% (7)	13% (6)
Monsanto maize	11% (5)	13% (6)

Of the farmers interviewed, 26% reported that they saved their traditional maize seeds. The common reason given for saving traditional maize seeds was for the purpose of replanting (Table 5.10). Farmers who were not saving their traditional maize seeds expressed that they were no longer using those seeds, this was represented by 17% of the sample population.

What was interesting, however was that several farmers continued to save Pannar hybrid and GM maize seeds despite the fact that this was not effective. It would be easy to interpret this as solely a misunderstanding about the viability of these seeds. However, some farmers claimed that they were willingly replanting these seeds for two or three seasons as a cost-saving strategy even though it would not be entirely fruitful. *“We keep them [GM maize seeds] when we do not have money to buy the seeds and exchange with those who do not have the seeds”* (Respondent 6, Hlabisa, 08 April 2015). Of the interviewed farmers, 15% and 11% respectively saved their Pannar hybrid and Monsanto maize seeds (Table 5.10).

A first-time user of GM maize seeds said he would not save the seeds because he heard that the second generation seeds would no longer have the same stalk borer protection, while some farmers who were saving their GM maize seeds did so because they were pleased with the yields. The fact that seed saving of GM varieties is legally prohibited by the Technology Use Agreement was also not understood by farmers, suggested their potential liability should this requirement be enforced.

Others did not attempt to save or exchange their maize seeds because they knew that the Pannar hybrid and Monsanto maize seeds could not be kept for a long time. Some farmers felt it was no longer beneficial to exchange with others when money had been invested into purchasing seeds. *“This time is time for money [this is the time for money]”* (Champion GM maize farmer, Hlabisa, 09 January 2016).

Pannar hybrid and Monsanto maize seeds were exchanged by 13% of farmers (Table 5.10). *“Once I tried to save but I was not satisfied. Others say the yields are good but I do not believe it.”* (Respondent 15, Hlabisa, 01 April 2015). Farmers complained about purchasing the expensive GM maize seeds, but said it was something that they have grown accustomed to over the years. These farmers are prone to getting into debt as they have low household incomes (Bryan et al., 2010). The expensive input costs were the main deterrent in the uptake of the GM maize seeds among non-GM maize farmers and a former GM maize farmer (Box II).

Box II: Account from a former GM maize farmer

Name: Ntombini Dladla* Name has been changed

Age category: 45 - 54

Occupation: Teacher

Monthly household income: R 1 501 – R 3 500

Ms Dladla first began using stacked white maize seeds in 2011/2012 after she learnt about them at a farmers' day. She was initially drawn to the seeds because of their perceived ability to withstand dry conditions and good yields. She experimented with some GM maize seeds she purchased at Empangeni which were cheaper, but claimed they were not as good as the seeds sold by the Champion GM maize farmer. In 2012/2013 she abandoned GM maize because she disliked not being able to intercrop butternut and potatoes with the maize she planted. Moreover, the price of the seeds increased by R100 from R450. *“These [GM] seeds are good but we want a reasonable price, the fertiliser and manure are expensive as well. We want to grow maize and feed our families.”* She reverted to growing Pannar hybrid maize, *“we could go back to it [GM maize] if we experience dry weather and it is guaranteed to give good yields”*.

In summary, the inability to save and exchange GM maize seeds has made respondents modify their ideas and ideologies about maize seed saving and exchange. On the one hand there are some farmers who have seemingly accepted that they cannot save or exchange maize seeds. They have bought into the culture of purchasing maize seeds. Others have displayed a general confusion about the viability of the seeds through saving and exchanging Monsanto and Pannar hybrid maize seeds. This implies that there was a lack of awareness and understanding of GM and hybrid maize seeds, and the farmers were not aware that they had to plant refugia and are prohibited from saving or exchanging the seeds.

5.6 Perceptions in quality of life after the uptake of GM maize

Farmers were asked to indicate whether their lives had become better, worse, or remained the same after the uptake of GM maize seeds. The perception that they had a better quality of life with the uptake of GM maize seeds was shared by 74% of farmers interviewed, yet almost half of the farmers were in debt due to using the technology. A further 17% felt that their lives have remained the same. The increased ability of farmers to provide white GM maize for their families until the next harvest season, and small opportunities to sell surplus white GM maize, were associated with an improvement in quality of life.

Farmers who have been able to sell their surplus white GM maize made up 49% of the sample population although profits were marginal. Moreover, the farmers complained about having no markets to sell their surplus maize and having to resort to selling off their maize at cheaper prices. *“We found that placing the pill in the tanks makes the maize last longer but the problem is that we do not have a market where we call sell [maize] so we just sell to the community and the maize gets spoilt quickly. It gets bad and it is discouraging because now you are forced to reduce the selling price. For example, that big 20 litre water tank [maize was stored in water tanks] will go for R50 or R25 and then you throw it away when it gets spoilt”* (Female farmer 3, Amaqawe focus group discussion, 13 January 2016).

It can be argued that the ability to sell surplus GM maize could augment the farmers’ ambitions of being entrepreneurial smallholder farmers, but their realities do not yet foster an environment where they can do so as they lack markets, infrastructure, and financial support.

There were a few cases where farmers claimed to make significant profits but, claimed that their profits changed on a yearly basis. One farmer claimed that she was able to send two of her children to university with the money that she made from selling GM maize. Another was able to build a *rondavel*⁹ with the earnings she made from selling GM maize. The Champion GM maize farmer also made an undisclosed commission from being the trader of GM maize seeds and associated inputs.

Health implications

Respondents were asked to report any symptoms they experienced while using Roundup and reveal their perceptions about the safety of the herbicide.

9 A South African term for a hut

Roundup was not perceived to be safe to use by 39% of the farmers, while 61% believed that it was safe to use. *“Yes, it was in the papers that Monsanto is not that safe and causes certain illnesses. There was a lot hype about it but we are not sure”* (Male farmer 4 Ndlovukazi focus group discussion, 13 January 2016).

Symptoms such as chest pains and itchiness with the use of Roundup were reported by 22% of farmers, compared to 78% with no symptoms. Seventy-seven percent of farmers took precautionary measures such as using boots, gloves, raincoats, and nose masks when Roundup was being handled, while 23% used no protective measures.

5.7 Summary

This Chapter has revealed that the complexity of maize farming on and off the fields. The farmers were comprised of an old population; with 39% between the ages of 55 - 65 years old. Fifty-three percent received less than R1 500 per month through social grants and had a minimal education. The local Department of Agriculture was identified as one of the most influential institutions, and was used as a conduit by Pannar and Monsanto to introduce smallholder farmers of Hlabisa to modern maize varieties. GM maize farmers financed this expensive agricultural biotechnology through credit and the use of social grants. There was little understanding of GM and hybrid maize viability among farmers who still chose to save these seeds for replanting, and they had no awareness of their contractual obligations with Monsanto. The self-perceived improvement in quality of life by GM maize farmers contradicts their weak financial health as 49% were debt and had no market to sell surplus maize.

CHAPTER SIX - DISCUSSION

6.1 Introduction

Previous discussions about the role of GM crops in smallholder agriculture have tended to focus on the technical successes and failures of the GM crop technology and its appropriateness in resolving social problems (Thomson 2008; Altieri 2009; Jacobson 2013). The problem lies with the framing of GM crops where the targeted constituents are viewed as actors who want to increase their yields and thus farm income. There were several key findings in this study which have suggested the uptake of GM maize is a complex process. The hope is to help enrich theories about why and how smallholder farmers decide to take up an agricultural innovation.

The Chapter will illustrate the manner in which institutions were able to influence the Hlabisa farmers to use GM maize through their construction and transmission of GM crop knowledge (Fig 6.1). This notion is derived from the empirical observations and is supported by scholarship concerning discursive power and institutions (Newell 2009; Schmidt 2010). What is meant by discursive power? The concept of power has been interpreted in various ways in literature and can mean different things to different people or disciplines (Sadan 1997). For instance, power is associated with authority, conflict, oppression and can be regarded as a resource or a means to define what is important and unimportant and influence decision-making processes. Here discursive power refers to way in which particular ideas, perspectives, myths, and narratives are constructed, supported and perpetuated by institutions supporting the uptake of GM crops (Newell 2009; Schmidt 2010).

In this case the institution, Monsanto, displayed its discursive power through the farmers' days which served as campaigns to spread their ideas about the merits of modern seed varieties over traditional ones. However, the institutional landscape in Hlabisa was not diverse and had no institutions contesting this discursive power and offering alternative perspectives on maize farming.

To further support this argument, an analysis of the understanding of knowledge imparted by the institutions is provided in this piece. Is the information transparent and understood by farmers? Do the farmers have agency to make informed decisions about their farming practices? Lastly the Chapter will highlight how the knowledge provided by institutions has impacted on farming practices. The Chapter thus has the following outline: (a) impacts of GM crops on farming practices, (b) and the influential power of institutions on decision-making processes of the GM maize farmer.

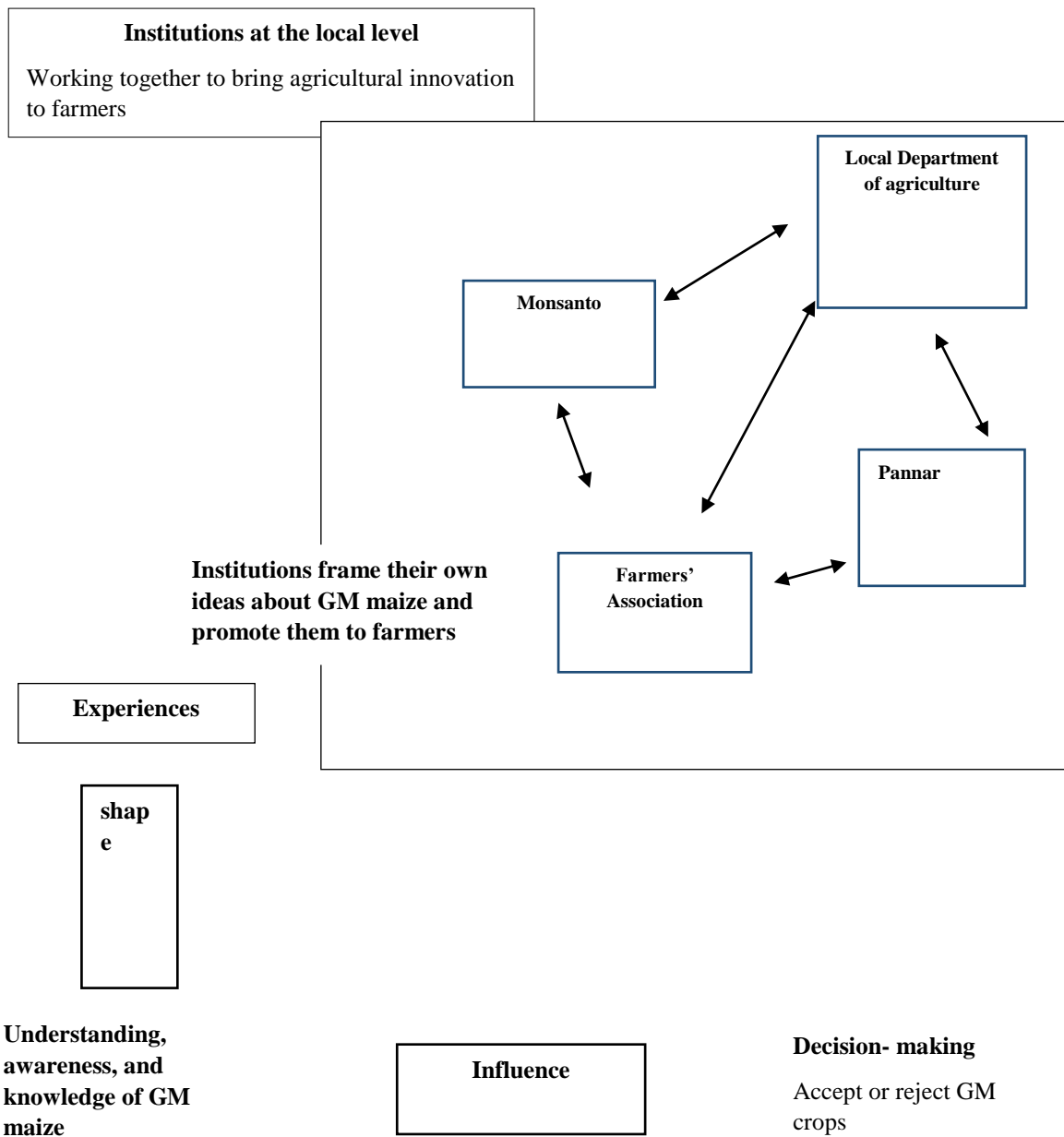


Fig 6.1: The influence of institutions on decision-making processes of the GM maize farmer

6.2 Impacts of GM crops on farming practices

The impacts discussed in this piece are derived from research findings and are pertinent to add to the debate about GM crops in smallholder agriculture. The study had intended on widening the scope and reporting other impacts outside farm level economics. This section will therefore dissect some of the issues associated with weakening of poly-cropping, seed saving and exchange practices, and concludes with a deliberation of why smallholder farmers are not following some of the farming practices associated with GM crops.

It is acknowledged that there were some positive impacts associated with the uptake of GM maize in this study such as, perceived increased yields and reduction of labour time, which have been previously reported (Gouse et al., 2005; 2006; 2009; Gouse et al., 2012). The high yield and labour saving qualities of GM maize are not novel findings and the study did not interrogate changes in maize yields and labour changes associated with the uptake of GM maize. There are however studies which have challenged the idea of increased yields and economic gains associated with GM crops (Glover 2010a; Gaurav and Mishra 2012).

6.2.1 Implications of mono-cropping

Home gardens not only serve as *in situ* genetic diversity sites, but are social and cultural spaces where knowledge is transmitted between farmers. The typical home garden of a smallholder farmer is regarded as a traditional agro-ecosystem which is multi-functional, uses little chemical inputs, and is structurally complex as opposed to the emerging homogenised farming systems in Hlabisa (Agbogidi and Adolor 2013). Heterogeneity exists in agricultural systems due to the different farming styles, practices, and knowledge, and approaches undertaken by farmers to reach specific goals. It is argued that this heterogeneity is a valuable asset as it can help farmers cope with stresses (van der Ploeg 2013). The argument is that GM crops are attempting to erode this heterogeneity where farmers are converted into mono-croppers.

One of the consequences of homogenising traditional farming systems through GM mono-cropping is the erosion of indigenous knowledge and reliance on outsourced top-down knowledge from seed companies and chemical distributors (Parmentier 2014). Farmers are converted into consumers and recipients of knowledge instead of being recognised as innovators and conservationists of seed varieties and holders of contextual agricultural knowledge. Moreover, farmers are losing their own weed management skills (Binimelis et al., 2009).

Mono-cropping farming systems are not common among smallholder farmers, but the uptake of GM maize has changed the appearance or the '*face*' of home gardens in Hlabisa. The Hlabisa farmers have dedicated most of their land to planting a staple crop and used secondary and communal gardens to grow fruit, vegetables, and in some cases medicinal plants. This raises questions about the contribution of a GM crop farmer's home garden towards nutritional food security, and whether the use of secondary home or communal gardens are as effective in addressing those needs.

There are three things to consider here before making any superficial judgements about the changes in the nutritional food security of the respondents. It is important to consider that poly-cropping is dependent on the farmer, availability of seed varieties, and growing times of crops (Seran and Brintha 2010). Secondly, the study observed a snapshot of a farming season,

and seasonality determines the types of crops grown at a particular time. The assumption is that farmers grow other crops to supplement their nutritional needs before, after, and during the maize growing season with the use of secondary and communal gardens, or by buying fruits and vegetables from the markets. Thirdly, traditional maize and a few non-maize crops was largely abandoned by the respondents. This would suggest the importance of evaluating the nutritional value of GM versus traditional maize.

The discontinuation of intercropping maize is an area for concern particularly soil health. Intercropping is a reflection of smallholder farmers maximising their production and adapting to the agro-ecological environment (Seran and Brintha 2010). Other benefits of intercropping include insurance against crop failure and effective use of labour. For instance, it would take less time to prepare a field to plant multiple crops compared to planting them separately (Lithourgidis et al., 2011). This suggests that there has been some form of labour displacement with the use of secondary and communal gardens used by the farmers.

Furthermore, intercropped systems are less likely to have pest and disease incidences (Oso and Falade 2010; Rao et al., 2012). In this case the Hlabisa farmers are perceived to have significantly less insect pressure after the uptake of GM maize, however very few of them were refuge compliant. We should be careful not to interpret this as proof that the Bt technology is effective in Hlabisa, and to draw up further inquiries about the levels of insect pressure that Hlabisa farmers experienced over the years since they first began cultivating GM maize. Furthermore, there are other reports outside South Africa which indicate pest resistance to the Bt toxins in the US, Puerto Rico, India, Australia, China, and the Philippines in maize and cotton (Test Biotech 2014). Interestingly, Brazilian farmers sued Monsanto in 2012 on the basis that they had to resort to spraying additional pesticides to manage infestations as the Bt soybean did not perform as expected. However, later the lawsuit was dropped when Monsanto offered to reduce prices on newer versions of Bt soybeans (RT News, 2012).

Another issue to touch on is the co-existence of GM and non-GM maize in the home gardens of farmers. There have been concerns about transgenic contamination in the maize fields of smallholder farmers given the relative proximity of the farms in these settings. Aheto et al. (2013) pointed out that the recommended separation distances between GM and non-GM maize fields are infeasible where there are numerous small farms in close proximity, which increases the likelihood of contamination in smallholder settings.

The issue of co-existence goes beyond just cultivating different maize types next to one another, but also to divorcing farmers from their norms and practices, introducing legalities, and drawing attention to how agricultural biotechnology has forced informal farming systems to adapt to its rules (Borowiak 2004; Aheto et al., 2013; Munyi and De Jonge 2015).

This discussion piece was not only attempting to illustrate the benefits of poly-cropping over mono-cropping in smallholder agriculture, but also sought to highlight that we need to dissociate the differentiated benefits with a particular cropping system. We should be seeking to understand whether the trade-offs made by farmers provide any real and long-term benefits.

6.2.2 Impacts on seed saving and exchange traditions

The act of saving and exchanging seed is prohibited with patent protected GM varieties, while hybrids are sterile so it is not viable to exchange and save such seeds, compared to traditional varieties which can be saved and exchanged for many years with minimal loss of vigour (Zeven 1998; Ives et al., 2001; Baranwal et al., 2012). Several scholars have discussed the significance of seed saving and exchange practices among smallholder farmers as these acts allow for free and relatively immediate access to seeds and contributes to their conservation (Wynberg et al., 2012; Barker et al., 2013; Bezner Kerr 2013; Coomes et al., 2015). This section will highlight some of the issues associated with the weakening practice of seed saving and exchange patterns within and outside Hlabisa.

It is within the interest of seed companies to prevent their GM varieties from being saved or exchanged as they would suffer financially. This is not only about patents discontinuing traditions, but brings other questions to light, especially with the co-existence of multiple seed systems in smallholder farmer settings. To what extent are farmers saving and exchanging contaminated traditional varieties? What are the impacts on social seed networks?

The results of the study suggest that there is a strong link between the introduction of hybrid maize and the weakening of maize seed exchange and saving traditions. These changes have affected some social dynamics in Hlabisa. For instance, farmers noted that they shared some traditional maize after harvesting with others, but that this ceased with the use of Pannar and Monsanto maize seeds. The use of money to purchase seeds meant that input costs are not shared equally. Furthermore, farmers began selling their surplus maize instead of presenting it as a gift or payment for harvest labour. These are some of the unforeseen social impacts.

Some of the benefits of using saved traditional maize seed varieties include using varieties that are adapted to the local environment and reducing inputs while freely exchanging seeds can be associated with maintaining diversity and fostering experimentation with new varieties (Badstue et al., 2007).

The study highlighted that some respondents made the choice to replant weaker Pannar and Monsanto seeds to avoid purchasing new seeds every season. This was not unique to Hlabisa as there are similar reports which have indicated that smallholder farmers recycle their hybrid and GM seeds for the same reasons despite being advised not to recycle the seeds (Gouse et al., 2005; Jacobson 2013). In addition, smallholder farmers are reported to be reusing hybrid and GM seeds due to the misunderstanding and lack of awareness about the sterility of hybrids.

6.2.3 Non-compliance with GM maize farming 'rules'

Non-refuge compliance is not unique to South African smallholder farmers but commercial farmers as well (Kruger et al., 2012). The reasons for non-compliance were due to the claimed lack of awareness in the study. Monsanto has reacted by sending consultants to monitor the fields of smallholder farmers growing Bt maize in the northern parts of KwaZulu-Natal province (Monsanto Agent, 10 September 2015, Johannesburg). Only time will reveal whether this act will be successful in enforcing compliance after many years of Bt maize use by the farmers. If held liable the impacts could be devastating for farmers already debt-ridden and deep in poverty.

It seems Monsanto has not been transparent with farmers of Hlabisa. How are the farmers expected to follow their rules when they are unknown to them; and a third party, Vemken, signs on their behalf? Jacobson and Myhr (2012, p.12) found that some Monsanto representatives framed the refugia seeds as “a gift to stalk borer” which led to the MFPP participants failing to practice refugia because essentially they did not want to feed stalk borers. This highlights the challenges faced by Monsanto to explain the concept of refugia to smallholder farmers and enforcing compliance.

In India, compliance is encouraged through using education programmes, rewards, and ‘rigorous’ monitoring among Bt cotton farmers (Zehr 2010, p.104). However, they did not indicate the success of these initiatives in attempting to raise more awareness about refuge compliance. The non-compliance issue seems to be used by Monsanto to mask the ineffectiveness of the Bt technology. In a perfect world the notion is that compliant and monitored farmers would have further delayed the development of Bt resistant species. The blame has thus been placed on the recipients of the technology instead of the creators. Monsanto has shielded itself through the Technology Use Agreement where it is not “liable for any incidental, consequential, special or punitive damages” (Monsanto 2015, p. 33). van den Berg (2012) suggested that the evolutionary processes of Bt toxin resistance should be another area of focus besides centring the conversation around non-compliance and considering new approaches to managing Bt- resistance.

6.3 The influential power of institutions on decision-making processes of the GM maize farmer

“No one asks for a meal they’ve never eaten. Or, do African farmers want genetically modified crops?” This was a very thought-provoking title chosen by Schnurr and Mujabi-Mujuzi (2014). The authors were suggesting that the voice of the African farmer has been muted, and institutions use their power to push their ideas about GM crops onto farmers. So did the Hlabisa farmers really want the GM maize or have they been influenced by institutions? This thesis argues for the latter by illustrating how institutions were key role players in driving the uptake of GM maize in Hlabisa.

6.3.1 Institutions as providers of agricultural knowledge

South African smallholder farmers do not receive adequate extension services and outnumber agricultural extension officers in their communities (Aliber and Hall 2012). For instance, the General Household Survey run by Stats SA in 2009 revealed that of the 5 700 sampled black agricultural households, less than two percent were in actual contact with an agricultural extension officer (DoA of South Africa 2005, Stats SA 2010). In this study there was one agricultural extension officer serving over a thousand smallholders. It has been shown that access to extension and advisory services contributes to the use of new agricultural technology by smallholder farmers (Nguthi 2008; Ali and Rahut 2013). The respondents in this study corroborated this notion, some of them began using Pannar maize seeds after they had been introduced to them by agricultural extension officers.

The Hlabisa case is unique in comparison to other areas, as the respondents were not provided with any financial assistance or access to markets; but were given what is argued as pseudo-extension and advisory services by Monsanto, or what Abdu-Raheem (2014, p. 1023) referred to as ‘politically-driven extension activities’. The extension and advisory services are

‘politically-driven’ because there are associated with the agenda of promoting modern seed varieties and chemical inputs.

It is important to evaluate the value of the pseudo-extension and advisory services provided by Monsanto in Hlabisa. One school of thought believes that the private sector is capable of addressing the shortcomings from the public sector, while others question the appropriateness and quality of the services provided by the private sector and more importantly how long will smallholder farmers have access to those services (Adebayo 2004; Sulaiman and Davis 2012, Abdu-Raheem 2014; Mutimba 2014)?

This approach of providing extension and advisory services has been used before by Monsanto with its failed Smallholder Programme (SHP) in the early 2000s. Monsanto placed its own staff in villages where farmers had easy access to advisory services and chemical inputs in countries such as Mexico, Indonesia, India, and South Africa (the Makhathini case was cited as part of the SHP) (Glover 2007).

Glover (2007) argued that Monsanto was attempting to navigate its way through the GM crop politics and generate evidence for the suitability of GM crops in smallholder settings and simultaneously develop an agricultural biotechnology market in the developing world when it conceived the SHP. The SHP was also used as a corporate social responsibility tool but it was stopped as it was not financially sustainable and the company suffered sale losses in the US at the time.

It was likely that the farmers began using GM maize seeds because they received technical maize farming advice from the local DoA and Monsanto without being exposed to alternatives. Furthermore, traditional maize farming has been undermined by agricultural policies and seed companies advocating for the use of ‘*better*’ modern maize varieties over the traditional ones. This could become a dangerous trajectory with the erosion of traditional maize farming knowledge in the smallholder agriculture context. For instance, farmers in this study perceived GM maize to be more drought tolerant than traditional maize, yet prior to the arrival of GM maize, farmers noted that they used maize varieties suited to tolerate droughts such as the red coloured maize. However, this knowledge and experience with the red maize was not even applied by the farmers during the drought of 2015/2016. In addition, the results indicated that the practice of saving and exchanging seeds is being eroded so the farmers might not even have the red maize seeds. This suggests that farmers are becoming dependent on the external organisations for agricultural knowledge and seeds instead of using their own experiences and local knowledge (Preston and Wickson 2016).

This is indicative of the deskilling that is taking place among the farmers in this study. Deskilling can be thought of a process that disrupts and degrades the farmer’s ability to perform, innovate and apply skills that were previously acquired through social and environmental learning (Parthasarathy 2002; Stone 2004, 2007). Agricultural inputs such as pesticides and hybrid seeds have been linked to the deskilling of farmers which is problematic as it benefits the proprietors of the technology at the expense of farmers. Farmers lose skills and knowledge that are later needed in unique or challenging conditions in the case of Hlabisa, the cultivation of red maize in dry conditions.

There is evidence that suggests that traditional maize can outperform modern maize varieties in drought-like scenarios (Mabhaudhi and Modi 2010; Bezner Kerr 2013). The GM crop

technology is problematic as it fosters monocultures, where polycultures may be more suitable for various climate conditions. Although the respondents chose to cultivate GM maize during the drought season, they could have presented or encouraged with planting non-maize traditional crops which are capable of performing in poor conditions. Examples of these crops are jugo beans, cowpeas and taros (Mohammed 2014; Mabhaudhi and Modi 2015).

There were virtually no alternative voices communicating the suitability and viability of GM maize in Hlabisa which makes areas like these vulnerable to only receiving information associated with a pro-GM crops agenda. An example of an alternative approach to the top-down method of the local DoA and seed companies, would be some form of participatory breeding programme where smallholder farmers could be directly involved in the research and development process of crop varieties (Mudhara 2010). This represents a form of an institutional learning process where research institutions, seed companies and farmers could be more interconnected, reflective and share their plant breeding experiences and innovations (Vroom 2009).

Altieri and others have supported the revival of agro-ecological practices as a way to counter the GM crop farming model and strengthen farmers' food sovereignty (Altieri and Koohafkan 2008; Altieri 2009; Altieri et al., 2012). Food sovereignty is defined as the capacity of each country to develop and maintain basic food crops. The features of agro-ecological farming consist of polycultures, use of landraces, natural pest enemies, and little use of external inputs to improve soil quality and yields (Altieri 2009; Altieri et al., 2012). Agro-ecology can be thought of as an avenue for smallholder farmers to become more self-reliant with food production by using shared knowledge. Others are yet to be convinced of the notion that smallholder farmers are capable of feeding a growing population through attaining food sovereignty (Bernstein 2014). This is a moot point as the take home message about agro-ecology is the seemingly inherent democracy that exists in the system that involves free access and exchange of seeds and knowledge among smallholder farmers.

6.3.2 Key institutions fostering the uptake of GM maize

A central finding of this thesis is that the perceptions of modern maize varieties were socially and contextually determined by the agricultural extension officers, Farmers' Associations and seed companies in Hlabisa. This section will highlight how these three institutions were pivotal in fostering the uptake of GM maize in Hlabisa and elsewhere. The discussion would not be complete without first discussing the weakening role of traditional authorities in smallholder agriculture.

Traditional institutions

The role and function of traditional authorities has evolved over the years in rural South Africa due to several societal processes such as colonisation, Apartheid, democracy and modernisation. Under the Apartheid regime traditional authorities were subjugated and removed from power and were used as political instruments to enforce some of the goals of the government. Post 1994 the state was faced with governance struggles (traditional versus 'modern' systems) and had the challenge of resolving the roles and functions of traditional leaders and dealing with stratified communities (Mabutla 2001; Oomen 2005; Khunou 2009).

The results suggest that traditional authorities have minimal influence over decisions made by smallholder farmers in comparison to the local DoA and seed companies. Political history has created a space where multiple actors are in a struggle for power, influence, and authority over people. These struggles can be extended into smallholder agriculture, where seed companies and the local DoA, seem to be wielding more power over traditional leaders and thus over people in these communities of South Africa. The results suggest that smallholder farmers and traditional authorities perhaps viewed the seed companies and local DoA as more capable of assisting with agricultural matters. The seed companies and local DoA were directly involved with farmers and provided support in the form of advisory and extension services, while the duties of traditional authorities in Hlabisa were related to local governance.

Influential institutions

The choice to use GM crops is often multi-layered and may or may not address the needs of a smallholder farmer. For instance, the cultivation of Bt cotton in Burkina Faso seemingly had more to do with the broader economic standing of the country and did little to alleviate inequalities between cotton companies and farmers (Dowd-Urbe and Schnurr 2016). In this case the cotton companies paid smallholder farmers after they had harvested and provided them with Bt seeds and chemicals. Bt cotton appealed to Burkinabè cotton companies due to its high yields, and in turn cotton farmers enjoyed some financial benefits. However, the companies lost out on profits as the Bt cotton quality was inferior in comparison to the non-Bt cotton. Here the financial health of cotton companies contributed to the decision taken by the Burkina Faso government to discontinue Bt cotton cultivation (Dowd-Urbe and Schnurr 2016).

The striking feature of the situation in Burkina Faso and Makhathini flats was the role played by public and private institutions in smallholder agriculture. The cotton companies subsidised smallholder cotton production and provided a stable market which enabled the uptake of the GM crop (Dowd-Urbe and Schnurr 2016; Fok et al., 2007). On the other side of the world, the cultivation of Ht soybean by Argentine commercial farmers was claimed to be associated with the displacement of small cotton producers; loss of their cotton landraces and dispossession of land through armed militia (Joensen et al., 2005; Arza et al., 2012; Arza and van Zwanenberg 2014).

Mutimba (2014) argued that the advisory and extension services branch of local DoAs are often blamed when productivity fails in small farming systems. In addition, he argues that agricultural extension officers are not given platforms to exchange their fieldwork experiences which could be incorporated into the design of agricultural policies. What was apparent in Hlabisa was the use of agricultural extension officers to actively promote GM maize to smallholder farmers and support them due to the institution's mandate. At national level policies supporting the conservation and sustainable use of landraces in South Africa are "uncoordinated, unbalanced, and sometimes contradictory" (Wynberg et al., 2012, p. 1). However, it is becoming apparent that the national DAFF possibly prefers to support Farmers' Associations or smallholder farmer co-operatives over individual farmers (DAFF 2013). It can be argued that these farmer institutions served as hubs which Monsanto targeted for the uptake of GM maize in Hlabisa and the MFPP villages. The strengths and weaknesses of smallholder agriculture co-operatives in South Africa have been covered elsewhere in the

literature, including problems such as lack of access to markets, extension services, infrastructure, and co-operatives requiring funding from the government (See Ortmann and King 2007; Simelane 2011; Ruete 2014).

A Farmers' Association represents a social network which has outside ties to individuals or organisations who share and exchange information. There were differences in how the Farmers' Associations and smallholder farmer co-operatives, henceforth co-operatives, functioned in Hlabisa and the Massive Food Production Programme (MFPP) villages. The MFPP introduced Bt maize to farmers of Eastern Cape in an attempt to increase yields and alleviate poverty (ECDoA 2002).

The difference among the studied individuals of Hlabisa and MFPP was the nature of the relationship among the farmers, the DoA, and Monsanto. Monsanto had a visible and closer association with the respondents of Hlabisa through the farmers' day versus the MFPP smallholder farmers who received extension services from the local DoA. The disparities could possibly be explained by the fact that the MFPP was a government-led intervention, whereas Hlabisa was directly targeted by Monsanto. Thus the government acted like a back-seat driver in the Hlabisa case, i.e. facilitating the access to farmers. The next step is to understand how the GM seed goes from being introduced to the farmer to being diffused through Hlabisa.

The risk-averse nature of smallholder farmers and their scepticism were some of the factors that could have delayed the immediate uptake of GM maize in Hlabisa. The perceived productivity success of the Champion GM maize farmer's Farmers' Association was instrumental in encouraging other farmers to experiment with or uptake GM maize.

The argument here about the diffusion of GM maize in Hlabisa, is that of using an influential individual such as the Champion GM maize farmer to encourage and relay information to his counterparts about GM maize. This argument is supported by the data where respondents identified the Champion GM maize farmer as the person who introduced GM maize seeds to them. A similar tactic was used by Monsanto in the Makhathini flats where the chairperson of Ubongwa Farmers' Association, TJ Buthelezi, was flown around the world to give testimony about the success of Bt cotton in the area. Moreover, Buthelezi was similarly regarded as an advisor regarding Bt cotton farming and sometimes rented out his land to Monsanto for Bt cotton trials (Pschorn-Strauss 2005).

However, with the withdrawal of institutional support in Makhathini, Buthelezi found himself among the many farmers who were in debt. Buthelezi and the Champion GM maize farmer are amongst the many farmers who have been propped up by Monsanto around the world claiming the effectiveness of GM crops in smallholder farmer settings. This is one of the realities of GM crop farming: when the institutional support disappears, smallholder farmers may find themselves in seemingly worse off conditions (Patel 2007).

In conclusion, the form of advisory and extension services received by smallholder farmers seem strongly influenced by the agenda of the national DAFF and its policies which promote privatisation and reduction of public extension service delivery and funding (Abdu-Raheem 2014).

6.4 Summary

In this Chapter the issues of the lack of awareness and understanding of GM crop technology and terms of use were covered. There are politics in sharing and communicating both the advantages and disadvantages of the uptake of GM crops in smallholder farmer settings which may prevent farmers from making informed decisions. In addition, the marriage between seed companies and the local department of agriculture (DoA) was instrumental in encouraging smallholder farmers to use GM seeds. These two institutions are regarded as new sources of agricultural knowledge. Lastly the home gardens of GM crop farmers are changing to becoming less diverse and homogenous like their commercial counterparts and valuable traditions are slowly being eroded.

What are these farmers telling us about agricultural innovation in smallholder agriculture? The case of Hlabisa is interesting as it represents an area where smallholder farmers have been using GM maize on a long term basis (Gouse 2012). However, GM maize has not completely diffused into Hlabisa. Moreover, the removal of the Monsanto depot suggests that the uptake of GM maize has been slow in the area. Sunding and Zilberman (2000) offered the lack of credit institutions as a constraint preventing farmers from taking up new technology. The non-GM maize farmers of Hlabisa supported this notion as they expressed that they were unable to pay for the expensive inputs. Although debt was an issue for the GM maize farmers in this study, it has not prevented them from using the technology. This suggests that the role of institutions needs to be interrogated further. Research to date has focussed on the economics and neglected the social and institutional context when discussing the uptake of agricultural innovations among smallholders.

Nair and Singh (2016) point out important aspects about the role of institutions in influencing a technological change in agriculture. They highlight how institutional change opens up pathways through which farmers can be granted or denied access to innovations. Secondly they argue some institutions may not have the capacity to innovate from within and instead use technology from the West which is not suited to their context. This adds another building block as to why smallholder farmers choose to use improved seed varieties. The more relevant issue is about ensuring that the farmers' voice and needs is heard and respected. Moreover, as seed companies present themselves as innovators, they essentially decide what type of innovations are appropriate for farmers.

Alternative pathways to agricultural innovations are required involving various institutions, actors, and forms of knowledge (Klerkx et al., 2009). It is probable that the Hlabisa farmers could reject GM crops if there were other voices contesting the ideas held by Monsanto, Pannar and the local DoA. There needs to be a space for alternative voices and institutions which can offer support and agricultural knowledge.

In conclusion the research has identified institutions as being pivotal in the promotion of GM crops. The argument can be made that there is a need to shift towards policies and institutions which better address the needs of farmers, but this would be a difficult task considering the global political economy of agriculture (Birner and Resnick 2010). The dominating views within the global model of agriculture are neoliberal; neoliberalism is associated with economic liberalisation, commodification, free markets, deregulation and privatisation. African smallholder farmers struggle to compete and function in such a model (Harvey 2005; Greenberg 2013).

Poverty continues to persist among GM maize farmers of Hlabisa and GM crops have done little to improve livelihoods. The study does acknowledge some of the perceived benefits identified by the farmers such as reduction in labour time and having surplus maize which can be sold, but believes so far GM technology has presented itself as technical solution, and has not fully addressed the needs of these farmers such as access to water, infrastructure, and appropriate seeds.

CHAPTER SEVEN - CONCLUSION AND RECOMMENDATIONS

7.1 Thesis overview

The promotion of genetically modified (GM) seeds to smallholder farmers has sparked several debates about food safety, environmental and health risks, the effect of the newly introduced seeds on livelihoods, cultures, and traditions (Gouse et al., 2012; Jacobson 2013; Mason 2013; James 2014; Fisher et al., 2015).

The aim of this study was to explore the uptake of GM maize in order to contribute towards understanding the implications of agricultural biotechnology in smallholder agriculture. This was achieved firstly through analysing the available literature for cases where GM crops have been introduced to South African smallholder farmers from 1999 - 2014. This timeframe was selected based on when GM crops were first introduced to smallholder farmers and when the research began. Secondly, Hlabisa was used as a case study where perceived problems and benefits associated with GM maize were analysed in depth. This area is unique as it possesses some smallholder farmers who have cultivated white GM maize for more than ten seasons (Gouse 2012). The study also identified institutional, political, social, and environmental factors that influenced the choices and decisions made by smallholder farmers to uptake GM maize. Lastly, the study investigated how GM maize has affected the well-being of farmers and social cohesion in the farming communities. Surveys, key informant interviews, and focus group discussions were used to help address the research aim and objectives.

The thesis focused on stacked, herbicide-tolerant and insect-resistant white maize types. Maize is an important staple crop for many South African smallholder farmers, and was one of the first crops to be commercialised in the country. In addition, maize could be a source of income for smallholder farmers (McCann 2007; Falck-Zepeda et al., 2013).

There have been mixed impacts and experiences associated with the uptake of GM crops by smallholder farmers in the developing world (Gruère et al., 2008; Glover 2010a; Arza et al., 2012; Dowd-Uribe and Schnurr 2016). Proponents of GM crops have claimed that South African smallholder farmers can benefit by using this technology which should help improve yields and increase farm income. These claims are countered by those who suggest that GM crops have only been promoted to smallholder farmers to increase the profit margins of seed companies and the technology has done little to resolve issues within smallholder agriculture such as access to markets, institutional support, and inequalities between plant breeders and farmers (Zerbe 2004; Arthur 2011; Gouse et al., 2012; Wynberg and Fig 2013; Fisher et al., 2015).

7.2 Key findings

Hlabisa was selected by the provincial KwaZulu-Natal Department of Agriculture (DoA) for the possible introduction of GM maize as it was “suffering agriculturally” (Monsanto agent, 10 September 2015). The initial introduction of GM maize was made in training sessions held in Pongola. A Champion GM maize farmer was indirectly and directly involved in encouraging his counterparts to use GM maize through farmers’ days organised by the local DoA and seed companies.

In summary, the perceived benefits of GM maize included high yields, reduction in labour time, and small opportunities to sell surplus GM maize. Seventy-four percent of the

interviewed GM maize farmers perceived an improvement in their quality of life due to these stated benefits. However, the farmers also highlighted concerns about affordability of seeds and other inputs, lack of awareness of their contractual obligations that required them to not save or exchange their GM maize seeds and plant refugia to delay the development of Bt-resistance. Furthermore, the local DoA and Monsanto were seemingly not transparent with the sharing of knowledge around any potential health and environmental risks associated with GM crop farming.

It is argued that the lack of agricultural extension services created a suitable environment for the entrance of seed companies who used top-down approaches to address the Hlabisa agricultural problems without considering the local needs of smallholder farmers (Abdu-Raheem 2014). This study indicated that the local DoA, seed companies, and Farmers' Associations were the dominant institutions which promoted and shaped the ideas of modern maize varieties being better than traditional maize in terms of yields, reducing labour, and giving protection against maize pests. Yet the GM maize offered no protection against the droughts, which are a regular occurrence in Hlabisa. The literature provides evidence that illustrates that traditional maize varieties have advantages over the hybrid and GM varieties in dry conditions (Mabhaudhi and Modi 2010; Bezner Kerr 2013). However, it appears that knowledge, and experience related to traditional drought-tolerant varieties, such as red maize is not being applied by the Hlabisa farmers. This is an important point to highlight as the study took place during the 2014/2015 drought season. A conclusion can be drawn from this study about how 'expert' knowledge from seed companies and local DoA seems to be applied over the experiences of farmers and their traditional knowledge.

The results of the study also suggested that smallholder farmers are finding themselves in the position where they have minimal chances to innovate and are passive recipients of external agricultural knowledge (Parmentier 2014; Preston and Wickson 2016). This has implications as farmers are losing their own weed and pest management skills, and are relying heavily on seed companies and the local DoA to address their agricultural issues. These findings suggest that many of the agro-ecological practices that farmers would have used in the past are no longer applied. This was visible in some of the farmers' home gardens which were monocropped and farmers had to resort to using secondary and/or communal gardens to grow non-GM maize crops.

The social relevance of agricultural practices of farmers has been affected as well. For instance, the practice of saving and exchanging seeds which began eroding with the introduction of Pannar hybrids, has intensified with the continued use of GM maize seeds by farmers. This suggests that GM seeds could potentially lead to the loss of farmers' seed networks which are associated with the free access and flow of seeds (Coomes et al., 2015). Another example of social changes brought about by the introduction of GM seeds was that farmers reported that in contrast to past practices (associated with traditional maize), they did not provide GM maize as a reward for harvest labour. This is because input costs were not shared by the farmers and persons helping out during the harvest season. This suggests that some interactions are being fractured due to GM maize despite the farmers reporting that their farming relationships have not changed. This represents one of the many unintended impacts of GM crops in smallholder agriculture.

7.3 Recommendations

The thesis echoes some of the policy recommendations made by scholars with regards to changes that are needed to better address the needs of smallholder farmers. It supports other studies which suggest that this technology is not suitable for small-scale production and also weakens the livelihoods of farmers (Manona 2005; Glover 2010a; Jacobson 2013). It seems as if policies related to GM crops have been ad hoc, are associated with punitive measures, and are impractical for smallholder farmers.

1. The first recommendation is centred on giving smallholder farmers agency through providing them with relevant information and full disclosure regarding the types of crop choices they have available to them. This is the responsibility of the government that should not be ceded to companies with vested interests. This creates platforms where smallholder farmers can voice their concerns and discuss their farming preferences and priorities (Schnurr and Mujabi-Mujuzi 2014).
2. There is an even greater need for the national DAFF to move away from the notion that smallholder farmers *need or must* commercialise farming practices, and that this must be done through scaling up production and using modern crop varieties. Studies have shown that the government has not been successful with this approach (Manona 2005; Aliber and Hall 2012; Jacobson 2013). To some extent this places smallholder farmers into boxes and they are not given enough support for choosing alternative farming models. For instance, Wynberg et al. (2012) suggested placing more emphasis on strengthening appropriate extension services that would support farmers practising traditional farming. Another recommendation would be recognising farmers' rights to continue with their traditions of freely exchanging and saving seed varieties, as these practices have contributed to conserving and maintaining agrobiodiversity and social traditions.
3. If farmers elect to plant GM crops, after having been provided with in-depth information and training in the risks and benefits of different options, there is a need for the monitoring of the social, economic, and environmental impacts of these choices. This thesis has illustrated the problems of the promotion of costly GM crop technology to poor smallholder farmers who tap into their social grants and credit to purchase agricultural inputs.

References

- ADB, 1999: *Fighting Poverty in Asia and the Pacific: The Poverty Reduction Strategy*, Manila: Asian Development Bank
- Abdu-Raheem, K., A., 2014: Exploring the Role of Agricultural Extension in Promoting Biodiversity Conservation in KwaZulu-Natal Province, South Africa, *Agroecology and Sustainable Food Systems*, 38 (9), 1015 - 1032
- Adebayo, K., 2004: Private Sector Participation in Agricultural Extension Services in Nigeria, Paper Prepared for Presentation at the Farm Management Association of Nigeria Conference, Abuja, Nigeria, October 19-21, 1 - 7
- Adesina, A., and Zinnah, M., 1993: Technology Characteristics, Farmers' Perceptions and Adoption Decisions - A Tobit Model Application in Sierra Leone, *Agricultural Economics*, 297 - 311
- Agbogidi, O., M., and Adolor, E., B., 2013: Home Gardens in the Maintenance of Biological Diversity, *Applied Science Reports 1* (1), 19 - 25
- Aheto, D., W., Bøhn, T., Breckling, B., van den Berg, J., Lim, L., C., and Wikmark, O., 2013: Implications of GM Crops in Subsistence-based Agricultural Systems in Africa, *Theorie in der Ökologie* 17, 93 - 103
- Ajzen, I., 1991: The Theory of Planned Behavior, *Organizational Behavior and Human Decision Processes* 50, 179 - 211
- Ali, A., and Rahut, D.B., 2013: Impact of Agricultural Extension Services on Technology Adoption and Crop Yield: Empirical Evidence from Pakistan, *Asian Journal of Agricultural and Rural Development* 3 (11), 801 - 812
- Aliber, M., and Hall, R., 2012: Support for Smallholder Farmers in South Africa: Challenges of Scale and Strategy, *Development Southern Africa* 29 (4), 542 - 568
- Altieri, M., A., and Koohafkan, P., 2008: Enduring Farms: Climate Change, Smallholders and Traditional Farming Communities, *Environment and Development Series* 6, 1 - 72
- Altieri, M., A., 2009: Agroecology, Small Farms and Food Sovereignty, <http://monthlyreview.org/2009/07/01/agro-ecology-small-farms-and-food-sovereignty,1-7>, Accessed 29 August 2015
- Altieri, M., Funes-Monzote, F., R., and Petersen, P., 2012: Agro-ecologically Efficient Agricultural Systems for Smallholder Farmers: Contributions to Food Sovereignty, *Agronomy for Sustainable Development* 32 (1), 1 - 13
- Arthur, G., D., 2011: Benefits and Concerns Surrounding the Cultivation of Genetically Modified Crops in Africa: The Debate, *African Journal of Biotechnology* 10 (77), 17663 - 17677
- Arza, V., Goldberg, L., and Vázquez, C., 2012: Argentina: Dissemination of Genetically Modified Cotton and its Impact on the Profitability of Small-scale Farmers in the Chaco Province, *CEPAL REVIEW* 107, 127 - 143

- Arza, A., and van Zwanenberg, P., 2014: Innovation in Informal Settings but in Which Direction? The Case of Small Cotton Farming Systems in Argentina, *Innovation and Development* 4 (1), 55 - 72
- Ashley, C., and Maxwell, S., 2001: Rethinking Rural Development, *Development Policy Review* 19 (4), 395 - 425
- Assef, A., 2007: Farmer Led Innovation: Experiences and Challenges in Ethiopia, 1 - 11
- Atkinson, R., and Flint, J., 2001: Accessing Hidden and Hard-to-reach Populations: Snowball Research Strategies, *Social Research Update* 33
- Baderoon, G., 2004: The Provenance of the Term ‘Kaffir’ in South Africa and the Notion of Beginning, 1 - 9
- Badstue, L., Bellon, M., R., Berthaud, J., Ramirez, A., Flores, D., and Juarez, X., 2007: The Dynamics of Farmers’ Maize Seed Supply Practices in the Central Valleys of Oaxaca, Mexico, *World Development* 35 (9), 1579 - 1593
- Bandiera, O., and Rasul, I., 2006: Social Networks and Technology Adoption in Northern Mozambique, *The Economic Journal* 116, 869 - 902
- Baranwal, V., K., Mikkilineni, V., Zehr, U., B., Tyagi, A., K., and Kapoor, S., 2012: Heterosis: Emerging Ideas About Hybrid Vigour, *Journal of Experimental Botany Advance*, 1 - 6
- Barker, D., Freese, B., and Kimbrell, G., 2013: Seed Giants vs. U.S. Farmers: A Report by the Center for Food Safety & Save Our Seeds, Washington DC, 1 - 52
- Beaman, L., Yishay, A., B., Magruder, J., and Mobarak, A., M., 2015: Can Network Theory-Based Targeting Increase Technology Adoption? Working Paper, 1 - 64
- Beinhart, W., and Coates, P., 1995 : *Environment and History: The Taming of Nature in the USA and South Africa*, London: Routledge, 1995
- Bennett, R., Kambhampati, U., Morse, S., and Ismael, Y., 2006: Farm-level Economic Performance of Genetically Modified Cotton in Maharashtra, India, *Review of Agricultural Economics* 28 (1), 59 - 71
- Bennett, R., Morse, S., and Ismael, Y., 2006a: The Economic Impact of Genetically Modified Cotton on South African Smallholders: Yield, Profit and Health Effects, *The Journal of Development Studies*, 42 (4), 662 - 677
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., and Rickne, A., 2008: Analyzing the Functional Dynamics of Technological Innovation Systems-A scheme of analysis, *Research Policy* 37 (3), 407 - 429
- Bernstein, H., 2014: Food Sovereignty Via the ‘Peasant Way’: A Sceptical View, *The Journal of Peasant Studies* 41(6), 1031 - 1063
- Bezner Kerr, R., 2013: Seed Struggles and Food Sovereignty in Northern Malawi, *The Journal of Peasant Studies* 40 (5), 867 - 897

Binimelis, R., Pengue, W., and Monterroso, I., 2009: “Transgenic Treadmill”: Responses to the Emergence and Spread of Glyphosate-resistant Johnsongrass in Argentina, *Geoforum*, 1-11

Biosafety South Africa, 2013: Genetically Modified (GM) Crops Granted General Release Approval in South Africa, Available from: <http://www.biosafety.org.za/resources/download.php?file=documents/Genetically>

Modified Crops in South Africa Approved for General Release (Dec13).pdf. Accessed 24 November 2015

Birner, R., and Resnick, D., 2010: The Political Economy of Policies for Smallholder Agriculture, *World Development* 38 (10), 1442 - 1452,

Bitsch, V., 2005: Qualitative Research: A Grounded Theory Example and Evaluation Criteria, *Journal of Agribusiness* 23 (1), 75 - 91

Bohman, J., 2013: Critical Theory - the Stanford Encyclopaedia of Philosophy (Spring 2013 Edition), Edward N. Zalta (ed.), [http://plato.stanford.edu/archives/spr2013/entries](http://plato.stanford.edu/archives/spr2013/entries/critical-theory)

/critical-theory, Accessed 10 March 2016

Borowiak, C., 2004: Farmers’ Rights: Intellectual Property Regimes and the Struggle Over Seeds, *Politics & Society* 32 (4), 511 – 543

Brooks, S., 2000: Re-reading the Hluhluwe - Umfolozi Game Reserve: Constructions of a ‘Natural’ Space, *Transformations* 44, 62 – 79

Bryan, M., Taylor, M., and Veliziotis, M., 2010: Over-Indebtedness in Great Britain: An Analysis Using the Wealth and Assets Survey and Household Annual Debtors Survey. London: Department for Business Innovation & Skills

Burt-Davy, J., 1914: *Maize: Its History, Cultivation, Handling, and Uses. With Special Reference to South Africa*, London: Longmans, Green, and Co., 316

Butler, T., 1998: Towards a Hermeneutic Method for Interpretive Research in Information Systems, *Journal of Information Technology* 13(4), 285 - 300

Byerlee, D., and Eicher, C., (eds), 1997: *Africa’s Emerging Maize Revolution*, Boulder: Lynne Rienner

Carpenter, J., E., 2010: Peer-Reviewed Surveys Indicate Positive Impact of Commercialized GM Crops, *NATURE BIOTECHNOLOGY* 28 (4), 319 - 321

Chen, R., Huang, J., and Qiao, F., 2013: Farmers’ Knowledge on Pest Management and Pesticide Use in Bt Cotton Production in China, *China Economic Review* 27, 15 - 24

Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), 2002: Los últimos escrutinios de maíz criollo en México no revelan la presencia del promotor relacionado con los transgenes. CIMMYT, Mexico, D.F.

Cooke, J., G., and Downie, R., 2010: African Perspectives on Genetically Modified Crops Assessing the Debate in Zambia, Kenya, and South Africa, Center for Strategic and International Studies, Washington, D.C., 1 – 30

Coomes, O., T., McGuire, S., J., Garine, E., Caillon, S., McKey, D., Demeulenaere, E., Jarvis, D., Aistara, G., Barnaud, A., Clouvel, P., Emperaire, L., Louafi, S., Martin, P., Massol, F., Pautasso, M., Violon, C., Wencélius, J., 2015: Farmer Seed Networks Make a Limited Contribution to Agriculture? Four Common Misconceptions, *Food Policy* 56, 41–50

Coudel, E., 2013: *Renewing Innovation Systems in Agriculture and Food: How to Go Towards More Sustainability?* Wageningen Academic Publishers

Court of Justice of the European Union, 2011

Cotton South Africa, 2011: *Small-Scale Farmer Production Estimates.*, <http://www.cottonsa.org.za>, Accessed 04 April 2016

Creswell, J., W., 2008: *Research Designs – Qualitative, Quantitative, and Mixed Methods Approaches*, Chapter One - The Selection of a Research Design, SAGE Publications, London 5 - 9

Daño, E., C., 2007: *Unmasking the New Green Revolution in Africa: Motives, Players and Dynamics*, Third World Network, Church Development Service (EED) and African Centre for Biosafety, 1 – 67

Darrah, L., L., McCullen, M., D., and Zuber, M., S., 2003: *Breeding, Genetics, and Seed Corn Production*, Chapter 2, In: White, P., J., Johnson, L.A., (eds), *Corn: Chemistry and Technology*, Edition 2nd, American Association of Cereal Chemists, Inc. St Paul, Minnesota, USA, 35-68

Department of Agriculture, 1997: *Genetically Modified Organisms Act, 1997*, South Africa

Department of Agriculture 2005: *Norms and Standards for Extension and Advisory Services in Agriculture*, Directorate: Scientific Research and Development, 1 - 25

Department of Agriculture, Forestry & Fisheries South Africa, 2013: *Strategic Plan for Smallholder Support*, 1 - 22

Department of Agriculture, Forestry & Fisheries South Africa, 2015: *Trends in the Agricultural Sector*, 1 - 65

Dewar, A., M., Haylock, L., A., Bean, K., M., and May, M., J., 2000: *Delayed Control of Weeds in Glyphosate-tolerant Sugar Beet and the Consequences on Aphid Infestation and Yield*, *Pest Management Science* 56, 345 - 350.

Dirwayi, T., P., 2010: *Application of the Sustainable Livelihoods Framework to the Analysis of the Provincial Growth and Development Plan of the Eastern Cape- A Case Study of the Massive Food Production Programme in Nkonkobe Municipality and Buffalo City Municipality*, Master of Science Thesis, University of Fort Hare, 1 - 158

Dodson, A., 2013: *The Natives Land Act of 1913 and its Legacy*, *Forum*, 1 - 4

Dowd-Uribe, B., and Schnurr, M.A., 2016: *Briefing: Burkina Faso's Reversal on Genetically Modified Cotton and its Implications for Africa*, *African Affairs*, 1 - 12

DuPont, 2012: *Pioneer-Pannar Merger*. [Online]. Available at

http://www2.dupont.com/South_Africa_Country_Site/en_ZA/Media_Center/Press_Releases/2012/Pioneer_Pannar_Merger.html, Accessed 11 June 2014

Eastern Cape Provincial Department of Agriculture (ECDoA), 2002: Secret Memorandum: Massive Food Production Scheme Through a Conditional Grant Scheme for Crop Production and a Rural Mechanisation Programme

Edwards-Jones, G., 2006: Modelling Farmer Decision-Making: Concepts, Progress and Challenges. *Animal Science* 82, 783 - 790

ETC Group 2013: Gene Giants Seek “Philanthropoly,”: <http://www.etcgroup.org/content/Ecomm-gene-giantsseek-philanthropoly>, Accessed 29 March 2016

ETC Group 2015: Breaking Bad, Big Ag Mega-Mergers in Play Dow + DuPont in the Pocket? Next: Demonsanto?, <http://www.etcgroup.org>, Accessed 29 March 2016

Ezcurra, E., Ortiz, S., and Soberón Mainero, J., 2001: Evidence of Gene Flow from Transgenic Maize to Local Varieties in Mexico. In: *LMOs and the Environment: Proceedings of an International Conference*, OECD, Durham, North Carolina, 289 - 295

Falck-Zepeda, J., Gruère, G., and Niang-Sithole, I., 2013: Genetically Modified Crops in Africa: Economic and Policy Lessons from Countries South of the Sahara (Eds.), International Food and Policy Research Institute, Washington DC, 1- 267

Fernandez-Cornejo, J., Wechsler, S., Livingston, and Mitchell, L., 2014: Genetically Engineered Crops in the United States, ERR-162 U.S. Department of Agriculture, Economic Research Service, 1 - 60

Fischer, K., Ekener-Petersen, E., Rydhmer, L., and Björnber, K., E., 2015: Social Impacts of GM Crops in Agriculture: A Systematic Literature Review, *Sustainability* 7, 8598 - 8620

Fischer., 2016: Why New Crop Technology Is Not Scale-Neutral- A Critique of the Expectations for a Crop-Based African Green Revolution, *Research Policy* 45 (6), 1185 - 1194

Fok, M., Hofs, J., Gouse, M., and Kirsten, J., 2007: Contextual Appraisal of GM Cotton Diffusion in South Africa, *Life Science International Journal* 1 (4), 468 - 482

Fukweni, N., 2009: Dynamics of Development Intervention, the Case of Peddie, Eastern Cape, Master of Social Science Thesis, University of Fort Hare, 1 - 171

Gaurav, S., and Mishra, S., 2012: To Bt or Not to Bt? Risk and Uncertainty Considerations in Technology Assessment, Indira Gandhi Institute of Development Research, Mumbai, January 2012, 1 - 36

Geilfus, F., 2008: 80 Tools for Participatory Development: Appraisal, Planning, Follow-up and Evaluation, 1 - 218

Glover, D. 2007: Monsanto and Smallholder Farmers: A Case Study in Corporate Social Responsibility, *Third World Quarterly* 28(4), 851 - 867

Glover, D., 2009: Undying Promise: Agricultural Biotechnology’s Pro-Poor Narrative, Ten Years on, Working Papers from the STEPS Centre, 1 - 68

Glover, D., 2010a: Is Bt Cotton a Pro-Poor Technology? A Review and Critique of the Empirical Record, *Journal of Agrarian Change* 10 (4), 482 - 509

- Glover, D., 2010b: The Corporate Shaping of GM Crops as a Technology for the Poor, *The Journal of Peasant Studies* 37 (1), 67 - 90
- Gouse, M., Kirsten, J., Shankar, B., and Thirtle, C., 2005: Bt Cotton in KwaZulu Natal: Technological Triumph but Institutional Failure, *AgBiotechNet* 7 (134), 1 - 7
- Gouse, M., Piesse, J., Thirtle, C., 2006 : Output and Labour Effects of GM Maize and Minimum Tillage in a Communal Area of KwaZulu-Natal, *Journal of Development Perspectives* 2 (2), 192-207
- Gouse, M., Pray, C., Schimmelpfennig, Kirsten, 2006a: Three Seasons of Subsistence Insect-Resistant Maize in South Africa: Have Smallholders Benefited? *AgBioForum* 9(1), 15-22
- Gouse, M., Piesse, J., Thirtle, C., and Poulton, C., 2009: Assessing the Performance of GM Maize Amongst Smallholders in KwaZulu-Natal, *AgBioForum* 12 (1), 78 - 89
- Gouse, M., 2012: GM Maize as Subsistence Crop: The South African Smallholder Experience, *AgBioForum* 15(2), 163 - 174
- Gouse, M., 2014: Assessing the Value of Glyphosate in the South African Agricultural Sector, University of Pretoria, 1 - 46
- Gouse, M., Sengupta, D., and Falck-Zepeda, J., 2016: Genetically Modified Maize: Less Drudgery for Her, More Maize for Him? Evidence from Smallholder Maize Farmers in South Africa, *World Development* 83, 27 - 38
- Greenberg, S., 2013: The Disjunctures of Land and Agricultural Reform in South Africa: Implications for the Agri-food System, Working Paper 26. PLAAS, UWC: Bellville, 1 - 33
- Gruère, G., P., Mehta-Bhatt, P., and Sengupta, D., 2008: Bt Cotton and Farmer Suicides in India: Reviewing the Evidence, IFPRI Discussion Paper 00808, 1 - 64
- Hall, C., Toma, L., and Moran, D., 2009: Investigation of the Factors Influencing Adoption of GM Crops at Country Level, Paper Prepared for Presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 1 - 14
- Hajdu, F., Jacobson, K., and Salomonsson, L., 2012: ‘But Tractors Can’t Fly...’ A Transdisciplinary Analysis of Neoliberal Agricultural Development Interventions in South Africa, *International Journal of Transdisciplinary Research* 6 (1), 24 - 64
- Harvey, D., 2005: *A Brief History of Neoliberalism*, Oxford University Press, 1 - 247
- Hazelle, P., Poulton, C., Wiggins, S., and Dorward, A., 2010: The Future of Small Farms: Trajectories and Policy Priorities, *World Development* 38 (10), 1349 - 1361
- Hebnick, P., Fay, D and Kondlo, K., 2011: Land and Agrarian Reform in South Africa’s Eastern Cape Province: Caught by Continuities, *Journal of Agrarian Change* 11 (2), 220 - 240
- Heckathorn, D., 1997: Respondent-driven Sampling: A New Approach to the Study of Hidden Populations, *Social Problems* 44, 174 - 199
- Henkel, J., S., 1937: Report on the Animal Ecology of the Hluhluwe Game Reserve with Special Reference to the Tsetse Flies, Natal Witness, Pietermaritzburg, South Africa
- Hesselbrath, K., 2013: The Deadly Myth of Bt Cotton, *AgriFuture*, Spring, 8 - 10

Himonga, C., and Nhlapo, T.,2014: African Customary Law in South Africa - Post Apartheid and Living Law Perspectives, OUP Southern Africa, 1 - 416

Hlabisa Municipality Draft IDP 2013/2014,
http://kzntopbusiness.co.za/site/user_data/files/Hlabisa_Municipality_Draft_IDP_2013_2014.pdf, Accessed 04 October 2014

Holt-Giménez, E., and Altieri, M., A.,2013: Agroecology, Food Sovereignty, and the New Green Revolution, *Agroecology and Sustainable Food Systems* 37 (1), 90 - 102

Hubbard, K., 2009: Out of Hand Farmers Face the Consequences of a Consolidated Seed Industry, National Family Farm Coalition, 1 - 60

Huesing, J., and English, L., 2004: The Impact of Bt Crops on the Developing World, *AgBioForum* 7(1&2), 84 - 95

Ismael, Y., Bennett, R., and Morse, S., 2002: Benefits from Bt Cotton Use by Smallholder Farmers in South Africa, *AgBioForum* 5 (1): 1 - 5

Iversen, M., Iun M. Grønsberg, I., M., van den Berg,J., Fischer, K.,Aheto, D.D.,W., and Bøhn,T.,2014: Detection of Transgenes in Local Maize Varieties of Small-Scale Farmers in Eastern Cape, South Africa, *PLOS one* 9 (12),1 - 21

Ives, C., L., Johanson, A., and Lewis, J., 2001: Agricultural Biotechnology: A Review of Contemporary Issues, USAID, 1 - 33

Jacobson, K. and Myhr, A., I., 2012: GM Crops and Smallholders: Biosafety and Local Practice, *The Journal of Environment Development* 20 (5), 1 - 21

Jacobson, K., 2013: From Betterment to Bt Maize: Agricultural Development and the Introduction of Genetically Modified Maize to South African Smallholders, Doctoral Thesis, Swedish University of Agricultural Sciences Uppsala, 1 - 158

James, C., 2012: Global Status of Commercialized Biotech/ GM Crops: 2012, International Service for the Acquisition of Agrio-Biotech Applications (ISAAA) Brief No. 44, 1 - 18

James, C.,2014: Global Commercialized Biotech/ GM Crops: 2014, International Service for the Acquisition of Agrio-Biotech Applications (ISAAA) Brief No. 49, 1 - 32

Jansen, K., and Gupta, A., 2009: Anticipating the Future: 'Biotechnology for the Poor ' as Unrealized Promise? *Futures* 41, 436-445

Joensen, L., Semino, S., and Paul, H., 2005: Argentina: A Case Study on the Impact of Genetically Engineered Soya, The Gaia Foundation, 1 - 30

Juma, O., M., 2013: Essays on Farm Technology Adoption, Technical Efficiency and Productivity in Smallholder Food Crop Agriculture in Kenya, Doctoral Thesis, University of Kenyatta, 1 - 162

Kambhampati, U., Morse, S., Bennett, R., and Ismael, Y., 2005: Perceptions of the Impacts of Genetically Modified Cotton Varieties: A Case Study of the Cotton Industry in Gujarat, India, *AgBioForum* 8(2&3), 161 - 171

Kathage, J., and Qaim, M., 2012: Economic Impacts and Impact Dynamics of Bt (*Bacillus thuringiensis*) Cotton in India, *PNAS* 109 (29), 11652 – 11656

- Keen, M., Brown, V., A., and Dyball, R., 2005: *Social Learning in Environmental Management. Towards a Sustainable Future*, Earth scan, London
- Kelly, K. and Terre Blanche, M. 1999. Interpretive methods. In Terre Blanche, M. and Durrheim, K. (eds) *Research in practice: Applied methods for the social sciences*, University of Cape Town Press, Cape Town: 123 - 146
- Khunou, S., F., 2009: Traditional Leadership and Independent Bantustans of South Africa: Some Milestones of Transformative Constitutionalism Beyond Apartheid, *PER* 12 (4), 1 – 46
- Kiers, E., T., Leakey, R., R., B., Izac, A., Heinemann, J., A., Rosenthal, E., Nathan, D., and Jiggins, J., 2008: Agriculture at a Crossroads, *SCIENCE* 320, 320 - 322
- Klein, H., and Myers, M., 1999: A Set of Principles for Evaluating and Conducting Interpretive Field Studies in Information Systems, *MIS Quarterly* 23 (1), 67 - 94
- Klerkx, L., Hall, A., and Leeuwis, C., 2009: Strengthening Agricultural Innovation Capacity: Are Innovation Brokers the Answer? *International Journal of Agricultural Resources, Governance and Ecology* 8 (5/6), 409 - 438
- Kohler, S., 2003: Case 20: The Green Revolution, 1 – 7, <https://cspc.sanford.duke.edu>, Accessed 13 February 2014
- Kok, E., Pedersen, J., Onori, R., Sowa, S., Schauzu, M., De Schrijver, A., and Teeri, T., 2014: Plants with Stacked Genetically Modified Events: To Assess or Not to Assess?, *Trends in Biotechnology* 32 (2), 70 - 73
- Kruger, M., Van Rensburg, J.B.J., and van den Berg, J., 2012: Transgenic Bt Maize: Farmers' Perceptions, Refuge Compliance and Reports of Stem Borer Resistance in South Africa, *Journal of Applied Entomology* 136, 38 - 50
- Kruger, M., Van Rensburg, J.B.J., and van den Berg, J., 2014: No Fitness Costs Associated with Resistance of *Busseola fusca* (Lepidoptera: Noctuidae) to Genetically Modified Bt maize, *Crop Protection*, 1 - 6
- Laband, J., and Thompson, P., 1989: *The Reduction of Zululand, 1874 - 1904 in Duminy and Guest (OOs) Natal and Zululand from earliest times to 1910: A New History*, University of Natal Press
- Laband, J., 2009: *Historical Dictionary of Zulu Wars*, Scarecrow Press, 113
- Liamputtong, 2010: Chapter 1: Focus Group Methodology: Introduction and Methodology, 1-14
- Lithourgidis, A., S., Dorda, C., A., Damalas, C., A., Vlachostergios, D., N., 2011: Annual Intercrops: An Alternative Pathway for Sustainable Agriculture, *Australian Journal of Crop Science* 5 (4), 1 - 15
- Mabhaudhi, T., and Modi, A., T., 2010: Early Establishment Performance of Local and Hybrid Maize under Two Water Stress Regimes, *South African Journal of Plant and Soil* 27 (4), 299 - 304

- Mabutla, F., G., 2001: The Fate of Traditional Leaders in Post-Apartheid South Africa, a paper delivered at the Spring Meeting of the South-eastern Regional Seminar in African Studies, held at Northern Kentucky University on the 6th and 7th April 2001, 1 - 25
- Magnani, R., Sabin, K., Saidel, T., and Heckathorn, D., 2005: Review of Sampling Hard-to-reach and Hidden Populations for HIV surveillance, Supplement 19, 67 - 72
- Mandikiana, B., W., 2011: The Economics of Bt Maize/ YieldGuard Production: Case of Smallholder Farmers in the Eastern Cape Province, Master of Science Thesis, University of Fort Hare, 1 - 129
- Manes, R., 2010: Determinants of Genetically Modified Maize by Smallholder Farmers of KwaZulu-Natal, South Africa, Master of Science Thesis, B.S, Kansas State University, 1 - 94
- Manona, S., S., 2005: Smallholder Agriculture as Local Economic Development (LED) Strategy in Rural South Africa: Exploring Prospects in Pondoland, Eastern Cape, University of Western Cape, 1 - 159
- Marshall, M., N., 1996: Sampling for Qualitative Research, *Family Practice* 13 (6), 522 – 525
- Masahiko, A., 2001: Towards a Comparative Institutional Analysis, The MIT Press, 1 - 482
- Mascarenhas, M., and Busch, L., 2009: Seeds of Change: Intellectual Property Rights, Genetically Modified Soybeans and Seed Saving in the United States, *Sociologia Ruralis* 46, 122 - 138
- Mas-Colell, M., W., and Green, J., R., 1995: *Microeconomic Theory*, Oxford: Oxford University Press
- Masifunde Education and Development Project Trust, 2010: Threats to the Food Security and Food Sovereignty in the Eastern Cape: Impacts of the Massive Food Programme (MFPP), GMOs and Cash Crops in Four Villages in the Amathole District Municipality, Grahamstown: Masifunde Education and Development Project Trust, 1 - 65
- Masina, E., M., 2006: Zulu Perceptions and Reactions to the British Occupation of Land in Natal Colony and Zululand, 1850 - 1887: A Recapitulation Based on Surviving Oral and Written Sources, Department of History, Doctoral Thesis, University of Zululand, 1 - 354
- Mason, R., 2013: Glyphosate - Destructor of Human Health and Biodiversity, 1 - 54
- Matsuoka, Y., Vigouroux, Y., Goodman, M., M., Sanchez, J., Buckler, E., and Doebley, J., 2002: A Single Domestication for Maize Shown by Multilocus Microsatellite Genotyping, *PNAS* 99 (9), 6080 - 6084
- McCann, J., 2007: *Maize and Grace: Africa's Encounter with a New World Crop, 1500 -2000*, Harvard University Press
- Meijer, S., Catacutan, D., Sileshi, G., W., and Nieuwenhuis, M., 2014: Tree Planting by Smallholder Farmers in Malawi: Using the Theory of Planned Behaviour to Examine the Relationship Between Attitudes and Behaviour, *Journal of Environmental Psychology* 43, 1-12
- Meinzen-Dick, R., Adato, M., Haddad, L., and Hazell, P., 2004: *Science and Poverty: An Interdisciplinary Assessment of the Impact of Agricultural Research*, International Food Policy Research Institute, 1 - 31

- Mendola, M., 2007: Farm Household Production Theories: A Review of “Institutional” and “Behavioral” Responses., *Asian Development Review*, 24(1), 49 - 68
- Metz, M., and Fütter, J., 2002: Suspect Evidence of Transgenic Contamination, *Nature* 416, 600–601
- Mohammed, S., M.,2014: Pre-breeding of Bambara Groundnut (*Vigna subterranean* [L.] Verd.), Doctoral Thesis, University of KwaZulu-Natal, 1 - 202
- Monge, M., and Halgin, D.,2008: How Change Agents and Social Capital Influence the Adoption of Innovations among Small Farmers, IFPRI Discussion Paper 00761, 1 - 76
- Monsanto, 2015: TUG: U.S Technology Use Guide and IRM Overview, 1 - 36, www.Monsanto.com/sitecollectiondocuments/technology-use-guide/pdf., Accessed 06 May 2016
- Mtero, F., 2012: Commercialization, De-Agrarianisation and the Accumulation/Reproduction Dynamic: Massive Maize Production Schemes in the Eastern Cape, South Africa, Global Land Grabbing II Conference, October 17-19
- Mudhara, M., 2010: Agrarian Transformation in Smallholder Agriculture: A Diagnosis of Bottlenecks and Public Policy Options, Conference Paper Presented at ‘Overcoming Inequality and Structural Poverty in South Africa: Towards Inclusive Growth and Development, Johannesburg, 20-22 September 2010,1 - 20
- Mueller, N., D., Gerber, J., S., Johnston, M., Ray, D., K., Ramankutty, N., and Foley, J., A.,2012: Closing Yield Gaps through Nutrient and Water Management, *NATURE*, 1 - 4
- Munyi, P., and De Jonge, B., 2015: Farmers’ and Breeders’ Rights: Bridging Access to and IP Protection of Plant Varieties in Africa, *The African Journal of Information and Communication* 16,16 - 25
- Murphy, S.,2012: Changing Perspectives: Small-scale Farmers, Markets and Globalisation (revised edition)”, IIED/Hivos, London/The Hague, 1 - 38
- Mutimba, J.K., 2014: Reflections on Agricultural Extension and Extension Policy in Africa, *South African Journal of Agricultural Extension* 42, 15 - 26
- Mwangi, M., and Kariuki, S., 2015: Factors Affecting Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries, *Journal of Economics and Sustainable Development* 6 (5), 208 - 216
- Naik, M., 2016: Fig 1.1 & Fig 3.1
- Nair, K., N., and Singh, G., 2016: Chapter 2: The Role of Technological and Institutional Changes in the Growth and Transformation of Agriculture in Punjab, *Economic Transformation of a Developing Economy*, 29 - 52
- Nandula, V., K., Reddy, K., N., Duke, S., O., and Poston, D., H., 2005: Glyphosate-Resistant Weeds: Current Status and Future Outlook, *Outlooks on Pest Management*, 184 - 187
- Newell, P., 2009: Bio-Hegemony: The Political Economy of Agricultural Biotechnology in Argentina, *Journal of Latin American Studies* 41, 27 - 57

- Nguthi, F., N., 2008: Adoption of Agricultural Innovations by Smallholder Farmers in the Context of HIV/AIDS: The Case of Tissue-Cultured Banana in Kenya, Wageningen Academic Pub, 1 - 215
- Noy, C., 2008: Sampling Knowledge: The Hermeneutics of Snowball Sampling in Qualitative Research, *International Journal of Social Research Methodology* 11 (4), 327 - 344
- Ntuli, S., H., 2006: The Transformation of KwaZulu Homeland from a Primary Agrarian to a More Integrated Socio-economic and Political Entity, Doctoral Thesis, University of Zululand, 1 – 138
- Ogueri, E., I., 2013: Influence of Public and Private Sector Extension Services in the Adoption of Improved Cassava Varieties by Farmers in Rivers State, Nigeria, *OIDA International Journal of Sustainable Development* 6 (3), 103 - 118
- Okeno, J., A., Jeffret, D., W., Misra, M., K., and Rodriguez, L., 2013: Africa's Inevitable Walk to Genetically Modified (GM) Crops: Opportunities and Challenges for Commercialization, *New Biotechnology* 30 (2), 124 - 130
- Oomen, B., 2005: Chiefs in South Africa: Law, Power & Culture in the Post-Apartheid Era, James Currey Publishing, 1 - 272
- Oreszczyn, S., Lane, A., and Carr, S., 2010: The Role of Networks of Practice and Webs of Influencers on Farmers' Engagement with and Learning about Agricultural Innovations, *Journal of Rural Studies* 26 ,404 - 417
- Ortmann, G.F., and King, R.P., 2007: Agricultural cooperatives II: Can They Facilitate Access of Small-scale Farmers in South Africa to Input and Product, *Agricultural Economics Research, Policy and Practice in Southern Africa* 46 (2), 219 - 244
- Oso, A., A., and Falade, M., J., 2010: Effects of Variety and Spatial Arrangement on Pest Incidence, Damage and Subsequent Yield of Cowpea in a Cowpea/Maize Intercrop, *World Journal of Agricultural Sciences* 6 (3), 274 - 276
- Owen, M., and Zelaya, I., A., 2005: Herbicide-Resistant Crops and Weed Resistance to Herbicides, *Pest Management Science* 61, 301 – 311
- Pannar, 2015: About Us, http://www.pannar.com/company_information, Accessed 24 November 2015
- Parmentier, S., 2014: Scaling-up Agroecological Approaches: What, Why and How? Discussion Paper, Oxfam-Solidarity, 1 – 93
- Parthasarathy, D. 2002: Globalization, New Agricultural Technologies, and IPRs: Implications of Modern Biotechnology and Genetic Engineering for Capabilities, Exclusion, and Livelihoods in Developing Countries. Paper Presented at the 9th Biennial Conference of the International Association for the Study of Common Property, Victoria Falls, Zimbabwe
- Patel, R., 2007: Making up Makhathini, In: *Stuffed and Starved*. London, UK: Portobello Books, 153 - 158
- Pereira, M., 2011: Understanding Technology Adoption and Non-adoption: a Case Study of Innovative Beef Farmers from Mato Grosso do Sul State, Brazil, Doctoral Thesis, Lincoln University, 1 - 347

- Prahalad, C., K., and Hart, S., L., 2002: The Fortune at the Bottom of the Pyramid, *Strategy + Business* 26,1 - 16
- Pray, C., E., MA, D., Huang, J., Qiao, F., 2001: Impact of Bt Cotton in China, *World Development*, 29 (5), 813 - 825
- Pray, C., E., Huang, J., Hu,R., and Rozelle, S., 2002 : Five Years of Bt Cotton in China- the Benefits Continue , *The Plant Journal* 31 (4) , 423 - 430
- Preston, C., and Wickson, F., 2016: Broadening the Lens for the Governance of Emerging Technologies: Care Ethics and Agricultural Biotechnology, *Technology in Society* 45, 48 - 57
- Program for Biosafety Systems (PBS) and Agricultural Biotechnology Support Project (ABSP) II (2004): Brief #1: What is Agricultural Biotechnology?, 1 - 2
- Pschorn-Strauss, E., 2005 : Bt cotton in South Africa: The Case of the Makhathini Farmers, <https://www.grain.org/article/entries/492-bt-cotton-in-south-africa-the-case-of-the-makhathini-farmers>, Accessed 06 May 2016
- RT News, 2012: Seeds of Doubt – Brazilian Farmers Sue Monsanto, <http://www.rt.com/brazil-farmers-gmo-refund>, Accessed 24 March 2016
- Qaim, M., 2003: Bt Cotton in India: Field Trial Results and Economic Projections, *World Development* 31 (12), 2115 – 2127
- QuickPhos, 2014: QuickPhos – The Verstile Fumigant, <http://www.uplquickpos.com>, Accessed 20 September 2016
- Quist, D., and Chapela, I., 2001: Transgenic DNA Introgressed into Traditional Maize Landraces in Oaxaca, Mexico, *Nature* 414, 514 - 543
- Ramey, E., A., 2010: Seeds of Change: Hybrid Corn, Monopoly, and the Hunt for Super Profits, *Review of Radical Political Economic* 42 (3), 381 - 386
- Rao, S., M., Rao, C., A., Srinivas, K., Pratibha, G., Vidya Sekhar, S., M., Sree Vani, G., and Venkateswarlu, B., 2012: Intercropping for Management of Insect Pests of Castor, *Ricinus communis*, in the Semi-Arid Tropics of India, *Journal of Insect Science*, 12 - 14
- Robin, M., 2008: The World According to Monsanto: Pollution, Corruption, and the Control of the World's Food Supply, *The New Press*, 1 - 385
- Ruete, M., 2014: Inclusive Investment in Agriculture: Cooperatives and the Role of Foreign Investment, *International Institute for Sustainable Development, Policy Brief 2*, 1 - 8
- Rusike, J.,1995: The Development of Maize Seed Markets in Sub-Saharan Africa, Washington DC: International Food Policy Research Institute
- Sadan, E., 1997: Empowerment and Community Planning: Theory and Practice of People, Chapter 1: Theories of Power, *Focused Social Solutions*, Tel Avi, 33 - 71
- Sadler, G., R., Lee, H., Lim, R., S., Fullerton, J., 2010: Recruiting Hard-to-reach United States Population Sub-groups via Adaptations of Snowball Sampling Strategy, *Nurse & Health Sciences* 12 (3), 369 - 374.

Schmidt, V., A., 2010: Taking Ideas and Discourse Seriously: Explaining Change Through Discursive Institutionalism as the Fourth 'New Institutionalism', *European Political Science Review* 2, 1, 1 - 25

Schnurr, M., A., 2012: Inventing Makhathini: Creating a Prototype for the Dissemination of Genetically Modified Crops into Africa, *Geoforum* ,1 – 33

Schnurr, M., A., and Mujabi-Mujuzi, S., 2014: ‘‘No One Asks for A Meal They’ve Never Eaten.’’ Or, do African Farmers Want Genetically Modified crops? *Agriculture, Human and Values* 31, 643 - 648

Schoffer, E., Hironaka, A., Frank, D., J., and Longhoffer, W., 2012: Sociological Institutionalism and World Society, *The Wiley-Blackwell Companion to Political Sociology*, 57 - 68

Scoones, I., 2002: Can Agricultural Biotechnology Be Pro-Poor? A Sceptical Look at the Emerging ‘Consensus’, *IDS Bulletin* 33 (4), 114 - 119

Scoones, I., 2008: Mobilizing Against GM Crops in India, South Africa and Brazil, *Journal of Agrarian Change*, 8 (2 & 3), 315 - 344

Seran, T., H., and Brintha, I., 2010: Review on Maize Based Intercropping, *Journal of Agronomy* 9, 135 - 145

Serratos-Hernández, J., A., Gómez-Olivares, J., L., Salinas-Arreortua, N., Buendía-Rodríguez, E., Islas-Gutiérrez, F., and de-Ita, A., 2007: Transgenic Proteins in Maize in the Soil Conservation Area of Federal District, Mexico, *Frontiers in Ecology and the Environment* 5, 247 - 252

Shankar, B., and Thirtle, C., 2005: 'Pesticide Productivity and Transgenic Cotton Technology: The South African Smallholder Case', *Journal of Agricultural Economics* 56 (1), 97 – 116

Shandu, M., N.,2004: Zululand District Municipality Disaster Management Sector Plan, 1-6, <http://www.zululand.org.za/media/2464/Annexure%20J1.pdf>, Accessed 08 May 2016

Simelane, N.,2011: An Assessment of the Role of Co-operatives in Smallholder Dairy Production and Marketing in Swaziland, Master of Science Thesis, University of Pretoria, 1-136

Simtowe, F., and Zeller, M., 2006: The Impact of Access to Credit on the Adoption of Hybrid Maize in Malawi: An Empirical Test of an Agricultural Household Model under Credit Market Failure, <http://ssrn.com/abstract=939515>, Accessed 30 September 2016

South African History Online, 2015: Transformations in Southern Africa After 1750, <http://www.sahistory.org.za/topic/political-changes-1750-1835> , Accessed 19 November 2015

Sniehotta, F., F., Presseau, J., Araujo-Soares, V.,2014: Time to Retire the Theory of Planned Behaviour, *Health Psychology Review* 8(1), 1 - 7

Spooner, D., M., and Williams, K., A., 2004: Germplasm acquisition, *Encyclopaedia of Plant and Crop Science*, Ed.: R.M. Goodman, Dekker Agropedia, New York, New York,537 - 540

- Statistics South Africa (Stats SA), 2010: General Household Survey 2009, Stats SA dataset, CDROM. Statistics South Africa, Pretoria
- Statistics South Africa (Stats SA), 2012: Census 2011, Statistics South Africa, 1 – 88
- Stone, G., D., 2004: The Birth and Death of Indigenous Knowledge: Paradoxical Effects of Biotechnology in India, In *Biodiversity and the law*, ed McManis, C., London: Earthscan
- Stone, G., D., 2007: Agricultural Deskillling and the Spread of Genetically Modified Cotton in Warangal, *Current Anthropology* 48 (1), 67 – 103
- Stone, G., D., and Glover, D., 2011: Genetically Modified Crops and the ‘Food Crisis’: Discourse and Material Impacts, *Development in Practice* 21 (4-5), 509 - 516
- Stone, G., D., 2012: Constructing Facts, Bt Cotton Narratives, *Economic & Political Weekly* 47 (38), 62 - 70
- Stone, G., D., and Flachs, A., 2015: Seeking Sustainability for Smallholders: Bt cotton in India, In *Africa’s Future...Can Biosciences Contribute?* Bennett, D., and Mitton, P., (eds.), Cambridge, Banson/B4FA, 119 - 128
- Sulaiman, R., V., and Davis, K., 2012: The “New Extensionist”: Roles, Strategies, and Capacities to Strengthen Extension and Advisory Services, *Global Forum for Rural Advisory Services*, 1 - 24
- Sunding, D., and Zilberman, D., 2000: *The Agricultural Innovation Process: Research and Technology Adoption in a Changing Agricultural Sector*, University of California, Berkeley, 1 - 105
- Swanepoel, S., 2014: *Seed Politics: An Exploration of Power Narratives in the South African Seed Industry*, Master of Philosophy, University of Stellenbosch, 1 - 87
- Taylor, J. E., and Adelman, I., 2003: *Agricultural Household Models: Genesis, Evolution and Extensions*. *Review of Economics of the Household* 1(1), 33 - 58
- Test Biotech, 2014: *Bt Crops Resistance Development in Pest Insects*, <http://www.testbiotech.de>, Accessed 24 March 2016
- Thirtle, C., Beyers, L., and Ismael, Y., 2003: Can GM-Technologies Help the Poor? The Impact of Bt Cotton in Makhathini Flats, KwaZulu-Natal, *World Development* 31 (4), 717 - 732
- Thoenig, J., 2011: *Institutional Theories and Public Institutions - New Agendas and Appropriateness*, *The Handbook of Public Administration*, Sage ,1 - 17
- Thomson, J., A., 2008: *The Role of Biotechnology for Agricultural Sustainability in Africa*, *Philosophical Transactions of the Royal Society* 363, 905 - 913
- Traxler, G., Godoy-Avilla, S., Falck-Zepeda, J., and Espinoza-Arellano, J. J., 2001: *Transgenic Cotton in Mexico: Economic and Environmental Impacts*. Paper Presented at the 5th International Conference, *Biotechnology, Science and Modern Agriculture: A New Industry at the Dawn of the Century*, Ravello, Italy, 15-18 June, 2001
- Trigo, E., and Cap, E., 2006: *Ten Years of Genetically Modified Crops in Argentine Agriculture*, *ArgenBio*, 1 - 52

- Uaiene, R., Arndt, C., Masters, W., 2009: Determinants of Agricultural Technology Adoption in Mozambique. Discussion papers No. 67E
- US EPA, 1995: Pesticide Fact Sheet for *Bacillus thuringiensis* ssp. *kurstaki* CryI (A) b delta-endotoxin and the Genetic Material Necessary for the Production (plasmid vector pCIB4431) in Corn. EPA publication no. EPA731-F-95-004. Washington, DC: US Environmental Protection Agency
- van den Berg, J., 2011: The South African National Biodiversity Institute. Monitoring the environmental impacts of GM maize in South Africa [homepage on the Internet]. c2011 [cited 2015 February 07]. Available from: <http://www.sanbi.org>, Accessed 07 February 2015
- van den Berg, J., 2012: Field-resistance of the African Maize Stem Borer to Bt Maize: What Did We Learn?, Scientific Conference 28-29 September, Advancing the Understanding of Biosafety GMO Risk Assessment, Independent Biosafety Research and Holistic Analysis, 1 - 5
- van Ittersum, M., K., Cassman, K., G., Grassinib, P., Wolfa, J., Tittonell,P.,and Hochman, Z., 2013 : Yield gap analysis with local to global relevance-A review, *Field Crops Research* 143 , 4 - 17
- van der Ploeg, J., D., Jingzhong, Y., and Schneider, S., 2010: Rural Development Reconsidered: Building on Comparative Perspectives from China, Brazil and the European Union, *Rivista di Economia Agraria* 2, 163-190
- van der Ploeg, J., D.,2013: Peasant-driven Agricultural Growth and Food Sovereignty, *Food Sovereignty: A Critical Dialogue: International Conference*, Yale University, 14 – 15 September, 1 - 36
- Van Rensburg, J., B., J., 2007: First Report of Field Resistance by the Stem Borer, *Busseola fusca* to Bt-transgenicM, *South African Journal of Plant and Soil* 24, 147 - 151
- Vroom, W., 2009: Reflexive Biotechnology Development: Studying Plant Breeding Technologies and Genomics for Agriculture in the Developing World, Wageningen Academic Publishers, 1 - 216
- Wang, S., Juts, D., R., and Pinstруп-Andersen, P., 2006: Tarnishing Silver Bullets: Bt Technology Adoption, Bounded Rationality and the Outbreak of Secondary Pest Infestations in China, *America Agricultural Economics Association Annual Meeting*, 1 - 35
- Witt, H., Patel, R., and Schnurr, M., 2006: Can the Poor Help GM Crops? Technology, Representation and Cotton in the Makhathini Flats, South Africa, *Review of African Political Economy* 109, 497 - 513
- Wolson, R., A., and Gouse, M., 2005: Towards a Regional Approach to Biotechnology Policy in Southern Africa: Phase I, Situation and Stakeholder Analysis—South Africa (Food, Agriculture and Natural Resources Policy Analysis Network [FANRPAN] Draft Paper), Pretoria, South Africa: FANRPAN
- World Health Organization (WHO): 2015: Evaluation of Five Organophosphate Insecticides and Herbicides, *International Agency for Research on Cancer (IARC) Monographs*, 112,

Lyon, France, 1 - 92,
<https://www.iarc.fr/en/mediacentre/iarcnews/pdf/MonographVolume112.pdf>, Accessed 28 July 2016

Wynberg, R., van Niekerk, J., Williams, R., and Mkhalihi, L., 2012. Policy Brief. Securing Farmers' Rights and Seed Sovereignty in South Africa. Biowatch South Africa and the Environmental Evaluation Unit, University of Cape Town, 1 - 20

Wynberg, R., and Fig, D., 2013: A Landmark Victory for Justice -Biowatch's Battle with the South African State and Monsanto, Biowatch South Africa, 1 - 84

Zapiain, A., O., 2008: Intellectual Property Rights, Genetically Modified Seeds and Farmers' Food Sovereignty: The Case Study of South Africa, Masters of Social Sciences Thesis, University of KwaZulu-Natal, 1 - 95

Zehr, U., B., 2010: Biotechnological Advances, Springer Science & Business Media, 1 - 245

Zerbe, N., 2004: Feeding the Famine? American Food Aid and the GMO Debate in Southern Africa, Food Policy 29, 593 - 608

Zeven, A., C., 1998: Landraces: A Review of Definitions and Classifications, Euphytica 104, 127 - 139

APPENDICES

Appendix I: GM maize Farmer Survey



Physical address: Environmental & Geographical Science Building,
South Lane, Upper Campus
Postal address: University of Cape Town, Private Bag X3,
Rondebosch 7701

Exploring the uptake of genetically modified crops by South African smallholder farmers

Participant Information Sheet

My name is Hellen Mahlase and I am investigating the positive and negative impacts of genetically modified crops on the livelihoods of smallholder farmers in South Africa for my Master of Science at the University of Cape Town.

The purpose of this research study is (1) to determine the reasons why South African smallholder farmers have chosen to plant genetically modified (GM) crops in their agricultural fields, (2) to examine the perceived risks and benefits associated with the use of GM crops and (3) assess the extent to which GM crops improve or constrain the livelihoods of South African smallholder farmers.

If you choose to part take in this research study, you will be required to spend about 45 min answering a questionnaire. You are not obliged to answer any questions.

In the questionnaire you will be asked to answer questions that will help me address the purpose of this research study. The information that you will provide in this research study will remain confidential and you will be an anonymous participant.

Your participation is appreciated.

Participant Consent Form

I was asked by Hellen Mahlase from the University of Cape Town to participate in this research study and have agreed to do so. No one has forced me to participate in this research study. I am taking part in the research voluntarily and understand that the information that I will provide in the questionnaire is confidential and my identity will remain anonymous.

Participant's name/signature

Date

Questionnaire Number

GM maize Farmer's Questionnaire

A. General Information

Interviewer's name

Respondent's name (optional)

Date

Location

GPS Coordinates

B. Qualifying questions

Please circle or tick the correct answer

I. Have you ever planted GM maize seeds? (a) No (b) Yes

II. Are you still using GM maize seeds? (a) No (b) Yes

If the answer was "yes" to the previous question ask the respondent question III. However if the answer was "no", ask the respondent question IV

III. How long have you been using GM maize seeds? State answer in number of years.....

IV. For how did you use GM maize seeds before abandoning them?

(a) I used them on a trial basis (or one year)

(b) I have used them for 2 years

(c) Other (Please state number of years.....)

Sit down questions

C. Farmer's Profile

1. Gender: (a) Female (b) Male
2. Language:
3. Age: 18-24 25-33 34-44 45-54 55-65 66-76 77-87 88-older
4. Marital Status:
 - (a) Divorced (b) Married (c) Separated (d) Single (e) Widow (f) Widower
5. Level of education:
 - (a) No formal education
 - (b) Incomplete primary school education (between Grade 1 and Grade 6)
 - (c) Complete primary school education (Finished Grade 7)
 - (d) Incomplete high school education (Between Grade 8 and Grade 11)
 - (e) Complete high school education (Finished Grade 12)
 - (f) Technical/ College education
 - (g) University education
6. Occupation:
 - (a) I am employed as a.....
 - (b) Self-employed (Please describe the type of work you do.....)
 - (c) Unemployed
 - (d) Pensioner and my previous job was
 - (e) Student/Learner
 - (f) Other (Please state.....)

18. What did you grow on this field/s before you began growing GM maize?

19. What is the size of your field/s? Please state size in hectares

20. What kind of farm labour do you use?

(a) Family labour

(b) Hired labour

(c) Both family and hired labour

21. How many people in total provide farm labour?

Type of farm labour	Number of female labourers	Number of male labourers
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Family labour		
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Hired labour		
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22. Do you divide your farm labour based on gender and age? (a) No (b) Yes

23. If you answered yes in the previous question please tell me how you divide your labour

24. Has your farm labour always been like this? (a) No (b) Yes

25. Please explain your answer to the previous question

26. Please draw a picture of the GM maize growing area below

Please note: separation distances between GM crops and non-GM crops; ask the farmer about the distance between his/her neighbours fields and whether he/she knows if the farmer uses GM or non-GM maize; note measures taken to prevent contamination: bare land, refugia, windbreaks, ask whether farmer is growing any plants for seeds, exchanging seeds or wanting to grow other crops

Ask the following questions when you get the fields

27. Was there ever a time you stopped using GM maize?

- (a) No
- (b) Yes, I stopped because

28. Did you sign a contract upon your purchase of GM maize seeds?

- (a) No
- (b) Yes

29. If you answered “yes” in the previous question, what did the contract say?

30. Please tell me which seeds you are currently saving and/or exchanging by placing in tick in the appropriate box

Maize seed type	Saving	Exchanging	Not doing anything
(a) Traditional			
(b) Pannar			
(c) Monsanto			

31. Please explain your answer/s to the previous question

Ask only if the farmer indicated that he/she is not saving or exchanging any maize seeds

32. How do you feel about not exchanging and/or saving your maize seeds?

33. What do you use GM maize for? Please select all options that apply to you

- (a) Eating
- (b) Livestock feed
- (c) Selling

If the farmer does not sell GM maize, please skip to the next questions

34. How much do you make selling GM maize?

- (a) I make enough money from GM maize to save
- (b) I only cover my costs
- (c) I lose money with GM maize
- (d) I cannot say because it changes from year to year
- (e) Other , please tell me

E. The Financial Costs of GM Maize and Associated Inputs

35. How do you feel about paying for GM maize seeds?

36. How do you pay for your GM maize seeds?

37. Are you always able to buy GM maize seeds?

(a) No, please explain

(b) Yes

Ask if the farmer uses pesticides and/or insecticides before asking the questions that follow.

38. Similarly how do you feel about buying pesticides?

39. Are you always able to buy pesticides?

(a) No, please explain

(b) Yes

40. Lastly how do you feel about buying insecticides?

41. Are you always able to buy insecticides?

(a) No. Please explain

(b) Yes

F. The Performance of GM maize

42. Please tell me what is good and bad about the following maize types:

Maize type	Good	Bad
Traditional maize		
Monsanto maize		
Pannar maize		

43. Has your pest management strategy changed with the adoption of GM maize?

(a) No

(b) Yes, please explain the changes

44. Did you receive any advice about dealing with insect pests when you adopted GM maize?

- (a) No
- (b) Yes, please tell me the advice

45. What have you noticed in the pest pressure since you adopted GM maize?

46. Similarly have you changed the way you deal with maize weeds since you adopted GM maize?

- (a) No
- (b) Yes, please tell me the changes

47. Did you receive any advice about dealing with maize weeds when you adopted GM maize?

- (a) No
- (b) Yes, please tell me the advice

48. What have you noticed in the weed pressure since you adopted GM maize?

49. Will you continue using GM maize in future? Please your answer?

G. Support associated with GM maize

50. What type of assistance have you received or received with the use of GM maize?

51. Who is the provider of the assistance?

52. How regularly do you receive assistance in a single GM maize growing season?

H. GM maize Seeds Health, Social and Cultural Implications

Health implications

53. Is Roundup safe to use? (a) No (b) Yes

54. Have you experienced any symptoms with the use of Roundup? (a) No (b) Yes,
I have experienced the following

55. Do you take any precautionary measures when using Roundup? (a) No (b) Yes

56. If you answered “yes” in the previous question please list all the precautionary measures you and/or your labourers take below

Social implications

57. Do you think the quality of your life is better, worse or the same since you adopted GM maize seeds?

Better

Worse

The same

58. Please explain your answer in the previous question

59. Has your relationship with other farmers changed since you adopted GM maize?

(a) No

(b) Yes

60. Please tell me how your relationship has changed

61. Has your involvement in the farming community changed since you adopted GM maize?

- (a) No
- (b) Yes, please tell me how it has changed

62. Who is responsible for making production decisions?

63. Has it always been like this?

- (a) No, please tell me what has changed
- (b) Yes

Cultural implications

64. Which maize seeds do you use for cultural/traditional events or ceremonies if you have them? Please select more than one option if applicable

- (a) Traditional maize seed
- (b) Monsanto maize seed
- (c) Pannar maize seed
- (d) All of the above

65. Please explain your answer to the previous question below

66. Which mielie-meal (uphuthu) tastes better?

- (a) Traditional mielie-meal flour

- (b) Monsanto mielie-meal flour
- (c) Pannar mielie-meal flour
- (d) No difference in taste

67. Which umqombothi (traditional beer) tastes better?

- (a) Umqombothi made from traditional maize seeds and other ingredients
- (b) Umqombothi made from Monsanto maize seeds and other ingredients
- (c) Umqombothi made from Pannar maize seeds and other ingredients

68. Is there anything else that you would like to add about GM maize?

Thank you for your time.

Appendix II: Non-GM maize farmer survey



Physical address: Environmental & Geographical Science Building,
South Lane, Upper Campus
Postal address: University of Cape Town, Private Bag X3,
Rondebosch 7701

Exploring the uptake of genetically modified crops among South African smallholder farmers

Participant Information Sheet

My name is Hellen Mahlase and I am investigating the positive and negative impacts of genetically modified crops on the livelihoods of smallholder farmers in South Africa for my Master of Science at the University of Cape Town.

The purpose of this research study is (1) to determine the reasons why South African smallholder farmers have chosen to plant genetically modified (GM) crops in their agricultural fields, (2) to examine the perceived risks and benefits for smallholder farmers using GM crops and (3) to assess the extent to which GM crops improve or constrain the livelihoods of South African smallholder farmers.

If you choose to part take in this research study, you will be required to spend about 45 min answering a questionnaire. You are not obliged to answer any questions.

In the questionnaire you will be asked to answer questions that will help me address the purpose of this research study. The information that you will provide in this research study will remain confidential and you will be an anonymous participant.

Your participation is appreciated.

Participant Consent Form

I was asked by Hellen Mahlase from the University of Cape Town to participate in this research study and have agreed to do so. No one has forced me to participate in this research study. I am taking part in the research voluntarily and understand that the information that I will provide in the questionnaire is confidential and my identity will remain anonymous.

Participant's name/signature

Date

Questionnaire Number

Non- GM maize Farmer's Questionnaire

A. General Information

Interviewer's name

Respondent's name (optional)

Date

Location

GPS Coordinates

B. Qualifying questions

Please circle or tick the correct answer

I. Have you ever heard about GM maize seeds (a) No (b) Yes

II. Have you ever planted GM maize seeds? (a) No (b) Yes

III. What kind of maize do you grow? Please select all options that apply to you

(a) Traditional maize

(b) Pannar maize

Sit down questions

C. Farmer's Profile

1. Gender : (a) Female (b) Male
2. Language :
3. Age : 18-24 25-33 34-44 45-54 55-65 66-76 77-87 88-older
4. Marital Status :
 - (a) Divorced (b) Married (c) Separated (d) Single (e) Widow (f) Widower
5. Level of education :
 - (a) No formal education
 - (b) Incomplete primary school education (between Grade 1 and Grade 6)
 - (c) Complete primary school education (Finished Grade 7)
 - (d) Incomplete high school education (Between Grade 8 and Grade 11)
 - (e) Complete high school education (Finished Grade 12)
 - (f) Technical/ College education
 - (g) University education
6. Occupation :
 - (a) I am employed as a.....
 - (b) Self-employed (Please describe the type of work you do.....)
 - (c) Unemployed
 - (d) Pensioner and my previous job was
 - (e) Student/Learner
 - (f) Other (Please state.....)

7. What is the household's income on a monthly basis?

- (a) <R1000
- (b) R1001- R1500
- (c) R1501-R3500
- (d) R3501-R5000
- (e) R5001-R7500
- (f) >R7500

8. Please tell me three sources which contribute the most to the household's monthly income

9. Farming experience : 0-1 year 2- 5 years 6-10 years + 10 years

10. How many family members are you supporting with farming?

11. Where do you grow your maize?

Please ask the farmer to take you to where he/she grows maize

Type of farm labour Number of female labourers Number of male labourers

Family labour

Hired labour

18. Has your farm labour always been like this? (a) No (b) Yes

19. If you answered no in the previous question, please explain your answer

20. Please tell me which seeds you are currently saving and/or exchanging by ticking in the appropriate box

Maize seed type Saving Exchanging Not doing anything

(a) Traditional

(b) Pannar

21. Please explain your answer/s to the previous question

Ask only if the farmer indicated that he/she is not saving or exchanging any maize seeds

22. How do you feel about not exchanging and/or saving your maize seeds?

23. What do you use maize for? Please select all options that apply to you
- (a) Eating
 - (b) Livestock feed
 - (c) Selling

If the farmer does not sell maize, please skip to the next questions

24. How much do you make selling maize?
- (a) I make enough money from maize to save
 - (b) I only cover my costs
 - (c) I lose money with maize
 - (d) I cannot say because it changes from year to year
 - (e) Other , please tell me

E. The Financial Costs of GM Maize and Associated Inputs

25. How did you feel about paying for GM maize seeds?

Ask if the farmer uses pesticides and/or insecticides before asking the questions that follow.

26. Similarly how do you feel about buying pesticides?

27. Are you always able to buy pesticides?
- (a) No, please explain

(b) Yes

28. Lastly how do you feel about buying insecticides?

29. Are you always able to buy insecticides?

(a) No, please explain

(b) Yes

F. The Performance of Maize

30. Please tell me what is good and bad about the following maize types :

Maize type Good Bad

(a) Traditional maize

(b) Pannar maize

31. How do you typically deal with maize insect pests?

32. Did you receive any advice about dealing with insect pests that attack your maize?

(a) No

(b) Yes, please tell me the advice

33. What have you noticed in insect pest pressure over the years?

34. Similarly how do you typically deal with maize weeds?

35. Did you receive any advice about dealing with maize weeds?

(a)No

(b) Yes, please tell me the advice

36. What have you noticed in the weed pressure over the years?

37. Will you ever consider adopting GM maize in future? Please explain your answer?

G. Support Associated with Maize

38. What type of assistance have you received with the use of your maize?
39. Who is the provider of the assistance?
40. How regularly do you receive assistance in a single maize growing season?

H. Maize Seeds, Social and Cultural Implications

Social implications

41. Do you think the quality of your life will become better, worse or the same should you adopt GM maize seeds?

Better Worse The same

42. Please explain your answer to the previous question
43. Please describe your relationship with other farmers?
44. Has your involvement in the farming community changed over the years?

(a) No

(b) Yes, please tell me how it has changed

45. Who is responsible for making production decisions?

46. Has it always been like this?

(a) No, please tell me what has changed

(b) Yes

48. Is there anything else that you would like to add about GM maize?

Thank you for your time.

Key informant schedule

Date	Key informant	Number	Institution
20.11.2014	Local agricultural extension officer	1	Local department of agriculture, Hlabisa
10.09.2015	Monsanto agent	1	Monsanto South Africa
23.10.2015	AfricaBio representative	1	AfricaBio (GM crop lobby body)
11.01.2016	Chief of Hlabisa <i>Nduna</i> of Hlabisa	2	Traditional authority of Abakwa Hlabisa

Hlabisa local agricultural extension officer interview template

Extension Experience

1. What is your extension experience?
2. How many extension officers are serving farmers in the area?
3. What type of support do you offer famers of this area?
4. How do you keep up with the latest agricultural technologies?
5. What kind of training did you receive with using GM maize seeds and associated chemical inputs? Ask: who gave you this training?
6. Maybe first ask: Tell me about the farmers' days that you hold. And this can lead into the rest of the questions. Why did this local department of agriculture start using farmers' days?
7. How long has the department of agriculture been running these farmers' days?
8. What kind of agricultural projects have been introduced to farmers in the past?

The introduction of GM maize seeds

9. How you were first introduced to GM seed?
10. Why was Hlabisa selected as an area for the introduction of GM maize seeds? And who selected it? When?
11. Please tell me of your involvement with introducing GM maize seeds to farmers over the years? What is the overall experience of farmers with these seeds? What are the positive and negative aspects?
12. What do you think were the factors which contributed to some farmers choosing to adopt GM maize seeds?

13. Please tell me about cases where farmers did not adopt or rejected GM maize seeds, and why.

Supporting farmers

14. What type of support have GM maize seed adopters received from the local department of agriculture over the years?
15. What do you think are the factors which contributed to the adoption of GM maize seeds in Hlabisa?
16. What benefits do GM maize seeds offer to the farmers in this area?
17. How are the potential risks and benefits of GM maize seeds communicated to farmers?

Issues with adopting GM maize seeds

18. What were the challenges farmers face with adopting GM maize seeds?
19. What are the common problems reported by farmers about GM maize seeds?
20. Do you inform the smallholder farmers that you work about planting refugia? (a) No (b) Yes, I tell them the following
21. What role do you see for yourself as an agriculture extension officer over the next 5-10 years?

Monsanto agent interview template

Number of years working at Monsanto South Africa:

1. Please describe the role that you play at Monsanto?
2. How does Monsanto get involved in local agriculture and the uptake of GM crops?
3. How does Monsanto get introduced to the local communities?

Introducing GM seeds to farmers

1. Why is Monsanto interested in smallholder farmers?
2. Please take me through the process of selecting potential smallholder farmer adopters
3. How do you introduce GM seeds to smallholder farmers?
4. Please tell me about your involvement in introducing smallholder farmers to GM seeds over the years
5. What challenges did you face when introducing GM seeds to smallholder farmers?

6. What were the responses of smallholder farmers when GM seeds were introduced to them?
7. What do you think has contributed to smallholder farmers choosing to use Monsanto seeds?
8. Why do you think some smallholder farmers have not yet adopted GM seeds?
9. How are the benefits of GM seeds communicated to smallholder farmers?
10. Do the adopters report any problems associated with the use of GM seeds? If yes, how do you try to resolve those problems?

Support from Monsanto offered to smallholder farmers

1. Does Monsanto offer any support to smallholder farmers? (a) No (b) yes, please tell me about the type of support offered to them?
2. Has Monsanto taken any steps to make GM seeds and associated inputs affordable or accessible to smallholder farmers?
3. In the case of Hlabisa, how did Monsanto become involved with the farmers' days?

AfricaBio interview template

1. Please tell me why you are interested in smallholder farmers?
2. Why are you promoting genetically modified (GM) crops to smallholder farmers?
3. What are your areas of operation in South Africa?
4. Please describe the relationship that you have with the Department of Agriculture, Fisheries & Forestry?
5. Similarly please describe your relationship with Monsanto and Pannar
6. Please tell me about the cases where AfricaBio was directly/indirectly involved with the introduction of GM crops?
7. What challenges did AfricaBio face when trying to introduce GM crops to smallholder farmers?
8. Were there any cases when GM crops were rejected by smallholder farmers? If yes, please tell me what the reasons of rejection were
9. Are there any cases where GM crops were successfully adopted by smallholder farmers?
10. What challenges have adopters reported after the introduction of GM crops?
11. How are adopters advised to deal with the risks associated with using GM crops?

Traditional authority interview template

1. How long have you been a chief/ chief in this area?
2. Please tell me about the relationship you have with the department of agriculture?
3. How have you helped or how are you helping the farmers in this area?
4. Please tell me about the time you first heard about Monsanto maize seeds
5. What was your attitude towards Monsanto seeds?
6. Who was given the responsibility of telling the farmers about Monsanto maize seeds?
7. What was the reception of Monsanto maize seeds from the farmers?
8. Why do you think some farmers use Monsanto maize seeds and other farmers are not using Monsanto maize seeds?
9. What is good about Monsanto maize seeds?
10. What is bad about Monsanto maize seeds?
11. Is there anything else you would like to add?