CHAPTER 3

ADOPTION AND REASONS FOR ADOPTION OF GENETICALLY MODIFIED CROPS BY SOUTH AFRICAN FARMERS

3.1 INTRODUCTION

According to Clive James of the International Service for the Acquisition of Agric-Biotech Applications (ISAAA), agricultural biotechnology continues to be the most rapidly adopted technology in agricultural history. As has been mentioned in Chapter 2 the total global area under transgenic crops has increased by 8.4 million hectares from 2000 to 2001 and by a further 6.1 million hectares (12%) between 2001 and 2002. As can be seen in Table 3.1, herbicide tolerant soya beans covered 36.5 million hectares globally (62% of the total global transgenic area of all crops) in 2001 while insect resistant maize covered 7.6 million hectares (21% of the total global transgenic area). Herbicide tolerant crops - primarily soya beans and canola - covered 44.2 million hectares or 75 percent of the total global commercial transgenic crop area (ISAAA, 2003). The impressive rates of adoption for many of these transgenic crops are strong evidence of their perceived value to farmers (Marra et al., 2002)

Table 3.1: Most popular crops and genetically induced traits in 2001/2002

	GM crop	Million Ha	Million Ha	Crop traits
Most popular	Soya beans	36.5	44.2	Herbicide tolerant
2nd	Maize	12.4	10.1	Insect resistant
3d	Cotton	6.8	4.4	** Stacked gene
4th	Canola	3		

**Herbicide tolerant / Insect resistant combination

Source: ISAAA

This chapter reviews the adoption of genetically modified crops by South African farmers. Furthermore this chapter gives a brief overview of the cotton and maize industries and discusses the farm and household profiles of the adopters. This is necessary to put in context and to understand the reasons for adoption put forward by the different farming groups. The different reasons and their implications are discussed.

3.2 ADOPTION OF TRANSGENIC CROPS IN SOUTH AFRICA

South Africa is currently the fifth largest transgenic crop producer in the world and produces in extent of 300 000 hectares of transgenic cotton, maize and soya beans (ISAAA, 2003). Since the introduction of insect resistant cotton in South Africa in 1997 and insect resistant yellow maize in 1998 the adoption rate of these two new products by South African farmers has been impressive.

Figure 3.1 illustrates the percentage composition of annual cotton seed sales. Adoption in the introduction season (1997/1998) was rather insignificant but 1998/1999 saw close to 40% adoption. Bt cotton seed sales increased in 1999/2000 but decreased again in 2000/2001. According to surveyed farmers and extension officers from both Clark Cotton (the major ginning company in SA) and Delta Pineland (the only seed company distributing transgenic cotton seed in SA), the decrease was caused by a combination of factors, including low bollworm pressure in 1999/2000, and the popularity of a conventional variety called Delta Opal.

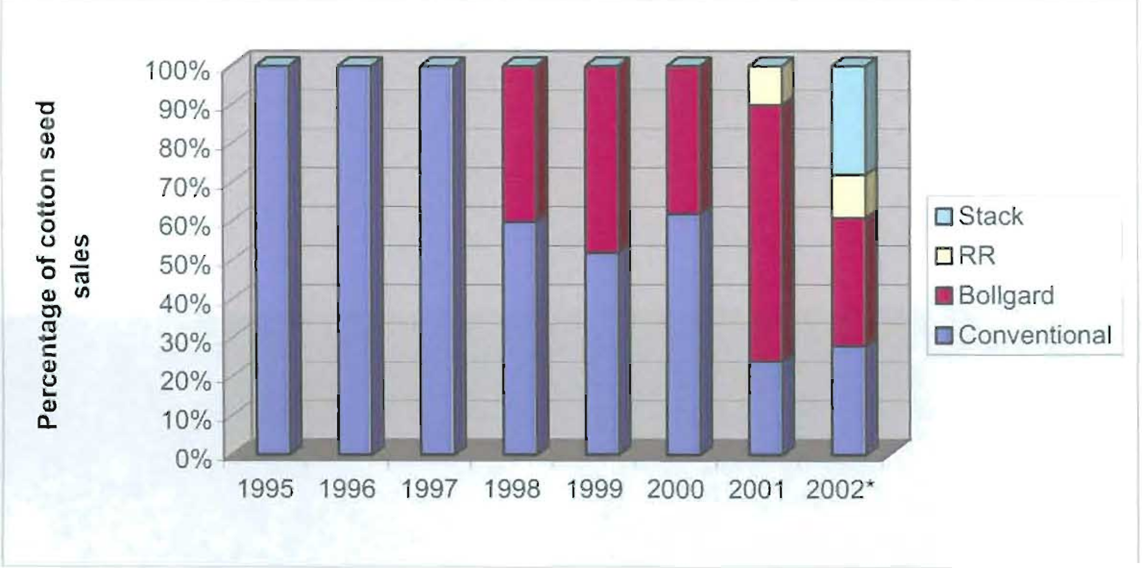

Figure 3.1: Adoption of new cotton seed varieties

* Estimation

Source: Cotton SA, Journal to the Cotton Industry

In 2001/2002 Delta Pineland introduced NuOpal (Opal with the Bt gene) and adoption increased again while this season also saw the introduction of herbicide tolerant cotton. According to a Cotton SA estimation (Figure 3.1) the demand for Bt cotton would have decreased for the 2002/2003 season due to the introduction of the "stacked gene" technology (Cotton SA, 2002). It has however become apparent that the "stacked" seed could not be released for the 2002/2003 season due to a delay caused by some additional legislative and regulatory requirements.

Table 3.2 indicates the current commercially produced transgenic crops in South Africa and the estimated areas planted, while Table 3.3 indicates the percentage of seed sales or the total crop area these crops cover.

Table 3.2: Estimated area planted to transgenic crops (ha).

Crop	1999/2000	2000/2001	2001/2002	2002/2003
Bt Cotton	13 200	12 000	25 000	18 000
RR Cotton	0	0	1 500	3 500
Bt Yellow Maize	50 000	75 000	160 000	197 000
Bt White Maize	0	0	6 000	55 000
RR Soya-beans	0	0	6 000	15 000

Source: SANSOR, Monsanto and own survey

Table 3.3: Transgenic crops according to percentage of seed sold or as percentage of area planted.

Crop	1999/2000	2000/2001	2001/2002	2002/2003
Bt Cotton*	50%	<40%	70%	70%
RR Cotton*	0	0	<10%	12%
Bt Yellow Maize**	3%	5%	14%	20%
Bt White Maize**	0	0	0.4%	2.8%
RR Soya-beans*	0	0	5%	10.9%

* Percentage of seed sales as estimated by Cotton SA and SANSOR

**Percentage of area planted

This study will not report on the introduction, adoption and performance of herbicide tolerant cotton and soya-beans. Table 3.3 clearly shows that the adoption of insect resistant cotton has been much more dramatic than that of insect resistant yellow maize. The reasons for this difference in adoption will become clear when the reasons why farmers adopted the new technology are considered. Firstly it is necessary to establish who these technology-adopting farmers are.

3.3 BRIEF INDUSTRY OVERVIEW AND PROFILES OF ADOPTING FARMERS

3.3.1 COTTON INDUSTRY OVERVIEW

In the 1999/2000 season an estimated 51 000 hectares of cotton were planted, showing a decline of more than 50% from the previous season's 99 000 hectares. In February 2002 Cotton SA estimated the seasons production on 31 224 hectares, a further decline of 45% from the 56 692 hectares in 2000/2001. This drastic decline in cotton area could be mainly attributed to a relatively lower world price for cotton while the latest area decline in 2001/2002, can also be attributed to farmers substituting maize for cotton due to a drastic increase in the price of maize, a competing crop, caused by factors like a weaker domestic currency, a regional drought, food insecurity and political uncertainty in Southern Africa. South African cotton farmers are dependent on, or rather exposed to a deflated cotton world price, caused by subsidised over production by large cotton producing countries. Chapter 5 will focus more on these aspects.

Despite various land reform projects attempting to settle small-scale cotton farmers in established cotton production areas, the traditional small-scale cotton production areas of Tonga (Kangwane) in Mpumalanga (just north of Swaziland, next to the border with Mozambique) and Makhathini in northern KwaZulu Natal (Locality C on the map in Figure 3.2) remain the major contributors. Cotton production by large-scale farmers mainly takes place in 6 production areas in South Africa. The most important dryland production areas are: the Springbok Flats (A) in the Limpopo Province and in the Dwaalboom region (B) in the North West. Irrigated cotton is produced around the towns of Marble Hall and Groblersdal and on the Loskop irrigation scheme (D) in Mpumalanga, at Weipe (F) next to the Limpopo River in the Limpopo Province and in the Northern Cape and Orange River area (E). There are also some large-scale farmers in the Pongola district close to the Makhathini Flats in northern KwaZulu Natal.

Figure 3.2: Main cotton production regions in South Africa

A – Springbok Flats, Settlers
B – Dwaalboom region
C – Makhathini Flats
D – Loskop Irrigation Sceme and areas around Groblersdal and Marblehall
E – Northern Cape with production on the Vaalharts Irrigation Scheme and areas around the Orange River next to towns and cities like Douglas, Prieska, Luckhoff, Keimoes and Upington.
F – Weipe

3.3.2 LARGE-SCALE COTTON FARMERS

In the 2000/2001 production season an estimated 300 commercial large-scale farmers produced 95% of the South African cotton crop. The 43 large-scale farmers surveyed and included in this study were from the irrigation areas in the Northern Cape, Mpumalanga as well as some dryland farmers on the Springbok flats in the Limpopo Province. Budgets and other information were also obtained from the Clark Cotton ginnery branches across the country.

Farmers surveyed on the Springbok flats planted between 85 and 550 hectares of cotton, irrigation farmers in the Groblersdal area plant between 20 and 160 hectares on average, with the farmers in the Northern Cape planting an average of 30 hectares. Cotton farmers on and around the Loskop irrigation scheme produce cotton in addition to their other farming enterprises such as the production of export table grapes, citrus, deciduous fruit and vegetables. The main farming activities of the farmers in the Northern Cape are viticulture (as the Northern Cape is a major wine producing area) export table grapes and the production of groundnuts. Some farmers in this area make use of flood irrigation instead of the more effective but more capital intensive pivot irrigation systems. Most irrigation farmers in Mpumalanga and the Northern Cape rotate or substitute maize and cotton in the summer and produce wheat in the winter. On the Springbok flats cotton is rotated with maize and sunflower. In most of the production areas cotton is usually not the dominant enterprise and is produced in combination with other crops. The choice of enterprise is usually determined by the rotation requirements of the soil and the relative prices of the competing enterprises. A profile of the surveyed farmers is provided in Table 3.4.

Table 3.4: Profile of surveyed large-scale cotton farmers

	Northern Cape		**Mpumalanga**	**Limpopo Province**
	Flood Irrigation	**Pivot Irrigation**	**Pivot irrigation**	**Dry land**
Dominant age group of farmers	50+	50+	40-49	30-39
Gender	98% Male			
Average farm size	78 ha	387 ha	550 ha	736 ha
Dominant farming enterprises	Groundnuts, Maize, Viticulture	Maize, Wheat, Viticulture	Maize, Cotton, Subtropical Fruit	Maize, Cotton, Sunflower
Mean area planted to cotton	22 ha	36 ha	51 ha	313 ha

Source: Own survey

3.3.3 SMALL-SCALE COTTON FARMERS

During the 2000/2001 production season there were more than 40 farmer organisations on the Makhathini Flats, with membership varying between 15 and 300 members per organisation. It is estimated that potentially 4 500 cotton farmers could be active in the Makhathini area planting on average between 1 and 3 hectares of rain fed cotton. Depending on credit availability and the price of seed cotton, between 2500 and 10 000 ha of cotton is planted annually (Bennett, 2001). Key players in the cotton industry envisage that small-scale farmers could produce up to 30% of the total cotton crop in South Africa by the year 2005 (Cotton SA, 1998). Whilst large-scale irrigation farmers can substitute or rotate cotton with maize, vegetables or groundnuts and large-scale dryland farmers, with less severe climatic conditions, can plant sunflower or maize, small-scale cotton farmers on the Makhathini are dependent on cotton, because of low, irregular rainfall and a lack of production credit for other crops. The Makhathini Flats is said to be one of the best, if not the best agricultural area in South Africa. The area has a deep, fertile soil and has an enormous (currently unutilised) irrigation potential – being situated close to the Jozini dam.

Until the 2000/2001 season, the Vunisa Cotton company (part of Clark Cotton – owned by AFGRI formerly known as OTK Holdings Ltd) was the main ginnery and credit source active on the Makhathini Flats. By managing and facilitating production credit supplied by the Land Bank, distributing production inputs on account, and by supplying production information and assistance through extension officers, Vunisa has vastly contributed to the success story of cotton farmers on the Flats.

Small-scale farmer data were gathered on the Flats through a survey in November 2000[2] (Ismaël et al, 2001). Input and production data were also gathered in collaboration with Vunisa administrative personnel. A brief profile of the average small-scale cotton farmer on the Makhathini Flats is supplied in Table 3.5.

The Makhathini Flats has shown an increase in the adoption of Bt cotton from 7% in 1997/1998 to 75% in 1999/2000 (Ismaël et al, 2001). An adoption rate of between 80 and 90 percent was expected for the 2000/2001 season and the same for the

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[2] Research conducted by the University of Reading in collaboration with the University of Pretoria

2001/2002 season. (Van Jaarsveld, 2002). Over 95% of the cotton produced in the Tonga area is insect-resistant (Anthony, 2002).

Table 3.5: Profile of small-scale farmers on the Makhathini Flats

Mean age of farmers	40+
Gender of farmers	48 % Female 52 % Male
Land ownership per household	2.5 ha – 5 ha
Dominant farming activity	Cotton
Mean area planted to cotton	2 ha

Source: Ismaël et al., 2001

3.3.4 MAIZE INDUSTRY OVERVIEW

Maize is the most important field crop in South Africa and annually covers an estimated 30% of the total arable land. Maize serves as staple food for the majority of the South African population and also as the main feed grain for livestock. Maize is the largest contributor to the total gross value of agricultural production, with 16% in 2002. On average the South African maize harvest consists of 48% yellow maize and 52% white maize and is mainly produced by commercial farmers, although subsistence farmers produce white maize for own consumption. In spite of the fact that maize is grown in most parts of the country the main production areas are situated in the Free State, North West and Mpumalanga Province. Figure 3.3 illustrates South Africa's dryland yield potential.

The maize area planted has gradually declined from more than 5 million hectares in the mid eighties, to approximately 3.5 million hectares in 1998/99. Annual average maize production for the past decade has been approximately 8 million tons. Although the area planted has declined over the past years, the production has not declined dramatically. This can be attributed to the fact that the yield has increased over the years as production technologies have improved. The biggest limiting factor on the production of maize in South Africa is rain. Yellow maize's highest average yield of 3.35 t/ha was achieved in 1993/1994 which was a wet production season, with its lowest average yield in the drought of 1991/1992.

Domestic maize consumption requirements are estimated at 7.5 million tons with approximately 4.4 million tons of white maize and 3.1 million tons of yellow maize needed. The maize industry is also an important earner of foreign revenue for South Africa through the export of maize and maize products. South Africa mainly exports maize to Zimbabwe, Japan, Zambia, Malawi, Mauritius, Kenya and Mozambique. Figure 3.4 illustrates the maize utilisation in South Africa.

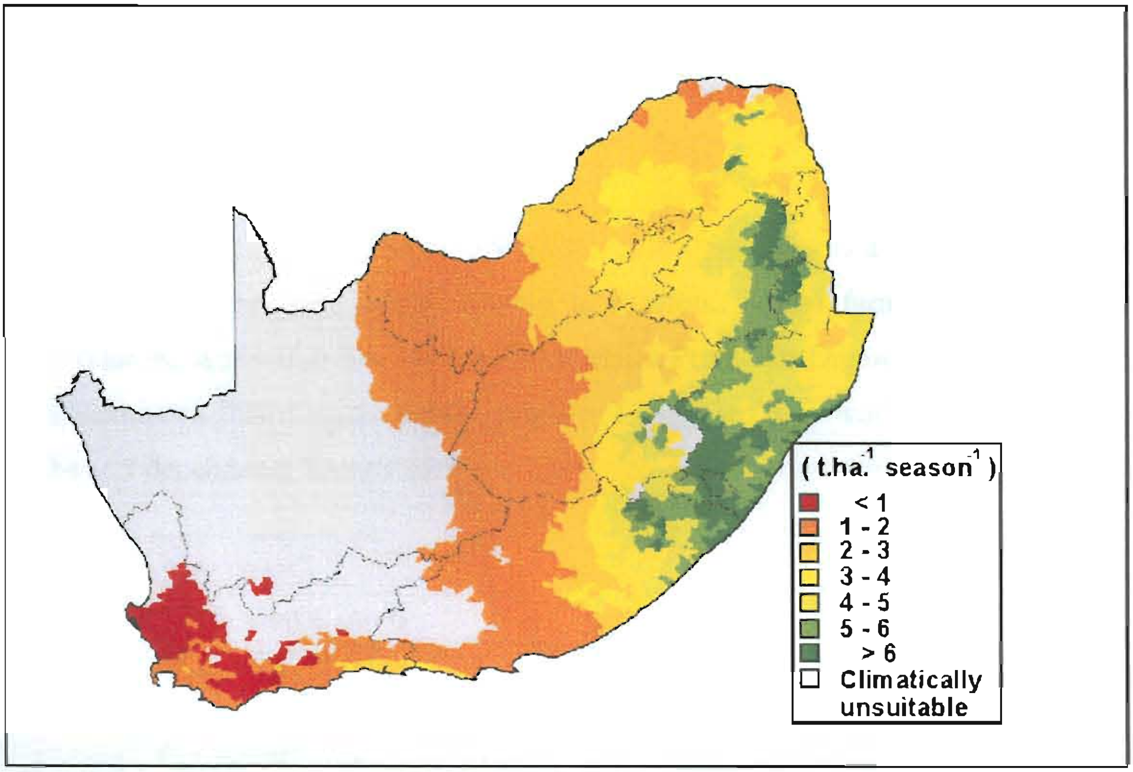

Figure 3.3: Maize yield estimation map of South Africa

Source: Department of Agricultural Engineering, University of Natal

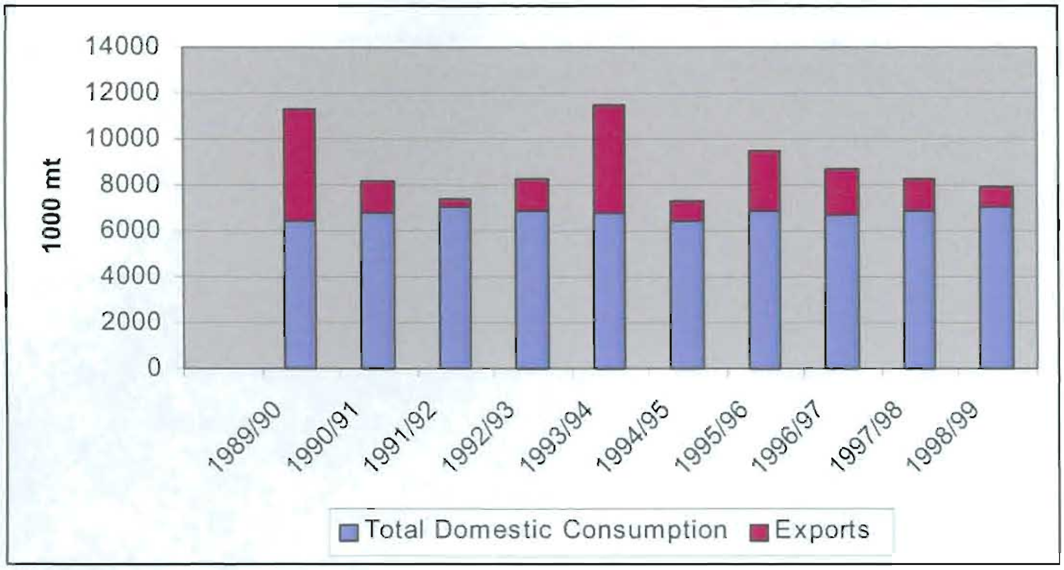

Figure 3.4: Maize utilisation

Source: SAGIS

3.3.5 LARGE-SCALE COMMERCIAL MAIZE FARMERS

White and yellow maize are produced under dryland and irrigation conditions by an estimated 6 000 large-scale maize farmers in South Africa. The age, gender and average farm size profile of maize farmers is very much the same as that of the cotton farmers as most cotton farmers surveyed are predominantly maize farmers. This study focussed mainly on irrigation farmers in the Northern Cape and irrigation and dryland farmers in Mpumalanga and the North West Province. Yellow maize production is the dominant farming activity of 94% of the surveyed farmers. 28% of the surveyed farmers were younger than 39 and 31% were older than 50 years of age. Irrigation farmers generally make use of beans, wheat, cotton or potatoes as rotating crops, while dryland farmers plant mainly sunflower, cotton or soya-beans. Table 3.6 gives an indication of the areas planted by surveyed maize farmers. The main aim of this table is to show the difference in areas planted by maize farmers within selected areas.

More than 66% of the farmers sold their yellow maize harvest to local cooperatives while 21% sold their maize directly to feedlots, broiler farmers or animal feed producers. According to a 1993 National Maize Producers Organisation publication, it is estimated that a maize farmer employs 15 regular farm workers who on average have 5 dependents living with them. They also employ a substantial number of casual workers for two to three months of the year. It is estimated that 40% of maize farmers have a qualification higher than a high school diploma (NAMPO, 1993).

Table 3.6: Maize areas planted by surveyed farmers

Province	Irrigation area	Dryland area
Northern Cape	95-1000 ha	
Mpumalanga	60-500 ha	300-3080 ha
North West	20-100 ha	150-1200 ha

Source: Own survey

3.3.6 SMALL-SCALE MAIZE FARMERS

Insect resistant white maize was introduced to small-scale subsistence farmers during the 2001/2002 season through a project initiated by Monsanto. Farmers or rural households producing maize under dry-land conditions were identified and selected in nine areas across Mpumalanga, KwaZulu Natal, Eastern Cape (Transkei) and Limpopo Province. Farmers in these areas where informed about the traits and characteristics of Bt maize through workshops held in their respective areas and were then supplied with small quantities of maize seed. Most farmers received two bags of seed, each containing 250g of white maize seed, but farmers planting larger areas received more seed. One of the bags contained Carnia 4549 seed, also known as Yieldgard, insect-resistant or Bt maize seed, while the other bag contained the isoline or conventional variety, Carnia 3549 that is genetically identical to Carnia 4549 except that it does not contain the Bt gene. Farmers were asked to plant and harvest these varieties separately but in all other practises to treat them the same way as they would treat their other maize. As most farmers plant a hectare or more of maize and only small amounts of seed were supplied by Monsanto, farmers still had to buy and plant, or use their own saved maize seeds

It would thus be wrong to refer to these farmers as adopters, as the seed was supplied to them for free. As data become available the 2002/2003 season will reveal more about the adoption of Bt white maize seed by subsistence farmers in South Africa, when these farmers, based on their 2001/2002 production experience, will have decided whether to buy Bt seed or conventional seed. Table 3.7 gives a breakdown of the characteristics of households in four of the six surveyed areas.

Table 3.7: Household and farm profile of subsistence maize farmers

Province & site	Mpumalanga Northern Highveld	KwaZulu Natal Hlabisa	Limpopo Province Venda	Eastern Cape Mqanduli
Avg. household size	6.17	6.38	6.50	7.64
Percentage of households with a pensioner	62%	52%	31%	41%
Avg. age of father	65	60	53	57
Avg. age of mother	58	57	46	52
Who makes decisions regarding maize farming?	Male 71% Female 29%	Male 57% Female 43%	Male 58% Female 42%	Male 62% Female 38%
Maize planting experience	>10 years 37%	>10 years 61%	>10 years 83%	>10 years 92%
Avg. total farm size	1.87 ha	1.93 ha	3.20 ha	4.07 ha
Avg. total maize area	1.44 ha	1.76 ha	1.97 ha	2.42 ha
Biggest household expenditure	Food 75%	Food 66%	Food 50%	Food 60%

Source: Own survey

3.4 REASONS FOR ADOPTION OF INSECT RESISTANT CROPS

In an attempt to provide objective, science-based information on the use of biotechnology in cotton production, the International Cotton Advisory Committee initiated an expert panel on biotechnology. In a report this expert panel concluded that numerous benefits of insect resistant cotton accrue to the grower, the global cotton industry, and society on many levels – economic, environmental and social (ICAC, 2000). According to various publications these benefits are not limited to Bt cotton but are in many cases also observed with Bt maize. These benefits are thus alleged to be inherent to the Bt gene and can be divided into direct and indirect benefits. Direct benefits consist of reduced pesticide use, improved crop management effectiveness, reduced production costs, enhanced yield and profitability, a reduction in production risk, and improved opportunity to grow crops in areas with sever pest infestations. The indirect benefits of the technology are the benefits that also appeal to the more environmentally conscious producers. These include improved populations of beneficial insects and wildlife in fields, reduced pesticide runoff, improved farm worker and neighbour safety, less air pollution and waste from the use of insecticides, a reduction in labour costs and time, a reduction in fossil fuel use, and improved soil quality because of less traffic in the fields.

An analysis of data from large-scale maize and cotton farmers, making use of a Logit model of factors such as area planted, age, education and credit did not render significant results as factors influencing the adoption of transgenic crops. An analysis of the characteristics of adopting small-scale cotton farmers compared to non-adopters and their reasons for adoption by Ismaël et al. (2001) rendered more satisfactory results. The tendency was for the older, more experienced farmers and those with larger farms to be the adopters. According to Ismaël et al. (2001), this can be explained by the fact that these were the farmers who were more likely to be granted credit, or were able to finance the higher seed costs from savings or from other income sources. The current situation on the Makhathini Flats supports this indication. The 2001/2002 season saw the emergence of a second ginning company on the Flats. Despite borrowing production credit from Vunisa and signing contracts vowing to deliver cotton to Vunisa many farmers delivered their cotton to the new gin. This caused Vunisa and the Land Bank to lose a substantial amount of money. Not surprisingly no credit was made available to cotton farmers on the Makhathini Flats for the 2002/2003 production season. Without production credit a very small number of small-scale farmers planted cotton (estimated 580 ha). Early indications of a 2002/2003 survey funded by CIRAD shows that the majority of farmers who did plant cotton this season are the older farmers who could fund inputs with pension money. The majority of these farmers planted Bt cotton (Hofs, 2003).

3.4.1 LARGE-SCALE COTTON FARMERS

Of the 43 large-scale cotton farmers interviewed, 39% indicated that the most important benefit of Bt cotton is saving on pesticides and application cost (Table 3.8). Peace of mind about bollworms came in as the second biggest reason for adoption with 25% of farmers indicating the benefit as most important. When asked to indicate all the benefits of insect-resistant cotton, 77% of farmers indicated peace of mind and 72% indicated better crop and risk management as a benefit. All the surveyed large-scale farmers were involved with other farming activities during the cotton season. Therefore, the large indication of peace of mind is not surprising. Using hired labour, scouting and spraying is especially difficult over the Christmas - New Year period and this is a crucial time in the production cycle of cotton in South Africa. The low labour saving perception may indicate that farmers feel that pesticide application is more capital- than labour intensive.

Table 3.8: Reasons for adoption of Bt cotton by large-scale farmers

Benefits and reasons for adoption	Most important reason / benefit (% of farmers)	Specific benefit (% of farmers)
Increased yield	7%	52%
Pesticide saving	39%	62%
Better crop and risk management	18%	72%
Better boll worm control	9%	55%
Peace of mind about bollworms	25%	77%
Labour saving	0%	2%
Better for environment	0%	37%
Other		9%

Source: Own survey

When asked about the disadvantages of Bt cotton the most common answer was the cost of seed and the technology fee. This is also the reason why some farmers have stopped planting Bt-seed. In 2000/2001 the cost of a 25kg bag of Bt seed amounted to about R210 and a farmer also has to pay an additional R600 technology fee. Large-scale farmers try to stretch a 25kg bag of Bt seed as far as possible using precision planters. A farmer planting 20kg of seed per hectare indirectly spends R 480 on bollworm control through the additional technology fee. Some commercial farmers who have already invested in spraying machinery feel that they can control bollworms for less. Most farmers don't spend R480/ha on the control of bollworms in a year with low bollworm pressure, but when the pressure is high, chemical and application costs can easily exceed this additional fee. In the 2001/2002 season, Monsanto, in alliance with Delta and Pineland, implemented a possibly more acceptable technology fee payment system. Farmers now have the option to pay R400/ha technology fee for irrigation land and R120/ha for dryland, on condition that they present a GPS map of the planned cotton field. The R600 per bag technology fee system is also still available for farmers, so each farmer can decide which option is the most cost effective.

3.4.2 SMALL-SCALE FARMERS

The impressive increase in the adoption of Bt cotton by small-scale farmers from 7% in 1997/1998 to around 90% in the 2001/2002 season can possibly be attributed to the success of the farmers who first adopted the new technology (DFID, 2001). Looking at the benefits indicated by the adopters and the perceived benefits indicated by the then non-adopters, it is revealing to compare the before and after benefit perception (Table 3.9). While 32% of non-adopters indicated that a yield increase is the most important benefit of Bt-cotton, increased yield was only indicated as the most important benefit by 18% of adopters. Increased yield is still indicated as a reason by more than 58% of adopters, but it seems that the most important benefit of Bt-cotton after adoption has become pesticide saving. In rural areas where infrastructure, transport and services are almost non-existent, managing pest infestation in crops is a major problem.

Table 3.9: Benefits of Bt-cotton as indicated by small-scale farmers

Real and perceived benefits	Most important benefit (% of farmers)		Specific benefit (% of farmers)	
	Non-adopters	Adopters	Non-adopters	Adopters
Increased yield	32%	18%	62%	58%
Better quality cotton	5%	3%	12%	30%
Higher price for cotton	0%	1%	12%	15%
Pesticide saving	35%	50%	77%	70%
Labour saving	10%	10%	42%	35%
Application saving	5%	3%	30%	18%
Other	10%	13%	27%	40%

Source: Own survey and Ismaël et al, 2001

3.4.3 DIFFERENCE IN ADOPTION BEHAVIOUR OF LARGE- AND SMALL-SCALE COTTON FARMERS

Compared to small-scale farmers the increased yield benefit is not that important to large-scale farmers. Although more than 50% of large-scale farmers indicated increased yield as a benefit, it is seen more as a bonus. The big advantage for large-scale farmers is that insect-resistant cotton gives them the peace of mind and the managerial freedom to go on with other farming activities. As previously mentioned, the whole process of pesticide application is more capital and management intensive than labour intensive for large-scale farmers. Large-scale farmers have to hire an aeroplane or use their own tractors to apply pesticides. The difficulty lies in fitting sprays in between the rain and irrigation schedules.

The large percentage of small-scale farmers indicating that pesticide saving is the most important benefit is not really surprising. When one includes saving on application cost, and labour saving with pesticide saving, more than 63% of small-scale Bt-adopters agree on the entire bollworm control benefit of Bt cotton. Pesticide application implies huge difficulties for small-scale cotton farmers. With a low level of education amongst small-scale farmers, problems with the mixing of pesticides and calibration of knapsack sprayers for different pesticides cause concern about the real efficacy and effectiveness of pesticide application. Applying pesticides is a labour intensive action for small-scale farmers. Walking with a knapsack sprayer on his back a farmer has to cover a distance of between 10 and 20 kilometres per hectare. Water has to be fetched from communal water points and water (especially in the Tonga community) is a scarce commodity and has to be fetched with water trucks or any other transport available. By the time a farmer has noticed bollworms, bought his pesticides and started to spray, severe damage has already been done.

Large-scale cotton farmers indicated some environmental or indirect benefits of Bt cotton. Spraying less pesticide or none at all has caused beneficial predator insects to flourish. More than 46% of farmers have noticed more beneficial insects on their Bt-cotton fields. Some farmers in the Northern Cape have indicated that Lady Bird beetles and Lacewings have reduced aphid populations to such a level that farmers did not have any need to spray for aphids on winter wheat. In the past some farmers in the Groblersdal area have experienced some pesticide resistance with bollworms. For them Bt cotton is a much needed solution. In seasons where bollworm pressure is high, farmers are forced to use pyrethroids, killing all beneficial insects and causing Red Spider Mites to thrive. Chemical control of Red Spider Mites is very expensive. The environmental effects of Bt crops however fall outside the scope of this study and still needs to be researched.

3.4.4 LARGE-SCALE COMMERCIAL MAIZE FARMERS

Large-scale maize farmers aim to maximise profit per hectare through high yields and cost minimisation by means of effective application of inputs. This statement is confirmed by the survey results in Table 3.10. Almost 70% of farmers indicated higher yield, better pest control or easier crop management as the most important benefits of genetically modified maize. It is thus also not surprising that more than 70% of the farmers indicated that the use of Bt maize seed offers them peace of mind regarding stalk borers. Even though none of the farmers indicated it as the most important benefit, 45% of the farmers did specify that they considered lower pesticide usage to be a benefit of Bt maize.

Table 3.10: Reasons for adoption of Bt maize by large-scale yellow maize farmers

Benefits and reasons for adoption	Most important benefit (% of farmers)	Specific benefit (% of farmers)
Higher yield	31%	62%
Lower pesticide use	0%	45%
Better pest control	15%	48%
Peace of mind	8%	72%
Easier crop management	23%	59%
Labour saving	0%	3%
Environmentally friendlier	0%	10%
Other	20%	

Source: Own survey

A number of farmers indicated the biggest advantage of Bt maize to be a longer planting period. Conventional maize is at risk of being severely damaged by stalk borers when planted early or late in the season - due to the peaking in stalk borer moth flights. Farmers planting Bt varieties have the freedom to make use of early rain or to wait for later better rain to plant their maize crop. With this freedom some farmers also felt that they are also able to be on the market earlier in the season and were able to secure a better price for their maize. Approximately 10% of farmers indicated that with Bt maize they had no more problems with lodging (falling over) of maize plants due to damage caused by the stalk borers.

When farmers were asked about disadvantages or problems with Bt maize the issues adopting-farmers were worried about were the same ones a small sample of non-adopting farmers presented as reasons for not adopting. These issues also seem to be the reason why the adoption rate of Bt maize has not been as impressive as that of Bt cotton. Most adopting farmers indicated that they were aware of and concerned about the international tumult about genetically modified food. In South Africa yellow maize is not directly consumed but is fed to animals and processed in the wet milling industry. Maize is however, as opposed to cotton, a foodstuff and more susceptible to consumer trepidation. Of the non-adopting farmers, 75% listed concern about "consumer response" and whether they "would be able to sell Bt maize" as a reason why they did not adopt. In the Northern Cape the local cooperative and main maize buyer in the area (SENWES) asked farmers not to plant Bt yellow maize. The reason for this is that this cooperative has maize export contracts to feedlots in Namibia and it is reported that feedlots are not allowed to feed GM maize to their cattle as they have beef export contracts with the EU. According to some farmers they were also promised a premium on non-Bt maize but this premium never materialised. The remarkable increase in adoption from 2000/2001 to 2001/2002 (Tables 3.2 and 3.3) suggests that after two seasons of Bt yellow maize production, farmers are less worried that they will not be able to sell their Bt harvest.

In 2000, when the survey was conducted, only a small number of Bt varieties were available to farmers. Some farmers indicated that they felt the Bt variety they planted was not the best suited for their specific production conditions. An increase in the number of different Bt yellow maize varieties as marketed by different seed companies would give farmers a broader choice of varieties.

3.4.5 SMALL-SCALE MAIZE FARMERS

During the 2001/2002 production season subsistence farmers in nine areas in South Africa were able to compare Bt white maize with the conventional isoline and with their own seed, whether it was a hybrid, an open pollinated variety or traditional white maize seed. Bt white maize seed was introduced to close to 1500 small-scale / subsistence farmers through this Monsanto project. Due to the impressive number of farmers in different areas who received seed, it is suggested that this study was not so much an attempt to test the expediency of insect resistant maize produced under small-scale conditions, as it was a marketing strategy to introduce Bt maize to small-scale farmers.

Figure 3.5 illustrates the biggest benefits of Bt maize indicated by small-scale farmers. The percentages indicate the percentage of farmers in each site that indicated the specific benefit. The "other" benefits include easier management, insecticide savings and less need for spraying water. For all the sites, the two major benefits indicated by farmers were increased yield and better quality of both fresh green mealies and harvested grain. The trade-off between the importance of yield and quality in Figure 3.5 can be better explained by considering the specific uses of the maize harvest and the poverty levels at each of these sites. As can be seen in Table 3.11 households on the Northern Highveld and in the Hlabisa area in KwaZulu Natal (KZN) consume substantially more green mealies than households in Venda and Mqanduli and thus the quality of the green mealies plays a more important role. The Moutse-Dennilton area in the Northern Highveld where the survey was conducted is more urbanised than the other sites and there is a market for green mealies with a large number of taxis and commuters travelling through the area on a daily basis. It is part of the Zulu tradition to consume green mealies and thus even though the Hlabisa area in KZN is one of the poorest of the six sites surveyed, green mealies are still consumed there. Subsistence farmers see the consumption of green mealies as a luxury.

The actual poverty level in these sites are indicated by the large number of farmers that keep a considerable portion of their harvest to process themselves instead of sending it to millers to be milled at a cost. For many of these farmers quantity is more important than quality. The area in Venda that was surveyed is less poverty stricken and a large number of farmers sell maize and takc maize to the miller to be milled for mealie meal.

It is interesting to note the labour saving perception difference between small-scale cotton farmers and subsistence maize farmers. The first seasons' study showed that on average less than 50% of small-scale maize farmers applied pesticides. In most cases a carbaryl is applied in granular form on a once-off basis when stalk borers are observed. Maize does not require the intensive insecticide-spraying program that cotton does and Bt adopting maize farmers thus have a lower pest control linked labour saving perception.

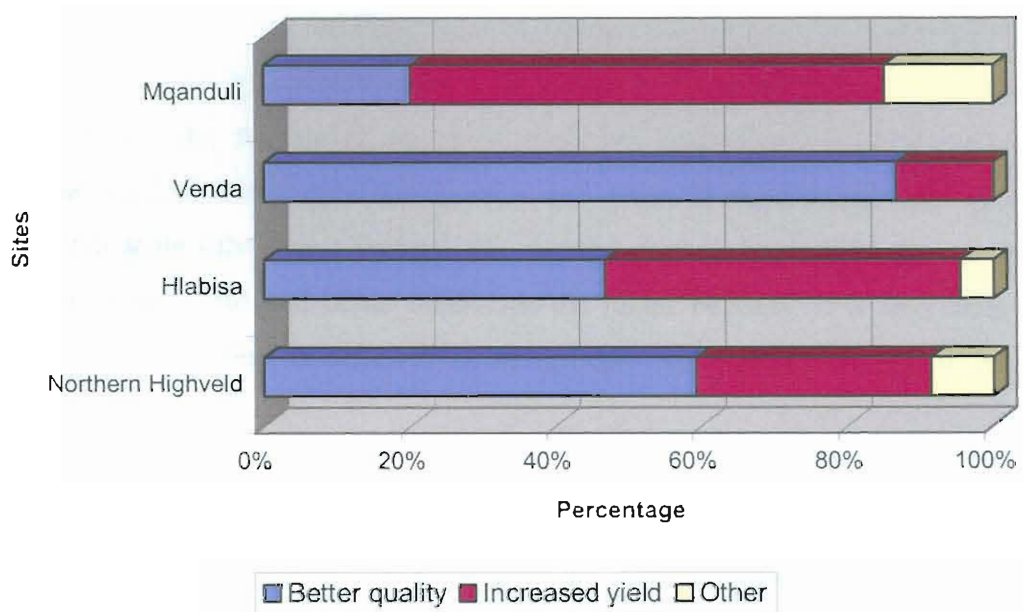

Figure 3.5: Benefits of Bt maize as indicated by subsistence farmers

Source: Own survey

Table 3.11: Harvest and use of maize by subsistence farmers

	Mpumalanga	KwaZulu Natal	Limpopo	Eastern Cape
Site	Northern Highveld	Hlabisa	Venda	Mqanduli
Harvested green mealies?	Yes 50%	Yes 66%	Yes 3%	Yes 0%
Sold green mealies?	Yes 20%	Yes 4%	0%	0%
What did farmers do with their harvested grain?	Sent to miller for milling 47% Sold 22% Kept 24%	Sent to miller for milling 10% Sold 16% Kept 75%	Sent to miller for milling 34% Sold 15% Kept 46%	Sent to miller for milling 12% Sold 10% Kept 76%

Source: Own survey

The one big problem farmers indicated with Bt maize was damage caused by birds. In the Southern Highveld, Hlabisa and Venda areas where farmers enjoyed the highest yields the maize cobs seem to be longer than the husk that covers it and birds fed on the part of the cob that protrudes from the husk. Some farmers however had this same problem with the conventional isoline so it is possible that this problem is linked to the variety and not to the presence of the Bt gene.

3.5 CONCLUSION

This chapter focused on the different farmers groups in South Africa who adopted genetically modified maize and cotton and highlighted the groups' different reasons for adoption. It is suggested that perceived and real benefits as indicated by seed agents and observed through own cotton and maize production experience can be accepted as reasons for adoption of the new technology. Large-scale cotton farmers for whom cotton production is usually not the dominant farming activity indicated better crop and risk management, pesticide saving and peace of mind as the main benefits. Small-scale resource poor cotton farmers in comparison indicated higher yield and saving on insecticides as the major benefits. Large-scale commercial yellow maize farmers who attempt to maximise profit per hectare indicated higher yields, better pest control, easier crop management and peace of mind as the main benefits, while small-scale subsistence farmers who depend on their harvest for food security, indicated higher yield and better quality as the major benefits. It is thus clear that different benefits appeal to different farmer groups - each group reacting to its own needs.

While Chapter 3 focused on the benefit perceptions of different farming groups, Chapter 4 will aim to quantify those benefits by focusing on the on-farm effects of adoption of insect resistant maize and cotton experienced by the different groups of farmers.