TRACEABILITY, SEGREGATION AND LABELLING OF GENETICALLY MODIFIED PRODUCTS IN SOUTH AFRICA

A Position paper on the implementation of the Consumer Protection Act and mandatory labelling of GM food

African Centre for Biosafety

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Contents

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The African Centre for Biosafety (ACB) is a non-profit organisation, based in Johannesburg, South Africa. It provides authoritative, credible, relevant and current information, research and policy analysis on genetic engineering, biosafety, biopiracy, agrofuels and the Green Revolution push in Africa.

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Introduction

South Africa has promulgated national legislation, the Consumer Protection Act (CPA), which creates an opportunity for the mandatory labelling of certain foodstuffs containing or which are genetically-modified organisms (GMOs). The Act sets out a number of consumer rights that have relevance to the sale of products with genetically modified components. These include the right to choose; the right to disclosure and information; the right to fair and honest dealing; and the right to fair value, good quality and safety.

Labelling falls under the right to disclosure and information. Labels must be in plain language that a consumer "with average literacy skills and minimal experience as a consumer of the relevant goods or services, could be expected to understand the content, significance and import of the notice…without undue effort" (s22.2). The Act allows for guidelines in this regard, which may be published for public comment (although this is not a statutory requirement) (s22.4). Section 24(4) of the Act says the Minister may prescribe categories of goods that must be labelled according to the Act. This can be taken to mean it is at the Minister's discretion. However, section 24.6 explicitly calls for disclosure, through a display on the packaging, of the presence of any genetically modified ingredients. This must be taken to mean that the Minister cannot exclude products with GM ingredients on the prescribed list, otherwise it would not be mentioned in its own sub-section. Single foods must also be labelled (e.g. maize meal, tofu or cotton seed oil). Applicable regulations will be developed. These regulations will include which goods are prescribed in the Act. Section 61.1 of the Act places liability on producers, importers, distributors and retailers for a) supplying any unsafe goods; b) defect or hazard in any goods; c) inadequate warnings provided to the consumer pertaining to hazard arising from or associated with the use of any goods. Consumers will be able to claim compensation for harm suffered in respect of any such goods supplied after 24 April 2010 if they can prove that the supplier supplied the goods to them and that they suffered harm as a result of using the goods. This means all actors in the value chain can be held liable. Suppliers will not be able to contract out of product liability anymore (McGee, 2010). Retailers must deal with consumer complaints and will not be permitted to refer the consumer to suppliers (Luterek, 2009). Nevertheless, this liability is limited in section 61(4)c which says liability does not arise if "it is unreasonable to expect the distributor or retailer to have discovered the unsafe product characteristic, failure, defect or hazard, having regard to that person's role in marketing the goods to consumers". This means consumers will probably have to make claims against manufacturers or importers rather than retailers or distributors, unless product testing was possible at the retail level (Woker, 2009:10).

Regulations passed by the Department of Health in 2004 require the labelling of any foodstuff with GM ingredients that are significantly different to the norm in respect of the composition, nutritional value, and mode of storage, preparation or cooking, allergenicity or human or animal origin. 'Significant difference' basically means the use of GM must result in the product becoming something distinct from those not using GM. Since none of these conditions apply to any existing GM products, the regulations do not require labelling (Mayet, 2006:2). It is anticipated that new regulations in the CPA will supersede these.

At an international level, the Codex Alimentarius Commission, a global food standards body, has a Committee on Food Labelling. While the committee has been working on draft guidelines for more than 10 years, no agreement has yet been concluded. The US, Canada and Argentina, three of the largest GM producers globally, have resisted attempts to make labelling mandatory (Cowan & Becker, 2009:25). The Biotechnology Industry Organisation (BIO) argues that, since consensus cannot be reached, all work on "labelling of food derived from modern biotechnology" should be discontinued at Codex (Codex Committee on Food Labelling, 2010:10). It is clear from this that industry does not want any international agreement on labelling, however weak.

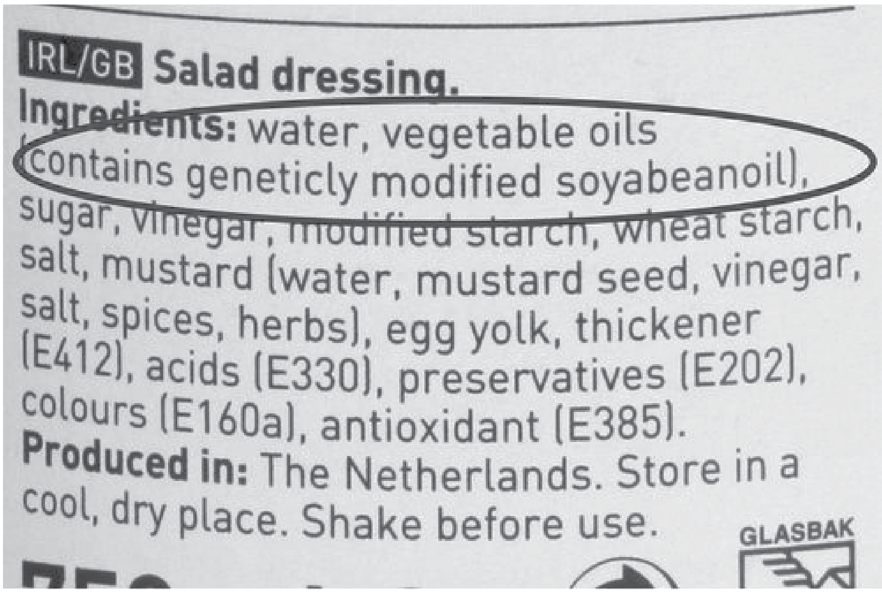
Structure of paper

This report considers some of the issues relevant to the effective labelling of products containing GM ingredients in South Africa. Since the CPA only refers to food for human consumption in relation to labelling for GM products, the report will focus narrowly on this. The report starts with the objectives of labelling and the integrity of the labelling system; and what type of labelling could be used. It then considers the value chains for the three GM crops in South Africa - maize, soy and cotton - and considers where power lies in each chain. Demand for non-GM products in South Africa is considered next. This is important because, in a market-driven economy, premiums for non-GM products will determine the sustainability of segregation and labelling systems. Segregation and testing systems underpin the verification process for information provided on labels. Possible and existing systems for segregating GM from non-GM produce are identified next, along with available testing systems to quantify GM content. Some reference is made to imports, because these will also require testing and segregation on arrival in South Africa if the overall labelling system is to have any integrity. Finally, the costs of segregation and identity preservation, testing and labelling are considered for key parts of the value chain. This includes some reflections on who should bear the costs of mandatory labelling, based on who the beneficiaries are. The paper concludes with some broad recommendations.

Labelling

Objectives of labelling

There are three primary purposes for labelling: to verify food safety; to indicate product ingredients in the same way as other additives are indicated; and to give consumers a choice about what they eat. With regard to GM products, not all of these apply in all countries. In the US, for example, labelling is essentially about food safety and not consumer choice. GM food is 'generally regarded as safe' if it has gone through the various risk assessments and regulatory checks prior to being commercialised. These procedures are mostly stricter than for conventional foods. The issue for GM products, however, is to ensure that the risks are the same or less than for its non-GM counterparts. If any food, whether GM or non-GM, is found to have significant human health risks it should be banned from the market outright and so labelling would not apply to those products. If the GM food is accepted as



Source: http://i.treehugger.com/images/2007/10/24/GM%20label.jpg

being 'generally regarded as safe' as a result of following strict assessments and approval procedures, and the purpose of labelling is for health and safety reasons, the argument is that mandatory labelling has the effect of increasing costs, especially those associated with segregation and testing, without any real benefit to the consumer. Industry acknowledges the need for labelling and identity preservation systems for the purposes of consumer choice, but do not accept that there are safety issues (Giroux, 2009:5).

Consumer choice relates to whether people want to eat GM products or not. While industry suggests that the health and safety issues are dealt with in the approval process, absence of evidence of health or ecological risk is not evidence of absence of such risk. This is especially the case when most scientific research is funded, directly or indirectly, by the corporations that profit from the expansion of GM crops (Ho, 2001). There are scientific studies that show that GM content may have unknown or negative health impacts for those consuming it. These include potential transfer of altered genes into the consumers' DNA, the unstable and potentially disruptive process of gene insertion, and a reduction in nutritional properties and rise in allergens (for example see Smith, 2003). Ecologically, the possibility exists for gene flow between non-GM and wild plants, and of increased pesticide and herbicide resistance in non-target species (Cowan & Becker, 2009:26). Cases of toxic residue build-up in soil and stalk-borer resistance to Bt maize have been reported in South Africa in recent years (Sansor 2008:34; van der Walt, 2008:15). There is also growing evidence of resistance in weeds to Roundup, the herbicide that Monsanto's herbicide tolerant GM seeds are designed to withstand. This means farmers are having to fall back on older methods to combat weeds or are having to use additional herbicides. The New York Times recently reported an estimated 7-10 million acres of Roundup resistant weeds are now found in the US, which Monsanto recognises as "a serious issue" even though it claims the problem is still under control (Neuman & Pollack, 2010). Lack of absolute certainty as to the potential effects of the technology justifies consumers asking for labels to identify whether there is any GM content in the products that are being offered for sale.

One of the core arguments regarding GM technology is whether increasing the amount of food available using GM technology is a benefit for broader society or not. Proponents of the technology cite the deepening starvation and hunger across the world as evidence of the need to produce more food. But this is an ideological argument that decontextualises food production and distribution from increasing corporate control over the supply chain, and the dependency of industrial agriculture on an unsustainable oil-based economy. That debate has been raging across the globe for some decades now, and need not detain us here. However, it is necessary to acknowledge this context and that the 'benefits' of GM production accrue primarily to a handful of agrochemical and seed multinationals, and to a lesser extent to some producers who benefit financially in the short term from the use of GM seed. Claims made that there are ecological benefits of adopting GM technology because of lower pesticide use must be balanced with the fact that they simultaneously entrench large-scale monocrop agriculture that remains dependent on the oil economy (Pfeiffer, 2006). Likewise, claims that GM technology will result in more, cheaper food for the poor ignores systemic limits to the distribution of food in a capitalist society, as well as the growing diversion of food crops (especially GM) into non-food uses, such as agrofuels and pharmaceuticals. This has the effect of reducing crops available for food and increasing food prices. These are social impacts of the technology that are out of range of assessments of its technical merits.

Consumers may choose not to eat GM products for any or all of these reasons. They need to be informed about the content of the food on the shelves so they can make these choices if they want to. Government has decided, through the CPA, that it believes that consumer choice in what they eat is a right that must be upheld. This is closely linked to broader awareness raising about the technology, because people are not aware of the potential ecological or health risks of GM food products - or at the very least are not being offered a balanced picture about the pros and cons of the technology. By now most food products with maize, soy or cotton or their by-products contain some GM content - which is a large array of processed foods in particular. We can't assume that everybody knows that: surveys show that the vast majority of people have not even heard of GM.

The issue is how to make people aware of a controversial technology so that they can choose how to respond. Richer consumers can vote with their wallets by purchasing certified organic and non-GM food, but not everyone has that luxury. While government does sponsor the public understanding of biotechnology programme this tends to be biased in favour of biotechnology. Surveys conducted through the programme ask leading questions like: "Would you eat genetically modified foods that are healthier, containing vitamins and less fat?" (Pouris, 2003:514), even though such products do not exist. The communication strategy is to blur the boundaries between genetic modification and biotechnology in general. Information is then provided about how biotechnology has been with humans for as long as controlled fermentation (beer, cheese) has been practiced. This type of argument is then used as a wedge to suggest that GM is not fundamentally different to longstanding food processing technologies. This is untrue, since the insertion of foreign genes into a plant's DNA has never happened before, and the potential long-term consequences of this are not known by science. Information needs to be more balanced so that people can make informed choices.

Labelling can form one part of this provision of balanced information, but has to occur in conjunction with a broader information campaign that explains to people why reading labels is important and what the information means. Most of the poor do not read food labels. Surveys have found that about half of the population never read food labels, while a quarter always read labels. More than a third of the highest income groups read labels, but this dropped to 10% for the lowest income groups. One fifth of all respondents indicated that they would like to see more information on ingredients on labels, and the same proportion indicated that they would like information on health benefits (Rule & Langa, 2005:4). Despite lack of knowledge about genetic modification and limited use of reading labels to make choices about what to buy, fully 71% of respondents in a survey on public understanding of biotechnology agreed that GM foods should be specially and clearly labelled. Just 4% stated they did not agree (Pouris, 2003:514).

The integrity of the labelling system

The key issue with labelling is that the system must have integrity. If there is reason not to believe what the label says, trust in the system collapses and it is of no value. Integrity is directly related to ability to check the accuracy of claims. The argument that food safety issues are already dealt with prior to a product being approved is dependent on the integrity of food safety regulators, since it is based on the idea that food considered unsafe for human consumption will not enter into the market in the first place. This is somewhat questionable, especially given the recent global crises around bovine spongiform encephalopathy (BSE, or Mad Cow Disease) and the H5N1 virus (avian flu), both of which are diseases generated by an industrial food system with poor regulatory oversight (Patel, 2007). These recent experiences give cause to harbour some doubt regarding food safety regulation globally. While scares of this nature have not been widespread in South Africa, imports are often permitted on the basis of documentation from the source country, which means that regulators in other countries, over which our own authorities have no control, have to be trusted.

One of the few surveys that has asked questions about public trust in science and technology amongst the general public in South Africa found that only 34% of respondents indicated strong confidence in the scientific community, 35% expressed strong confidence in major companies and just 19% had strong confidence in the executive arm of government (Pouris, 2003:513). This is a low level of confidence in public and private institutions alike. This is a deeper issue that goes to the heart of the nature of democracy and society. But it is the context in which the integrity of the labelling system must be put in place.

In South Africa, the South African Committee for Genetic Experimentation (SAGENE) was responsible for evaluating risk assessments (food, feed and environmental) on imported GM products until 1997. With the passing of the Genetically Modified Organisms Act in 1997, SAGENE was disbanded and the Directorate: Genetic Resources Management in the National Department of Agriculture (now Department of Agriculture, Forestry and Fisheries) administers the Act. The Act makes provision for a Registrar, an Advisory Committee, an Executive Council and inspectors. The Advisory Committee consists of scientists who are selected by the Minister. The Executive Council is a decision-making body with representatives from seven government departments (Agriculture, Health, Environmental Affairs, Labour, Trade and Industry, Science and Technology, and Arts and Culture). Approval for commercial use in South Africa is based on passing a series of regulatory trials and laboratory assessments. The Advisory Committee evaluates all risk assessments and make a recommendation to the Executive Council, including risk management procedures that should be applied. The public is invited to make inputs before the Executive Council makes a decision (Keetch, Green & Webster, 2008:6-9). The key structure in this process is the Advisory Committee, since it makes the technical assessments of the safety of GM crops, from a human, animal and environmental point of view. The second checkpoint is the labelling authority. In South Africa, this is the National Consumer Commission, which is set up in terms of the CPA. It is a new structure, so few people will be aware of it. While its' creation is a positive development, information about its role and how people can use it must be made widely available.

What type of labelling?

There are a number of labelling options. First, labelling can be mandatory or voluntary. The CPA clearly indicates that mandatory labelling is required. This is appropriate, since there is clear evidence that voluntary labelling is not effective in providing consumers with accurate information about what the food they eat contains. Voluntary labelling implies private regulation and consequently there are no uniform standards for the type of information that is provided. This can lead to consumers being misled. In South Africa, where labelling of products currently is voluntary, tests of products labelled 'GMO-free', 'non-GM' or 'organic', found that 31% had a GM content of above 1%, and 20% had GM content above 5% (Botha & Viljoen, 2009). Unregulated labelling neither provides choice nor protection to consumers. Mandatory labelling ensures more accuracy and lays the basis for consumers to have recourse if claims about content are false.

Second, labelling can apply to any products that involved GM processes, or only those that have GM content in the final product. This relates to the difficulties of identifying GM content in highly processed products (of which more below). Content labelling will be impossible in this regard, since the GM content will be unknown. But the product could still be labelled based on whether GM processes were used at any stage in the production of the final product. There are various levels of stringency that could be applied in this regard too. GM labelling could be required only if GM ingredients are directly present in the final product (e.g. GM maize), or they could be required if any GM processes were employed at any stage in production (e.g. milk from animals fed with GM grains, or the use of GM micro-organisms in the process of producing an additive which does not in itself have GM content).

Third, labelling can either be positive (labelling of products with GM content), negative (labelling of products without GM content), or both. Negative labelling (non-GM) would require documentary verification that it tested below a threshold. In South Africa this is currently set at 1% for adventitious presence (Viljoen, 2009:56). Negative labels could indicate GMO free, which implies that no GM exists in the system at all; non-GM, which implies that GM is not present at a predetermined threshold; and organic, which may not contain GM or which contains GM below a regulated threshold (Viljoen, 2009:18). As we will see, however, complete absence of GM in non-GM batches is impossible to verify, which makes the issue of thresholds very significant as the point at which adventitious presence is tolerated. Adventitious presence is the unintended commingling of GM with non-GM seed or produce.

Most countries globally select either 5% or 1% as the threshold. Twenty countries internationally had labelling regulations in 2009, with the threshold varying from 0.9% to 5%. In fifteen of these countries labelling was mandatory (Viljoen, 2009:32). The main reason why 1% is considered as the lowest threshold is because it is virtually impossible to ensure 100% segregation. In addition, tests are not yet accurate enough to identify GM presence below this amount. However, tests are becoming more accurate and thresholds should be re-considered as these tests become available. Costs to meet thresholds are not linear. Costs rise exponentially the lower the threshold (Giroux, 2009:14). A 5% threshold is favoured by agro-industry because of costs, but makes consumer choice meaningless, since it won't allow consumers to choose not to eat GM if they don't want to.

The value chain of genetically modified crops in South Africa

Currently South Africa has three commercialised GM crops: maize, soy and cotton. GM production has risen rapidly in all three in recent years. Without doubt, GM products are currently found throughout the food chain in South Africa. Of the three crops, maize and maize products are the most widespread in the food chain since maize is the staple food of the majority in the country. While soy and cotton products are far less used for human consumption, they are found in a very wide range of everyday products as oils and components of food additives. Each of these crops is also imported into South Africa, and global trade in these crops is dominated by GM technology, as indicated below. Regulations in the national food system are introduced in the context of porous borders for GM production from other countries, in particular the United States, Argentina and Brazil.

Maize

In South Africa, maize is the staple food for the majority of the population, especially the poor. Low-income consumers spend up to 20% of their income on maize (Traub & Jayne, 2008:235). White maize is used mainly for human consumption, while yellow maize is mainly used for animal feed. In 2007/08, 13.2 million tons of maize was produced with a gross value of R20.8 billion. This is 17% of the total value of agricultural production (National Department of Agriculture, 2009:7). About 50% of the crop is used for human consumption, 40% for animal feed and the remaining 10% for seed and industrial uses (National Department of Agriculture, 2006a:12). There are no precise figures of the number of maize farmers, partly because many farmers do not produce maize all the time, and many farmers produce maize as well as other products. Estimates range between 6,000 and 9,000 large-scale commercial farmers, with limited or no economic concentration at the production node. Domestic demand is met almost entirely by domestic production although there are imports. These vacillate significantly depending on production levels

Source: http://farm4.static.flickr.com/3233/2682607621_abc8ff0f4d_o.jpg

and prices. In 2007, 1.23 million tons of maize were imported into South Africa (FAOSTAT, 2010a), but on average just 607,000 tons of maize and around 13,000 tons of maize products (bran and flour) per year were imported between 2000 and 2007 (FAOSTAT, 2010b).

Four GM maize events are currently approved for commercial planting in South Africa, viz.: MON810/Yieldguard (insect resistant), NK603 (herbicide tolerant), Bt11 (insect resistant) and MON810 x NK603 (stacked herbicide tolerant and insect resistant). Other events have been approved for commodity clearance (i.e. for import but not for domestic production), viz. Syngenta Bt11 x MIR162 X GA21, MON810 x GA21 and TC1507 (stacked genes for insect resistance and herbicide tolerance), GA21 and T25 (herbicide tolerant), and Bt176 (insect resistant) (Jooste et al., 2007:25). An estimated 56% of area planted to white maize and 55% of area under yellow maize in South Africa was GM in 2007/08, although the South African National Seed Organisation (Sansor) estimated a lower 42% of total area was planted to GM maize in that season (van der Walt, 2008:9&14). Sansor (2009:11) estimated that GM maize seed sales constituted 52% of the local market in 2008/09. Insect resistant Bt maize is the most widespread GM maize crop for both white and yellow maize (an estimated 38-40% of all maize hectares planted), followed by pesticide resistant RR varieties (13-15%) (Gouse et al., 2008:58). Stacked (Bt and RR) varieties were only introduced in 2007/08 and were only a small portion of maize planted (2-3% in 2007/08), though they are likely to dominate over time if evidence from other countries and other crops is anything to go by. In 2009-10, white maize plantings constituted just under two-thirds of the total crop. It was estimated that 78% of the total hectares planted to maize in 2009/10 would be GM (Business Day, 10 March 2010). Based on existing technology, this is around the expected saturation point (Jooste et al., 2007:44).

The producer price (i.e. the price the farmer receives, or farm gate price) is the South African Futures Exchange (SAFEX) spot price minus transport from the farm gate to silo, and handling and storage costs which are borne by the producer. In 2003, transport costs were 7.5% of the spot price, and handling and storage costs were 2.5% of the spot price (National Agricultural Marketing Council, 2003:151). The SAFEX spot price fluctuates daily, while transport, handling and storage costs will have risen at least with inflation over the seven years since then. But at that time, around 10% of the price farmers received for their crop were deducted for these costs.

Afgri, Senwes and Noordwes, all regionally-based former co-operatives, dominate the storage node of the grain value chain, holding 70% of domestic storage facilities between them. There are 220 depots on the Highveld, accounting for around 83% of capacity, and 46 in the Western Cape which account for less than 6% of total capacity (National Department of Agriculture, 2006a:16; National Agricultural Marketing Council, 2003:148). Profits of these three were considered to be well above average rates for the industry in 2002 (Chabane, 2002:17). Senwes and Afgri also accounted for more than 30% of grain traded in 2003/04. There are just four major grain traders on the South African Futures Exchange (Safex) (Competition Commission, 2008:29). The Competition Commission has suspicions that silo owners are using their economic strength to engage in unfair competition. In 2009 the Competition Tribunal found that Senwes was engaged in unfair pricing policies for storage that discouraged farmers from selling to traders competing with the Senwes trading arm (Competition Appeal Court, 2009). In March 2010 the Competition Commission announced an investigation into Afgri, Senwes, NWK, OVK, Suidwes, VKB and the Grain Silo Industry (GSI) on possible collusion in setting silo tariffs (Senwes, 12 March 2010).

Maize is processed by the wet- and dry milling industries. Dry milling produces maize meal. Derived products are samp, maize grits and maize rice, unsifted, sifted, coarse, super and special maize meal (National Department of Agriculture, 2006a:16). Around 37% of total deliveries in 2008/09 were processed for human consumption (National Department of Agriculture, 2009:8). Yellow maize is dry milled for animal feed, with 60-70% consumed by the poultry industry (Gouse et al., 2008:55). Hominy chop is a white maize by-product of the milling process that is used in feedlots for livestock other than poultry because it is cheaper than yellow maize (National Agricultural Marketing Council, 2003:149). Maize and maize-derived products constituted 55% of raw materials for feed in 2008/09 (Animal Feed Manufactuers Association, 2009:26). The top animal feed manufacturers are Afgri, Bokomo Voere, Epol, KK Animal Nutrition, Meadow Feeds, Noordwes Voere, and Senwesko Voere.

Wet milling is a process to obtain pure starch from maize. The kernel is then separated into its various components, namely the husk, starch, gluten and the germ (National Department of Agriculture, 2006a:16). The husks, gluten and germ, along with the steep water used in wet milling, are used for animal feed supplements. The wet-milling industry manufactures starches and syrups from maize. This part of the chain consumes around 600,000 tons of maize a year, of which about 50,000 tons maize equivalent is exported (Jooste et al., 2007:32). Maize products are widespread in many parts of the food industry (e.g. high fructose corn syrup (HFCS) and thickeners) and the manufacturing industry (e.g. paper, paint, textiles and medicines). While there are more than 190 maize millers in South Africa (National Department of Agriculture, 2006a:16), four firms control 73% of maize milling output (Cutts & Kirsten, 2006:328). These four - Premier Foods, Tiger Milling, Pioneer and Afgri - are also vertically integrated into processing. The National Chamber of Milling had 17 members in 2002, representing the main milling companies (Chabane, 2002:14). Milling is a 'high volume-low profit' business (Chabane, 2002:14).

The 2003 Food Pricing Monitoring Committee found 'asymmetric price transmission' in the maize sector during the rapid price rises around that time. Even though there should be a four month lag between the SAFEX spot price and retail prices (because grain is usually contracted at least four months in advance), millers transmitted price rises to consumers immediately. However, when spot prices started declining, the declines were not transmitted to consumers until much later (National Agricultural Marketing Council, 2003:157). The ability of some agents within the value chain to manipulate the market in this way signifies concentrated power in the chain. It is apparent that there are a number of dominant, vertically integrated corporations operating in the maize value chain, notably Afgri, Senwes and NTK. These corporations all were former co-operatives that emerged from the privatisation of the co-operative assets that were built up over decades. The three hold dominant positions in the farm input, storage, milling and animal feed manufacturing nodes of the maize chain.

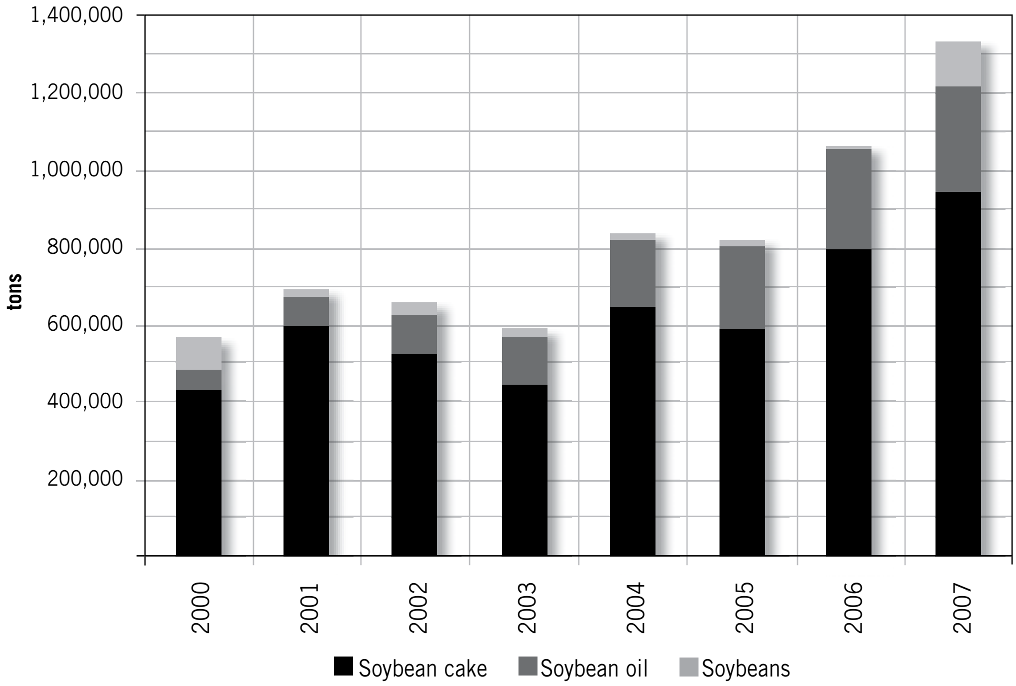
In 2007, six supermarket chains had a 94% share of grocery retail sales, meaning that the sector is concentrated (Louw et al., 2008:291). The two largest food retailers, Pick n Pay and Shoprite, had a combined turnover of R61.7 billion in 2007 (Competition Commission, 2008:29). In the maize sector the milling/retail margin (the difference between the retail price of maize-meal and the millers' purchase price of maize grain) has been growing despite deregulation. This may reflect a greater share accruing to retailers over time rather than to millers (Traub & Jayne, 2008:234).

Soybeans

Soy is a small industry in South Africa. In 2007/08, 165,000 ha were planted, with total production of 282,000 tons and a gross value of R1.13 billion (less than 1% of total value of agricultural production) (National Department of Agriculture, 2009:19). However, production is rising sharply, and was at 506,595 tons in 2008/09 (Animal Feed Manufacturers Association, 2009:29). An estimated 75% of area planted to soy in South Africa was GM in 2006 (Botha & Viljoen, 2009:1060). By 2008, 88% of soy seed sales were of GM seed (Sansor, 2009:11). Organically grown soybeans or foods from the manufacture of organically produced soybeans receive premiums or returns for farmers that are almost twice as much as they receive for ordinary soybeans for meal (Trade Information Service, 2006:31).

An average of 822,000 tons a year of soy products were imported into South Africa between 2000 and 2007. This was mainly in the form of soybean cake for animal feed, with soybean oil also a significant import. There was a steady rise in imports of soybean products over this time (FAOSTAT, 2010b). Imports constitute more than 3 times the volume of domestic production and are therefore dominant in the South African soybean industry. For soy cake and soy oil, the most important soy product imports, imports were almost 12 times the volume of domestic production. While domestic soy production has increased sharply in recent years and it is possible that this trend will continue, imports will remain a significant part of the industry for some time to come. Almost two-thirds of soy imports came from South America (mainly Argentina and then Brazil) (Department of Trade and Industry, 2010). Almost all soybean production in these countries is GM (more detail provided in section 5.3 below), which means that GM soy products are already widespread in the food chain.

Figure 1: Rising imports of soy products into South Africa, 2000-2007



Source: FAOSTAT, 2010b

The primary use of soybeans is to produce protein for animal feed. Demand for soy oil or soybean meal is largely a by-product of this mainstream activity (Trade Information Service, 2006:1). In 2008 the major use of domestically produced soy was for oil and oil cake (52.3%), followed by seed and feed (38.3%) and then human consumption (9.4%) (National Department of Agriculture, 2009:20). In 2008/09, soy and soy-derived products constituted 18% of the raw materials (Animal Feed Manufacturers Association, 2009:25-26). There is growing use of soy oilcake in the manufacturing of biofuels, and both Sasol and the Central Energy Fund have been importing soy oilcake for this purpose in recent years (Animal Feed Manufacturers Association, 2009:11).

In 2005, around 45,000 tons of soy was used for human consumption, with the market valued at R582 million. The major food use is textured soy protein or textured vegetable protein (TSP/TVP), followed by isolates, soy blends, soy flours and meals, and concentrates (BMI, 2006:6). Protein products are constituted from more than half the soy for human consumption, followed by the bakery market, health supplements and cereals (BMI, 2006:7). There are two distinct markets for soy as a protein in human consumption: a low income market where soy is used as a meat substitute, and a high income health and vegetarian market. There is likely to be limited demand for non-GM soy in the low income market, and a high demand for non-GM soy in the high income market. Apart from these distinct markets, soy is also used throughout the food chain to produce lecithin (as an emulsifier and lubricant) and other food additives, including in baking. It is estimated that soy plays at least a small part in 20,000 to 30,000 products that are on the market today, and it is found throughout the food chain (GMO Compass, 2006). There is widespread use of soy as an extender in canned meats and cold meats. Soy oil is also used in human consumption. An average of more than 161,000 tons of soy oil per year was imported between 2000 and 2007. Labels referring to vegetable oil are often referring to soy oil. There are also non-food uses of soy oil such as bio-diesel, inks, crayons and paints.

Cotton

The cotton industry is a small one in South Africa, and makes a negligible contribution to total production value in agriculture. The industry has been in serious decline since the late 1980s, with hectares planted to cotton in 2007 dropping to about 7.5% of the area planted in 1987. Production dropped to around 14% of the 1987 tonnage, and gross value in 2007 was just 54.5% of that in 1987 (without taking inflation into account), at R105 million (National Department of Agriculture, 2009:29). This is less than 0.1% of total agricultural production value. The decline of the cotton sector in South Africa is mainly because of low international prices, largely the result of heavy producer subsidies in the US and other wealthy countries. Presently, South Africa imports between 40% and 60% of its cotton needs, mainly from the southern African region[1].

An estimated 92% of the area planted to cotton was under GM varieties in 2006 (Jooste et al., 2007:3). In 2008/09, approximately 96% of cotton seed sales were GM varieties (Sansor, 2009:11). 89% of GM cotton was stacked (Bt and Roundup Ready) in 2006/07 (Gouse et al., 2008:32). A large share of the conventional cotton is mandatory refugia cotton planted alongside the GM cotton to prevent insect resistance from developing (Gouse et al., 2008:31). Since the introduction of GM cotton, Delta and Pineland (D&PL - acquired by Monsanto in 2007) has completely dominated the market, with well over 90% of the market since 2002. Clark Cotton, which was the locally dominant cotton seed company with 70% of the market in the mid-1990s, saw its market share collapse to almost zero (Gouse et al., 2008:33).

In the 2004/05 marketing season, five ginners accounted for 90% of the market. Between them Clark Cotton and Noordelike Sentraal Katoen (NSK) held 63% of the ginning market. Ginners separate the seed from the fibre and these outputs become two separate value chains. Lint goes to spinners who produce fabric. In 2004 ginning production costs were R600/ton of seed cotton (Cotton Strategy Working Group, 2004:11). In 2004/05 there were nine spinning companies in South Africa and two in Swaziland, and Frame Group was the largest spinner. Spinners may purchase the cotton outright and then sell on for their own account, or the growers might contract the ginner to spin and sometimes market on

1. Information in this section from National Department of Agriculture, 2006 unless otherwise specified.

their behalf. Major lint products are weaving yarns and knitting yarns. Spinners sell these to clothing and textile manufacturers. In 2006, industry sales totalled R18.4bn (Textile Federation, 2007). Clothing and textile producers then sell their products on to retailers.

The ginning, spinning and clothing and textile manufacturing nodes of the lint chain are under extreme global pressure, increasingly from China. Government has made a number of interventions in an attempt to restructure the sector and place it on a more competitive footing. These include the two-year China Restraint Agreement, from 2007-2009, to reduce quotas for Chinese textile products coming into South Africa. The Customised Sector Programme was introduced to develop the domestic market and upgrade the sector, but retailers withdrew from it early on and it had limited impact. An export promotion scheme was not renewed after it expired in 2007 (Textile Federation, 2007). Despite government attempts to protect the sector, global competitiveness has not improved and the downstream part of the chain is likely to all but disappear in South Africa in years to come.

In the seed value chain, which is of more relevance for the purposes of this current study, seed goes to oil pressers, processors, animal feed manufacturers and back to growers. CSP was the only cotton oil processor in South Africa in 2004/05. Major cottonseed products are meal (used in cake/meal for flour, feed and fertiliser); oil (used in soaps, explosives, etc.), hulls (used for feed, fertiliser, synthetic rubber, etc.), linters (used in pulp, medical appliances, yarns and felts) and planting seed (CottonSA, n.d.). Although animal feed is a major use of cotton products, cotton seed and cotton seed oil cake constituted just 0.5% of the total raw materials used for animal feed in 2008/09 (Animal Feed Manufacturers Association, 2009:25), meaning it is of limited importance to the animal feed industry. Cotton produces a potent toxin called gossypol which protects it from insects but is also poisonous to humans. Because of this, human consumption of cotton products is limited to refined oil and only a small amount of cotton by-products therefore find their way directly into the food chain. Cottonseed oil is used mainly for commercial frying and in dressings and sauces. Cellulose from cotton can be used as a thickening agent and binder in food for human consumption, including in flour for bread, cake and biscuits. Viscose is used to make sausage casings.

Demand for non-GM products in South Africa

South African consumers generally have low levels of knowledge, understanding or awareness of GM issues and as a result few have formed opinions about GM food (Pouris, 2003; Rule & Langa, 2005; Vermeulen et al., 2005). Nevertheless, there is evidence that some consumers will be willing to pay a premium for non-GM maize. A survey conducted in South Africa in 2003 found that a third of respondents would be prepared to pay more for non-GM food, and only one quarter definitely said they would not pay more (Pouris, 2003:514). Another much smaller survey of urban maize consumers found that 35% wanted non-GM maize and were brand aware (Vermeulen, 2005:133).

How has the agricultural sector responded to this situation? For primary producers, in the context of a market dominated by large producers the economics will play a very important role in determining decisions on what to plant. This has two sides to it: the economic benefits of planting GM crops, and the costs of segregation of GM and non-GM crops. Evidence generally suggests that producers benefit economically from planting GM crops. This is primarily the result of lower costs of pesticides and herbicides, as well as improved yields as a result of less damage by pests and weeds. This cost is offset by a significantly higher cost of seed, which is the way that the seed companies recoup their investments and make a profit. But overall, there is generally an economic benefit for producers. If there wasn't, they wouldn't use the GM seed. Those producers not planting GM seed may receive a premium for their product in what are rapidly becoming niche markets for non-GM crops. For these producers, if the costs of segregation and testing are higher than the premium the farmer will get for their non-GM produce, there will be no economic incentive to produce non-GM crops and hence no reason for segregation. Premiums for non-GM maize in South Africa are relatively low, at between R0 and R45/ton for dryland maize, and R75/ton for irrigated maize (Jooste et al., 2007:30) where the price of maize is around R1,000/ton. Premiums to silo owners vary from R10-R35/ton, and traders' premiums vary between R30 and R40/ton.

In reality, non-GM crops are becoming a speciality crop for niche markets. This is an explicit industry strategy. Giroux (2009:7), speaking on behalf of Cargill, one of the four dominant global grain traders, argues that the speciality crop isolates itself from the generic crop (which is now taken to be GM) and that consumers must be willing to pay a premium associated with these costs of keeping the speciality crop separate from the mainstream. Without this premium, says Giroux, speciality markets are not sustainable. This is probably true if it is left to market forces. One argument is that non-GM producers should consequently pay for the costs of segregation because they are the beneficiaries of a segregated system by receiving a premium for their product. However, segregation and identity preservation are forced on these producers by other producers who benefit economically from producing GM crops. Despite this, the onus remains on non-GM producers to prove that their product is non-GM, because producers of GM crops can just state it is GM without needing to prove that; their market will still exist. In a mandatory labelling system, costs are incurred across both the non-GM and GM commodity chains because segregation for non-GM produce automatically means segregation for GM produce as well, since they are segregated in relation to one another.

Breakfast cereal manufacturers demand non-GM maize as insurance against possible future negativity surrounding GM foods, though the demand from this sub-sector for maize is small at around 8,000 tons per year. There is no demand for non-GM maize from feed manufacturers. Even if they were to use non-GM maize, they would be forced to use GM soybeans in their mix because most soy produced globally is now GM. There is no demand for non-GM feed from their customers and they are unlikely to pay premiums for non-GM feed (Jooste et al., 2007:31). In contrast, the wet-milling industry demands non-GM maize, mainly because of exports (50,000 ton maize equivalent per year) where consumers demand non-GM products. However, the demand is declining as costs of segregation rise and because South African maize is expensive (Jooste et al., 2007:32). Jooste et al. (2007:50) found that a complete consumer rejection of GM-based maize foods with a continuation of

GM maize for feed would have a limited impact on the maize sector, in particular because costs associated with segregation would be eliminated.

There is an export market that offers price premiums on non-GM products, although this is mainly in the EU and Japan at present. Since more than 90% of South Africa's maize exports currently go to other African countries (Jooste et al., 2007:34), the direction of development of the biosafety regulatory regimes in these countries may have a significant impact on the extent to which producers and handlers are prepared to maintain identity preservation and crop segregation systems. In 2003 the Southern African Development Community (SADC) agreed to develop a common biotechnology policy based on the CPB and the African Model Law on Biosafety, but to date no individual countries apart from South Africa and Kenya have developed national policies. Zambia does not permit any GM imports, while other SADC countries allow the import of GM maize if it has been milled first (Jooste et al., 2007:36). This suggests that the concerns are related to the environment rather than health or consumer resistance. At the moment, non-GM certification for exports from South Africa is dependent on import country requirements and is not mandatory. African countries importing from South Africa do not retest consignments on arrival and rely on the integrity of South African certification (Jooste et al., 2007:34). Protests in Kenya blocked the shipment of GM maize from South Africa in April 2010, indicating concerns in other African countries about the lack of safety checks on GM imports (BBC News, 8 April 2010).

Segregation and testing systems

Segregation and identity preservation

For labelling to have integrity, consumers must be confident that what is written on the label is accurate, and that there is a readily available way of verifying the information supplied on the labels. Systems must be put in place to ensure accuracy and verifiability of claims made on labels. Systems of segregation and identity preservation of crops with specific attributes have already evolved in numerous commodities, and systems for testing of GM presence in crop deliveries are developing and improving in accuracy in response to regulations around the world. Generally the buyer decides what procurement strategies work best for them. This often involves contracting directly with the producer or with the silo owner with specifications on the thresholds for adventitious presence, with the appropriate paperwork proving the claim.

At each point in the supply chain the requirement is to make sure the grain is non-GM, and to prevent grain from commingling before selling it forward. Segregation isolates like products with particular attributes (e.g. non-GM) but does not preserve their identity beyond that. Segregation is a common practice in the commodity chains of other differentiated products where grade factors, nutritional content and other functional traits are important for buyers. Monitoring of maximum pesticide residues, food quality and other issues are all a growing part of the commodity chain, requiring farmers and processors to show what processes the product has followed. Producers now routinely deal with the segregation of new crop varieties with unique characteristics that result from conventional plant breeding (ACIL, 2005:6). This is evolving to accommodate the differentiation in markets brought

Source: http://notochemo.files.wordpress.com/2009/08/nowlecithin.jpg

about by GM technology. Apart from increasing the number of varieties that need to be segregated, the main challenge posed by GM segregation is that it raises the required level of purity (Bullock et al., 2000:15).

Traceability and identity preservation are related to segregation systems, and involve being able to track the product back to its point of origin on request by any party along the commodity chain. The overall costs of traceability can be reduced through due diligence in compliance, meaning that the tracking system relies on appropriate documentation throughout the supply chain and not continual testing at each step. Testing then only kicks in if the paper trail fails (Wong, 2003:16). However, this system is open to abuse, since it opens the door for corruption. Overall Wilson et al (2005) conclude that a segregation and testing system is an efficient way of assuring buyers of GM content at a 1% threshold, with the cost being far lower than a full identity preservation system.

Segregating non-GM crops from GM crops would not be very complicated because there is already a system and standards in place. South African National Standards (SANS, formerly the South African Bureau of Standards) has three schedules related to the implementation of an identity preservation system (IP system) for non-genetically modified products. Part I sets out the required standards for the production, storage, handling and transportation of non-genetically modified, unprocessed agricultural products. Part II is for the processing and manufacturing industry, and Part III sets out sampling and testing protocols.

A detailed traceability system for exports is in place in terms of 2005 regulations flowing from the Agricultural Product Standards Act of 1990. Food business operators (FBOs) throughout the export supply chain are registered with the Department of Agriculture, Forestry and Fisheries (DAFF) and supplied with a number they must use on all products they handle to ensure traceability throughout the chain (Mayet, 2006:6). They are geared primarily towards managing pesticide residue levels and other food quality issues for the EU market and are not explicitly applied to GM content. Although these standards only officially apply to exports, the grain and oilseeds industry has taken a decision to extend them to all products, whether for export or domestic consumption. In addition, the Hazard Analysis and Critical Control Point (HACCP) system was promulgated in 2003. These already established systems for monitoring throughput could be adapted to incorporate GM testing.

Testing systems

Systems of segregation and identity preservation are only as good as the testing system. Testing only applies to non-GM crops, since it would not be necessary to test lots known to contain GM. There are two main methods that can be conducted to test for GM presence or the degree of presence: protein-based and DNA-based methods. Protein-based methods include strip testing and enzyme-linked immunosorbent assay (ELISA) testing. Strip testing is a simple and cheap way of testing for the presence of GM materials, though it cannot determine the quantity. In 2007 a strip test cost R45/test or R200-R300/silo bin (Jooste et al., 2007:26). While it is not as accurate as other procedures, traders and processors in South Africa are satisfied with them. The ELISA test is a more accurate qualitative test which can test several samples simultaneously to give a quantitative result. It costs between R150 and R800 per test and results only arrive after 24 hours (Jooste et al., 2007:27). However, it cannot detect GM presence below a 1% threshold (de Leon, et al., 2004:62).

A Polymerase Chain Reaction (PCR) test is a DNA-based method of testing. PCR can indicate not just whether GM content is present, but what the quantity is. This is obviously very important for labelling purposes, especially where a threshold is used. PCR tests are very accurate, and can measure the presence of a modified gene in minute quantities, e.g. 0.1% to 0.05% (de Leon, et al., 1994:61). However, the test is slow and relatively expensive. Costs range between R780 for a test that takes a few days to get results to R1,700 for tests that take one day for results (Jooste et al., 2007:26). A challenge in using PCR is that maize needs to be dried within 48 hours of harvesting otherwise quality will decline, but PCR test results usually take more than 48 hours to produce a result (Coleno, 2008:307). There are high level technologies that can filter 'false positive' results (showing a sample with very low adventitious presence as having a positive GM presence), but the capital equipment is very expensive (de Leon, et al., 2004:61).

Before transporting, a diverter sampler can be used. This is a laboratory test, but the product can travel while the test is being conducted, and the results can be handed over before the product is unloaded at its destination. End-point laboratory testing is carried out to verify claims made on content. Independent agents, such as Swiss company SGS, do the sampling, testing and certification (Mayet, 2006:4). In-house company test results are accepted if their laboratories have the necessary accreditation (ISO accreditation or participation in the International Seed Testing Association's GMO Proficiency Test) (Sansor, 2009:13). However, because declaration of content is still voluntary, companies' internal testing systems are not always adequate (Viljoen, 2009).

There are technological limits to testing for GM presence in processed goods. Studies in the US have shown that up to 70% of all processed food contain corn or soy-derived ingredients used as carriers for flavours, colouring and vitamins (cited in Golder, et al., 2000:17). Final food testing is the most difficult, especially for highly processed food, because the refining process tends to eliminate all traces of GM content. According to de Leon et al. (2004:5), GM content will not be traced in final testing of the following products: i) cooking oil or salad oils, refined soy oil, refined corn kernel oil; ii) corn oil margarines; iii) soy lecithin as additives; iv) enzymes derived from soy beans; v) soy flour used as carrying agent or adjuvant; vi) crystalline sugars and sugar syrups from corn, such as high fructose corn syrups (HFCS), glucose-syrup from corn, glucose-fructose syrup from corn, and dextrose uses. Cotton fibre is a cellulose and contains no proteins and it is thus not possible to distinguish between a Bt or a conventional or a organic fibre (Gouse et al., 2008:53). Content labelling on these products therefore would be impossible, but it would still be possible to provide labels indicating that the process involved GM. In the EU, labelling regulations require traceability of products where protein or DNA cannot be detected.

Testing is not perfected yet. As the threshold drops below 0.9% GM content, tests become much more expensive. The biggest challenge is not the testing procedure but the sampling, because one sample may contain a GM kernel while another form the same batch will not. These will yield different results. Testing is most effective at the first point of contact in each node in the supply chain (Giroux, 2009:19). However, costs will escalate as the number of tests and locations in the commodity chain at which they are applied increase (Wilson et al, 2005:23). 'Due diligence' regulations based on a paper trail, rather than testing at every stage, will reduce costs but are also more likely to produce errors. While testing is relatively straightforward when there are just three crops, expectations are that the number of GM crops will rise fourfold, from 30 in 2009 to 120 in 2015 (Stein & Rodriguez-Cerezo, 2009). This will place immense strain on the monitoring and testing of imports. As the number of GM varieties increase, testing becomes more difficult and the cost increases, because each 'event' must be tested separately. There is need for the development of a single test for all varieties, as well as a trustworthy, verifiable and economically viable method of testing. Some argue that these should be a precondition for the approval of any new varieties (African Products, cited in Mayet, 2006:5).

What about imports?

It is clear, as indicated above, that imports are a significant component of the soy and cotton industries in South Africa, with maize less so. To reiterate, between 2000 and 2007 South Africa imported an annual average of 822,000 tons of soy products (mainly soybean cake and then oil) equivalent to 330% of domestic production; 222,000 tons of cotton products (mainly cake, seed, and lint) equivalent to 196% of domestic production; and 620,000 tons per year of maize and maize products equivalent to 6.7% of domestic production. At least

Source: http://www.omorganics.org/images/usda.gif

some of these imports find their way into the human food supply and therefore traceability and identity preservation for these imports is necessary if labelling is to have any meaning. The main importing countries have all adopted GM technology on a wide scale for these three crops.

Argentina accounted for 98.6% of soybean cake imports to South Africa in 2009, and between them Argentina and Brazil accounted for 93% of soybean oil imports (Department of Trade and Industry, 2010). All soybean plantings in Argentina were GM in 2008 (James, 2008:22), while Brazil had a GM soybean adoption rate of 71% in 2009 (James, 2009:7). This means the overwhelming bulk of these imported products will have GM content. South Africa imports unprocessed soybeans to a far lesser extent, and these imports come mainly from Zambia and Malawi. Neither of these countries have any GM soybean production.

The main cotton product imports are cotton seed cake followed by cotton seed and lint. Cottonseed cake is categorised along with other oilcakes (excluding soybean cake) by the department of Trade and Industry. Argentina is the main country of origin, with 41% of imports into South Africa, and Zimbabwe and Benin are also significant countries exporting to South Africa (Department of Trade and Industry, 2010). Argentina also dominates cotton seed oil imports to South Africa. This is a relatively small but significant import line, since cotton seed oil is used in the human food chain. In 2007, 95% of cotton grown in Argentina was GM cotton (GMO Compass, 2009). Cotton seed and lint are sourced mainly from Zimbabwe, Zambia and Malawi, none of which have GM cotton production at present. Both Zimbabwe and Malawi have approved the testing of Bt cotton in 2008 (Gouse et al., 2008:30).

The main source of imported maize in the past decade or so was the US, followed by Brazil and Chile. However, Argentina was dominant from 2006 to 2008. In 2008, 80% of maize produced in the US was GM, while 84% of Argentina's maize was GM in 2007 (GMO Compass, 2008). In Brazil, GM maize was planted commercially for the first time in 2008, but the adoption rate was extremely rapid and 46% of maize planted in that year was GM (James, 2008:35). Chile has got a small amount of GM maize, all of which is for export (James, 2008:127). South African processed food imports have also been expanding and many of these may contain GM ingredients as additives. These products will need to be labelled in accordance with any regulations if labelling is to have any meaning.

The Cartegena Biosafety Protocol (CBP), signed by 130 countries, aims to harmonise risk assessment, risk management and information sharing on the transboundary movement of living modified organisms (LMOs). It established the principle of advanced informed consent, which allows importing countries to request accurate information of the content of imports and to stop imports until a proper risk assessment has been completed. Where LMOs are going to be consumed in the importing country but not planted, the procedures are a bit looser. Issues of thresholds at which information must be provided on GM content, and the amount of detail that should be provided, remain unresolved (Jooste et al., 2007:9-10). At present, importing countries can decide on the thresholds of adventitious presence they will tolerate. In South Africa, imports are only tested in the country of origin to make sure no unapproved GM events are present. This is despite the fact that commingling can still occur on ships after testing (Jooste et al., 2007:33).

Evidently the South African position is that the regulatory authorities in the other countries can and should be trusted. A challenge at the global level is that different countries have different regulations on what to test for and how to test. This means that tests conducted in other countries are not always applicable to the requirements in South Africa. Efforts are being made globally to harmonise regulations, though conflicting economic interests will make this difficult in practice. If all countries agree on what has to be tested and what tests should be conducted, testing in one country will have applicability in another country. However, this should not be decontextualised from the global balance of power. As in the case of the CBP, some powerful countries (in particular the US and Canada) can hold out against regulations that do not work in favour of their own exporters. Because they are major exporters, their lack of participation makes any agreement between other countries relatively insignificant.

But even beyond this, harmonisation can also be a way of advancing an agenda that forces countries to adopt technologies they don't necessarily want. For example, harmonisation eliminates the possibility of individual countries choosing to ban GM imports if they wish, unless all countries take that decision - which is not going to happen. The purpose of harmonisation is to eliminate the proliferation of systems tailored for different countries. An individual country - especially if it was a small player in global commodity markets - would isolate itself form global trade in the relevant commodities if it demanded segregation and identity preservation systems outside of the harmonised norms. The result is that smaller, weaker countries on a global scale will lose their sovereignty in regard to defining their own import policies. This has a similar effect to the way World Trade Organisation agreements limited the sovereignty of individual countries to make their own policies, and forced them to conform to global policies that were in the interests of the imperialist powers.

Costs of segregation and testing in the commodity chain

Overview

Overall, there is no doubt that mandatory labelling will increase the cost of producing food. Through the CPA, government has already indicated that it considers this necessary and in the consumers' interest. The remaining question, then, is who will bear the costs of implementing a segregation, testing and labelling system. Costs of mandatory labelling will be distributed throughout the commodity chain. Studies conducted in the US have shown that the main cost to producers of non-GM maize and soy beans is transport, followed by additional storage costs, and certification and testing costs (de Leon, et al., 2004:44). These costs may be borne in the production node or the storage and handling node of the chain.

A study on mandatory labelling in Canada found that the production node would bear the greatest portion of increased costs, followed by storage and handling. The study did not find information on possible costs at the seed production and retailing nodes of the chain (table 1 below). It should be noted that this does not mean consumer prices will rise 9-10%, only that the share of the final retail price constituted by raw materials will rise by 9-10%. Since commodity prices fluctuate significantly, it is not possible to establish precisely what this cost is except through detailed research. The National Agricultural Marketing Council (2007:94-95) found that raw materials vacillated between 24% and 67% of the final cost of maize meal between 2004 and 2007. This converts into a 2.4-6.7% increase in overall final cost based on a 10% increase in raw materials costs as a result of mandatory labelling. Other more highly processed products will contain a smaller portion of raw ingredients requiring labelling. The higher the proportion of the relevant raw ingredient costs in the final cost of the product, the higher the price increase for mandatory labelling will be.

Table 1: Possible distribution of price increases of modified ingredients in the supply chain with mandatory labelling (Canada)

Stage in supply chain	**Potential areas of cost impact**	**Approximate estimated cost increase expressed in…**	
		producer prices	**consumer prices**
Seed production	Increased level of genetic testing and certification of seeds Separate production and storage	Not available	Not available
Grain/oilseed production	On-farm storage, transport, testing and certification	14%	3.4-3.6%
Elevator/grain handling/transport	Separation of receiving and storage facilities, cleaning systems Testing and certification	10-11%	2.6-2.7%
Processing	Downtime of processing lines for cleaning	5-7%	1.3-1.7%
Manufacturing	Dual storage and handling systems; changes to product labels and testing/documenting products	6-9%	1.5-2.2%
Retailing	Modification of merchandising strategies	Not available	Not available
Regulatory monitoring and enforcement		Not available	Not available
Total		**35-41%**	**9-10%**

Source: Golder et al., 2000

Primary production

Seed purity is the starting point for an identity preservation system. Sansor is the designated authority to manage and execute seed certification functions on behalf of the government, and reports to the Registrar of the Plant Improvement Act No 53 of 1976. Sansor is a private sector body consisting of seed companies in South Africa. The government has no representation in the organisation apart from the agricultural research councils, which are associate members. The South African Seed Certification Scheme is legislated for in the Act. As part of its assignment, Sansor also compiles and maintains lists for seed varieties where certification is a requirement, but where the varieties were not specifically listed in the Act. The Registrar of Plant Improvement in the Department of Agriculture, Forestry and Fisheries (DAFF) maintains a full variety list of seed registered in South Africa. Identity preservation for seed is already built into compliance requirements for seed standards. The seed certification and testing system appears to be functioning well and already keeps individual lines separate.

Following planting, there are three sources of producer risk: volunteers in subsequent crops, pollen drift and on-farm adventitious commingling (Wilson & Dahl, 2002:10). Recent studies suggest that volunteer plants may become a serious threat in the future. In the US, for example, a study found that volunteer maize with stacked traits had the potential to create problems both for weed management as well as insect resistance management as they could facilitate more rapid evolution of insect resistance (Krupke et al., 2009). Control of volunteer cotton plants is likewise becoming more difficult, especially given the increasingly heavy reliance on glyphosate (the active ingredient in Monsanto's Roundup, which dominates the herbicide market globally) (Charles & Taylor, 2006).

Contamination of non-GM crops by pollen from GM crops in the field threatens segregation and identity preservation. Soybean seed is primarily self-pollinated so high levels of purity are obtained. However, seed purity of maize poses more of a challenge because maize is cross-pollinated in the field. This can result in undesirable characteristics travelling from one plant to another, which may then be used for planting in the following season (Bullock et al., 2000:4). At the same time, however, maize pollen has a short flight range (Della Porta et al., 2008). Cotton is generally regarded as self-pollinating, but it is often cross-pollinated in reality (Van Deynze et al., 2005).

Systems that eliminate the possibility of contamination in the fields are therefore necessary. Maintaining purity would require spatial and temporal isolation of fields from GM maize fields and planting of all-male border rows (Bullock et al., 2000:6). In South Africa farmers planting GM crops are required to plant specified areas of non-GM crops to ensure that insects and weeds do not develop resistance, and to maintain specific separation distances from non-GM fields (Jooste et al., 2007:30). For Bt crops, there is a compulsory planting of 5% conventional varieties adjacent to Bt fields without spraying or 20% conventional planting as insect refuge in the vicinity under 400m distance, which can be sprayed with an insecticide (Gouse et al., 2008:22). However, it is not certain that it is always followed, and Sansor is making a particular effort to ensure that growers do follow refuge recommendations and that monitoring is undertaken in this regard (Sansor, 2009:24). Administration of refuges may prove difficult. Inspection is mostly left to private regulation by the seed and technology companies.

Cleaning farm machinery to ensure no adventitious presence is not very costly. It only needs to be done by producers who are producing both GM and non-GM crops, and will only need to be done once a season, between the planting of the two crops. A cost effective procedure is to hire workers to clean machines by hand to remove all excess grain kernels, and then 'flush' the machine using a batch of non-GM grain, which will then have to be sold as ordinary grain, not at a non-GM premium (Bullock et al., 2000:7).

The logic leads to the conclusion that the most effective way of ensuring separation of GM and non-GM crops may be to cluster production into separate geographical areas, where production is co-ordinated on the basis of voluntary agreements between producers (Jank et al, 2006:199). This both reduces the chances of cross-pollination and reduces transport and storage costs. A number of such areas already exist in South Africa: the Middelburg/Ogies/Bethal districts in Mpumalanga, and in the Hopetown, Luckhoff, Prieska and Marydale districts in the Northern Cape (Jooste et al., 2007:30).

Costs that are likely to be incurred by producers include additional transport costs if silo operators designate silos for Gm or non-GM crops; additional on-farm storage time in cases where temporal segregation is practiced; higher land costs due to reduction in the effective production area; and testing and certification costs (Golder, et al., 2000:22).

Storage, handling and distribution

The majority of adventitious presence occurs after the farmgate. Bullock et al. (2000) find that the biggest cost for identity preservation is the reduced flexibility of the handling system, which has opportunity costs for handlers. While grain elevator facilities are designed to keep themselves reasonably clean, they are not designed to be kept 'kernel clean' and the cost of doing so would be prohibitive. The most cost effective procedure is to have separate grain paths for GM and non-GM grain (Bullock et al., 2000:10). But will mean that more storage facilities (and drying facilities for maize) will be needed, and existing ones will be too large. Basically more and smaller handling facilities are needed. Because of the high capital costs of new infrastructure, this kind of change is likely to be gradual. It will be easier for elevators with multiple grain paths to manage the transition, or for co-ops or companies that have a number of silos in close proximity to one another and can then dedicate entire silos to one or the other grain type. There may be increased transport costs to the producer associated with this, but this cost is far lower than building new storage and handling infrastructure (Bullock et al, 2000:18).

A study in Canada found that segregation within terminals was cheaper than using separate terminals or multiple designated terminals (cited in Wilson et al., 2005:25-26). Costs are context specific, depending, for example, on the geographical distribution of silos. In France, for example, a modelling exercise found that the allocation of silos for crop segregation raised transport costs 700%. These costs are borne by the producer. In this case, timing delivery of GM and non-GM crops so they didn't coincide proved to be the most cost

Source: http://fooddemocracy.files.wordpress.com/2009/07/non-gmo-project.jpg

effective method of segregating (Coleno, 2008). If non-GM grain is delivered first, the risk of mixing is eliminated. However, this assumes that there are no separate production areas for GM and non-GM crops. It is also a practical issue of where silos are located in relation to production in a given place.

In the maize supply chain the maize goes from harvest to collection silos, then to driers and then to storage silos. If each cell in the collection silo has grain, the silo owner must decide whether to accept new deliveries and mix the grain, or refuse some deliveries to avoid mixing, but with the possibility that the producer may take the grain elsewhere (Coleno, 2008:307). The extent to which this is a pressure on the silo owner is dependent on the amount of competition in the silo industry in specific localities (are there other elevators the producers could turn to?) and also on regulations regarding traceability and segregation. Silo concentration in South Africa means that producers are under pressure to accept the conditions set by silo owners (as revealed in the Competition Commission case against Senwes referred to above). This has an impact on the choices farmers can make about where to deliver their grain.

On-farm storage is an option. Silo bags are used extensively in the US and Argentina to store varieties separately on the farm. The technology was introduced in South Africa in 2005 and their use is increasing. The bags can store 190 tons of maize or 180 tons on soybeans per bag, at a cost of around R45/ton (Jooste et al., 2007:37). Storage in silo bags may actually be cheaper than in conventional silos. However, the bags can only be used once and are then disposed of (Mayet, 2006:6-7). There are also some issues regarding quality control.

In South Africa a segregation system for maize is already in place for maize and soy, although not all companies offer a non-GM service. For those that do, tests are conducted on farm at intake, as well as on arrival at the silos, where non-GM grain is segregated from GM maize (Mayet, 2006:4). The rapid strip tests used at this stage are not very accurate and some intermingling could occur. The costs associated with this are negotiated between handlers and buyers (Jooste et al., 2007:37). Most commonly, buyers who want a non-GM product contract directly with farmers and who carries the costs of ensuring the purity is negotiated between them. The system is not yet able to keep different GM varieties separated from each other once they reach the silo. This is important because testing procedures may be different for the different varieties. Overall segregation and identity preservation costs for non-GM maize in South Africa stood at R40/ton in 2006. This was expected to rise to R100/ton as adoption rates of GM maize approached 70%, making sourcing of non-GM maize more expensive (Jooste et al., 2007:45).

Processing and retail

Processors and manufacturers would carry greater cost than retailers in the case of mandatory labelling. The main additional activities would be testing, separate storage, handling and transportation, labelling, and preparation of supporting documentation and supporting the paper trail (Golder, et al., 2000:29). Manufacturers will be required to run two separate production lines if they handle both GM and non-GM products, in the same way as silo owners. Similarly, too, the two strategies for realising segregation are spatial or temporal segregation. Because of limited production facilities, again it is likely to make more sense for manufacturers to specialise in either non-GM or GM products in a particular facility (de Leon et al., 2004:53). Demand for non-GM processed products will determine the economic viability of this strategy. While segregation may impact on economies of scale both in handling and processing, this could be seen as an opportunity to bring in smaller enterprises that could align with national economic transformation objectives and goals of breaking down monopoly control of the economy (African National Congress, 2007). Some manufactured food items may contain 40 core ingredients and up to 700 minor ingredients. The manufacturer would have to monitor the GM status of each of the ingredients across multiple suppliers, producing a vast paper trail that could be difficult to manage (Golder, et al., 2000:31).

There are other additional costs that will have to be included in processors' and retailers' overheads. Separate printing will be required for non-GM and GM packaging and labelling, and the smaller print runs and segregation of labels will mean an increase in costs that might add 1% to overall prices, based on manufacturing overhead estimates (de Leon, et al., 2004:68). Third party auditing of certification is another cost. A study of segregation costs in Ontario published in 2000 found that this constituted just 0.5% of total production costs (cited in de Leon et al., 2004:45). However, this will obviously vary both by locality and by the type of technology used to conduct the certification tests.

Given the liability clause of the CPA, retailers and suppliers will probably need to take out insurance to cover for possible liability claims, and they may pass these costs onto the consumer (McGee, 2010). It is unclear what the impact of product liability across the supply chain will have on labelling, especially where it is not known whether a product contains GM or not. If such products are labelled as potentially containing GM (the cheapest option from a labelling point of view), suppliers may be liable to damage caused by the GM content in that product. Nevertheless, it may prove very difficult for consumers to show a direct link between the GM content of food they consume and any ill-effects they experience. While the debate about the negative health effects from consuming GM food is still polarized, there is some evidence of adverse microscopic and molecular effects resulting from the consumption of GM food. More systematic testing may find different results (Magaña-Gómez & Calderón de la Barca, 2008). The hedging of liability indicated in section 61(4)c of the CPA mentioned in the introduction suggests that a test conducted on the product that found a GM content below the threshold would be a reasonable protection against liability. Where it is not feasible to test or segregate, the supplier must be willing to take liability for damage in accordance with the Act.

Who should bear the costs of segregation, testing and mandatory labelling?

The most just response to the question of who should bear the costs of segregation, testing and mandatory labelling would be to base the answer on who benefits from GM technology that has imposed the need for all of these on everyone. At present, the beneficiaries of GM technology are mainly seed and biotechnology corporations and producers, who may realise higher yields or lower pesticide costs by using GM seed. Table 2 below indicates the welfare distribution of various studies conducted in the US on GM soy and cotton production. The study shows that producers adopting the technology and the biotech/seed companies benefited the most from the adoption of GM technology. While consumers did benefit, for countries where US GM products were exported, local producers suffered negative effects. This was the only group to be affected negatively by the introduction of GM technology. Another study reported in the same paper, but which was not quantified in the same way, found that consumers in other countries, technology corporations and then producers in the US were the main beneficiaries of RR soy production in Argentina (Wilson et al., 2005:4). Consumer benefits arise from cheaper products as a result of greater production.

Table 2: Study results on distribution of benefits from GM production in the US

	Bt cotton	Bt cotton	RR cotton	RR soybeans
Producers in the US	59%	29%	4%	20%
Producers in other countries		negative	negative	negative
Biotech/seed companies	26%	35%	7%	68%
Consumers in the US	9%	14%	57%	5%
Producers and consumers in other countries	6%	22%	33%	6%

Source: Wilson et al, 2005

To date, there are no GM crops on the market with output traits that benefit handlers, processors or consumers. Consumer benefit is limited to lower prices, but with the side-effect of undermining local producers (and thereby local employment and self-sufficiency). Research has found or assumed yield advantages of GM maize over conventional maize of between 7.5% and 11.3% in South Africa, while farm income benefits of GM maize between 1996 and 2005 were estimated at US$59m in South Africa (Jooste et al., 2007:ii). The main beneficiaries of GM cotton in South Africa are the farmers and Monsanto as the technology supplier and seed company (via D&PL). Ginning companies did not accrue any benefit from the adoption of GM cotton in South Africa (Gouse et al., 2008:45).

There is a line of thought that proposes that consumers should pay the costs of labelling, since they are the beneficiaries of labelling policies that enable them to make choices about what to eat (Golder et al., 2000:3). But this argument does not hold water, since consumers had no input into producer decisions to adopt GM technology. Those who have created and adopted the technology for their own profit have imposed the burden of labelling on all consumers and should carry the costs.

Giroux proposes (2009:12) that costs should be apportioned across the supply chain in accordance with the key risk points. If the costs of segregation are distributed throughout the supply chain in accordance with risk, handlers will bear the bulk of the costs since this is where the greatest risk of intermixing is. But it is questionable that handlers should bear the additional costs when they are not the beneficiaries of the technology and nor do they have any say in whether producers adopt the technology or not. The costs should be borne by those making the choice to adopt the technology and who gain materially from its adoption. The beneficiaries of GM technology should pay the costs of segregation and identity preservation since they are imposing the need for segregation on others. The primary beneficiaries are producers, and seed and biotechnology multinationals.

However, in an economy where costs are determined by market forces, costs will be passed onto consumers by incorporating costs associated with segregation, testing and labelling into overheads which will be built into selling prices at each point in the chain. This will be mediated by the extent of elasticity of demand i.e. by the extent to which consumers can or will shift to alternative products should the price rise too high. Where there is a limit to the price increase consumers will tolerate, manufacturers will attempt to shift the residual cost back upstream, to handlers and producers. Since handling and storage is concentrated in South Africa, producers - who have less bargaining power in the chain - will probably bear most of this residual. This can be done by seeking alternative, cheaper supplies of raw materials, thus forcing prices down.

Regulatory costs will be incurred by government unless a levy is imposed on those profiting from producing food to cover such costs. These include costs of building and maintenance of testing facilities; procurement of laboratory equipment, kits and reagents; continuous training of technical personnel; and conducting of testing, certification, auditing, monitoring activities and compliance enforcement (de Leon, et al., 2004:85).

Recommendations

- A maximum threshold level of 1% should be permitted to allow for the adventitious presence of products produced using GM. This is the current threshold and can be comfortably accommodated using existing technology and will offer consumers meaningful choice.
- Wherever possible, all products with a GM equivalent should be tested. The results of the testing should determine the labelling as follows:
  - If GM content is below a 1% threshold, as demonstrated by test results, then the product should be labelled as ‘genetically modified content is below government-approved

threshold of 1%' or alternatively 'this product used no or negligible genetically modified ingredients or processes in its production', or alternatively left unlabelled (i.e. negative labelling should be voluntary);
  - If the product is intentionally and directly produced using GM processes or has GM content, then it should be labelled as 'produced using genetic modification';
  - If the product sometimes contains ingredients obtained through GM or derived from such a product or from GM processes anywhere along the production chain, or if this is not known, and it is not feasible to test or segregate, then it should be labelled as 'may contain genetically modified ingredients' or 'may be produced using processes of genetic modification'.
- GM labelling regulations should clearly define the use of terminology and its application. For example, does genetic modification refer only to recombinant DNA insertion, or is it extended to include mutagenesis and other methods of modification?
- Labels should apply to all products for which there is a GM option (currently maize, soy and cotton and their by-products), including additives in processed products where the additive itself has GM content (like lecithin from GM soy).
- Highly refined food where the effect of the refining process is to remove the novel DNA and/or protein, and processing aids and food additives, except those where novel DNA and/or protein is present in the final food should be exempted from labelling.
- Following EU regulations, food products made using GM enzymes of which the enzyme is not the food could be exempted.
- Animal products where animal feed included GM content could be exempted from labelling, but only in cases where there was no other GM content or process involved (e.g. the use of recombinant bovine growth hormone for milk production).
- Restaurants and food sold direct to the public should be included in regulations requiring a clear indication of GM content.
- Labelling requirements should apply to local and imported foods and ingredients alike.
- Labelling should be coupled with balanced information about the evidence on human and environmental health.
- Costs should be borne by those who were in a position to make choices about whether or not to adopt GM technology, and who chose to do so. The consumer should not bear the costs of segregation and testing since they did not have a choice about whether to adopt the technology or not.
- Government costs associated with regulation and enforcement should be subsidised through a levy on GM seed sold, the costs which should be borne equitably between the technology licence holders and the seed purchasers.
- A condition for the authorisation of new GMOs should be that customised tests exist to test for their presence.

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