Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)

Discussion Paper

Towards a Regional Approach to Biotechnology and Biosafety Policies for Southern African Countries

Phase I: Situation Analysis and Stakeholder Views – South Africa

by

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Abstract

Developing countries in general, and countries in the Southern African Development Community in particular, are at a crossroads regarding whether or not to embrace rapidly evolving biological technologies and related products, such as genetically modified organisms (GMOs).

In South Africa, an application to the Department of Agriculture in 1989 to perform field trials with genetically modified cotton kick-started the South African biosafety process and initiated the first trials with transgenic crops on the African continent. In 1997, South Africa became the first country in Africa to produce transgenic crops commercially. To date, the commercial release of insect-resistant cotton and maize, as well as herbicide-tolerant soybeans, cotton and maize has been approved. Various studies have shown that large- and small-scale farmers in South Africa have benefited from the introduction of genetically modified crops.

The GMO Act, in conjunction with its implementing Regulations, came into effect on 1 December 1999. It was intended to promote the responsible development, production, use and application of GMOs while limiting potential risks, and laid down the requirements for the importation, production, release and distribution of GMOs. While it appears highly unlikely that South Africa will ever go back on its decision to embrace GMOs, if the current and potential benefits they offer can be sustained and achieved, and the possible risks avoided, flaws in the biosafety regulatory system will have to be addressed.

Although many users of the system believe it is functioning well and point to the absence of any accidents or problems as evidence of this, some observers feel that there are no adequate safety measures in place to prevent or limit damage that might occur in the future. One of the most crucial issues to tackle is the lack of transparency, which is said to breed distrust, expose the system to challenge and, in the long run, could limit the uptake of the technology and prevent it from reaching its potential to solve African problems for African farmers and consumers. This requires that access to information be made easier and that more opportunities for meaningful public participation be provided. At the same time, the rights of private parties to protection of their legitimately confidential information must be safeguarded, and increased public participation must not lead to delays that slow down approvals to an unworkable extent.

Although the GMO Act has only been in force for a few years, amendments have been anticipated for some time and an amendment bill has recently been presented to parliament.

List of Acronyms and Abbreviations

AC	Advisory Committee
ACB	African Centre for Biosafety. <http://www.biosafetyafrica.net>.
AGOA	African Growth and Opportunity Act
AgriBEE	agricultural black economic empowerment
Bt	*Bacillus thuringiensis*
CBD	Convention on Biological Diversity
CIRAD	*Centre de coopération internationale en recherche agronomique pour le développement*
COSATU	Congress of South African Trade Unions
CPB	Cartagena Protocol on Biosafety. <http://www.biodiv.org/convention/default.shtml>
D&PL	Delta and Pine Land
DEAT	Department of Environmental Affairs and Tourism
DGR	Directorate for Genetic Resources, National Department of Agriculture
DoH	Department of Health
DST	Department of Science and Technology
DTI	Department of Trade and Industry
EC	Executive Council
FANRPAN	Food, Agriculture and National Resources Policy Analysis Network
FAO	Food and Agriculture Organization of the United Nations
FEST	Foundation for Education, Science and Technology. FEST was renamed in 2002 and is now known as the South African Agency for Science and Technology Advancement. It is a government agency with the mandate to advance public awareness, appreciation and engagement of science, engineering and technology in South Africa.
FTA	Free Trade Agreement
GDP	gross domestic product
GM	genetically modified
GMO	genetically modified organism
HSRC	Human Sciences Research Council
IPs	intellectual properties
IPRs	intellectual property rightss
LMO	living modified organism
NBS	*National Biotechnology Strategy*
NCF	National Consumer Forum. <http://www.ncf.org.za/>

NDA	National Department of Agriculture. In addition to the National Department of Agriculture, each province has a provincial Department of Agriculture, but biosafety regulation is a national competency and provinces have as yet not played a role in GM matters.
NEPAD	New Economic Partnership for Africa's Development
NGO	non-governmental organization
OECD	Organization for Economic Cooperation and Development
PBRA	Plant Breeders' Rights Act
PlantBio	National Innovation Centre for Plant Biotechnology. PlantBio is one of four biotechnology innovation centres. The other three are regional, located in each of the country's main commercial centres. Each has defined focus areas aligned with national imperatives, market demand and existing regional expertise. The focus areas are plant transformation (GMOs); marker-assisted and conventional breeding; *in vitro* propagation; biocontrol and biofertilization. They are required to provide technology platforms in their respective focus areas; to facilitate the sharing of capital equipment and specialized expertise; to select and disburse funding to research programmes at existing R&D organizations, including universities, science councils and industry; and to attract anchor investors.
PUB	Public Understanding of Biotechnology. See <http://www.pub.ac.za/about/index.html>
R&D	research and development
SABS	South African Bureau of Standards
SACC	South African Council of Churches
SACU	Southern African Customs Union
SADC	Southern African Development Community. SADC headquarters are in Gaborone, Botswana.
SAFeAGE	South African Freeze Alliance on Genetic Engineering. <http://www.safeage.org>
SAGENE	South African Committee for Genetic Experimentation
SANSOR	South African National Seed Organization. <http://www.sansor.org/about2.htm>
TDCA	EU-SA Trade Development and Cooperation Agreement
TRIPs	Trade-Related Aspects of Intellectual Property Rights
UPOV	International Union for the Protection of New Varieties of Plants. UPOV was established by the International Convention for the Protection of New Varieties of Plants. The UPOV Convention was first signed in Paris in 1961 to provide a form of legal protection of plant varieties for western European countries. It was revised in 1972, 1978 and 1991.
USAID	United States Agency for International Development
WFP	World Food Programme
WHO	World Health Organization
WTO	World Trade Organization

Towards a Regional Approach to Biotechnology Policy in Southern Africa

Phase I: Situation Analysis and Stakeholder Views – South Africa

1. INTRODUCTION

1.1 Background

Developing countries in general and, in particular, the Southern African Development Community (SADC) countries, are at crossroads regarding whether or not to embrace rapidly evolving biological technologies and related products, such as genetically modified organisms (GMOs). The pace at which SADC countries are engaging in biotechnology is a cautious and precautionary one. While a number of them are striving to establish policy and regulatory frameworks on biosafety and biotechnology, few have the capacity to fully enforce them. This emphasizes the need for a common regulatory approach and policy position in the SADC region, with acceptable standards that could be approved across countries.

The Food, Agriculture and National Resources Policy Analysis Network (FANRPAN), in collaboration with national SADC nodes and technical partners, and funded by the United States Agency for International Development (USAID) through its Programme on Biosafety Systems, has endeavoured to document a balanced review of the technical information needed to inform SADC's regional biosafety policy choices responsibly. The initiative is designed to generate the latest information for the SADC countries regarding biosafety regulation and legislation, necessary market systems and infrastructure, and identification and quantification of possible costs and benefits, as well as the economic costs and benefits of attempting to remain 'GM-free'.

The ultimate aim of this project is to ensure improved food security and incomes in the agricultural systems in the SADC countries through adoption of appropriate productivity enhancing technologies. It will help to ensure that the SADC countries have a balanced view of the costs and benefits of biotechnology/GMO adoption, for better decision-making.

The project has been undertaken in three selected SADC countries, i.e., Malawi, Mauritius and South Africa. They have strong national biotechnology institutions but are at different levels of biosafety regulation and legislation development. FANRPAN works with its national nodes in the three focal countries (Bunda College of Malawi, the University of Mauritius and the University of Pretoria) with its technical partners, which include BioEroc (Malawi), the Mauritius Sugar Industry Research Institute and AfricaBio (South Africa).

This working paper endeavours to describe and summarize the current situation in South Africa pertaining to biotechnology in the agricultural sector, as well as public understanding of biotechnology and biotechnological applications in the country, and stakeholders and role-players in its agricultural biotechnology sector. South Africa's biosafety regulatory system and the issues that surround it is also discussed and light is shed on how international and regional trade in agricultural products have been influenced by the adoption of genetically modified (GM) crops in South Africa.

A significant amount of research has already been conducted in South Africa on stakeholder analysis, commercial GM crop adoption and performance, and the development, appropriateness and effectiveness of the biosafety regulatory structures and legislation. This paper aims to summarize some of these findings and applicable literature in order to sketch a picture of the current agricultural biotechnology sector and the structures and stakeholders

that surround it. **This paper draws strongly on a recent report by Rosemary Wolson that was part of a New York University project on International GMO Regulatory Conflicts, supported by the Rockefeller Foundation.** Rosemary's paper *Country Study: South Africa* is augmented with findings and views from a number of other recent publications.

1.2 The South African scenario

The advent of democracy in South Africa (SA) and the concurrent rise of globalization have together shaped the significant policy and economic transformation that has taken place in SA in the past decade. After years of isolation, the country has rejoined the international community and, on certain issues, is beginning to take a prominent role as a mouthpiece for the interests of a broader constituency of African and other developing countries. The insular, inward-focused policies of the past, which were designed to benefit only a minority of privileged citizens, have been discarded and replaced with new measures aimed at redressing the inequities of the past, eradicating poverty and improving quality of life. Simultaneously, policy reforms have been directed at building a competitive local economy capable of integrating into global markets and fuelling national growth.

Despite the extensive restructuring that has taken place, however, the apartheid legacy of a dual economy endures, in which developed and developing world conditions coexist. The gulf between the two remains wide, and interventions that support one sector are sometimes perceived to be in conflict with the interests of the other. South African debates on contentious issues are therefore often a microcosm of similar debates in the international arena, with different stakeholders championing viewpoints typically associated with both the North and the South. The reality, though, is that SA is a developing country, despite visible pockets of developed infrastructure and affluence, and it is imperative that national policies promote sustainable development.

The potential role of GM crops in supporting or hindering development objectives has given rise to hotly contested debates around the world, and the South African government's decision to embrace the technology early on has not gone undisputed. Scientists, government departments, parliamentarians, non-governmental organizations (NGOs), churches, trade unions, retailers and industry have engaged in a wide-ranging discourse, covering the health, environmental and socioeconomic implications of genetically modified organisms (GMOs) in food and agriculture, both in favour of and opposing the technology. However, participants on both sides of the fence have been confined to small sectors of the population and, although awareness appears to be growing, for most South Africans it remains a fairly arcane topic. Nonetheless, the stakes are potentially high, as many believe that the battle for acceptance or rejection of GM crops elsewhere in Africa will be won or lost in SA (or will at least be heavily influenced by the South African experience). As the first country on the continent to approve commercial use of GM crops, other countries and agricultural biotechnology companies with an eye on expanding their GM product offerings into other African markets are observing the South African situation to see how developments unfold. If rejection of GM crop applications increases in SA, or if regulatory or biosafety problems arise, other countries with less capacity are likely to be reluctant to engage with GM crops. On the other hand, growing acceptance, increased uptake, and a smooth regulatory process in SA could provide a roadmap to guide others, provided adverse GM-related experiences or scares are avoided.

While the most crucial 'GM battle' globally is arguably the one currently being waged between the United States and the European Union, the impact of GMOs in Africa is also the subject of extensive discussion internationally – almost disproportionately so, considering the fact that SA remains the only African country to produce GM crops commercially, and that no African-developed GM crop events have been brought to market yet. Supporters and opponents each claim that failing to follow their position will be detrimental to Africa.

Proponents of the technology believe that it offers enormous potential for food security in the future, while critics argue that multinational seed companies are turning their attention to Africa because other markets are rejecting the technology, and that they are exploiting food security concerns to gain control of Africa's agriculture and food supply by creating new markets in Africa for GM products that will eliminate freedom of choice for non-GM products in the future.

2. THE SOUTH AFRICAN AGRICULTURAL SECTOR

Agriculture plays a vital role in the national economy, by contributing to food security and providing a significant source of employment and export earnings. Primary agricultural production accounts for 4.5% of the gross domestic product (GDP) of SA, while the agrifood sector accounts for another 9%. Farming practices in SA are diverse, ranging from the large-scale commercial sector to small-scale operations and subsistence farming. About 50,000 commercial farmers employ one million workers (equivalent to 11% of formal sector employment), and provide housing, schooling and livelihoods for an estimated six million family members of these workers. An estimated 240,000 small-scale farmers support over one million family members and provide occasional employment for an additional 500,000 people. It is estimated that there are a further three million subsistence farmers in SA (Department of Agriculture, 2001; Mogford, 1996).

South Africa is a net exporter of agricultural products, exporting about R16 billion[1] worth of agricultural products annually. Exported products (in processed and unprocessed form) include wool, maize, sugar, citrus, deciduous fruit, wine and paper, and make up approximately one tenth of the country's total export earnings. South Africa is largely self-sufficient in most primary food crops, other than wheat, rice and oilseeds (Department of Agriculture, 2000). Even though SA is considered to be the third most biodiverse country in the world, it is not a centre of origin or diversity for any major food crops.

Maize is considered South Africa's most important field crop, and white maize is the major staple food. The average local consumption requirements are estimated at 7.5 million tons. This can be split up into 4.2 million tons of white maize and 3.2 million tons of yellow maize. In the 2002/2003 marketing year, maize was responsible for the largest contribution (13.78%) to the total gross value of agricultural production, with a gross value of R9.5 billion. Fowls slaughtered followed a close second with R8.6 billion (Meyer, 2002). The area annually planted under maize has varied between 3.2 and 5 million hectares over the last 40 odd years, representing about a quarter of the total arable land. There has been a general decline in the area planted under maize, yet the production trend is upward-sloping. This proves that the marginal production areas have been taken out of production and the average yields have improved. In 2004, the Crops Estimation Committee estimated the white maize harvest at 5.8 million tons and yellow maize at 3.67 million tons (www.sagis.org.,za). Commercial production of white maize averaged 4.3 million tons and that of yellow maize averaged 3.9 million tonnes over the last 10 years. Less than 500,000 tonnes, predominantly of white maize, are produced each year by subsistence farmers for household consumption: In 2003/2004, subsistence farmers produced less than 171,000 tons of white maize and about 57,000 tons of yellow maize.

South Africa has a well-developed seed sector, with local and international players and with an annual turnover close to R1,000 million (US$160m). Seed for maize and wheat account for 66% of the seed market, vegetable seed is second with 18%, pasture/forage accounts for 13% and flowers for 3% (Kirsten & Gouse, 2002). On the South African variety list of October 2004 (Department of Agriculture), there were more than 400 registered white and

[1] Amounts in Rands at an average Rand/US$ exchange rate of 8.

yellow maize hybrids available for commercial production. These hybrids are marketed by 18 companies or institutions and there are also a number of high lysine and open-pollinated varieties available. Four companies dominate the maize seed market. The South African company, Pannar, owns 44% of the hybrids on the variety list, and the rest are owned by international companies: Monsanto owns 23%, Pioneer Hi-bred 18% and Syngenta 16%. The number of hybrids does not necessarily equate to the quantity of seed sold but Pannar is the leading maize seed company in SA. Monsanto, through its acquisition of two South African seed companies (Carnia and Sensako) in 1999/2000, has been able to capture a major share of the maize seed market and also owns 48% of the wheat hybrids on the variety list. All these companies' germplasm research and development has mainly focussed on high-yielding varieties for commercial farmers who use plenty of fertilizer. Up to now, only Pannar and South Africa's Agricultural Research Council have really purposefully invested in developing and marketing maize varieties more conducive for subsistence farming. Syngenta, with its partnership with Seedco in Zimbabwe, might also be heading in this direction (Gouse, Pray, Kirsten & Schimmelpfennig, 2005). South African companies and South African subsidiaries of international companies supply seed to many other African countries.

Primary agriculture is affected by a number of constraints. Only 14% of South African land is estimated to be suitable for crop cultivation (and as little as 3% is considered to be high potential land). The vast majority of crops are dependent upon rainfall, which is generally low and highly variable from year to year. Furthermore, in the past decade, the agriculture sector has also been forced to adjust to new circumstances. These include the final deregulation of the marketing boards in 1997, abandonment of protectionism with a steady decline in import tariffs, trade liberalization, new labour standards and minimum wages, land reform[2] and agricultural black economic empowerment (AgriBEE)[3].

These factors help explain why the sector is not functioning at full potential. Nevertheless, there are signs that restructuring in response to the reforms has made the sector more productive. There are many successful operations and a solid foundation on which to build. Development of the informal farming sector offers opportunities for the alleviation of poverty in rural areas. The *Strategic Plan for South African Agriculture* (Department of Agriculture, 2001) was developed with the cooperation of commercial and small-scale farmers, agribusiness and government to map the way forward for the benefit of all participants. The strategic objective of the Plan is "equitable access and participation in a globally competitive, profitable and sustainable agricultural sector contributing to a better life for all." Core and complementary strategies are identified to achieve this: Biotechnology is described as a 'strategically important' technology, and government support is called for to ensure better funded and coordinated research and to facilitate partnerships to promote acquisition of appropriate technology – but GM crops are not specifically discussed.

3. AGRICULTURAL BIOTECHNOLOGY IN SOUTH AFRICA

3.1 General information on the research and development system in SA

South Africa has a well-established research system, but this is under strain on a number of fronts. Heavy investment by the former government in technology missions aimed at priority

[2] This involves government programmes for land restitution and redistribution to previously disadvantaged communities to redress hardships and inequities suffered under the apartheid regime.

[3] The AgriBEE framework addresses issues unique to agriculture, like land reform and deracialization of land ownership and control in SA, and it helps black South Africans to own, establish or participate in agricultural enterprises. Government has set a target of 30% of agricultural land under black ownership by 2014 and an additional 20% to be made available through leaseholds.

areas such as military dominance and energy self-sufficiency served to establish solid technological capabilities. Expertise in manufacturing, agriculture, mining and minerals was also developed. However, only a small segment of the population was able to participate in the research and development (R&D) system in the past, and investment in R&D fell as a proportion of GDP for much of the 1990s, as the new government focused on new national priorities. At present, gross domestic expenditure on R&D is estimated at about $1.5 billion,[4] and amounts to 0.76% of GDP.[5] Government plans to double public spending on R&D over a period of three years (2005–2007) to bring total R&D expenditure up to 1% of GDP. Public funding programmes have become more competitive, and frequently demand that research proposals demonstrate relevant application of the project to end-users. The private sector performs just over half of national R&D, the higher education sector a quarter, and government about 20%. R&D spending by the public and private sectors respectively is approximately equal.

The country's science and technology policy is set out in a *White Paper on Science and Technology* (Department of Arts, Culture, Science and Technology, 1996), which adopts the concept of a National System of Innovation. In 2002, a National R&D Strategy was articulated, in which strategic interventions were proposed to address current weaknesses, in an attempt to enhance the impact of the policy and ensure that its vision was sustained. Biotechnology was considered a key technology platform (Department of Science and Technology, 2002).

In a 2003 National Biotechnology Survey (Department of Science and Technology, 2004), it was found that 622 research groups were engaged in 911 research projects relevant to biotechnology in SA. The survey identified 106 companies active in modern biotechnology in SA. Biotechnology is the main business focus for 47 of these companies (core biotechnology) and the rest were non-core biotechnology – just utilizing biotechnology. Of the core biotechnology companies, 39% were in human health and 13% supplied support services; 26% of the non-core biotechnology companies were in the plant sector, and the human health and industrial sectors made up 15% each. The number of core biotechnology companies increased from four since 1984 to 47 in 2003 but growth in non-core biotechnology companies was slow. Less than 20% of South African biotechnology firms had an annual revenue above R10 million. Of the core biotechnology companies, 33% were new and 37% were spin-offs from research groups. The majority of research groups were small and engaged 10 or fewer researchers. Biotechnology research projects were spread over a number of sectors, including human and animal health, plant, food and beverage, industrial, environmental and other sectors. The human health sector had the most projects, with the plant sector in second place. The survey identified 30 plant biotechnology and 22 food and beverage companies. It estimated that only 10% of biotechnology companies were conducting innovative cutting edge research and development, with the majority involved in new applications of low-tech modern biotechnology.

Research efforts have been fragmented, support mechanisms have been inadequate (in terms of both financial and human resources) for moving innovative technology out of the laboratory into the marketplace, and a risk-averse financial community has not displayed much interest in investing in biotechnology. Despite the research activity, few local biotechnology products and processes have been commercialized, particularly those based on third generation biotechnology (relating to GM crops).

[4] Adjusted for purchasing power parity. It should be noted that the currency is relatively volatile and, as a result, dollar amounts stated are only an approximation.

[5] Compared to the OECD average of 2.5%.

3.2 Policy measures to support the development of biotechnology in SA

It is estimated that, over the years, about ten different strategy documents for the promotion of biotechnology in SA have been developed, by several different organizations (PlantBio, 2004). In terms of current relevance for and future impact on agricultural biotechnology in particular, the most important of these is the *National Biotechnology Strategy* (NBS) (Department of Science and Technology, 2001). The NBS recognizes biotechnology's potential to contribute to economic development and address national needs in fields such as health, food security and the environment, provided that associated challenges can be overcome. It is intended to provide an enabling environment appropriate to local conditions, for the development of a South African biotechnology sector that is able to make a positive socioeconomic impact. About $70 million has been made available by government over a period of three years for the first phase of implementation of the NBS.

While brief mention is made in different sections of the NBS of some of the possibilities, constraints and concerns around GM crops and foods, it does not spell out how these ought to be handled. Responsibility is assigned to the National Department of Agriculture (NDA) to improve the administration of GM crop trials, increase biosafety R&D and build capacity in biosafety. PlantBio, the National Innovation Centre for Plant Biotechnology, located in KwaZulu-Natal, is tasked with implementing aspects of the NBS relevant to GM crops through a more detailed and focused strategy and business plan.

PlantBio's objectives are:

- to contribute to increasing South Africa's GDP through the creation of a domestic plant biotechnology industry;
- to build South Africa's competitive advantage by generating and exploiting new intellectual properties (IPs) and building capacity in relevant areas;
- to make a positive social impact by improving the quality of life of South Africans through developing better products and addressing food security needs; and
- to become sustainable by raising finance, investing, realizing value and re-investing.

As in other focus areas, the balance between building a competitive local industry and addressing socioeconomic needs is not easy to achieve with limited resources. PlantBio's role is to support biotechnology R&D at the upstream end of the value chain, and it recognizes its limitations with respect to downstream activities. Nonetheless, it will consider the potential downstream constraints to ensure that efforts are made to manage them appropriately.

PlantBio has identified five strategic focus areas for support, on the basis of predictions for a better than average probability of creating technological, social or commercial value. Plant transformation/genetic modification is one of the selected focus areas. Some fairly serious risks are identified, including market acceptance, health concerns, environmental concerns, technological risks, time to market and the high levels of investment needed. Nevertheless, support is considered worthwhile, provided certain conditions are met: Sufficient investment is required (which will involve raising substantial finance from external sources, initially from public, development and philanthropic sources, and later from commercial institutions), selected traits must address food security, mechanisms must be put in place to ensure access to the end products by small-scale farmers, and market risks and costs of research must be reduced to lower than the industry average. PlantBio has identified drought tolerance and disease resistance of maize as the main priority area for support in this area. Support for similar research on cassava will also be considered if additional funding and support can be attracted.

While PlantBio recognizes the risks surrounding market access and acceptance, it is not part of its core business to deal with these directly. Rather, it will encourage other entities within

whose domains these fall to tackle the relevant issues. Its main responsibility to small-scale farmers in the area of GM is to provide products that address major crop disease and abiotic stress, thereby increasing yields and possibly expanding the range of crops suitable to a particular area (PlantBio, 2004). A future project being contemplated and for which funding is being sought is the establishment of a South African biosafety network, which will employ local infrastructure, facilities, scientists, breeders and farmers to provide local biosafety data for GM trial crops.

3.3 Research and development on genetically modified crops

One source shows 98 research projects underway in SA on GM crops, which equates to about 25% of total plant biotechnology projects (PlantBio, 2004).[6] The same source estimates that plant biotechnology commands about one-third of total biotechnology funding, and that about 40% of biotechnology projects with products in development are in the plant biotechnology sector, which is higher than for biotechnology research projects in other areas, indicating a greater emphasis on product orientation in the plant sector than in other sectors.

Another study identifies 28 transformation events[7] in the South African public research pipeline, encompassing seven GM crops. The phenotypic traits introduced cover a broad spectrum: (in order of frequency) fungal resistance, insect resistance, product quality, agronomic properties, viral resistance, herbicide tolerance and bacterial resistance (Sithole-Niang, Cohen & Zambrano, 2004).

Some of the more advanced South African agricultural biotechnology projects using GM techniques are listed in Table 1.

Table 1: Genetically modified food crops in the South African pipeline

Institution	Plant	Trait
Agricultural Research Institute – Vegetable and Ornamental Plant Institute	Potato	Insect resistance
Agricultural Research Institute – Infruitec	Strawberries	Herbicide tolerance*
Council for Scientific and Industrial Research	Maize	Fungal resistance
Council for Scientific and Industrial Research	Pearl millet	Fungal resistance
South African Sugar Experiment Station	Sugar cane	Herbicide tolerance

** Although field trials were promising, the project was abandoned, as it was not economically viable to bring the product to market due to high licence fees for the herbicide. Source: South Africa Plant Improvement Act No 53 of 1976 (Thomson, 2004).*

3.4 Field trials and commercial release of genetically modified crops

An application to the South African Department of Agriculture in 1989 to perform field trails with genetically modified cotton, kick-started the South African biosafety process and initiated the first trials with transgenic crops on the African continent. The application came from the US seed company, Delta and Pine Land (D&PL), which used SA as an over-wintering haven for field trials. The application was reviewed and approved by the South African Committee

[6] This includes projects at all stages of development, including those at an early stage.

[7] A 'transformation event' is defined as the stable expression of a transgene introduced into a particular crop in a project led by a particular lead research institute.

for Genetic Experimentation (SAGENE), and the Department of Agriculture issued a permit. D&PL's involvement in SA increased and, in 1995, after approval, [Bacillus thuringiensis (Bt) seed was multiplied in SA for the first time, for sale in the US].

3.4.1 Field trials

Crops for which field trial permits have since been issued include maize, cotton, soybeans, wheat, potatoes, sugar cane, canola, strawberries, tomatoes, apples and sweet potatoes (Jooste *et al*.., 2004). In 2004, approval was granted to conduct field trials at six sites around the country for GM potatoes resistant to tuber moth, developed by the Agricultural Research Council in a partnership with Michigan State University, funded by USAID. It is possible that the potatoes will be commercialized by 2007, and they are expected to be the first GM vegetable on the market in SA.

3.4.2 Commercial release and adoption

In 1997, South Africa became the first country in Africa to produce transgenic crops commercially. To date, insect-resistant (Bt) cotton and maize, and herbicide-tolerant (RR) soybeans, cotton and maize have been approved for commercial release. Cotton with the 'stacked gene' (Bt and RR) was approved for commercial production in October 2005 – just in time for the cotton planting season. Farmers started adopting insect-resistant (Bt) cotton varieties in the 1997/1998 season and insect-resistant (Bt) yellow maize in the 1998/1999 season. Herbicide-tolerant cotton was made available for commercial production in the 2001/2002 season, and a limited quantity of herbicide-tolerant soybean seed was also released. Bt white maize was introduced in the 2001/2002 season, and 2002/2003 saw the first season of large-scale Bt white maize production. A limited quantity of herbicide-tolerant maize seed was commercially released for the 2003/2004 season. Table 2 summarizes the areas planted under transgenic crops in South Africa for the most recent seasons.

Table 2: Percentages and estimated areas planted to transgenic crops (hectares)

Crop	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004
% Bt Cotton	50%	<40%	70%	70%	81%
Bt Cotton area	13,200	12,000	25,000	18,000	30,000
% RR Cotton	0	0	<10%	12%	7%
RR Cotton area	0	0	1,500	3,500	2,500
% Bt Yellow Maize	3%	5%	14%	20%	27%
Bt Yellow Maize area	50,000	75,000	160,000	197,000	250,000
% Bt White Maize	0	0	0.4%	2.8%	8%
Bt White Maize area	0	0	6,000	55,000	175,000
% RR Soya-beans	0	0	5%	10.9%	35%
RR Soya-beans	0	0	6,000	11,000	47,000

Source: Percentages – CottonSA and SANSOR; Area – author's own estimations.

The US cotton seed company, Delta and Pine Land, has the sole use of Monsanto's Bt cotton gene in their cotton seed in SA. In 1997/1998, D&PL introduced two Bt varieties – NuCOTN 35B and NuCOTN 37B. These two varieties were based on D&PL's older Acala 90 variety and were not initially adopted with great enthusiasm, as the newer Delta Opal, a conventional variety, was D&PL's more popular variety at the time. In 1998/1999, D&PL's cotton seed market share was therefore estimated around 10%, with Clark Cotton (also a cotton ginning company) selling most of the cotton seed in SA. However, 1999/2000 saw D&PL's market share increase to close to 20% and, when NuOpal (Opal with Bt) was

introduced for the 2000/2001 season, D&PL's market share soared to over 80%. With the release of herbicide-tolerant cotton in 2001/2002, D&PL's market share increased to over 95% (Gouse, Pray & Schimmelpfennig, 2005).

The initial spread of Bt yellow maize was quite slow. In 2000/2001, after two years' experience with it, farmers planted less than 3% of the total maize area under Bt maize. Farmers and seed companies suggest three reasons for the slow spread of Bt maize. First, the Bt hybrids that were on the market were not well adapted to the South African consumer markets or to local agricultural production conditions. White maize is usually planted on 45–60% of the maize area, but Bt white maize was not for sale to farmers until the 2001/2002 production season. The Bt yellow maize varieties available were not the ideal hybrids for the region. A second reason for slow adoption was that many farmers did not see a big productivity increase from the use of Bt maize seed. The main target insects of Bt maize in SA are the African maize stalk borer (*Busseola fusca*) and the Chilo borer (*Chilo partellus*). Many farmers felt that, if they planted at the time recommended for avoiding the moth flight times, they would have limited damage, whether they planted Bt or conventional varieties. Many of them also felt that the increased yield from Bt maize was not enough to pay for the technology fee charged on top of the seed price, especially when compared with newer, better-adapted conventional hybrids. Thus, Bt was at first mainly adopted where stalk borers were a particularly difficult problem. The third reason for the initial slow spread of Bt maize was that farmers feared they might not be able to sell their crops because of consumer concerns about GM food (Gouse, Pray, Kirsten & Schimmelpfennig, 2005).

By 2000 and 2001, seed companies in SA had been able to cross the Bt gene into newer and more appropriate local yellow maize hybrids, and the first Bt white maize hybrids were released in 2001. Farmers' perception of low profitability with Bt maize also changed in 2001/2002, due to a substantial stalk borer infestation in a number of major maize production areas. Many farmers suffered high rates of damage and yield loss on their conventional maize, and Bt maize rendered significant comparative yield benefits due to more effective borer control. The final adoption constraint – farmers' concern regarding demand and consumer acceptance – has not become a significant reality in SA thus far. Most farmers have had no problem in selling their GM maize and there is currently no price premium on non-GM maize in SA. Exports of non-GM maize to niche markets, mainly in Asia, have been limited and the profits were captured by the commodity trading companies, not by the producers (Gouse, Pray, Kirsten & Schimmelpfennig, 2005).

4. SOCIOECONOMIC IMPACTS – EVIDENCE TO DATE

South Africa has a dualistic agricultural system, with a relatively small number of large-scale, commercial farmers producing more than enough agricultural products for national food security, and a relatively large number of small-scale farmers producing on a subsistence level. It is thus important to take both small- and large-scale farmers into consideration when new agricultural technologies are introduced.

Comprehensive independent studies of the socioeconomic impacts of the introduction and adoption of GM crops into South Africa are rather limited. A Rockefeller Foundation-supported study by the University of Pretoria assessed and compared the on-farm effects of Bt cotton and Bt yellow maize amongst small- and large-scale farmers. A Department for International Development-funded project by the University of Reading in the UK focussed on small-scale Bt cotton, and a number of papers were published, using the findings from both these studies. In collaboration with the University of Pretoria, the French research institute, *Centre de coopération internationale en recherche agronomique pour le développement* (CIRAD), is also actively involved with research on Bt cotton in SA, and has produced a number of working papers. From 2001 to 2004, the University of Pretoria conducted a study on the socioeconomic effects of Bt white maize, especially amongst small-scale farmers in SA, and a current study supported by the Rockefeller Foundation aims to measure effects of

Bt maize on labour and to make some *ex ante* labour estimations regarding herbicide-tolerant maize adoption by small-scale farmers. Little independent research has been done on RR soybeans in SA but the impressive adoption rate (Table 2) suggests that farmers are benefiting from the new technology.

4.1 Insect-resistant (Bt) cotton

Studies on the impact of Bt cotton adoption amongst small-scale farmers in SA focussed on the Makhatini Flats in northern KwaZulu-Natal. This is because the Makhatini Flats is the larger of only two areas in SA where smallholders have fairly continuously produced cotton over the last two decades. Depending on credit availability, the price of seed cotton and pre-season rain indications, between 2,500 and 10,000 hectares of cotton are planted on the Flats annually. The impressive adoption rate of Bt cotton on the Makhatini Flats can be attributed partly to the success of the farmers who first adopted it. Bt cotton was first introduced there in 1997, when four farmers planted demonstration trials on their plots. According to Monsanto, the results were impressive and so, in 1998/1999, 75 small-scale farmers planted Bt cotton on approximately 200 hectares. In 1999/2000 the number of Bt adopters rose to 411 farmers on about 700 hectares , and in 2000/2001 to 1,184 adopters on about 1900 hectares (Bennett, 2002). Currently, close to 90% of the cotton on the Flats is genetically modified (Bt and RR) but the total area planted by small-scale farmers has declined dramatically due to a lack of production credit and the low seed cotton price (Gouse, Pray, Kirsten & Schimmelpfennig, 2005).

The yield benefits of Bt cotton in South Africa are comparable to those reported in Argentina (Qaim, Cap & de Janvry, 2003; Qaim & de Janvry, 2005). Yield increases due to more effective control of the bollworm complex, in South Africa and Argentina, differ for large-scale commercial farmers and small-scale farmers, mainly due to their different pest control practices. Gouse, Kirsten and Jenkins (2003) found an 18.5% yield increase for large-scale irrigation farmers for the 2000/2001 season, and a 16.8% increase was measured on field trials at the Clark Cotton experimental farm in Mpumalanga. Large-scale dryland farmers enjoyed a 14% yield increase, while small-scale dryland farmers enjoyed an increase in excess of 40% in the wet 1999/2000 season (Gouse *et al.*, 2003). These figures compare well with the findings in Argentina, where large-scale commercial farmers were reported to enjoy 19% yield increases and small-scale farmers 41% yield increases.

Like Qaim *et al.* (2003), South African researchers attribute the difference between the Bt yield advantages for small- and large-scale farmers to the financial and human capital constraints on chemical pest control for smallholders. By the time a small-scale farmer in SA has noticed bollworms, bought pesticides with a limited amount of cash or credit, and started to spray, severe damage has already been done. Shankar and Thirtle (2005) showed that the average insecticide application by small-scale farmers on the Makhatini Flats is lower than 50% of the optimal level. Many small-scale farmers indicated that they could not even apply pesticides to their whole field due to a lack of time, knapsack sprayers, labour, and the cost of the pesticide. With a low education level causing problems with the mixing of pesticides and the calibration of knapsack spraying nozzles, the efficacy and efficiency of insecticide applications is questionable for many small-scale farmers anyway.

Nevertheless, large- and small-scale farmers in SA still need to apply chemical insecticides for sucking insects like *Jassids* and *Aphids*, and from time to time for insects like stinkbugs that were in the past all killed in the crossfire aimed at bollworms. Even though Bt adoption has significantly reduced farmer expenditure on insecticides, in most seasons the saving on chemicals alone has not been sufficient to offset the increased cost of seed due to the additional technology fee levied by the Bt gene owner. The yield advantage of Bt cotton compared to conventional cotton is thus very important in the cotton seed decision. Preliminary results from a study by CIRAD in collaboration with the University of Pretoria (Hofs, Fok & Gouse, 2005) found no statistically significant yield difference between Bt and

conventional varieties on the Makhatini Flats in the dry 2003/2004 season. This can be attributed mainly to a very low bollworm pressure. The dilemma in South Africa is however that, for most seasons, it is very difficult to predict the bollworm pressure at planting time.

Gouse, Pray and Schimmelpfennig (2005) showed in a static calculation using cotton production budgets by Gouse *et al.* (2003) that, despite having a monopolist as a seed supplier (D&PL) and monopolist as a gene supplier (Monsanto), South African cotton farmers in 1999/2000 and 2000/2001 captured the lion's share of the welfare created by the introduction of the Bt technology into the South African cotton sector (Table 3). Even though D&PL's share of the additional profit seems small, they were able, through their agreement with Monsanto, to secure most of the South African cotton seed market. The technology supplier captured its share through the technology fee and farmers benefited through increased yield and savings on insecticide chemicals. Other benefits indicated by farmers included peace of mind, managerial freedom, saving on spraying water, labour and machinery but were not quantified or included in the calculation.

When Bt cotton was introduced to the Makhatini Flats, the institutional arrangements were also successful for the first couple of seasons. The Land Bank supplied credit and the risk of default was shared between the Land Bank and the local cotton gin, Vunisa. Vunisa administered production loans from the 1998/99 season, with a loan recovery rate of close to 90%. Then, in 2001/2, a new company, Makhatini Cotton (Pty) Ltd, erected a new gin on the Flats, right next to the Vunisa depot. Some farmers avoided repaying their loans by selling to the new gin and, having lost substantial sums, in 2002/3 Vunisa was no longer offering inputs on credit so in 2002/2003 the area under cotton on the Flats decreased to just over 500 ha.

Table 3: Distribution of additional benefits to farmer groups, 1999/2000–2000/2001.

	Small-scale dryland farmers	Large-scale dryland farmers	Large-scale irrigation farmers
Seed company: D&PL	32 500 3%	54 600 2%	74 200 1%
Technology supplier: Monsanto	299 400 28%	1 309 800 52%	1 779 700 20%
Farmer	1 038 600 69%	1 323 500 45%	5 988 100 79%
Primary Consumer: Ginning company	0%	0%	0%
Insecticide companies	-90 600	-777 700	-1 086 400

Amounts in Rands at a Rand/US$ exchange rate of 8. Source: Gouse, Pray & Schimmelpfennig, 2005.

There is a clear lesson here that is widely understood in African conditions: The only asset that can be used as collateral for a loan is the crop itself. Loans are not made for maize because the farmers can eat it, but with cotton, if there is only one mill, the company that owns the mill can make loans. If there is more than one mill, however, the farmers will default and the inability of financial corporations to enforce repayment of loans, combined with the fact that most farmers on the Flats cannot finance their own cotton production inputs, means little subsequent production (Gouse, Kirsten, Shankar & Thirtle, 2005). What happened on the Makhatini Flats is thus a case of technological triumph but institutional failure. Processes are currently being put in place to remedy the institutional situation.

SA is a net importer of cotton, mainly from Malawi, Zambia and Zimbabwe, and importers were recently in many instances able to import seed cotton or ginned cotton from these countries for less than what they would pay domestically. South African cotton gins would like to support cotton farmers in SA (especially irrigation farmers) so as to be relatively sure of a fixed, lower risk quantity of seed cotton that can be purchased and ginned to cover the gin's fixed cost. However, South African cotton farmers cannot compete with farmers in large cotton-producing countries who enjoy subsidies, nor with the small-scale farmers in other Southern African countries where labour costs are minimal and climatic conditions more ideal for cotton. In SA, cotton competes, mainly with maize, for the area under irrigation and with maize and sunflowers on dry land. In the 1999/2000 season, an estimated 51,000 hectares of cotton were planted, showing a drastic decline from the previous season's 99,000 hectares. The 2002/2003 harvest was estimated to be around 31,000 hectares, and the current estimation for 2004/2005 is a mere 21,200 hectares. South African cotton farmers are dependent on, or rather exposed to, a deflated world cotton price and a fluctuating Rand/US$ exchange rate. Large-scale commercial farmers can usually convert to a different crop or farming system but, for small-scale farmers in dry areas like the Makhatini Flats, cotton used to be the difference between subsistence and poverty (Gouse, Pray, Kirsten & Schimmelpfennig, 2005).

4.2 Insect-resistant (Bt) maize

In SA and other Southern African countries, the losses sustained in maize crops due to damage caused by the African maize stalk borer (*Busseola fusca*), are estimated to be between 5% and 75% and it is generally accepted that *B. fusca* reduces the South African maize crop by an average of 10% annually (Annecke & Moran, 1982). Accordingly, *B. fusca* and the Chilo stalk borer (*Chilo partellus*) are the most harmful pests of maize and grain sorghum in South Africa (Kfir, 1997). A conservative estimation of 10% for damage caused by both *B. fusca* and *C. partellus* means an average annual loss of just under a million tons of maize, with an approximate value of US$100 million. Both *B. fusca* and *C. partellus* can be controlled to a satisfactory level with the use of the Bt gene currently used in South African Bt varieties, Cry1Ac.

Monsanto has not only been selling its Bt gene in its own hybrids but also licensing the gene to other maize seed companies in SA, like Pioneer Hi-Bred and Pannar, for use in their hybrids. In 2003, the biosafety committee of SA approved Syngenta's Bt maize, breaking Monsanto's monopoly on Bt genes in SA. Table 4 indicates the sources of genes and hybrids for GM maize.

Table 4: Genetically modified maize sources of genes and hybrids

Crop	Source of gene	Source of hybrids	Year gene approved for commercial use	First planting year
Bt Yellow maize	Monsanto	Monsanto	1998	1998
	Monsanto	Pioneer	1998	1999
	Monsanto	Pannar	1998	1999
	Syngenta	Syngenta	2003	2003
	Dow	Pioneer	future	future
RR Yellow maize	Monsanto	Monsanto	2003	2003
Bt White maize	Monsanto	Monsanto	1998	2001
	Monsanto	Pioneer	1998	2001
	Monsanto	Pannar	1998	2004
RR White maize	Monsanto	Monsanto	2003	2003

Source: Gouse, Pray, Kirsten & Schimmelpfennig (2005)

4.2.1 Large-scale maize farmers

Gouse, Pray, Kirsten & Schimmelpfennig (2005) found that large-scale commercial maize farmers benefited economically from the use of insect-resistant yellow maize. Despite paying more for seeds, farmers who adopted Bt yellow maize enjoyed increased income on Bt maize compared to conventional maize, through savings on pesticides and increased yield due to better pest control. Data were collected for the 1999/2000 and 2000/2001 seasons from a total sample of 33 farmers, producing maize under dryland and irrigation conditions.

Table 7 summarizes the yield advantages enjoyed by large-scale farmers who adopted Bt yellow maize. It is important to note that the differences in mean yields of Bt and conventional hybrids were statistically significant (at a 95% confidence level) only in the total irrigation and the total dry land calculations. Farmers did not report a high level of stalk borer infestation in either season or survey region. These yield benefits can therefore be expected to vary between regions, farmers and seasons according to the stalk borer pressure in the particular season, the conventional variety the Bt variety is compared with, and the pest control practices of the particular farmer.

Contrary to what was found by Marra, Pardey and Alston (2002) in the US, the level of damage caused by stalk borers in SA in most seasons and maize production areas necessitates application of chemical insecticides. Depending on the seasonal stalk borer infestation level, saving on insecticides has been found to be significant with Bt maize.

In 2003/2004, the University of Pretoria conducted a new survey of 40 large-scale farmers producing white maize mainly on dry land in Mpumalanga and the Eastern Free State. More than 50% of the farmers indicated that stalk borers on conventional maize are only a problem when they are forced by rain to plant late or early, while 44% of the farmers indicated that stalk borers are a problem every season. 32% indicated that they spray conventional maize for stalk borers every season as a precaution, while 24% indicated that precautionary spraying for stalk borers is done only when planting late or early.

Table 5: Average maize yields for Bt and conventional hybrids, 1999/2000 & 2000/2001

Province	Production condition	Yield with Bt maize (kg)	Yield with conventional maize (kg)	% Yield advantage
Mpumalanga	Irrigation	11,280	10,500	7%
Northern Cape	Irrigation	12,160	10,860	12%
Total	**Irrigation**	**12,081**	**10,881**	**11%***
Mpumalanga	Dryland	5,000	4500	11%
North West	Dryland	3,130	2,920	7%
Total	**Dryland**	**3,398**	**3,072**	**10.6%***

*Note: * Statistically different at 95% confidence level.*
Source: Gouse, Pray, Kirsten & Schimmelpfennig (2005).

Although almost all the farmers indicated that Bt maize seed was too expensive due to the additional technology fee, 34 farmers (87%) indicated that they were planning to plant Bt maize again next season and 3 farmers were not going to plant maize at all in the following season due to the low grain price. Only 20% of farmers indicated that a yield increase was the most important benefit; 31% of farmers indicated a decrease in expenditure on chemical insecticides and application as the most important benefit, while 34% indicated peace of mind about stalk borers and easier crop management as the most important benefits.

The fact that South African large-scale maize farmers benefit from the Bt technology is not really surprising as the farming practices and managerial skills of large-scale farmers in SA compare well with those of farmers in the developed countries where the Bt technology was developed. Due to the innate ability of Bt maize to control insects, one would expect that this technology would also appeal to small-scale farmers.

4.2.2 Small-scale maize farmers

In 2001/2002, Monsanto introduced Bt white maize to small-scale farmers through workshops in nine areas in four provinces in SA. Farmers who wished to try out the new seeds received two small bags of white maize seed. One of the bags contained 250 grams of CRN 4549 seed, also known as Yieldgard, insect-resistant or Bt maize seed, while the other bag contained 250 grams of the isoline conventional variety (CRN 3549, which is genetically identical to CRN 4549 except that it does not contain the Bt gene). As Monsanto supplied only a small quantity of seed to each farmer, farmers still had to buy and plant their own seed of choice, or use their own saved maize seeds. In 2002/2003, the small-scale farmers had to buy maize seed as usual, based on their experience of the previous season.

The University of Pretoria studied the first three seasons of Bt white maize production by small-scale farmers in SA (Gouse & Kirsten, 2005). The first season rendered some interesting results, with 175 small-scale farmers across 6 sites reporting yield increases between 21% and 62% and an average of 32% with Bt maize above the conventional isoline. It is thought, however, that these findings might have been influenced by some preconceived yield increase perceptions by small-scale farmers due to the workshops and free seed samples. Unfortunately for the study and for many small-scale farmers, only a limited number of them were able to buy Bt seed for the 2002/2003 season due to a limited seed supply and an increased demand for Bt seed by large-scale farmers. The 2002/2003 season saw an impressive demand for Bt seed from various sites (Transkei for instance ordered 4.5 tons of Bt seed), but in only two sites in KwaZulu Natal were a significant number of subsistence farmers able to purchase Bt white maize seed.

Large-scale maize farmers in SA order their maize seed months in advance, in most cases directly from the seed companies. Seed can also be bought from large local agricultural input suppliers (former farmer cooperatives). Small-scale farmers and subsistence farmers in SA who produce maize on a larger scale than just a vegetable garden, are mainly situated in remote areas[8] where there are very few large-scale farmers and economies of scale (relatively small quantities of inputs, packaged in small units and transported over long distances) cause problems for input suppliers. In some areas, the farmers, supported by provincial department of agriculture offices, have formed small farmer cooperatives to buy inputs in bulk and to negotiate better prices but, in many of these rural areas, small-scale farmers are still dependent on the local shop to order some type of maize seed in time for planting.

Despite lower-than-normal stalk borer pressure and seasonal rainfall in 2002/2003, small-scale farmers in KwaZulu Natal enjoyed a statistically significant yield increase of 16% (at the 95% confidence level) due to better stalk borer control with Bt maize. On average, a farmer who planted a 10-kilogram bag of Bt seed per hectare enjoyed a yield increase of 110 kilograms of grain, compared to when he planted 10-kilogram bag of conventional hybrid seed. Farmers who adopted Bt maize were better off than farmers who planted conventional hybrids, despite the additional technology fee. Due to the low average yield achieved by small-scale farmers in the dry 2002/2003 season, a statistically significant yield increase of 110 kilograms (16%) hardly seems economically significant. However, a 16% yield increase in a season with good rainfall will result in a substantial increase in food security. If the rule-of-thumb annual requirement of fourteen 80-kilogram bags of maize meal for a household of seven is used, then the 110-kilogram yield advantages enjoyed in KwaZulu-Natal resulted in approximately 36 more days of maize meal for a 7-member household.

In 2003/2004 no significant difference between the yields of Bt and conventional maize seed could be found due to drought, a very low stalk borer infestation level, and damage to maize ears caused by late rain, which complicated measuring and comparing yields.

Based on the findings of the three years of research, it was concluded that small-scale subsistence farmers in SA could benefit from the use of genetically modified insect resistant white maize. Like large-scale farmers however, due to the nature of the technology, small-scale farmers can only benefit from the use of Bt maize seed if stalk borers are present in that particular season. Even though farmer perceptions suggested otherwise, savings on insecticides were not found to be substantial, due to a low level of chemical insecticide application linked to low stalk borer pressure. In the third season, which was also the fourth consecutive drier-than-usual season in the research area, the stalk borer infestation level was very low and farmers who planted Bt maize enjoyed similar yields to those of farmers who planted conventional hybrids, and they were thus in all likelihood marginally worse off due to the additional technology fee. It seems that small-scale farmers have realized this to a certain extent, not only for Bt maize seed but also for expensive conventional hybrids, as a large number of farmers in KwaZulu-Natal, in 2003/2004 and in the current 2004/2005 season, bought Bt and conventional hybrids but decided not to plant expensive bought seed after a very dry pre-season. In order to minimize financial risk, they planted some traditional seed or less expensive open-pollinated varieties without fertilizer and plan to plant the Bt and conventional hybrids with fertilizer next season, which they hope and pray will be a wetter, more maize-production-friendly season.

[8] In the former homelands, like the former Transkei and Ciskei areas in the Eastern Cape, and designated tribal areas, like Zululand in northern KwaZulu-Natal.

5. PUBLIC UNDERSTANDING OF BIOTECHNOLOGY IN SA

5.1 Risks and concerns

5.1.1 Health

Some believe that the effects on human health of consuming GM foods have not been investigated thoroughly enough, and that there is insufficient data to rule out adverse effects (e.g., due to toxicity or allergenicity). They do not believe that lack of evidence of this in places like the US, where GM foods have been consumed for much longer, is necessarily relevant in the South African context. For one thing, GM crops have not been consumed as a staple in the US, as white maize is in SA, in not very highly processed form. For another, the effects of GM food consumption have not been investigated in an environment presenting a higher prevalence of poverty, malnutrition and HIV/AIDS infection. Health risks are raised less frequently than environmental or socioeconomic risks and, when they are, this sometimes appears to be more as an afterthought, appended to objections on other grounds in an effort to strengthen an anti-GM argument, than as an issue in itself.

5.1.2 Environmental

Environmental risks are raised mainly in the context of having insufficient data to assess the impact of GMOs on the environment (including the chance of horizontal gene flow to non-target species, the possibility of volunteers becoming weeds in subsequent crops, the extent of pollen drift, the build-up of resistance to Bt by insect pests, and the possibility of insects' finding alternative hosts). This is because environmental risk assessments are not mandated, as well as because of the limited capacity of the regulatory authorities, both to assess the environmental risks when granting permits to grow GM crops, and to monitor the release of GMOs into the environment over time (for example, to track whether target organisms develop resistance to Bt crops). Furthermore, since much of the data supplied for regulatory approval is generated in other countries, all relevant local environmental conditions may not be taken into account. In the event of adverse environmental impacts, there is concern that there are insufficient safeguards in place to minimize and contain the damage.

5.1.3 Socioeconomic

Since all GM events currently approved for commercial use originate from multinational companies, there are fears that dependence on these companies will increase. Already, the cost of GM seed is greater than for non-GM varieties, because of the technology fee charged on top of the seed price. If the seed companies increase their prices for GM seeds in future, this could cancel out any net financial gains experienced by farmers, who might find it difficult to revert to non-GM varieties, having adjusted their farming practices to become reliant on the GM crops concerned. This could compromise the autonomy of national agriculture, and limit options available to farmers. Difficulties in ensuring segregation of GM crops from non-GM crops could affect export markets for South African agricultural exporters, and labelling regulations that are not considered sufficiently rigorous deny consumers the option of choosing between GM and non-GM products. The importation of cheap GM commodities could create local surpluses, thereby threatening the viability of local farming operations and the jobs of farm workers.

5.2 Benefits

5.2.1 Maize

Borer damage (which the South African Bt maize is designed to address) is one of the most serious insect problems for South African maize farmers, but the extent of infestation differs

across farming regions and from year to year. So, the benefits of growing Bt maize are expected to be variable, depending on the extent of the borer problem. Yield increases have nonetheless been experienced by farmers, even when stalk borer pressure has not been high. Reduced use of pesticides has also been shown. The African stalk borer in South and southern Africa causes significantly more damage than the European stalk borer does to US maize farmers, so more plant protection measures must be taken in South and southern Africa. This is why greater pesticide savings are realized by South African maize farmers than by their US counterparts (Gouse, Pray, Kirsten & Schimmelpfennig, 2005). Further benefits are reduced application cost as well as peace of mind for farmers, who often apply pesticides only when signs of insect damage become apparent, and therefore have to monitor the crops regularly for early indications of the borers. The net income effect for farmers adopting GM maize has been positive, with the increased yields and reduced pesticide costs more than compensating for the higher seed cost. Less pesticide in the environment and reduced residue on crops are other positive factors (Gouse, Pray, Kirsten & Schimmelpfennig, 2005; Jooste *et al.*, 2004).

5.2.2 Soybeans

For soybeans, the main benefits appear to be that GM soybeans enable minimum or no-till cultivation and soil condition is improved. Since herbicide residues do not persist, crop rotation is facilitated (Jooste *et al.*, 2004).[9]

5.2.3 Cotton

For cotton, the cost savings realized by reduced use of pesticides are generally balanced out by the higher seed cost and technology fee. However, with less of the crop being lost to insect damage, resulting in increased yields, the overall income effect is positive. Reduced use of pesticide generates several benefits: cost savings, time available for other productive pursuits, which in the past was spent spraying pesticide by hand, and improvement in health.[10] Other positive effects cited are peace of mind and better crop and risk management. In addition, as an indirect benefit, some farmers have seen an increase in beneficial predator insects on their Bt cotton fields (Kirsten *et al.*, 2002; Jooste *et al.*, 2004).

5.3 Public perceptions of biotechnology and GMOs

5.3.1 Surveys

While the range of risks, concerns and benefits discussed in the South African context is broad, it is necessary to point out that only a small proportion of the population participates in these debates or has strong opinions either pro or anti GMOs. This has been borne out by several surveys and polls, which have been conducted over the years in an attempt to ascertain the extent of public knowledge and understanding of GM foods, and to assess public attitudes towards the technology. Some of these include:[11]

- a 2001 survey commissioned by the Foundation for Education, Science and Technology (FEST);
- surveys in 2001 and 2003 commissioned by AfricaBio (personal interviews and questionnaires);

[9] Soybeans are not a food staple, but a common ingredient of processed foods.

[10] Since the adoption of Bt cotton by farmers in the province, reported cases of pesticide poisoning in KwaZulu-Natal have dropped by over 60% (Jooste *et al.*, 2004).

[11] The surveys are listed at: <http://www.pub.ac.za/resources/research.html>.

- a 2003 National Consumer Forum (NCF) questionnaire survey (a combination of cold canvassing and internet);
- a 2003 focus-group survey from Potchefstroom University for Christian Higher Education's Consumer Sciences and Nutrition Sections (the only one to take a predominantly qualitative approach);
- opinion polls following a 2004 television debate (live studio audience and phone-in);
- a 2004 survey undertaken by the Human Sciences Research Council (HSRC) in conjunction with a Public Understanding of Biotechnology (PUB) programme (interviews).

All except the last were limited in scope, low-profile, canvassed small samples, and were not demographically representative of the population (they were usually confined to respondents in urban areas). Some followed questionable methodology. Nonetheless, some of the data they yielded provides a useful snapshot of public perception.

For illustrative purposes, some of the data from the 2001 FEST survey can be examined. The survey sample consisted of 1,000 South Africans aged 16 to 60, living in the main metropolitan centres around the country. The survey found that just over a quarter of respondents considered themselves somewhat familiar with the term 'genetically modified foods', with only 7% believing that they knew enough about the topic to explain it to a friend. A link was found between level of education and awareness of GM, with a higher percentage of respondents with tertiary education deeming themselves familiar with the term, and as having sufficient understanding to explain the term to someone else. Black respondents were found to have less knowledge of and familiarity with the concept of GM than other population groups. More than half of the respondents overall did not know whether GM foods were being sold in South African supermarkets. Basic knowledge about what GM actually means was found to be low, with only 14% of respondents correctly identifying as false the statement: "Ordinary tomatoes do not contain genes, but GM tomatoes do." Questions about using modern biotechnology to improve nutritional content and taste of foods, and to make crops more resistant to drought and disease, were met with a high percentage of uncertainty from respondents. Almost half indicated that they would be willing to buy GM foods if they tasted better, and a similar percentage if GM foods were healthier than their conventional counterparts but, in both cases, almost as many respondents were unsure. About one-third of the sample stated that they would be willing to pay more for non-GM foods, but over 40% of consumers were unsure. Strong support for greater regulation of GM foods than other foods was expressed. Over 60% overall (and over 86% of those with degrees) supported labelling of GM foods.

In 2004, in an effort to build a more complete and reliable data set on public opinion of biotechnology in SA, the PUB programme, in partnership with the HSRC, undertook a more comprehensive survey (Rule & Langa, 2005). This was designed to give a more accurate picture of the *status quo*, in order to be able to inform an appropriate targeted communications strategy, as well as to provide baseline data for future similar surveys, to allow comparisons to be made and trends to be observed.

The sample consisted of 7,000 adults aged 16 and older from across the country, with a race, gender, age, income level and urban/rural mix, and was considered representative of a population of about 29.5 million adults. An overwhelming majority of respondents (almost 80%) was found to know very little or nothing about biotechnology, and over two-thirds had never heard of biotechnology before. Of those who expressed negative views about biotechnology, over half were unable to supply any reasons for their feelings, with the most common reason from those who did being health concerns. Most people did not know whether they had ever eaten any foods containing GM ingredients, and respondents were generally not aware of which foods might be GM. Two-thirds of respondents could not

identify any GM foods, and of those who did, a significant proportion named fruit or vegetables, despite the fact that no GM fruit or vegetables are sold in SA yet.[12]

All of the surveys confirm that public awareness of GM foods in SA is low, with most consumers uninformed about and indifferent to the topic, and some of those who consider themselves at least somewhat knowledgeable harbouring misconceptions or possessing erroneous knowledge. There is also no evidence that public awareness has grown over time. All indications therefore point to the fact that, at present, the average consumer is not sufficiently informed about relevant issues to formulate an opinion either for or against GM products. All of the research conducted in this area highlights the critical need for more balanced information to be communicated to ensure that the public is better educated on the issues and hence empowered to make informed choices as responsible consumers.

Some of the surveys investigated consumer preferences in relation to information providers and means of accessing information. Television seems to be viewed as the most effective medium for communicating information of this nature. In terms of which institutions were considered most trustworthy to provide truthful information to the public, different surveys yielded different responses. In the most recent (and most statistically significant) survey, 23% of respondents indicated universities, 21% the media and 16% government, followed by consumer groups and environmental organizations, religious organizations and industry (in that order).

5.3.2 Role of the media

From time to time, a flurry of discussion emerges in the media around particular events, but this is not sustained and, even then, is often of limited interest to the public at large, failing to generate widespread debate amongst those who are not already somewhat informed on the issues. For the most part, GM issues seem to be of relatively low priority for both the media and the public. This must be viewed against the background of generally inadequate coverage of science and technology in the South African press.[13]

5.3.3 Role of the Public Understanding of Biotechnology programme

The PUB programme was established in 2003 as one of the outcomes of the NBS. It is funded by the Department of Science and Technology (DST), but positioned to operate at arms' length from government in order to be viewed as autonomous and unbiased. The Programme aims to promote a clear, balanced understanding of the potential benefits and risks of biotechnology and to ensure broad public awareness, dialogue and debate about biotechnology and its current and potential future applications (including GMOs), to enable informed decision-making. The target audience spans all sectors of society, with particular emphasis on consumers, educators and learners. The PUB programme attempts to represent all stakeholders, encouraging debate rather than presenting prescribed views.

5.3.4 Implications for future acceptance of GMOs by the public

There are no clear indications as to the level of public acceptance for GMOs that will ultimately develop in SA. As more GM food products start to enter the market, and as international debates on the topic intensify, it is expected that public awareness will increase. Whether this leads to greater acceptance or growing rejection will depend on the nature and quality of information made available to the public, and how effectively it is communicated. All of the available survey evidence makes it clear that existing measures are inadequate,

[12] There are however GM fruit and vegetables undergoing field trials.

[13] One study found that science articles constituted only 1.8% of total articles, that over a third of these originated from news agencies rather than local journalists, and that 74% took the form of news reports or snippets rather than in-depth pieces (van Rooyen, 2004).

but there remains no consensus on how best to provide 'impartial' information (and by whom) to a very heterogeneous society. This of course is not unique to the South African environment, but is a matter with which stakeholders are grappling around the world.

6. STAKEHOLDERS IN THE GMO DEBATE

6.1 General

Stakeholders who are involved with or have expressed views on issues related to GMOs in SA include several government departments and organs, NGOs, scientists, local and multinational seed companies, retailers, farmers, consumers, trade unions and church organizations. This section provides a brief snapshot of the main stakeholders, and attempts to locate them within the local GMO context.

Analysis of a stakeholder survey carried out in 2000 classified stakeholders based on their attitudes towards agricultural biotechnology. 48 respondents from 33 organizations could be grouped into three perception clusters. The first group was made up of 15 respondents with a negative attitude, mainly representing environmental NGOs. The second group consisted of 25 respondents with affiliations to government, industry, academia and producer organizations, who displayed a moderately positive view towards agricultural biotechnology, believing in its potential to solve certain South African agricultural problems. The third group of 8 respondents, representing a range of organizations and affiliations (with the exception of environmental NGOs), was very positive, holding strong beliefs in the power of agricultural biotechnology to alleviate current problems. Overall, representatives of environmental NGOs were found to be most strongly opposed to GMOs, while scientists (from both the public and the private sector) emerged as the most supportive stakeholder group (Aerni, 2001).

6.2 Governmental stakeholders

While primary responsibility for GM crops falls within the National Department of Agriculture, and in particular its Directorate for Genetic Resources (DGR), several other government bodies engage with certain matters relevant to the use and regulation of GMOs. This is acknowledged in the composition of the Executive Council (EC), the decision-making body set up in terms of the Genetically Modified Organisms Act (GMO Act, No 15 of 1997), which includes representatives of the Departments of Agriculture, Environmental Affairs and Tourism, Health, Labour, Science and Technology, and Trade and Industry. The respective roles and responsibilities of the various government organs concerned are summarized briefly below, while those of particular importance are discussed in more detail elsewhere in the paper.

6.2.1 National Department of Agriculture

The NDA's DGR is responsible for administration of the GMO Act and Regulations. The International Trade Directorate is involved with the agricultural aspects of international trade negotiations (although international trade is predominantly a function of the Department of Trade and Industry). The Agricultural Research Council is a science council falling under the NDA, with a statutory mandate to conduct R&D and technology transfer to promote agriculture and industry. It renders a multidisciplinary agricultural research service to the South African agricultural sector. The NDA also administers legislation which may be relevant to GM crops in certain cases (although not aimed at GM crops in particular), such as the Plant Improvement Act and the Agricultural Pests Act (both of which contain provisions for importation of plants and/or plant propagating material, with which GM imports have to comply), and is responsible for the registration of plant breeders' rights.

rights.[14]

6.2.2 Department of Environmental Affairs and Tourism

The Department of Environmental Affairs and Tourism (DEAT) administers environmental legislation applicable to the environmental impact of GMOs, although not aimed specifically at the regulation of GMOs. The most important statutes in this regard (together with accompanying Regulations) are the Environment Conservation Act, National Environmental Management Act and National Environmental Management: Biodiversity Act. The DEAT has primary responsibility for representing SA in matters relating to the Cartagena Protocol on Biosafety (CPB), although the NDA (as the agency responsible for carrying out most of the obligations undertaken in terms of the Protocol) has recently begun playing a role in co-operation with the DEAT (e.g., the South African delegations to meetings of the parties now include representatives of both departments).

6.2.3 Department of Health

The Department of Health (DoH) is responsible for food safety in general, through its Food Control Directorate, which has issued guidelines for food safety and risk assessments for GMOs and their products. The DoH oversees regulations for the labelling of GMO-derived food products and represents SA in the Codex Alimentarius.[15]

6.2.4 Department of Science and Technology

The DST's main interest in GMOs is in promoting biotechnology R&D via the implementation of the *National Biotechnology Strategy* (and in particular, through the activities of PlantBio, and the PUB programme).

6.2.5 Department of Trade and Industry

The DTI is the lead agency overseeing international trade. It is also responsible for most aspects of IP registration and policy, with the exception of plant variety protection.

6.2.6 Attitude of the South African Government towards GMOs

The South African government's stance with regard to GMOs has been described as 'guardedly positive'.[16] This is borne out by a 2004 public statement from the DGR of the NDA, which is responsible for administering the GMO Act and Regulations, in which the belief was reiterated that the use and application of GMOs can play an important role in poverty eradication, but the risks associated with application of the technology were also acknowledged.[17] However, many would argue that government's approach is in fact highly supportive of the technology. It has been suggested that the long title of the GMO Act, which states its first objective as the 'promotion' of the responsible development, production, use and application of GMOs, encourages the regulatory authorities to promote GMO activities, which impedes their ability to assess the risks impartially and mitigate against them (Mayet, 2001). While the DEAT has occasionally made statements that are more critical than those

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[14] Act No 53 of 1976.

[14] Act No 36 of 1983.

[14] See Section 7.7.

15 <http://www.codexalimentarius.net/web/index_en.jsp>. See Section 8.2.2.

[16] *Reuters News Service*, 22 April 2003, 'South Africa affirms guarded stance on gene crops'. http://archives.foodsafetynetwork.ca/agnet/2003/4-2003/agnet_april_21-2.htm#SOUTH

[17] *Business Day*, 8 July 2004, 'Government reassures on gene crops'; BuaNews, 14 July 2004, 'GMOs to eradicate poverty, says Dept' http://allafrica.com/stories/200407080152.html

emanating from the NDA (and which have resulted in the government's being accused of sending 'mixed messages'), the DEAT defers to the NDA as the lead agency on GM issues.

6.3 Main non-government stakeholder groups

Stakeholders representing a wide range of constituencies have taken part in the GM debate, but the main protagonists are Biowatch, campaigning against the technology, and AfricaBio, in support. Organizations with similar views often work together fairly closely, support one another's positions or submissions on GM-related matters, make joint responses and take collaborative action.

6.3.1 Business

A. Multinational seed companies

Monsanto is the dominant player on the local GM seed market. The company has licensed some of its GM technology to other multinationals (including Pioneer Hi-Bred, Delta and Pine Land, & Stoneville) and to domestic seed companies (e.g., Pannar), for incorporation into their proprietary hybrids. To some extent, these companies view SA as a testing ground for the exploitation of GM products elsewhere in Africa.

B. Local seed companies

No local seed companies have developed their own GM traits, but there are examples of local companies' "in-licensing" GM genes from Monsanto, and backcrossing them into their own hybrids. Pannar, a local seed company that commands the highest share of the market for maize seed in SA, has followed this route. While Pannar has a breeding programme for maize varieties targeted at the needs of small-scale farmers, it has yet to introduce GM traits into these varieties. Pannar supports collaborative academic R&D on GM maize, with a view to commercializing viable events for both commercial and small-scale markets.

C. South African National Seed Organization

The South African National Seed Organization (SANSOR) was formed in 1989 as a result of the amalgamation of other trade and technical associations. It is a private, non-profit company operating as a Secretariat with permanent staff, and has a membership of about 100. It functions as a representative spokesbody for the South African seed industry, as the seed certification authority for government, and as licensing agent for public varieties of seed crops. It also provides training for the seed trade, to seed inspectors, plant breeders and seed analysts. It contributes to the development of relevant legislation and, in this capacity, participated in the government working group that was responsible for drawing up the GMO Act. SANSOR is calling for harmonized biosafety legislation amongst SADC member states. The organization has expressed support for GM crops in various public fora, and has close ties with AfricaBio.[18] In a 2002 press release, (available on their website) the organization spelled out the seed industry's position on the production of conventional and GM crops. It stated its belief that GM technology "has come to stay as a valuable additional tool in plant improvement" but acknowledged the need for seed companies to offer farmers a choice between GM and conventional seed. It stressed the importance of identity preservation, with a documented audit trail to minimize the risks of fraudulent claims, unintentional mixing and consequent legal disputes, and expressed confidence in the capacity of SANSOR members to maintain and improve their grain separation procedures.

[18] <http://www.seedquest.com/forum/v/VanDerWaltWynand/11.htm>

D. Food retailers

Only one of the main national food retailers has a policy of avoiding GM products wherever possible, and of labelling any products that contain GMOs if alternatives cannot be sourced. Woolworths, a chain store with historical links to Marks & Spencers in the United Kingdom, catering to an upmarket customer base willing to pay a premium for their preferred product choices, announced its intention to implement this policy in 1999, following a meeting with the South African Freeze Alliance on Genetic Engineering (SAFeAGE). This was apparently a proactive move taken after monitoring trends in Europe where consumer resistance to GM foods was being experienced, rather than a direct response to pressure from local consumers. Woolworths then entered into negotiations with suppliers to provide non-GM alternatives for products containing GM ingredients.[19]

The other large food retailers (who all command a greater market share), with support from AfricaBio, declined to follow suit, after consulting with suppliers, and criticized Woolworths' decision. Reasons cited included the higher costs associated with labelling that would have to be passed on to consumers, and difficulties of identifying which foods actually contained GM ingredients, particularly processed foods in which soya is a common ingredient.[20] The companies concerned also wanted to wait to see what the anticipated labelling guidelines (which had not been released at that time) would prescribe. Information pamphlets were released by both Woolworths and at least one other chain. No subsequent policy changes have been communicated by the main supermarket chains. Biowatch however recently announced that it is entering into discussions with major retailers to persuade them either to label GM products sold in their stores or to eliminate them altogether.[21]

These decisions must be put into perspective, as a relatively small percentage of the population shops regularly at the large food retailers, most buying instead from the informal sector, supplied by wholesalers who have not taken a position on GM foods. For these consumers, price is usually the primary consideration, although brand loyalty is surprisingly high even amongst low-income consumers (Agriculture and Agri-Food Canada; Robinson; USDA).

6.3.2 NGOs

A. NGOs opposed to GMOs

a. Biowatch[22]

Biowatch is the most active and influential organization opposing GMOs in SA. It is a national organization whose work involves researching and monitoring the commercialization of biological resources; promoting sustainable livelihoods, agriculture and food security; monitoring the impacts of GMOs in SA; capacity-building; and raising public awareness on biodiversity issues to encourage informed participation in policymaking. Biowatch opposes GMOs on health, environmental and socioeconomic grounds. It is funded by a number of mainly European NGOs and by GTZ, the German technical co-operation agency. It plays a strong lobbying role, challenging the biosafety regulatory regime by invoking the public participation and appeal provisions of the GMO Act and leveraging its rights under other

[19] *Reuters*, 21 December 1999, 'Woolworths roots out GM food'; *Cape Times*, 16 October 2000, 'South Africa's Woolworths bans GM foods'

[20] *Business Day*, 23 December 1999, 'Woolworths to clear its shelves of genetically modified food'; *Business Day*, 24 December 1999, 'Chain stands by 'Frankenfoods''.]

[21] *The Biowatch Bulletin*, March/April 2005.

[22] http://www.biowatch.org.za

relevant legislation (including the Constitution, environmental legislation and access to information legislation).

b. South African Freeze Alliance on Genetic Engineering

SAFeAGE describes itself as an alliance of 250,000 consumers and over 130 organizations calling on the South African government to impose a minimum five-year moratorium on field trials and commercial releases of GM crops, until (in their words) the technology is proven to be safe, environmentally harmless and in the interests of the people of South Africa. SAFeAGE is also calling for a freeze on the import and export of GM food and crops and the patenting of genetic resources for food and farm crops.

c. African Centre for Biosafety

The African Centre for Biosafety (ACB) is a one-person organization set up by an environmental attorney as a mechanism for lobbying against GMOs in SA and internationally, campaigning for stringent biosafety measures and promoting solidarity amongst civil society groups on biosafety issues.

d. Environmental Justice Networking Forum[23]

The Environmental Justice Networking Forum is an umbrella organization with a large grassroots network, set up to serve the common interests of its non-governmental and community-based organization members in the areas of environmental justice and sustainable development. It runs a campaign on food security and gender, which encompasses GM issues, carries out training, and has from time to time supported certain anti-GM initiatives in collaboration with other organizations.

e. Earthlife Africa[24]

Earthlife Africa is an organization of "environmental and social justice activists, founded to mobilize civil society around environmental issues in relation to people". It has three branches in SA and one in Namibia, which operate autonomously but carry out common campaign activities. The organization highlights problems and promotes ecologically sound activities, through lobbying and advocacy activities, running community campaigns, engaging the media, carrying out research and producing materials. It has a GMO campaign but this does not appear to be its main focus, and much of its work in this area is carried out in conjunction with other organizations.

f. National Consumer Forum

The NCF is an NGO set up in 1994 to protect and promote the rights of South African consumers. Its main role is as a provider of information and advice on matters that affect consumers, such as goods, services, health and personal finance. The Forum has called for honest engagement amongst stakeholders in the GM debate. It has expressed concern on several issues, including the ability of technology to address hunger without solving surrounding socioeconomic problems, insufficiency of health-related information, failure to label GM-containing products (thus taking away the consumer's right to know), and the potential adverse impact on farmers no longer entitled to save seed. The NCF commissioned a survey of consumer opinions and knowledge of GM food and provides input into various fora on GMOs.

[23] <http://www.botany.uwc.ac.za/inforeep/ejnf.htm>

[24] <http://www.earthlife-ct.org.za>

B. NGOs supportive of GMOs

a. AfricaBio[25]

AfricaBio seeks "to promote the safe, ethical and responsible research, development and application of biotechnology and its products in the food, feed and fibre sectors." Its main objectives are to provide information to key stakeholders, the media, the general public and international organizations, and to lobby key stakeholders. One of the reasons it was established was to provide a counter-view to those put forth by organizations opposing biotechnology and actively disseminating negative information. Its membership includes representatives from industry, academia and research organizations. While it presents itself as an independent organization, it has drawn criticism as a result of the active support it receives from its industry stakeholders, and some believe that it is a 'front' for industry and therefore more accurately described as an industry organization rather than the civil society organization it purports to be. However, its stakeholder base is broader than industry alone and its activities extend beyond lobbying industry interests.

b. A Harvest Biotech Foundation International[26]

A Harvest is an NGO with offices in the US, Kenya and SA, whose CEO is a prominent Kenyan biotechnologist. It champions the use of biotechnology to fight hunger, malnutrition and poverty in Africa and the developing world, by increasing agricultural yields and incomes. It carries out its mission through technical programmes, in which access to technology is facilitated, and through a communication programme, which aims to improve the quality of debate by supplying factual information to national stakeholders, as well as to "represent" Africa by "effectively presenting the case for biotechnology in international fora". It operates via networks at the international, pan-African and national levels, in co-operation with organizations such as the African Union, the Forum for Agricultural Research in Africa, national agricultural organizations and grassroots movements. Its South African activities focus on its communication programme rather than on the provision of technology.

6.3.3 Other national stakeholders

A. Academia and the scientific community

For the most part, scientists working in biotechnology tend to support GMOs, generally acknowledging that there are risks involved, but believing that these can be managed. Biowatch has claimed that members of the scientific community with GM expertise are unwilling to give "honest and independent" opinions on the topic, as a consequence of financial support received by scientists from Monsanto.[27] However, while many academics and scientists in the field are likely to have engaged with Monsanto at some stage, the company is not a big supporter of R&D on GMOs by South African public research institutions, and it seems unlikely that these interactions would pose a significant conflict of interest on a widespread basis that would affect the academic community as a whole.

Few South African academics are carrying out research in the social sciences on the non-scientific impacts of technology in general, and of biotechnology in particular. The area that has received the most attention, from a handful of local agricultural economists, but mainly from overseas academics, has been on the effects of the adoption of Bt cotton by small-scale farmers. Clearly, much more research is needed into both the scientific (environmental, agronomic and health) and non-scientific (regulatory, economic, ethical and social) risks,

[25] <http://www.africabio.com>

[26] http://www.ahbfi.org/vision.asp

[27] <http://www.biowatch.org.za/pop_sum_Apr04.htm>

benefits and impact, in order to ensure safe and sustainable use of agricultural biotechnology in the long term.

B. Farmers

The rapid adoption of GM cotton by small-scale farmers, and their apparent overall satisfaction with the benefits they have experienced as a result, have already been discussed. Annual increases in uptake of GM crops by commercial farmers appear to be an indication that GM technology is yielding benefits for them too.

a. Grain SA[28]

Grain SA is a voluntary farmers' organization representing the interests of South African grain farmers. It provides commodity strategic aid and services to South African grain producers to support sustainability. It participates in matters affecting the well-being of the industry, and strives to monitor all potential and actual impacts on its members, and to play a facilitating role. Subcommittees are responsible for matters such as marketing, production inputs, labour matters and public relations.

While many members have embraced GM crops, Grain SA made waves in 2004 by submitting an objection to an application by Monsanto for import clearance permits under the GMO Act for maize containing Bt traits not previously approved in SA. The objection was made on the basis that it had not been evaluated locally for its impact on human and animal health, and that there was a danger of the grain being used for domestic production, as there was no guarantee that it would be milled on entry. This was a surprising move, because Grain SA and Monsanto have generally enjoyed a cordial relationship and the organization had not previously expressed negative views towards GM technology.

The gene concerned protects against corn root worm and has been approved in the US. Since corn root worm is not a pest affecting South African maize, Monsanto had no intention of incorporating the trait into South African planting seed, nor of importing grain containing the trait itself. The application was rather a means of paving the way for other parties to import maize containing the Monsanto technology. It has been suggested that the real reason underlying the Grain SA objection might be a protectionist attempt by local maize farmers to limit a source of imports in order for domestic maize prices to rise.

b. Organic farmers

The Organic Agricultural Association of South Africa put out a public notice in 2002 in which it set out its position on the use of GM seeds and urged members of the general public to submit written objections to the use of GMOs to the Registrar of GMOs. Its notice raised two main objections, one relating to lack of information on the potential effects on human health of the consumption of plant material containing Bt in every cell (as opposed to the consumption of Bt as a sprayed insecticide, commonly used for some time – and acknowledged as safe – by organic farmers); and the other relating to the build-up of resistance to Bt by target pest populations.[29]

However, for the most part, the organic farming community has been relatively silent in the GM debate. This is probably because fruit and vegetables constitute the majority of organic produce grown in SA, and no GM fruit or vegetables have yet received approval for commercial release.

[28] http://www.grainsa.co.za/content.asp?ContentId=67

[29] <http://www.oaasa.co.za/newsflash_special_gmo.html>

C. Churches and religious communities

The Anglican Archbishop of Cape Town spoke out in May 2004 against GM crops, on the basis that they could compromise "the rights of future generations to a safe, healthy and diverse environment", and that they could threaten rural livelihoods, food security and local control over genetic resources as corporations gained ownership of life forms through the patenting of seeds and genes. He described the South African government's approach to GMOs as "cavalier" and argued that Africa ought not to adopt GM technology until the consequences were more certain, until it could be proven safe, affordable, containable, and suitable for African farmers and farming systems, and that it would not reduce jobs, destroy biodiversity or increase dependence on wealthy nations. He stated that, if the GM seed companies were genuinely concerned about reducing poverty, "they would lobby their governments to stop subsidizing their farmers instead of trying to sell Africa newly patented seed".[30]

A few days later, the South African Council of Churches (SACC) held a consultation on GMOs, out of which a statement was issued, entitled *Food is life: The right to food is not negotiable*.[31] The document raised several concerns about GMOs, including the "purely technical" approach taken by proponents, which "delink[ed] science from ethics, values, economic and political ideology", as well as from "African communal spirituality about life and food". Further concerns related to the role of GMOs in perpetuating unequal power relations through a link with globalization, commodification of life through patenting, supremacy of profits over health, environmental safety and food supply, lack of public awareness and participation (including by the SACC itself) in GMO developments, scientific uncertainties regarding long-term risks in light of the irreversibility of release of GMOs, and erosion of national autonomy through international treaty obligations.

The document calls on the SACC and its members to "co-own" GMOs as part of a "longstanding commitment to solidarity with the poor and marginalized"; to intensify efforts to fight poverty; to denounce the ideology of "neo-liberal economic globalization"; to gather material and commission research to empower the church to pursue its position on GMOs through engagement with a range of stakeholders; to petition government, "while it is still allowing GM technology to operate and have an impact on our environment", to acknowledge the risk of GM technology, impose a moratorium on new GMO permits and become fully compliant with the CPB; to co-operate at the regional and continental level; to campaign and lobby locally; to institute a strategy process and report on it; and to publicize the document amongst member churches and other stakeholders.

In March 2005, a national conference of religious communities (including the Christian, Muslim, traditional African, Hindu, Buddhist and Baha'i) was convened with the purpose of establishing the South African Faith Communities Environmental Institute, to facilitate greater involvement by faith communities in environmental issues. The meeting called for better public participation in decision-making on GMOs.[32]

D. Trade unions

The labour movement, an important player in the struggle against apartheid, remains very influential in SA, with the Congress of South African Trade Unions ([COSATU], an umbrella organization of trade unions) part of the ANC's tripartite coalition government.[33] At the COSATU Congress in 2003, a call was made for a moratorium on making GMOs available

[30] *Sunday Argus*, 23 May 2004, 'Archbishop slams use of GM crops'.

[31] http://www.wcc-coe.org/wcc/what/jpc/gmos.html

[32] *The Biowatch Bulletin*, February 2005; *The Biowatch Bulletin*, March/April 2005.

[33] The third member of the coalition is the South African Communist Party.

for human consumption in retail markets. Trade unions have also expressed fears that cheap imports of GM crops could affect the prices of local commodities and lead to job losses, and they are concerned that control of GM technology is in the hands of multinational companies who therefore have the power to cultivate dependence in a form of neo-colonialism[34]. The Food and Allied Workers Union, a COSATU member, has in the past threatened industrial action if a ban on GM food were not imposed, but did not follow through on this.[35]

E. Traditional leaders

Biowatch, Monsanto and AfricaBio were invited to address a conference of traditional leaders in 2004 but, as a group, traditional leaders have yet to formulate a formal position on whether to support or reject GM crops.

7. BIOSAFETY REGULATION AND LEGISLATION

7.1 Historical perspective

The South African Committee for Genetic Experimentation, a scientific advisory committee, was set up in 1979 to monitor and advise on the development of GMOs in the country. Until the implementation of the GMO Act in 1999, regulation of transgenic crops was carried out by the National Department of Agriculture, utilizing the services of SAGENE, which issued regulatory guidelines, informed largely by British guidelines in place at the time. Compliance with SAGENE's requirements was voluntary, but there is no evidence of any GMO releases having taken place in contravention of these requirements. The first application for a GM field trial was made in 1989 for Bt cotton. The commercial releases of Bt cotton and Bt maize were approved under the SAGENE guidelines before the GMO Act came into effect. SAGENE also participated in drafting the GMO Act. The Advisory Committee (AC) established in terms of the GMO Act took over SAGENE's functions after the Act came into force, and some of SAGENE's members subsequently became members of the AC.

7.2 The GMO Act

7.2.1 Objectives and application

The GMO Act, 1997, in conjunction with its implementing Regulations,[36] came into effect on 1 December 1999. It is intended to promote the responsible development, production, use, and application of GMOs while limiting potential risks, and lays down the requirements for the importation, production, release and distribution of GMOs. The Act applies to (a) the genetic modification of organisms; (b) the development, production, release, use and application of GMOs (including viruses and bacteriophages); and (c) the use of gene therapy (although techniques involving human gene therapy are explicitly excluded from the ambit of the Act).

7.2.2 Organs

The GMO Act provides for the establishment of several organs:

- **An Executive Council** is made up of officials from the departments of Agriculture; Environmental Affairs and Tourism; Health; Science and Technology; Trade and Industry; and Labour, to advise, to make decisions on applications and to monitor

[34] http://www.numsa.org.za/article.php?cat=&id=752

[35] *Business Day*, 12 February 2002, 'Strike looms on genetically modified food'.

[36] Government Notice R1420 of 26 November 1999.

matters relating to GMOs, including their potential environmental and socioeconomic impact;

- **The Registrar,** housed in the NDA's Directorate of Genetic Resources, is responsible for administering the Act. This includes issuing permits for applications approved by the EC;
- **An Advisory Committee ,** consisting of up to eight scientists with GMO-related expertise,[37] and two members of the public sector (i.e., government officials) with knowledge of ecological matters and GMOs, acts as the national advisory body on matters relating to GMOs. It has authority to advise the Minister of Agriculture, the EC, other ministries and other appropriate bodies, on request or of its own accord, on matters concerning the genetic modification of organisms, and may call for expertise from other bodies or persons and appoint subcommittees to deal with specific matters, as required.
- **An inspectorate of officials** has authority to examine, inspect and monitor registered facilities and activities authorized under the GMO Act during office hours, without need for a warrant.

Amongst its powers, the EC may require that an applicant for a permit under the GMO Act submit an assessment of the risk of the development, production, use, application or release that is the subject of the application. In some cases ("where required"), the EC might ask that an assessment of the impact of the environment also be provided, but the conditions under which this might be required are not elaborated.

7.2.3 Other provisions

Further provisions of the GMO Act deal with matters such as liability, conflict of interest, confidentiality, appeals, the scope of Regulations under the Act and offences and penalties.

A. Liability

Liability for damage caused by the use or release of a GMO is borne by the user of the GMO, who is obliged to take appropriate measures to avoid an adverse impact on the environment that might arise from the use of GMOs.[38]

B. Conflict of interest

The conflict of interest section applies specifically to members of the AC, who are obliged to recuse themselves from participating in AC proceedings if they have any direct or indirect interest in the subject matter at issue, or if their participation could lead to a conflict of interest for any other reason. An equivalent provision governs the position of anyone appointed to an appeal board in terms of the GMO Act.

C. Confidentiality

The confidentiality provisions set out what types of information may remain confidential, what types of information must be disclosed, and the conditions under which disclosure may be permitted or prevented. Information obtained by anyone exercising his or her powers or performing his or her duties under the Act may not be disclosed except to the extent "necessary for the proper application" of the Act, for the purposes of relevant legal proceedings, by order of a competent court, or on authorization by the Minister. The EC

[37] Applicable scientific fields include animal health, human medicine, biochemistry, molecular biology, ecology, entomology, plant pathology, biotechnology, and virology.

[38] The user is however exempted from liability if the GMO in question was in the hands of an inspector and the user could not have been expected to foresee or prevent the damage concerned.

determines which information should remain confidential, after consulting the applicant. Information that shall not be kept confidential includes the description of the GMOs, the name and address of the applicant, the purpose of the contained use or release and the location of use, the methods and plans for monitoring the GMOs and for emergency measures in the case of an accident, and the evaluation of foreseeable impacts (in particular any pathogenic or ecologically disruptive impacts). However, if the applicant is able to satisfy the EC that certain information listed above should be withheld in order to protect the applicant's intellectual property, the EC may withhold such information for the period needed to protect such rights. 'Intellectual property' is not defined in the Act. If an application is withdrawn by the applicant, the confidentiality of information supplied for the purposes of the application must be respected.

Anyone who feels aggrieved by a decision or action of the EC, the Registrar or an inspector is entitled to appeal against such decision or action to the Minister, who will appoint an appeal board of one or more people suitable to decide on the issues of the appeal concerned. Appeal board members who are not employed in a full-time capacity by the State may be remunerated. An appeal board may confirm, set aside or amend the decision or action that is the subject of the appeal concerned, or refer the matter back to the Registrar for reconsideration by the EC, or make any other appropriate order. The decision, supported with reasons, must be reduced to writing and submitted to the Minister, who may take further action as s/he may deem necessary. The Regulations stipulate that an appeal must be lodged in writing within thirty days from the date on which the appellant was notified in writing of the relevant decision or action. The appellant must be available to appear before the appeal board to clarify any issue concerning the appeal, and is entitled to legal representation during such appearance. An appeal board is obliged to provide its decision to the Minister within thirty working days after the appeal was lodged with the appeal board.

D. Offences

A person convicted of an offence under the Act or Regulations may be liable for a fine or imprisonment.

7.3 GMO regulations

The Regulations, supplemented by AC guidelines (Department of Agriculture, 2004a), spell out the procedures for implementation of the GMO Act. Permits are required for the importation, exportation, development, production, use, release and distribution of GMOs. However, organisms used under certain conditions of contained use, within a laboratory or growth room in academic or research facilities (but not in a greenhouse), and GMOs previously cleared for commercial release and/or food or animal feed,[39] are exempt from this requirement.

A "suitable and sufficient" assessment of risks to the environment and human health must be made before an activity involving genetic modification may be undertaken. The Regulations attempt to incorporate the precautionary principle by requiring that "[l]ack of scientific knowledge or consensus on the safe use of GMOs shall not be interpreted as indicating a particular level of risk, an acceptable risk or an absence of risk". This formulation, though, has been criticized for implying that lack of scientific knowledge or consensus on the safe use of GMOs is not relevant to the assessment of risk, as it is not framed in relation to minimizing, limiting or avoiding risks or adverse impacts (Mayet, 2001).

Facilities where genetic modification activities take place must be registered and records of risk assessment must be maintained.

[39] GMOs falling into this latter category are listed in a table annexed to the Regulations.

Applications for permits are made to the Registrar. Information to be provided includes:

- name, address and contact details;
- name and identity of the living modified organism (LMO) concerned;[40]
- taxonomic classification and common name;
- identified characteristics related to biosafety;
- centres of origin and centres of genetic diversity of recipient and/or parental organisms and a description of the habitats where the organisms may persist or proliferate;
- description of the nucleic acid or modification introduced, the technique used, and the resulting characteristics of the LMO;
- intended use of the LMO or its products;
- suggested methods for the safe handling, storage, transport and use, including packaging, labelling, documentation, disposal and contingency procedures, where appropriate;
- any unique identification of the LMO;
- approved uses of the LMO;
- risk assessment;
- in the case of import or export: information on the exporter and importer; date of transboundary movement; point of collection/acquisition; quantity or volume of LMO to be transferred; regulatory status of the LMO in the exporting country (Department of Agriculture, [n.d.]).

The Regulations stipulate the time frames for approval and fees payable for different types of applications. The Registrar reviews an application to ensure compliance with the legislative requirements before submitting it to a review committee of the AC[41] made up of individuals with expertise appropriate to the application. Risk assessment data is evaluated, and the applicant may be asked, via the Registrar, to clarify aspects of the data or submit additional information. Once all concerns have been addressed, a recommendation report is supplied to the Registrar, who then submits the application, the AC review recommendations and all public input to the EC. In making its decision on whether or not to approve an application, the EC will consider all of this documentation. The EC may also, at its discretion, consider the potential socioeconomic impact of introduction of the GMO in question on a community living in the vicinity of where the GMO is to be introduced. However, the Regulations provide no guidance in respect of the circumstances under which socioeconomic impact must be assessed, nor criteria to be considered in this regard. Applicants may be requested by the Registrar to provide clarification of additional concerns raised by the EC. The EC will approve an application once satisfied that all potential risks have been addressed and that adequate risk management measures could be put in place to prevent a negative impact on the environment. If the EC approves a particular activity, it will authorize the Registrar to grant a permit. If an application is refused, written reasons for the refusal must be furnished by the EC.

Applications in respect of which a permit has previously been issued may be fast-tracked at the discretion of the Registrar.

[40] The term 'LMO' is used, as in the CPB, rather than 'GMO', used in the Act and Regulations.

[41] The review committee is an AC subcommittee.

An applicant must notify the public of any proposed trial or general release of a GMO, prior to applying for a permit for such release.[42] This must be done by means of a standard notice containing specified information, published in at least three newspapers in circulation in the area in which the proposed release will take place. Information to be supplied includes:

- full name and address of applicant;
- full description of the GMOs which applicant proposes to release;
- description of the proposed trial release, including area and environment in which release is to take place;
- request that interested parties submit comments or objections to the Registrar within a period not less than 30 days from the date in which the notice appears in the press;
- Registrar's address for submission of comments or objections.

A copy of the notice and proof of publication must accompany the application for the permit. Any interested party[43] may submit comments or objections to the Registrar, who passes these on for consideration by the EC when making its decision on whether to approve the application concerned.

In the event of an accident involving GMOs, a user is obligated to notify the Registrar verbally and in writing, as well as to take all appropriate short-term, medium-term and long-term measures to avoid or mitigate any adverse impact of the accident on the environment and human health.

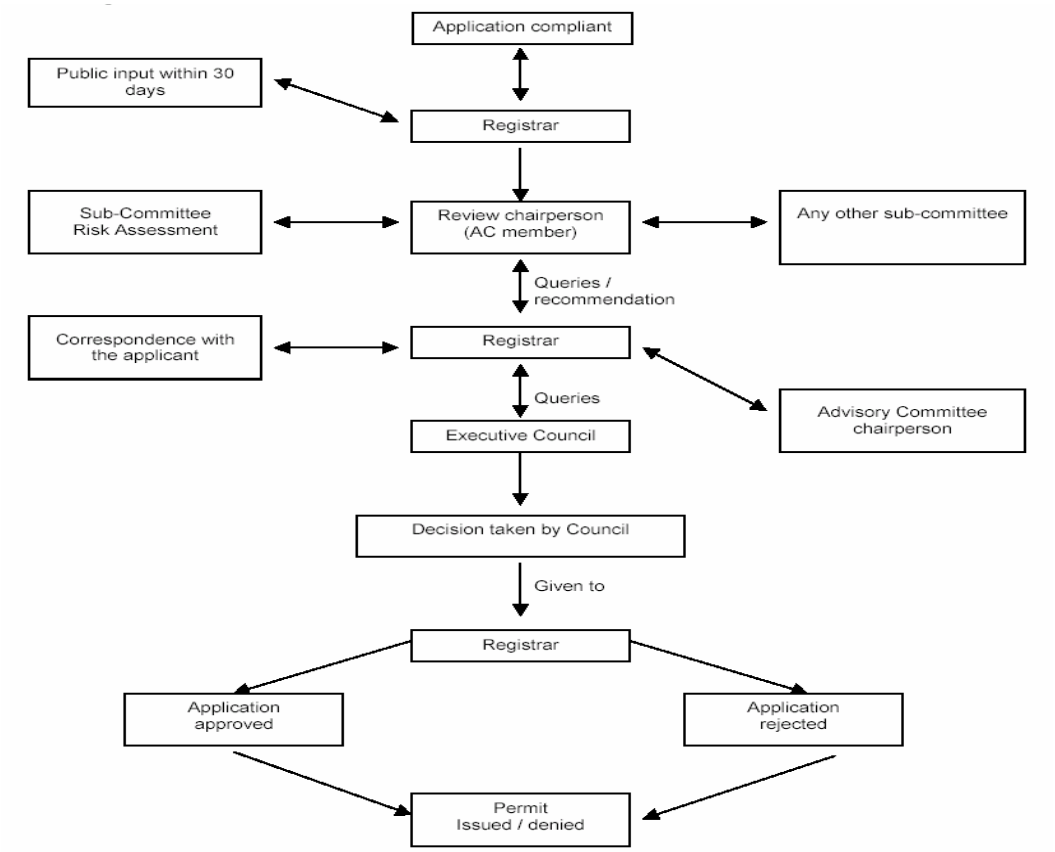
7.4 Recent changes to incorporate certain CPB requirements

Certain changes to procedures regulated by the GMO Act were necessitated by South Africa's accession to the Cartagena Protocol on Biosafety, which came into force for SA in November 2003, 90 days after ratification. The revised procedures were first communicated in March 2004, following the first Conference of the Parties in Malaysia the previous month, taking effect immediately. The Registrar reserved the right to amend any procedures in order to comply with the requirements of the CPB or to accommodate national needs. Exporters could request assistance from the Registrar's office if difficulties were experienced in complying with the new requirements. New application forms for permits for import, export, contained use, trial release, fast-tracking, general release and commodity clearance were drawn up, and fairly detailed step-by-step procedures were set out for exporters and importers applying for permits, to take into account the advanced informed consent requirements of the CPB.

[42] Other activities involving GMOs are not subject to the public notification requirements.

[43] The Regulations do not define what constitutes an 'interested party'.

Figure 1: Procedure for handling GMO applications44



Aspects covered include the following:[45]

- For GM grain imports where the genetic modification event in question has already been approved in SA, the importer is required to notify the NDA, who will grant an import permit.
- For imports that may contain a genetic modification event not approved in SA before, approval will only be granted subject to a full biosafety review under the GMO Act.
- For consignments destined for neighbouring countries, but in transit in SA, the requirements of the importing country will be taken into account. Where grain must be milled, milling will take place at the port closest to the importing country and the consignment will be shipped as processed product.

Further changes involved the need for certain decisions, which in the past were taken by the Registrar, now to be taken by the EC, longer stipulated time periods for the granting of some categories of permits, and additional risk assessment documentation requirements. Additional measures towards achieving full compliance have been incorporated into draft amendments to the GMO Act.

[44] From the AC Guidelines.

[45] National Department of Agriculture, *Genetically Modified Organisms – Revised Procedures*, Reference number: 17/R – 17 March 2004.

7.5 Upcoming changes to the GMO regulatory framework

7.5.1 Genetically Modified Organisms Amendment Bill[46]

Although the GMO Act has only been in force for a few years, amendments have been anticipated for some time. An Environmental Affairs Parliamentary Portfolio Committee meeting in November 2002 questioned the effectiveness of the GMO Act and Regulations and called for a review. Amongst other things, it was claimed that Parliament was insufficiently informed when it passed the GMO Act, and that it should be revisited on this basis.[47] The same meeting questioned whether GMO regulation would not be located more appropriately under the aegis of Environmental Affairs. In response, a public conference was subsequently held by the Portfolio Committee on Agriculture and Land in April 2003 to allow all stakeholders to be heard and to provide the basis for a report to Parliament on whether or not such a review was required. GMOs were confirmed to be the primary responsibility of Agriculture, but the need for interdepartmental cooperation was acknowledged.

South Africa's ratification of the CPB in 2003[48] further necessitated amendments to the legislation, which were published late in 2004. Some of the relevant proposed amendments are summarized below:

- Certain new definitions are introduced, and other definitions are amended, mainly for the purpose of catering for requirements, or obtaining consistency with the language, of the CPB.
- It is proposed that the EC be expanded to allow for representation by two additional government departments, namely the Departments of Arts and Culture[49] and Water Affairs and Forestry.
- Allowance is made for relevant information to be conveyed to the Biosafety Clearing House[50] established under the Convention on Biological Diversity (CBD).
- The EC is only required to "make available" (rather than "publish", as per the existing language) guidelines for all uses of GMOs.
- The Registrar's functions are expanded to include the power to issue an extension permit for importation and exportation of GMOs, and for extending the time period to complete activities relating to GMOs, for which a permit had previously been issued. The Regulations currently allow the Registrar to "fast track" an application for a GMO activity for which a permit had previously been issued. However, this power has been challenged as *ultra vires* by the ACB. The proposed amendment could therefore remedy this defect.[51]
- The two public sector representatives on the AC should, in addition to the existing requirement that they have knowledge of ecological matters, "have a non-prejudicial

[46] Government Notice R2166 of 2004.

[47] In light of the plethora of legislation that has been promulgated as part of the new political dispensation since 1994, this is a particularly worrying motivation for review that could undermine much of the new law, but this has not been focused on.

[48] See Section 7.4.

[49] When the GMO Act was drafted, the department in existence at the time was a combined Department of Arts, Culture, Science and Technology, which subsequently split into two separate departments.

[50] <http://bch.biodiv.org/>

[51] M Mayet, 9 Nov 2004, *Submissions on South Africa's Genetically Modified Organisms Amendment Bill published 8 October 2004*, http://www.biosafetyafrica.net/_DOCS/ACBCommentsGMOAmendmentBill.pdf

position, with regard to GMOs". Other members of the AC are not subject to this requirement.

- A proviso has been added to the liability section, which removes liability that, in terms of the GMO Act, usually attaches to a user for damage caused by activities relating to GMOs if "otherwise indicated through a process identified in terms of Article 27 of the Protocol" (i.e., the CPB). This recognizes the process taking place in the CPB to negotiate a liability and redress regime, and foresees the need to change the current liability provisions once a regime has been agreed by the parties to the CPB. Until such time, though, it is proposed that the existing liability measures will continue in effect.

The draft amendments are apparently an attempt to comply with minimum requirements of the CPB. Activists are questioning whether even this low threshold has been achieved, and are calling for the amendments to go further than mere minimum standards. Biowatch has requested that the procedure for introducing amendments be started anew, beginning with a guiding policy and full consultation, before draft amendments are put out for comment.

The Bill certainly raises some problems. Some of the drafting is unclear, which will hopefully be rectified in the next draft. No amendments to the Regulations have been released or proposed, and some of the language and terminology in the draft amendments is not consistent with that in the Regulations. It is therefore critical that this be addressed before the amendments take effect in order to avoid potential conflicts or confusion. Importantly, these amendments have not attempted to address the calls for increased opportunity for public participation or improved access to information, and could even be interpreted to be making the situation worse. No attempt has been made to introduce consistency or to clarify the relationship of the GMO Act with relevant environmental legislation.

It remains to be seen whether and to what extent further changes will be incorporated in the next version of the Bill, taking into account comments submitted by the public. If the problems identified are not addressed, the regulatory system is likely to experience increased difficulties and open itself up to ongoing legal challenges.

7.6 Role of the Department of Health in GMO regulation

7.6.1 Food safety

A food safety assessment is required as part of the permit application process set out in the GMO Act for GMOs intended for food or feed, and is conducted case by case and step by step. The DoH has accepted Codex Alimentarius principles and guidelines as policy for food safety requirements for GM foods, and its Food Control Directorate has drawn up a document to provide guidance to applicants, which urges consultation of relevant Codex Alimentarius documents (Department of Health, 2004). Applicants are required to submit data in a specified format. Information to be submitted in the report includes:

- Good Laboratory Practice and Quality Assurance information on the laboratory conducting the tests;
- description of methodology (with the recommendation that the toxicological methods of the Organization for Economic Cooperation and Development (OECD) and the analytical methods of the Codex Alimentarius be used);
- results and evaluation of specific tests (using appropriate statistical methods and providing relevant references);
- discussion of results;
- full details of registration status in other countries (specifically with reference to food safety issues);

- where the foodstuff concerned is derived from recombinant DNA plants, the Codex Alimentarius framework must be used. The data to be submitted includes:
    - description of the recombinant DNA plant;
    - description of the host plant and its use as food;
    - description of the donor organism;
    - description of the genetic modification;
    - characterization of the genetic modification;
    - safety assessment covering the expressed substances, compositional analysis of key components, evaluation of metabolites, food processing and nutritional modifications;
- exposure assessment based on South African food intake data;
- assessment of the presence of antibiotic marker genes, taking into account the availability of any clinically used antibiotics in SA.[52]

7.6.2 Labelling

Regulations governing the labelling of foodstuffs obtained through certain techniques of genetic modification[53] were published under the Foodstuffs, Cosmetics and Disinfectants Act in January 2004. The regulations cover foods composed of GMOs, containing GMOs or produced from GMOs, and include food additives and ingredients, but exclude foods derived from a non-GM animal fed on GM feed. They adopt the US approach of 'substantial equivalence'.

- Where the composition or nutritional value of food obtained from GM techniques differs significantly from conventional counterparts, labelling is required to inform the consumer accordingly. The regulations define 'significantly different' in respect of a foodstuff obtained through certain techniques of genetic modification, as having "characteristics scientifically assessed through an appropriate analysis of data (which) are different from those of a corresponding existing foodstuff, taking into account accepted limits of natural variation in that foodstuff".
- For foods where mode of storage, preparation or cooking differs from corresponding existing foods, labels must provide clear instructions for use.
- Foods containing listed allergens must be labelled. The relevant allergens are listed in an Annexure to the Regulations and are based on a 1992 US Food and Drug Administration policy statement (Mayet, 2004a).
- Labels informing the consumer about the origin of a relevant nucleic acid or protein are required for food derived from plant material containing animal-derived nucleic acid or animal or human proteins, and for food derived from animal material containing nucleic acid or protein from a human or different animal taxon, to address religious and ethical concerns.[54]

[52] The DGR has recently sent out a memorandum to certain stakeholders stating that applications for GMOs containing antibiotic resistance markers will no longer be considered.

[53] Government Notice R25 of 2004.

[54] Department of Health, *Explaining GMO Food Labelling*, http://www.doh.gov.za/department/foodcontrol/docs/explain.html

- Voluntary labelling is permitted for claims about enhanced or improved traits resulting from certain techniques of genetic modification, but such claims must be substantiated by an accredited independent body.

There are currently no GM foods on the market that must be labelled in terms of these Regulations (Mayet, 2004a).

An earlier draft of the regulations included provisions dealing with voluntary labelling to distinguish food as non-GM. It was proposed that this be permitted where GM content was below 1%, provided that the claim was verified by an accredited independent body, supported with an identity preservation audit trail. Permitted language was to be limited to "not genetically modified" or "not produced by certain techniques of genetic modification" or "prepared without certain techniques of genetic modification". Claims of 'GM-free' or similar wording were not to be permitted, as this could be misleading. The relevant sections were apparently omitted because SA does not currently have an identity preservation system in place. Standards and methods are in the process of being developed. It is intended that testing will be performed under the auspices of the South African Bureau of Standards (SABS), which will have the power to accredit independent organizations to conduct certification, and is expected to cost about $3.20/ton. When this has been finalized, the regulations will be amended accordingly (Jooste *et al*., 2004).[55]

In practice, voluntary identity preservation systems are used by many agricultural producers, who segregate GM crops from non-GM at the silo, but insufficient testing takes place to guarantee that this is effective (Mayet, 2004a). A facility to test foods for GM content was established in 2003 at the University of the Free State, in an arrangement with a German-based food diagnostic company, where certification of non-GM products can be obtained. However, initial take-up of the services was slow.[56]

The regulations make specific reference to 1993 Regulations Governing the Labelling and Advertising of Foodstuffs (also promulgated under the Foodstuffs, Cosmetics and Disinfectants Act),[57] stating that these apply also to foodstuffs obtained through certain techniques of genetic modification. In terms of these regulations, it is prohibited to make a claim on labels or in advertisements that a foodstuff is free of a particular substance when all other foodstuffs in the same class or category are free of such substance.[58]

Both supporters and opponents of GMOs criticized the labelling regulations. SAFeAGE accused the regulations of "display[ing] a cynical disregard for consumer rights" by "effectively prevent[ing] them from making properly informed choices about the source of their families' food" and alleged that consumer rights were "sacrificed in favour of corporate interests",[59] as consumers who wanted GM-free food would have to pay a premium.[60] On the basis of cost analysis studies carried out overseas, the DoH estimates that comprehensive, compulsory labelling of GM food could raise prices by up to 10%. AfricaBio's main objection concerned the removal of the provisions that were present in the draft regulations to deal with claims of 'non-GM' status. They asserted that this omission could lead to fraudulent labelling, as no standards were put in place to regulate non-GM

[55] *Business Day*, 20 August 2002, 'Law to control labelling of genetically modified food in force soon'; *Business Day*, 6 February 2004, 'Open wide for genetically modified bite'.

[56] *Business Day*, 14 August 2003, 'Facility to help food keep to standards'; *Engineering News* 31 October 2003, 'GM Testing Facility is Underutilised'.

[57] Government Notice R2034 of 1993.

[58] So, for example, since no GM fruit is currently available commercially in South Africa, no fruit may be labelled 'GM-free'.

[59] SAFeAGE press release, 1 February 2004, 'NGOs slam sham GM labelling regulations'.

[60] *Business Day*, 29 January 2004, 'South Africa has new GM food regulations'.

claims.[61] However, the applicability of the 1993 regulations on labelling would seem to deal with this concern.

DoH has emphasized that the regulations were introduced as "an interim measure … to put attainable consumer protection in place while the matter enjoys further investigation." Amendments are expected in response to new requirements or standards arising out of fora such as Codex Alimentarius and CPB, technological developments, and the finalization of the anticipated identity preservation system.[62]

While stakeholder groups have campaigned for labelling of GM food, there is not much evidence to show that this is an important issue for the public at large. According to the 2004 HSRC/PUB survey, over half of the respondents indicated that they never read information on food labels (apart from brand name). A correlation was found between income level and frequency of consulting food labels, with individuals from higher income groups more likely to read food labels. 21% of respondents indicated that they would welcome more information on ingredients on food labels, and an equal percentage indicated a wish for more health information, while 22% did not know what information they would like to see on food labels. Only 1% of respondents wanted to see labels contain information on GM content of foods, (with an equal proportion specifying that they would like information on organic certification) (Rule & Langa, 2005). This seems to suggest that the introduction of more detailed labelling requirements, which might increase product costs, is not a high priority for most consumers, and perhaps even less so for those from low-income groups. At the same time, though, the consumer's right to know must be upheld, and the value of labels in building awareness ought not to be dismissed, calling for a careful balance to be struck.

7.7 Intellectual property rights

For a developing country, SA has a relatively strong framework of intellectual property rights (IPRs) in many respects, entrenched well before this became necessary for many other countries on acceding to the World Trade Organization (WTO) Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs). Despite the fact that the patent office (an agency of the DTI) is a registration rather than an examining office, with severely limited capacity, the system as a whole is considered to operate effectively for the most part, bolstered as it is by strong legislation upstream and enforced by competent courts downstream, which have generally tended to uphold the rights of patent-holders. A small but well-qualified cadre of IP attorneys practises in the country. Expertise in government, industry and academia remains severely limited, although there are indications that capacity is growing, and some universities and research institutions have established dedicated technology transfer offices to manage their IP.

The Patents Act (as amended from time to time) was historically based on British law, and more recently has taken its lead from the European Patent Convention. If the courts were called upon to determine the patentability of a particular biotechnological invention, it is expected that the approach would be guided by practice in the European Patent Office. Plant variety protection is governed by the Plant Breeders' Rights Act (PBRA). South Africa has been a member of the International Union for the Protection of New Varieties of Plants (UPOV) since 1977 and is a party to the 1978 Act of the Convention. 1996 amendments brought South African legislation into compliance in almost all respects with the 1991

[61] AfricaBio press release, 26 January 2004, 'New GM food labeling leaves major gap'.

[62] Department of Health, *Food for Thought*, July 2004, Vol 4, Issue 2.

revisions of the Convention, which SA has signed, but not ratified.[63] The PBRA makes provision for a breeder's exemption and farmer's privilege, by providing that certain activities undertaken using legitimately acquired propagating material will not constitute infringement of another party's plant breeder's right. These include development of a different variety, *bona fide* research, private or non-commercial use, and use by farmers of harvested material. It is estimated that 42% of registered varieties is held by South African plant breeders, who also register their varieties in appropriate overseas markets, and foreign companies operating in SA make use of the system extensively to ensure protection of their varieties (Dold, 1982; van der Walt, 1996; van der Walt & Koster 2005; Wolson 2003).

The relatively strong IP regime and sizable agriculture sector have meant that foreign companies actively seek IP protection for their technology in SA. GM crops are typically protected under multiple forms of IP: patent protection for the GM trait, a plant breeders' right for the plant variety and a trademark for the name or number of the variety or a descriptor of the GM characteristic (e.g., RoundupReady). In addition, GM seed is usually sold subject to a technology contract agreed by the farmer, stipulating terms and conditions under which the seed must be used (van der Walt & Koster, 2005). For example, while the patent for glyphosate, the active ingredient of Roundup, expired in 1990, and other herbicides containing glyphosate are now on the market, farmers buying RoundupReady seed are contractually bound to use Monsanto's Roundup brand (Mayet, 2005).

As local applications of GM technology approach the commercialization stage, extensive in-licensing of IP belonging to multinational companies will be required in order to ensure freedom-to-operate. The cost of this is likely to be substantial and could materially affect the commercial feasibility of bringing locally-developed GM crops to market. There is increasing international pressure, particularly from some of the major philanthropic foundations, for companies to allow cheap or free access to their technology for 'humanitarian use', which would include applications designed to promote food security for use by small-scale farmers. Organizations such as the Nairobi-based African Agricultural Technology Foundation and the US-based Public Intellectual Property Resource for Agriculture have been established to try and facilitate improved access to agricultural IP. However, concerns remain that IP issues could present a barrier to the effective commercialization of local GM technology.

Although its capacity in IP issues is limited, the South African government has previously shown a will to use IP policy to promote national interests in the arena of health, when it introduced measures to allow parallel importation of patented medicines. The high-profile legal challenge mounted by multinational pharmaceutical companies, and the subsequent withdrawal of the action, hit international headlines in 2001 and gave exposure to the need for developing countries to be given sufficient flexibility to craft IP policies appropriate to their particular circumstances and development needs. The South African government has announced that it is planning a review of its IP regime. It is expected that this will, amongst other things, examine the impact of the current framework on development goals, although it is premature to speculate on how this might affect the creation and application of new technology such as GMOs.

8. INTERNATIONAL INFLUENCES ON GM POLICY AND DEBATES IN SOUTH AFRICA

The GM debates in SA are very much dominated by local organizations and individuals, rather than international players. Nonetheless, both supporters and opponents interact

[63] It appears that a political decision was taken not to ratify UPOV 1991, but this decision seems to have had limited practical effect because of the legislative amendments in line with UPOV 1991 which have been implemented.

closely with international organizations, and often receive NGO and development aid funding from overseas. The influential NGOs that have been prominent in opposing GMOs internationally, such as Greenpeace, the Third World Network and Friends of the Earth, have not had a direct local presence, although they do have linkages with and/or provide funding to South African organizations. Greenpeace is said to be considering opening a South African office in the near future.

The perception exists amongst some observers that scientists are heavily influenced by the agricultural input industry, especially the multinationals. However, while relationships exist and many researchers will have received financial or other benefits from such companies, the multinationals do not provide sufficient funding to set local research agendas and there is no hard evidence that scientific independence has been compromised in the research community as a whole.

USAID supports biosafety capacity-building initiatives in SA and elsewhere in Africa, and there is some scepticism surrounding the leading role that the US is taking in this regard. It is feared that these capacity-building programmes are designed to exert undue influence on biotechnology policy decisions by African nations, by promoting the uptake of GMOs and advocating the adoption of 'weak' biosafety regimes that follow the US approach. Since the US is not a party to the CPB (and is not eligible to become a party by virtue of not being a party to the CBD), it is felt that the efforts of US organizations are unlikely to give adequate consideration to CPB standards. The ACB has alleged that the funding of biosafety initiatives by American organizations (with USAID at the forefront) is in fact a tool to position "US agri-business to profit from hunger in Africa" (Mayet, 2004b). At the same time, activists frequently cite the lack of regulatory capacity as a reason for rejecting GMOs, which makes it difficult to accept at face value their arguments against supporting capacity-building.

It is undisputed that capacity-building is critical to underpin a well-functioning and sustainable system, and that SA can benefit from international expertise and experience. Obviously, the terms and conditions attached to different forms of assistance must be scrutinized, but there would seem to be sufficient local expertise to evaluate the suitability of programmes and to reject or renegotiate untenable terms. This is not to deny that there are risks associated with any one donor's exercising disproportionate influence, so efforts should be made to structure projects to involve funding by multiple donors, or at least to allow for multiple perspectives to be featured in the project scope. Developing countries share some responsibility to be more proactive in the design of donor-funded projects.

South Africa has not been actively involved in the UNEP-GEF[64] Project on Development of National Biosafety Frameworks, although the DEAT has been appointed the National Executing Agency.

International linkages are often invoked to challenge or malign the positions of 'the other side'. Those who believe in the potential for agricultural biotechnology to address food security and meet the needs of small-scale farmers in Africa often accuse opponents of taking a 'Eurocentric' approach, as many of the arguments levelled against the technology are borrowed from the anti-GM rhetoric in Europe. They feel that these arguments cannot be validly applied in the African context, and that alternative technologies should be embraced to overcome the problems associated with food security and agronomic conditions. Detractors in turn accuse supporters of the technology of aligning with multinationals at the expense of development, by allowing them to foist unwanted technology on a country that is not well-equipped to use it safely, and of cultivating dependencies which could compromise autonomy over future agriculture and food policy decisions.

[64] UNEP-GEF = United Nations Environment Programme Global Environment Facility

8.1 International trade

Although the DTI has overall responsibility for international trade, the International Trade Directorate of the NDA is responsible for agricultural trade negotiations. The directorate states that GMOs have not been a major issue of discussion in its negotiations. GM commodities may be imported or exported, provided the relevant regulatory requirements are satisfied.

8.1.1 Import issues

The major GM commodity imports are maize, soybeans and canola. The US and Argentina, both big GM growers, are two of the main suppliers of maize imports (Department of Agriculture, [n.d.]).[65] Approval is required under the GMO Act, and grain must be milled at the port of entry to minimize environmental impact. This means that it cannot be used for planting and so contamination resulting from unintentional spread is avoided.

Particular concerns about GM imports were triggered by a Monsanto announcement in January 2004 that it had sought approval to import GM wheat into SA for food and feed, despite the fact that it had not been commercially approved anywhere in the world (including in the US and Canada, where regulatory delays were being experienced). Monsanto explained that the application was made in anticipation of approval being granted in the US and Canada (two of the major suppliers of wheat imported by SA), and that no commercialization would take place until agreement was obtained all along the value chain, from producers to processors and consumers around the world. However, the move was viewed with alarm by some, as a pre-emptive attempt to gain control over the African market for GM wheat.[66]

Almost 40 civil society organizations objected to the application on the basis that SA ought not to be the first country to risk accepting GM wheat when the rest of the world has grave concerns over its social, environmental and economic impact. The groups expressed the fear that SA could become a "dumping ground for GM crops and a gateway for their distribution to other parts of the continent". They also noted that there had been too little public debate in SA on possible harmful effects of GMOs.[67]

The NDA has stated that the fact that a GM crop or product has not yet been approved elsewhere would not be grounds for outright rejection of an application for approval, but that this would be a consideration taken into account by the EC and would carry some persuasive weight. Monsanto subsequently announced that it was abandoning its wheat programme as a result of consumer resistance.

A recent study (Jooste *et al*., 2004) attempted to measure the possible impact of GMO commercialization on South African trade, according to various scenarios. However, due to limited availability of empirical data and restrictive assumptions made as a consequence, definitive quantitative results could not be generated. As a general conclusion, it is noted that, if it is assumed that GM crops generate sufficient productivity gains to lower the overall costs of producing the crop, and that these savings are passed down along the value chain, adoption of GM crops could promote the competitiveness of domestic industry. Conversely, slow uptake of GM crops locally could lead to the substitution of cheap GM imports for local products, which would adversely affect the competitiveness of the local agriculture sector

[65] Although a net exporter of maize, South Africa also imports some maize; for example, when short-term shortages are being experienced, or when favourable price differentials exist.

[66] *Business Day*, 22 January 2004, 'Monsanto denies plan to bring wheat into Africa'; Mayet, M, 15 Feb 2004, 'Monsanto pushes GM wheat to secure future access to lucrative African markets' http://seatini.org/bulletins/7.03.php

[67] Biowatch press release, 28 April 2004, 'Critical month for genetic engineering in South Africa'.

and agri-processing industries. However, the degree of consumer resistance both at home and overseas remains difficult to predict, and the value of the premiums that consumers will be willing to pay for non-GM food has not been adequately considered.

8.1.2 Export issues

The main export markets for South African maize and maize products are the SADC, Japan, Iran, Kenya, Venezuela, and Malaysia (Department of Agriculture, undated). SADC countries are the current destination for more than 80% of both maize and soybean exports. The growing concerns in certain SADC countries about GMOs must therefore not be taken lightly. For example, Namibia requires non-GM certification of its imported grain for animal feed, in order to preserve European markets for its meat exports.

Animal feed is made mainly from commodities (often imported) that are expected to have a fairly high GM content in certain cases. Currently, SA does not export meat to Europe. However, should this situation change, since many European meat importers require certification that animals have not been given feed containing GMOs, it might become necessary to maintain sources of non-GM animal feed which can be verified by an identity preservation system. This will only be justified however, if the premium offered for meat derived from animals fed on GM-free feed is sufficient to make up for the additional costs involved, and if local food prices are not unduly adversely affected (Jooste *et al.*, 2004).

The EU-SA Trade Development and Cooperation Agreement (TDCA) has been in force since 2000, but GMOs were not discussed in the extensive negotiations leading up to the agreement. A review of the TDCA is underway, but the main objectives for SA will be increased market access and reduced EU subsidies to farmers because the EU remains South Africa's largest agricultural trading partner overall. However, its share of South African agricultural exports has dropped in recent years, corresponding to increased exports to the Far East and to other African countries (especially SADC countries), in an effort to reduce over-reliance on the European market.[68] The EU is a major export market for South African cotton, but not for any of the other GM commodities produced in SA.

Exports to the US were relatively low during the apartheid-era trade sanctions, but have risen sharply in recent years. This is largely attributed to the US African Growth and Opportunity Act (AGOA).[69] In 2003 alone, agricultural exports rose by 35%, which is particularly remarkable when the strengthening of the local currency at the same time is taken into account. However, GM products were not a component of these exports. A Free Trade Agreement (FTA) is currently under negotiation between the US and the Southern African Customs Union (SACU, which consists of Botswana, Lesotho, Namibia, SA and Swaziland). The US has requested that the FTA incorporate an undertaking that SACU agree to accept GM exports from the US. From the South African perspective, this is unlikely to be problematic, as the biosafety regime provides a framework for approving such imports. For South Africa's SACU partners, though, this is not necessarily the case.

The nature of agricultural trade with the EU and the US has not dictated that SA join the US, Canada and Argentina in their WTO dispute concerning the EU's *de facto* moratorium on the approval of new GMOs.

With SA producing yellow maize mainly for animal feed and white maize for predominantly human consumption, the maize sector has for years been geared to separate white and yellow maize. Moreover, partly because of the previous government's emphasis on self-sufficiency, SA has ample silo storage facilities for grain. Even though SA does not yet have

[68] *Business Day*, 23 February 2005, 'SA looks past EU in bid to spread agricultural exports'.

[69] *Business Day*, 31 March 2004, 'Figures show AGOA has benefited SA'.

a functioning identity preservation system in place, infrastructure and a history of controlling what goes where have made it possible to separate GM and non-GM maize to an acceptable level where required. South Africa is a net exporter of maize to countries like Japan, Kenya, Malawi, Mauritius, Mozambique, Zambia and Zimbabwe, and is able to supply non-GM maize if there is a demand for it. Where non-GM maize is required, farmers have to declare whether they are delivering GM or non-GM maize; the maize is tested using an Elisa test kit; and then delivered into specific silos. It has also become more common for companies or exporters that require non-GM maize to contract specific farmers in specific areas to produce the maize for them.

8.2 South Africa's position in relevant international fora

8.2.1 Cartagena Protocol on Biosafety

South Africa ratified the Convention on Biological Diversity in 1995, and acceded to the CPB in August 2003. For the most part, this move was welcomed. Certain changes to the South African regulatory framework have had to be made in response, and some of these will address some of the objections that GM opponents have made in the past. Some supporters of GMOs recognize that the CPB, being a multilateral instrument, could help to build confidence in GM technology under the umbrella of an international regulatory framework. However, others believe that the CPB may lead to trade barriers, due to potentially wide interpretation of certain provisions and additional costs associated with implementation. It has even been suggested that "the Cartagena Protocol represents the biggest threat to international agricultural trade, after subsidies" (Jooste *et al.*, 2004), by potentially introducing additional requirements for cross-border trade in agricultural products, increasing bureaucracy, raising transaction costs and providing a means for countries trying to protect local markets to limit imports. At this stage, however, there does not appear to be sufficient evidence to support or refute this in the South African context. Shortly before ratification of the CPB by SA, the Portfolio Committee on Agriculture and Land Affairs expressed concern that accession could lead to job losses in the agriculture sector, by increasing agricultural production costs associated with keeping separate GM and non-GM product streams and reducing profit in the sector. It was noted that no other major grain exporters were at the time willing to accede to the CPB, and South Africa's decision to do so could turn the country into a 'guinea pig' and have unpredictable consequences. For these reasons, the committee called for accession to be delayed.[70] Notwithstanding, ratification took place barely a week later.

While the DEAT represented SA during CPB negotiations, the NDA now participates jointly with the DEAT in relevant meetings. The office of the Registrar of Genetic Resources has been designated as the Competent National Authority for the purposes of the CPB.

8.2.2 FAO/WHO Codex Alimentarius Commission

South Africa has been a Codex member since 1994 and recognizes its obligation to harmonize its standards with those of the Commission in order to protect consumers and promote fair trade. The National Codex Contact Point is the DoH's Food Control Directorate. A National Codex Committee is responsible for developing positions on Codex draft standards, guidelines and recommendations and attending meetings of the Commission and of relevant committees. It has representatives from the DoH, NDA, DTI, SABS and NCF.

South Africa participates in a number of Codex programmes and activities, concentrating resources on those committees of particular significance or interest to the country, which

[70] *Business Day*, 6 August 2003, 'Concern SA could be biosafety guinea pig'.

includes those dealing with food safety and labelling of GMOs. As reflected in the regulatory system, South Africa's approach tends to be aligned in large measure with that of the US.

8.2.3 World Trade Organization

South Africa has become a fairly influential player in the WTO, representing developing country interests on a range of issues. South Africa (together with Brazil, China and India) was one of the major players behind the formation of the G-20 bloc of developing countries which first emerged as a force in Cancun in 2003, sharing a common goal of ending developed country trade distortions in agriculture, in an effort to integrate developing countries into the global trade system. South Africa is also a member of the Africa Group (made up of 41 African countries), although not always aligned with its positions, as a result of differing national priorities arising out of often vastly different conditions. While SA participates actively in agricultural negotiations in the WTO, GMOs have not been a major focus of negotiations, because the key issues have been the removal of subsidies and improved market access.

8.2.4 Like-minded megadiverse countries

South Africa is a megadiverse country and a member of the Group of Like-Minded Megadiverse Countries, consisting of 17 countries that are estimated to hold over 70% of the world's biodiversity. The Group was formed in 2002 to provide a mechanism for promoting common interests and priorities relating to the conservation and sustainable use of biological diversity in international negotiations. South Africa is represented by the DEAT. Although the use of biotechnology and biosafety are identified as a priority area for the Group, this has not been a major focus of their activities to date, with the initial emphasis having been directed at questions of access and benefit-sharing relating to the sustainable use of biodiversity.

8.3 Regional issues related to GMOs

8.3.1 South Africa's influence on agricultural biotechnology policies in the region

South Africa's position as a regional leader means that its policies and opinions are often viewed as an example to be followed by other African countries, which look up to SA on many issues. Amongst other things, this creates a responsibility to share information and experiences, and to provide support. However, SA has also on occasion earned itself a reputation for 'arrogance' and for imposing its will on its neighbours, and is increasingly viewed as playing a neo-colonialist role as more and more South African companies set up business operations in the region. Effective engagement with neighbouring countries therefore requires a degree of sensitivity.

To date, there is no evidence of illegal spread of GM seed from SA to any of its neighbours. African countries are at different stages of considering, discussing, developing and implementing national biosafety frameworks, with some at fairly advanced stages. Technical capacity, at both legal and scientific levels, varies widely between countries, and it is acknowledged that SA is a leader in this regard. South African government bodies, organizations and experts are frequently consulted by other African governments and researchers for advice and assistance on biosafety matters, and certain countries are even said to be considering modelling their biosafety regulatory frameworks on South Africa's. This has caused some concern, as South Africa's system is not perfect. There is also concern that, even once biosafety frameworks are in place, the capacity will be lacking to implement them effectively. However, other countries are taking a more critical and cautious position, and are resisting, not only the adoption of GMOs in local agriculture, but also GM imports and even food aid. On balance, though, developments in and attitudes of neighbouring countries are unlikely to influence South Africa's well-entrenched GMO policy.

8.3.2 Rejection of GM food aid

The decision of certain African countries not to accept GM food aid has drawn attention to some of the pressures exerted on developing countries (especially the least developed countries) when they attempt to evaluate the risks of adopting GMOs and the consequences of rejecting them. The issue has stimulated debate in many places, including SA. The matter first rose to prominence in 2002, while parts of Southern Africa were in the midst of a severe drought, and some countries faced famine. Much attention was focused on Zambia, which refused to accept GM food aid, because of health concerns and fears that maize distributed for food might be replanted, thereby contaminating local crops, which could threaten future agricultural exports, particularly to the EU. While other countries threatened by the famine subsequently accepted milled grain, Zambia chose not to. Malawi, Mozambique and Zimbabwe eventually accepted GM food aid on condition that the GM grain was milled prior to distribution to prevent planting. Lesotho and Swaziland accepted non-milled maize as food aid, but warned the public that it should be used exclusively as food and not as seed (Mayet, 2004c). Zambia's decision to reject the food aid out of hand had the effect of banning the distribution of all food aid in the country for a time. The controversy led to an investigation being commissioned by SADC. Zambia continues not to accept GM food aid, but does import South African commodities that could have GM content (Jooste *et al.*, 2004).

In 2004, similar controversy erupted, with both Angola and Sudan placing restrictions on the acceptance of GM food aid (Mayet, 2004c). Angola insisted that all GM food aid be milled, and Sudan requested GM food aid to be certified 'GM-free'. These decisions were criticized by the World Food Programme (WFP) and USAID. In response, an open letter was sent to the WFP by over 60 groups from 15 African countries, representing farmer, consumer, environmental and development organizations, protesting against the pressure being exerted on the Angolan and Sudanese governments by the WFP and USAID to accept GM food aid against their will. The WFP was accused of laying down a crude choice between 'GM food aid' on the one hand or 'starvation' on the other, while alternatives existed. The WFP was urged to facilitate freedom of choice and to investigate other options, including alternative sources of food aid.[71]

[71] 'African groups accuse WFP and USAID of denying Africa's right to choose to reject GM food aid' 4 May 2004, http://www.gmfreeafrica.org/gmfa_main/article.php?story=20040509103549444.

9. CONCLUSION

The South African government has recognized the role biotechnology can play in agriculture, food security, rural development and poverty elevation and has stressed the importance of the creation of a knowledge-based 'bioeconomy' for SA as an international player and a leader in Africa. The South African government faces the considerable challenge of creating a policy, legislative and R&D environment where large-scale commercial farmers can produce affordable food for the increasingly urbanized South African population and the famine prone SADC region, where small-scale and emerging previously disadvantaged farmers can produce agricultural products of value in a sustainable manner, and where subsistence farmers can increase their food security. At the same time, South African farmers should be able to produce agricultural products for the international market and niche markets where it might be possible to earn a premium.

Both large- and small-scale farmers have benefited from the introduction of genetically modified crops in SA. The story of the technological triumph but institutional failure at Makhatini Flats, emphasizes the importance of governance, institutional structures and cooperation for successful adoption and dissemination of GM crops.

While it appears highly unlikely that SA will ever go back on its decision to embrace GMOs, if the current and potential benefits they offer can be sustained and achieved, and the possible risks avoided, flaws in the biosafety regulatory system will have to be addressed. While many users of the system believe it is functioning well, and point to the absence of any accidents or problems as evidence of this, some observers feel that there are not adequate safety measures in place to prevent or limit damage that might occur in the future.

One of the most crucial issues to tackle is the lack of transparency, which breeds distrust, exposes the system to challenge and, in the long run, could limit the uptake of the technology and prevent it from reaching its potential to solve African problems for African farmers and consumers. This requires that access to information is made easier and that more opportunities for meaningful public participation are provided. At the same time, the rights of private parties to protection of their legitimately confidential information must be safeguarded, and increased public participation must not lead to delays that slow down approvals to an unworkable extent. Balancing these competing interests calls for a degree of sophistication that some might believe to be lacking in the South African system at present – but, perhaps more importantly, the will to do so is also apparently lacking.

The debate remains highly polarized and adversarial, with activists on both sides each indignantly rejecting the validity of their opponents' arguments and claiming the moral high ground, and government playing a somewhat passive role. Efforts have to be made to build trust, without which meaningful engagement will not be forthcoming. However, with stakeholders seen as occupying one camp ('government, industry and specialists') or the other ('the concerned public') (as described by Jardine, 2001), it becomes difficult to identify an appropriate facilitator who is considered independent.

Since GMOs appear to be here to stay, opportunities should be exploited, while at the same time acknowledging and remedying weaknesses in the system. South Africa's agricultural biotechnology infrastructure and biosafety framework lay a foundation, which bodes well for the development and use of GMOs in the future, but which must be built upon and reinforced if these applications are to be sustainable. It is hard to refute the allegations that the current applications of GM crops in the country do not offer much in the way of tangible advantages to the majority of South Africans, even though some sectors of the population do appear to be benefiting. If GM crops are to have a future in SA and in Africa, it is essential that applications are developed locally to deal with endemic problems and locally relevant crops. While some efforts are underway, much more R&D directed at priority areas and crops is needed. Further academic research is also needed, in both the natural and social sciences,

to generate and assess empirical data on the health, environmental and socioeconomic impacts of GMOs in the South African context. Better information will facilitate better decision-making and build trust. If it is found that risks are greater than expected, they can be mitigated against and, if risks are shown to be unfounded, the data can be used to dispel fears.

10. REFERENCES

Aerni, P. (2001). *Public attitudes towards agricultural biotechnology in South Africa.* Science, Technology and Innovation Discussion Paper No 14. Boston, MA: Center for International Development, Harvard University.

Agriculture and Agri-Food Canada (2003) *Agri-food Country Profile, South Africa*, June.

Annecke, D.P. & Moran V.C. (1982). *Insects and mites of cultivated plants in South Africa*. Durban: Butterworths.

Bennett A. (2002). The impact of Bt cotton on small holder production in the Makhathini Flats, South Africa. *Bt Cotton Report.* Available from: www.monsantoafrica.com

Dold, D.M. (1982). Plant breeders' rights, *De Rebus, 475,* 178.

Gouse, M, & Kirsten, J.F. (2005). *Production of genetically modified maize under subsistence small-holder conditions in South Africa: Assessment based on three seasons of research*. Unpublished final report to Monsanto, South Africa.

Gouse, M., Kirsten, J.F. & Jenkins, L. (2003). Bt cotton in South Africa: Adoption and the impact on farm incomes amongst small-scale and large-scale farmers, *Agrekon*, 42(1), 15–28.

Gouse, M., Pray, C., Kirsten, J. & Schimmelpfenig, D. (2004). Impact of Bt white maize on small-scale farmers in South Africa. Paper presented at the *8th ICABR International Conference on Agricultural Biotechnology: International Trade and Domestic Production, Ravello, Italy, July 8-11.*

Gouse, M., Pray, C., Kirsten, J. & Schimmelpfennig, D. (2005). A GM subsistence crop in Africa: The case of Bt white maize in South Africa, *International Journal of Biotechnology*, 7(1/2/3), 84–94.

Gouse, M., Kirsten, J.F., Shankar, B. & Thirtle, C. (2005). Bt cotton in KwaZulu-Natal: Technology triumph but institutional failure, *AgBiotechNet*, 7(134), 1–7.

Gouse, M., Pray, C. & Schimmelpfennig, D. (2005). The distribution of benefits from Bt cotton in South Africa, *AgBioForum*, 7(4), 1–8.

Hofs, Fok & Gouse, (2005). Unpublished working paper. Department of Agricultural Economics, Extension and Rural Deveopment, University of Pretoria and CIRAD.

James, C. (2004). *Preview: Global Status of Commercialized Biotech/GM Crops: 2004.* Executive Summary. ISAAA Briefs, 32. [n.p.]:International Service for the Acquisition of Agri-biotech Applications. Available from: http://www.isaaa.org/.

Jardine, C. (2001). *A review of risk analysis for trial and commercial release of genetically modified organisms in South Africa.* Second Draft Report produced for Biowatch. Available from: <http://www.biowatch.org.za/docs/reports/risk_analysis.pdf>.

Jooste, A., van der Walt, W.J., Koch, M., le Clus, K., Otto, H. & Taljaard, P. (2004). *Possible impacts of genetically modified food production on South African exports.* Unpublished paper commissioned by Department of Science and Technology.

Kfir, R. (1997). Natural control of the cereal stemborers Busseola fusca and Chilo partellus in South Africa. *Insect Science and its Application*, 17(1), 61–67.

Kirsten, J.F., Gouse, M. & Jenkins, L. (2002). Bt cotton in South Africa: Adoption and the impact on farm incomes amongst small-scale and large-scale farmers. Paper presented at the *6th International Conference on Agricultural Biotechnologies: New Avenues for Production, Consumption and Technology Transfer, Ravello, Italy, 10-14 July*.

Kirsten, J.F., & Gouse, M. (2002). The adoption and impact of agricultural biotechnology innovations in South Africa. Chapter X in Kalaitzandonakes, N. (ed). *Economic and environmental impacts of agbiotech: A global perspective*, Kluwer-Plenum Academic Publishers, New York.

Marra, M.C., Pardey, P.G., & Alston, J.M. (2002). *The payoffs to agricultural aiotechnology: An assessment of the evidence*. Environment and Production Technology Division, International Food Policy Research Institute, January.

Mayet, M. (2001). *Critical analysis of pertinent legislation regulating genetic modification in food and agriculture in South Africa.* Produced for Biowatch South Africa. Available from: <http://www.biowatch.org.za/docs/legislation/2001/gmo_act.pdf>.

Mayet, M. (2004a). *Critical analysis of South Africa's labelling regulations for genetically modified food, feed and products derived from gm-fed animals.* Available from: <http://www.biosafetyafrica.net/_DOCS/SAGMLabellingAnalysis.pdf>.

Mayet, M. (2004b). Africa: The new frontier for the GE industry. *TWN Briefings for MOP 1*, 4. Available from: <http://www.biosafetyafrica.net/_DOCS/africa_new_frontier.pdf>.

Mayet, M. (2004c). *African agriculture under genetic engineering onslaught.* Available from: <http://www.biosafetyafrica.net/_DOCS/Africa_under_GE_onslaught.pdf>.

Mayet, M. (2005). *A profile of Monsanto in South Africa*. Information document produced by African Centre for Biosafety. Available from: <http://www.biosafetyafrica.net/_DOCS/ACB_Monsanto_Southafrica.pdf>.

Meyer, F.H. (2002). *Modelling the market outlook and policy alternatives for the wheat sector in South Africa*. Unpublished master's thesis, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria.

Mogford, D. (1996). The use of genetic resources in agricultural crop production and the seed industry. Proceedings of *Land and Agriculture Policy Centre Genetic Conservation Workshop, Johannesburg, 19–20 March*.

PlantBio. (2004). *Strategy document*. Hayfields, KwaZulu-Natal, South Africa: National Innovation Centre for Plant Biotechnology.

Qaim, M., Cap, E.J. & de Janvry, A. (2003). Agronomics and sustainability of transgenic cotton in Argentina, *AgBioForum*, 6(1&2), 41–47.

Robinson, H (2001) '*Biotechnology in South Africa: 2001'*, cable prepared as an intern at the US Embassy in Pretoria.

Rule, S and Langa Z (2005) *'HSRC client survey 2004',* Report to Public Understanding of Biotechnology <http://www.pub.ac.za or http://www.hsrc.ac.za>.

National Department of Agriculture. (2004). South African variety list as maintained by the Registrar of plant improvement, October.

Shankar, B and Thirtle, C (2003) '*Pesticide Productivity and Transgenic Cotton Technology: The South African Smallholder Case'*, University of Reading Department of Agricultural aQaim, M. & de Janvry, A. (2005). Bt cotton and pesticide use in Argentina: Economic and environmental effects. *Environment and Development Economics*, 10, 179–200.

Robinson, H. (2001). *Biotechnology in South Africa: 2001.* Cable prepared as an intern at the US Embassy in Pretoria.

Rule, S. & Langa, Z. (2005). *HSRC client survey 2004.* Report to Public Understanding of Biotechnology. Available from: <http://www.pub.ac.za> or <http://www.hsrc.ac.za>.

Shankar, B. &Thirtle, C. (2003). *Pesticide productivity and transgenic cotton technology: The South African smallholder case.* University of Reading. Department of Agricultural and Food Economics Working Paper. Available from:

<http://www.apd.rdg.ac.uk/AgEcon/research/workingpapers/JAE%20submission%20BS%20Jun%2003.pdf>

Sithole-Niang, I., Cohen, J. & Zambrano, P. (2004). Putting GM technologies to work: Public research pipelines in selected African countries, *African Journal of Biotechnology*, Vol 3 (11), pp 564-571.

South Africa, Department of Arts, Culture, Science and Technology. (1996). *White Paper on Science and Technology*. Available from: <http://www.dst.gov.za/legislation_policies/white_papers/Science_Technology_White_Paper.pdf>.

South Africa, Department of Health. (2004). *Guideline document for food safety and risk assessment of GMOs and products thereof. Availble from:* http://www.doh.gov.za/department/foodcontrol/gmo/risk.html

South Africa, Department of Science and Technology. (2001). *A national biotechnology strategy for South Africa*. Available from: <http://www.dst.gov.za/programmes/biodiversity/biotechstrategy.pdf>.

South Africa, Department of Science and Technology. (2002). *South Africa's National Research and Development Strategy*. Available from: <http://www.dst.gov.za/legislation_policies/strategic_reps/sa_nat_rd_strat.htm>.

South Africa, Department of Science and Technology. (2004) *National Biotechnology Survey* 2003. Available from: http://www.pub.ac.za/resources/docs/egolibio_survey_2003.pdf

South Africa, National Department of Agriculture. (n.d.) *Guidance document for use by the applicant to complete the application forms for activities with genetically (living) modified organisms in South Africa*. [Attached to Genetically Modified Organisms Act, No. 15 of 1997.]

South Africa, National Department of Agriculture. (n.d.). *Maize profile*. Available from: <http://www.nda.agric.za/docs/Maize/maize.htm>.

South Africa, National Department of Agriculture. (2001). *Strategic plan for South African agriculture*.

South Africa, National Department of Agriculture. (2004a). *Guideline document for use by the advisory committee when considering proposals/applications for activities with genetically modified organisms*. May.

South Africa, National Department of Agriculture. (2004b). South African variety list as maintained by the Registrar of Plant Improvement, October.

South Africa, National Department of Agriculture. (2000). *General information on agriculture in South Africa*.

South Africa. Agricultural Pests Act, No. 36 of 1983.

South Africa. Environment Conservation Act, No. 73 of 1989.

South Africa. Foodstuffs, Cosmetics and Disinfectants Act, No. 54 of 1972.

South Africa. National Environmental Management Act, No. 107 of 1998.

South Africa. National Environmental Management: Biodiversity Act, No. 10 of 2004.

South Africa. Patents Act, No. 57 of 1978.

South Africa. Plant Breeders' Rights Act, No. 15 of 1976.

South Africa. Plant Improvement Act, No. 53 of 1976.

Thomson, J.A. (2004). The status of plant biotechnology in Africa, *AgBioForum*, 7(1&2), 9-12. Available from: <http://www.agbioforum.org>.

USDA Foreign Agricultural Service. (2003). *South Africa, Republic of, Exporter Guide, Annual, 2003.* GAIN Report #SF3031.

van der Walt, W.J. (1996). Plant breeders' rights in South Africa. Proceedings of *Land and Agriculture Policy Centre Genetic Conservation Workshop, Johannesburg, 19-20 March*.

van der Walt, W.J. & Koster, B. (2005). An overview of plant variety protection in South Africa, *IPStrategy Today*, 13, 18–28.

van Rooyen, C. (2004). Science not a priority for SA press, *Science in Africa*, April.

Wolson, R.A. (2003). Intellectual property rights and biological resources: Current policy and legislative developments in South Africa. In Bellmann, C., Dutfield, G. & Melendez-Ortiz, R. (eds). *Trading in knowledge: Development perspectives on TRIPS, trade and sustainability.* [n.p.]: Earthscan Publications**,** 264-276.